AMERICAN FISHERIES SOCIETY

TRANSACTIONS

Volume 13

1884

TRANSACTIONS

—OF THE—

AMERICAN FISH-CULTURAL ASSOCIATION.

THIRTEENTH ANNUAL MEETING.

Held at the National Museum, in Washington, D. C.

MAY 13TH AND 14TH, 1884.

NEW YORK.

1884.

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CONSTITUTION

OF THE

American Fish-Cultural Association,

WITH ALL ITS AMENDMENTS AND CHANGES FROM ITS ORGANIZATION TO ITS LAST MEETING IN 1883.

COMPILED BY FRED MATHER.

Original Constitution, as adopted at the first annual meeting, New York, December 20th, 1870. From the first report of proceedings, 1872; pp. 3, 4.

ARTICLE I.—NAME AND OBJECTS.

The name of this Society shall be "The American Fish Culturists' Association." Its objects shall be to promote the cause of fish-culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the Association; the uniting and encouraging of the individual interests of fish-culturists.

ARTICLE II.—MEMBERS.

All fish-culturists shall, upon a two-thirds vote of the Society, and a payment of three dollars, be considered members of the Association, after signing the Constitution. The Commissioners of the various States shall be honorary members of the Association, *ex-officio.*

ARTICLE III.—OFFICERS.

The officers of the Association shall be a President, a Secretary, and a Treasurer, and shall be elected annually by a majority vote. Vacancies occurring during the year may be filled by the President.

ARTICLE IV.—Meetings.

The regular meetings of the Association shall be held once a year, the time and place being decided upon at the previous meeting.

ARTICLE V.—Changing the Constitution.

The Constitution of the Society may be amended, altered, or repealed by a two-thirds vote of the members present at any regular meeting.

AMENDMENTS.

First Amendment. [*Meeting at Albany, February 7th*, 1872.]

"On motion of Mr. Livingston Stone, the Constitution was amended by striking out the word 'and' after the word 'Secretary' in Article III., and inserting after the word 'Treasurer' the words 'and an Executive Committee of three members.'" First Report, page 10.

Second Amendment. [*Meeting at New York, February 10th*, 1874.]

"On motion of Mr. F. Mather the Constitution was so amended that the list of officers should include a Vice-President." Third Report, page 3.

Third Amendment. [*Meeting at New York, February 10th*, 1874.]

"On motion of Mr. Stone, all those who had paid five dollars and signed the Constitution, were made members of the Association without further action." Third Report, page 4.

Fourth Amendment. [*February 11th*, 1874.]

"Mr. H. J. Reeder moved that the Constitution be amended by striking out the last paragraph of Article II., relating to honorary members. Carried." Third Report, page 5.

Fifth Amendment.

"Mr. Page moved that the Executive Committee consist of five. Carried." Third Report, page 5.

Sixth Amendment. [*February 11th*, 1874.]

"Mr. George S. Page moved to amend Article II. by striking out the words 'all fish-culturists,' and inserting the words 'any person.' Carried." Third Report, page 5.

SEVENTH AMENDMENT. [*February 9th*, 1875.]

"Mr. Page moved that Article II. be amended by making the annual dues three dollars. Carried." Fourth Report, page 4.

EIGHTH AMENDMENT. [*February 28th*, 1878.]

"The Secretary (Mr. B. Phillips) proposed the following amendments to the Constitution:

"First: That the name of The American Fish-Culturists' Association be changed, and that of The American Fish-Cultural Association be adopted. Carried."

Second: "That the number of the Executive Committee be increased from three to seven members. Carried." Seventh Report, page 76.

[A foot note at the end of the proceedings says: "In changing the name of the Association from Fish-Culturists' to Fish-Cultural, the Secretary proposed that in the Constitution, after the final word 'Fish-Culturists'' the following be added: '*and the treatment of all questions regarding fish, of a scientific and economic character.*' This change and addition to the Constitution was adopted." Report of seventh annual meeting, February 27th, 28th, 1878; page 118.]

NINTH AMENDMENT. [*February 26th*, 1879.]

"Mr. Phillips moved for an amendment to Article III. of the Constitution, so as to include a Recording Secretary." Carried. Eighth annual meeting, page 50.

RESOLUTION. [*March 30th*, 1880.]

Mr. Phillips offered the following: "That in case members do not pay their fees, and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month, that they be, without further notice, dropped from the roll of membership." Carried. Ninth annual meeting, page 34.

TENTH AMENDMENT. [*March 30th*, 1881.]

Mr. Mather proposed to amend the Constitution to permit honorary members to be elected by a two-thirds vote, the same to be added to the Constitution as a part of Article II., relative to members, and to read as follows: "Any person shall, upon a two-thirds vote of the Society, be considered as an honorary member of the Society. Tenth annual meeting, page 3.

ELEVENTH AMENDMENT. [*April 3rd*, 1882.]

Mr. Evarts moved to amend the section relating to the election of officers by making those which are largely honorary, as the President and Vice-President, vacant after one year, and those holding them ineligible for the same office until after an interval of one year. Adopted. Eleventh annual meeting, page 4.

CONSTITUTION,

AS AMENDED UP TO AND INCLUDING THE TWELFTH ANNUAL MEETING IN 1883.

ARTICLE I.—NAME AND OBJECTS.

The name of this Society shall be "The American Fish-Cultural Association." Its objects shall be to promote the cause of fish-culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the Association; the uniting and encouraging of the individual interests of fish-culturists; and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.—MEMBERS.

Any person shall, upon a two-thirds vote and a payment of three dollars, become a member of this Association. In case that members do not pay their fees and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month, they shall be, without further notice, dropped from the roll of membership. Any person may be made an honorary member upon a two-thirds vote of the members present at a regular meeting.

ARTICLE III.—OFFICERS.

The officers of the Association shall be a President and a Vice-President, who shall be ineligible for election to the same offices

until a year after the expiration of their terms, a Corresponding Secretary, a Recording Secretary, a Treasurer, and an Executive Committee of seven, which, with the officers before named, shall decide upon the place of meeting and transact such other business as may be necessary when the Association is not in session.*

ARTICLE IV.—MEETINGS.

The regular meetings of the Association shall be held once a year, the time and place being decided upon at the previous meeting.†

ARTICLE V.—CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered, or repealed, by a two-thirds vote of the members present at any regular meeting.

[The revised Constitution may be found in reports 1879, page 61, and 1880, page 66. All honorary members were abolished in the third report, page 5, and the Constitution was amended to allow of the appointment of such members at the tenth annual meeting (page 3). The "Order of Business" adopted by the Association will be found in the reports for 1877, page 7; 1878, pages 3 and 116; 1879, page 51; 1882, page 4.]

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* This is not the exact wording of the Constitution, but it is the spirit of it. The original Constitution does not mention an Executive Committee. One is provided for in an amendment in the first report, page 10, and is afterward increased from three to five, (Third Report, page 5), and again to seven (Seventh Report, page 76). It has been the custom for the President, Vice-President, Secretaries and Treasurer to be members, *ex officio*, of the Executive Committee, and such a law may have been passed. If so, I have missed it. F. M.

† In the published reports there is no record of any date of meeting, so fixed. The first reference to such mode of appointing dates of meeting will be found at the close of the fifth annual meeting of the Association in New York, February 8th, 1876 (Fifth Report, page 7). The second reference to this clause will be found in the report of the special meeeting of the Association in Philadelphia, February 14th and 15th, 1877, page 9. The third date of meeting appointed is left indefinite as to the days, but indicates February, 1879 (Report of Seventh Annual Meeting, February 27th and 28th, 1878, page 118). In the proceedings of the eighth meeting, February 25th and 26th, 1879, it will be seen that (page 60) "the meeting adjourned to meet again in March or April, 1880, at the call of the Executive Committee." In the proceedings of the ninth annual meeting, page 65, these words occur: "the meeting then adjourned to next year, the date to be fixed at some future time by the Executive Committee." The report of the tenth annual meeting merely says: "The meeting adjourned." The eleventh report does not mention the adjournment, while the last one, June 7th, 1883, page 76, says: "The meeting then adjourned." This appears to me to sanction the appointing of the time and place of meetings by the Executive Committee. F. M.

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Thirteenth Annual Meeting

OF THE

AMERICAN FISH-CULTURAL ASSOCIATON.

FIRST DAY.

The opening session of the Thirteenth Annual Meeting of the American Fish-Cultural Asssociation was held on the morning of May 13th, in the lecture room of the United States National Museum, Washington, D. C. Among those present at the opening session were Mr. James Benkard, President of the Association; Mr. Eugene G. Blackford, Treasurer; Mr. Fred Mather, Recording Secretary; Messrs. Francis Endicott, G. Brown Goode, Marshall McDonald and Chas. B. Evarts, of the Executive Committee, and Messrs. George Daniels, Commissioner of Fisheries, Toledo, Ohio; Livingston Stone, Geo. Shepard Page, Dr. C. A. Kingsbury, Dr. J. C. Parker, Frank N. Clark, Charles G. Atkins, W. O. Atwater, H. J. Rice, and others. The Corresponding Secretary, Mr. Barnet Phillips, was unfortunately prevented from attending.

The President in calling the meeting to order, remarked that the interest taken in the subject of Fish-Culture was plainly evidenced by the presence of so many distinguished men of science. The Association was indebted to the United States Commissioner of Fish and Fisheries, for having suggested Washington as the place where the Association should meet this year.

The minutes of the last annual meeting were then read by the Recording Secretary, Mr. Mather, after which the Treasurer,

Mr. Eugene G. Blackford, reported upon the financial state of the treasury of the Association.

The following gentlemen were at different times proposed for membership in the Association and were elected:

Charles G. Atkins, Bucksport, Me.; Tarleton H. Bean, Washington, D. C.; Prof. A. S. Bickmore, New York; Dr. H. H. Carey, Atlanta, Ga. A. Nelson Cheney, Glens Falls, N. Y.; Frank N. Clark. Northville, Mich.; J. W. Collins, Washington, D. C.; W. V. Cox, Washington, D. C.; Hon. Thomas Donaldson, Philadelphia, Pa.; R. E. Earll, Washington, D. C.; H. W. Elliott, Washington, D. C.; W. E. Garrett, New York; A. A. Hayes, Washington, D. C.; Dr. J. A. Henshall, Cynthiana, Ky.; George S. Hobbs, Washington, D. C.; E. S. Hutchinson, Washington, D. C.; A. J. Kellogg, Detroit, Mich.; Hon. E. G. Lapham, M. C., New York; W. L. May, Fremont, Neb.; Hon. H. P. McGown, New York; Dr. J. C. Parker, Grand Rapids, Mich.; Hon. R. G. Pike, Middletown, Conn.; Richard Rathbun, Washington, D. C.; Hon. Ossian Ray, M. C., New Hampshire; Prof. J. A. Ryder, Washington, D. C.; Carl W. Schuermann, Washington, D. C.; Col. James Stevenson, Washington, D. C.; Joseph Willcox, Media, Pa.; Lieut. Francis Winslow, U. S. N.; S. G. Worth, Raleigh, N. C.

FRESH AND SALT-WATER HATCHING AT COLD SPRING HARBOR.

BY FRED MATHER.

The new station of the New York Fish Commission, designed for hatching both salt and fresh water fishes, is situated on the north side of Long Island, thirty-two miles east of New York city by railroad. The harbor was formerly a whaling station, and many old buildings connected with that industry still remain there unoccupied. The line between the counties of Suffolk and Queens runs through the center of the harbor, and while the village and post-office is in the former county, the hatcheries are in the latter. There are two points of especial excellence in the site which will at once commend it, and these are the

elevation of the springs, one of which is fully fifty feet above the hatchery, and the proximity to salt water, which at half tide is only two hundred yards away.

The work at the station was begun on January 1st, 1883, by the joint operations of the United States and the New York Fishery Commissioners, and has been continued by both commissions since. The grounds were given, rent free, by Mr. John D. Jones and his brothers Townsend, Samuel and Edward, and the upper spring by Dr. O. L. Jones, and in addition to this, Mr. Townsend Jones has given stone from the Connecticut quarries to build a sea wall to hold the tide at all times. Two old buildings have been fitted up as hatcheries, and the work done in the short space of time will bear close inspection and comparison with older establishments. Maps of the grounds will be found in the last report of the New York Fish Commissioners by those who care to know more of the station.

In the fresh water department the present capacity of the house has been nearly taxed by the hatching of 500,000 salmon, 10,000 landlocked salmon, 38,000 rainbow trout, 50,000 European trout and 1,000,000 whitefish. The fact that the European trout were in five different lots, which will be enumerated further on, rendered it necessary to place them in separate troughs, even though as small a lot as 2,000, taken from one English stream, were kept separate in a trough which could just as well have accommodated 30,000. The whitefish table will hatch 4,000,000 as well as 1,000,000, so that at present we can say that the capacity of the hatcheries is 800,000 salmon and 4,000,000 whitefish, or 1,000,000 salmon and the whitefish. This can be increased, if necessary.

TROUT.

Our native brook trout were formerly plenty in the ponds on this place, but owing to a lack of protection, they were very few when the land was leased to the Fish Commission; about fifty fish being the extent of their number. Eggs of the rainbow trout have been received from three different places, viz: Direct from the U. S. hatchery, at Baird, Shasta County, California; from the U. S. station at Northville, Mich., and from the New York station at Caledonia. They have grown well, but are a

fish that I have never fancied much, and am in greater doubts as to their value since reading the last report of the New York Fish Commission, which says:

"A good deal is to be learned yet respecting temperature and other local conditions affecting fish. Till the past year not enough had been done in stocking with rainbow trout to warrant a judgment of their ultimate success in the waters on the Atlantic side. Their time of spawning occurring at a different season from that of the native brook trout, it would not seem to be policy to plant them in waters inhabited by that fish. The protective seasons would need to be different, and inhabiting the same waters one kind might be taken often when the other was fished for, and thus unintended violations would be liable to occur. An obstacle to their ready success in our waters presents itself in the circumstance that at the season the fry are ready to plant, all other fish are greedily feeding, and consequently a considerable share of the fry are liable to be nipped in the bud. This, however, may be avoided by providing places where the fry can be free from the presence of predatory enemies till they are able to look after their own safety.

"From the circumstance that they have not been readily found always in the second year, where the plants have been made, it has been surmised that they are a migratory fish—working their own way, as soon as they attain any considerable growth, down stream toward the ocean. Their disappearance, however, may be accounted for by the other cause stated. Further experiments will be necessary to solve all the problems connected with their establishment in the Eastern waters; but the promise continues to be that they will prove themselves a fish of great value in stocking large streams whose temperature is too high for brook trout."

An editorial note in FOREST AND STREAM of May 1st, written by myself, says of the rainbow trout:

"We would call attention to the paragraph in our notice of the report of the New York Fish Commission concerning these fish. It is beginning to be learned that they are migratory, and do not remain in brooks. We have never been much in favor of this fish, because we have known, what is not popularly known,

that the fish is strongly suspected to be a salmon. There is no difference that an ichthyologist can find between the *Salmo iridea* and the salmon known as 'steelhead,' 'hardhead,' and 'salmon trout' on the Pacific coast, the *Salmo gairdneri*. Although this is the case, and the species *iridea* is a doubtful one, yet it has been thought best not to combine them for the present. We have been waiting and watching the habits of this alleged trout with great interest in order to learn if its habits might not show it to be in some respect different from the steelhead. The evidence of the Commission tend to show that it is a migratory fish, and if so it may escape to sea and be lost, as the other California salmon was. We believe that Mr. Roosevelt has not seen the rainbows which he planted in streams emptying into the Great South Bay, Long Island, since they were yearlings."

If this fish has to be confined by screens to prevent its migrating and perhaps entirely disappearing, as the quinnat salmon did, then it will be useless in our open brooks. The promise of the rainbow trout was that in it we had a quick growing fish, which was not as sensitive to warm water as our own *fontinalis*, a desideratum which now promises to be filled by the brook trout of Europe, *Salmo fario*. I would here call the attention of the Association to some specimens of this fish, which jumped out of the ponds last October, when they were six months old. They are, as you see, full six inches long, and are plump, handsome and finely formed. The eggs from which they came were sent to me as a personal present last year by Herr von Behr, President of the Deutschen Fischerei Verein, one of the most earnest and enthusiastic fish-culturists in the world. Two varieties were sent, one from the deep waters where they grow large, as in our Maine lakes, and the other from the swift mountain streams of the Upper Rhine, where they are smaller. This year he has repeated his gift by sending some to the United States Fish Commission, in my care, and some to Mr. E. G. Blackford, Commissioner for New York. Last year, when the fish were sent to me personally, I gave some of them to Mr. F. N. Clark, Superintendent of the U. S. station at Northville, Mich., and to Mr. M. A. Green, of the New York station at Caledonia. Both report them as doing well.

This year I repeated these divisions of the German eggs, and also received ten thousand eggs of the same species from Mr. R. B. Marston, editor of the *Fishing Gazette*, London. Five thousand of these were labelled "our best trout," 3,000 were from the Itchen, and 2,000 from the Wye. Both last year and this season the large German trout hatched well, but have died freely before taking food, while the small variety has thrived and been distributed to waters not named in this article. The large English trout have done splendidly and will be kept at the station for breeders. This European brook trout has, as you may see, a larger scale than ours, and to my eye is a more beautiful fish than our own trout. It is a fish that from its habit in Europe should live in the Hudson from North Creek, or above, down to Troy. In Europe it is found plentiful in the south of England, while the charrs, of which our so-called trout is one, are only found in the deep cool lakes of the North. I believe that we have the necessary conditions of the Atlantic coast to successfully acclimatize this fish, and I have always been skeptical about habituating the *Salmonidæ* of the short streams of the Pacific coast, with their snow-fed waters in midsummer, to our longer and warmer rivers, and this skepticism has increased since I have suspected the so-called rainbow trout to be identical with the steelhead salmon, *S. gairdneri*, which is a migratory fish.

WHITEFISH.

The great surface exposure of the reservoir at this station is favorable to the late hatching of the whitefish. The temperature of the water in the hatchery for the month beginning February 23rd, and ending March 23rd, varied from 34 degrees to 48 degrees, the mean being 38½. Shipments of whitefish were made this year to Great Pond near Riverhead, Long Island, on February 15th, and to Lake Ronkonkoma on March 19th. This is as late as the fish are hatched in the cold lakes, and the young will find food when planted in March.

THE SALT WATER WORK.

The cold weather caused us to suspend out-door work before

the completion of the great tidal reservoir, but we were enabled to hold the water as high as half tide and to begin work. The hot air engine worked very well, and we hatched the eggs of the little tomcod (*Microgadus tomcodus*), locally known as "frost-fish" in the fall of the year, and as tomcod in the spring. I sent some of these eggs to Prof. T. J. Ryder, at the Central Hatching Station of the United States Fish Commission, and he hatched them in artificial sea water. The spawning season of this fish is in November and December, and they had finished spawning before our engine was in position, but we gathered the eggs from the seaweed, to which they are attached, in bunches the size of a hen's egg, and are easily obtained by the oystermen when raking for oysters.

We also obtained several millions codfish eggs from the cars at Fulton Market, but none of them were good. They showed the shrunken vitellus which gives both them and shad eggs a "speckled" appearance, which indicates that there is no possibility of impregnating such an egg. In every case the parent fish had been brought in the well of a fishing smack, and after being dipped out had been thrown into the floating car alongside, falling from four to six feet, usually on the abdomen. This, in my opinion, is more than the delicate cod egg can stand.

The membrane, or shell, covering the egg of the codfish, is so delicate that a light touch of the finger, when the egg is on any hard substance, will burst it like a soap bubble, while a trout's egg will bear the hardest squeeze that can be given between the finger and thumb. It is possible that the eggs will have to be obtained from the fishing grounds and be taken when the fish are first hauled in, although they may possibly be found to be good after the smacks arrive and before the fish are put in the cars.

POSSIBILITIES OF THE STATION.

In addition to the salt-water fishes mentioned, it is possible to hatch many other species. The density of the water varies from 1.018 to 1.022, sea water being 1.028 and distilled water 1. The temperature of the water in the hatching jars has, during the months of January, February and March, varied from 33 to

48 degrees Fahr., the mean being 42¾. The water is clear and pure, and everything seems to be favorable for doing much good work. Spanish mackerel and other valuable fishes may be attempted, while in the opinion of Prof. H. J. Rice, the situation is most favorable for oyster-culture. The harbor is part of the celebrated Oyster Bay, and oysters and clams are usually abundant and excellent. The past year, however, has not been a good one for either of these products, but the difficulty, whatever may have been the cause, is probably a temporary one.

It is to be hoped that the State of New York will adopt some such system as Connecticut has, and which is now in good working order and giving general satisfaction, and in addition, begin experiments looking to the production of seed oysters At a comparatively small expense these experiments can be conducted on the grounds at Cold Spring Harbor, where the machinery for pumping salt water is now in position, and where the situation is favorable for making such ponds as may be necessary.

The experiments of the gentlemen who have devoted their time to the impregnation of the eggs of the oyster, have proved that they can be fertilized and hatched in laboratories, and there seems to be no obstacle to the work being carried on, in a suitable location, on a larger scale.

Mr. MATHER added: There has been much discussion in regard to this early hatching of the white-fish. At Caledonia and Northville, for instance, the young fish are put out so soon that some fish-culturists claim that there are no crustaceans hatched at that time for them to feed on. That is a question I cannot go into here, but I will state that at Cold Spring Harbor we can hatch out the fish much later.

THE PRESIDENT: I would say that my experience with California trout has been somewhat different. The original eggs sent from the Smithsonian Institution were hatched out by us at the South Side Sportman's Club of Long Island, four years ago, in the month of April. This last winter we had fry out in January. Probably the locality is a point to be considered in this connection.

Mr. BLACKFORD: I would like to hear Professor Ryder express his views in regard to the eggs of the cod-fish.

Prof. RYDER: My experience with cod-fish eggs, both at Fulton Market and at Wood's Holl, has been quite considerable. Our greatest success in handling these eggs has been in comparatively salt water, as Colonel McDonald can testify. The eggs taken at Wood's Holl were from fish that had been kept under the same conditions as those in Fulton Market. At the former place the eggs would float as they should normally, but at Fulton Market they had no tendency to float as did the eggs from the more northern locality. I also observed that in most cases the eggs had an abnormal appearance. The vitellus was disorganized, and the vitelline matter and germinal material were pulled out of shape. The germinal disc was formed, but defectively; in many instances, after formation, it had been broken into irregular fragments, which were certainly not characteristic of normal segmentation. What the cause was I cannot say, but I believe that the confinement of parent female fishes of any species would have a tendency to interfere with the fertility of the ova. That has been the experience at Havre de Grâce with the shad, and I should not be surprised if the confinement of female cod in the wells of the fishing smacks and the cars, would not tend to cause the eggs which were mature, and still contained in the ovaries, to become, to a certain extent, disorganized, and therefore incapable of fertilization. My conclusions have been formed deliberately, although the data have been very imperfect. There was this important difference between the eggs taken at Wood's Holl and Fulton Market. The latter exhibited a decided tendency to sink, which in our Wood's Holl experiment we always associated with a condition indicating that such eggs would never hatch. We invariably noticed this to be the case, and concluded to accept it as *prima-facie* evidence that whenever a cod egg went to the bottom, that was the last of it, so far as its capacity for development was concerned.

Mr. MATHER: I have observed that the cod-fish eggs which I have taken at Fulton Market, New York, had a tendency to sink, as just stated by Professor Ryder. When I removed them from

the pan into a jar, the same thing occurred, and you could see the upper line of the eggs about half way up the jar. When placed in the McDonald hatching jars, they acted like white-fish eggs, except that they were a little lighter. The moment the circulation of the water stopped, they all sank to the bottom. I confess to having been somewhat skeptical about "floating eggs" of cod-fish, although I understand from Professor Ryder and Colonel McDonald, that at Gloucester the eggs actually floated on the surface, resembling in appearance a honey-comb, and that they were so buoyant that a portion of the egg would literally stand out of the water. I attributed the failure to impregnate the eggs taken at Fulton Market, to the shock which the fish suffers by being thrown into the cars from the fishing smacks. They are cast from the deck to the surface of the water, a distance of from four to six feet, and usually strike on their bellies. The cod egg is exceedingly delicate, and breaks like a soap-bubble at a touch.

Col. McDonald: The fish from which the eggs at Wood's Holl were taken, were, as far as I know, handled very carefully, being transferred from the smack to the car with as little violence as possible. But may not the difference in the results of the observations made at Wood's Holl and Fulton Market, be explained by a difference in the density of the water at the two places? Of course the buoyancy of the cod egg depends upon the density of the water in which it is placed. Now at Wood's Holl, where the water opens out to the ocean, it surely must be much more dense than at New York harbor, and the effect of this difference upon the eggs is clearly proved by the fact that those eggs which floated at Wood's Holl sank at New York. In regard to the eggs taken at New York, they were sent on in hermetically sealed jars to Washington, where on arrival they were found to be impregnated and a small proportion developing. They were then put into salt water artificially prepared. (5 oz. of salt to the gallon of water). Development went on, I think, for fifteen or sixteen days until the embryo was moving and the heart beating, and yet after all we did not succeed in hatching them. Up to that time their development, I believe.

was normal. The embryological investigations were carried on by Professor Ryder, who perhaps will add a few words.

Prof. RYDER: You do not mean to say that all the eggs taken were fertile, but that the greater portion of them were. There were large quantities that I know would come to nothing. The vitellus had turned to a brownish hue, and the germinal disc was disorganized.

SALT AS AN AGENT FOR THE DESTRUCTION OF THE FISH FUNGUS.

BY PROF. H. J. RICE.

There are very few persons who have ever had anything to do with the artificial rearing of fish; especially if the rearing is carried on in comparatively quiet and warm water; or who have ever had very much to do with fish in aquaria, but have been more or less exercised over the decorations and ravages of that very insidious and annoying vegetable parasite, commonly known as fish fungus, although it occurs, indeed, on many other objects than eggs and fishes. Many means have been employed for its destruction, and innumerable efforts made to dislodge it from the tanks where it had obtained a firm foothold. Asphalt, tar, salycilic acid, salt and various other simple or compound agents of destruction have been employed, and while each and all of them have been pronounced beneficial, yet most of them are difficult to apply, and after being applied much care is necessary in order that the agent shall not be the means of doing that which they were employed to prevent; that is, cause the death of the eggs or fish experimented with. Of all the agents thus far employed for the purpose of destroying this fungus, or *saprolegnia*, common salt is, taking everything into consideration, probably the most useful, since it can always be easily obtained and quickly manipulated. But it is always well to bear in mind that with whatever agent the work is carried on,

the agent will perform its part only when associated with vigilance, persistence and zeal on the part of the operator.

Having had occasion, during the past season, to make certain experiments in the direction of dislodging and exterminating this undesirable form of vegetation, which had secured too firm a hold in certain tanks and upon certain animals and fishes in the laboratory at Fulton Market, New York, I determined to try the effect of the continued use of a strong solution of salt, and to note carefully the results. The work was thus merely supplemental to what has already been done in this direction, and, so far as it goes, corroborative of such previous efforts. The animals upon which I experimented, personally, were goldfish of the Japanese variety, black bass and specimens of *Necturus lateralis*, or the mud puppy. I also induced Mr. Geo. Ricardo, fish warden of Bergen County, N. J., to undertake some experiments as to the efficacy of salt in destroying the fungus which collects so plentifully upon the trays and bunches of eggs in the smelt hatching operations. The experiments with the goldfish were begun during the month of January, and continued several months. The specimens operated upon were from a lot brought over from Japan and China in December by Capt. Jones, of the steamer Oxfordshire, and placed immediately upon their arrival in tanks of running water at the stand of Commissioner E. G. Blackford in Fulton Market. The fish had been very severely handled during their ocean voyage, many of them having large numbers of the scales knocked from their sides, evidently from being thrown against the sides of their vessel as the steamer struggled in the rolling waves.

From this cause, and undoubtedly also from the fact that the water into which they were placed was too cold for their warmth-loving constitution, they commenced to die, one by one, within a day or two of their landing on our shores. Those that died first were hardly more than still before the velvet-like plush of the *saprolegnia* spotted their bodies or fins, or in some cases, literally enveloped them in a robe of white. Soon not only the dead, but the living were similarly decorated, and it became evident very quickly that if something was not done the *saprolegnia* would, before long, claim them all its victims, although it

is hardly more than justice, perhaps to state that the fungus in all probability was in these cases, whatever it may be in the other cases, a secondary rather than a primal cause of death. While death was thus making sad havoc in the ranks of these beautiful fishes which were kept in the running Croton water down-stairs, those which I had taken, very soon after their arrival up-stairs into the laboratory and placed in a small aquarium of moderately warm water, were getting along nicely and were not troubled at all with the fungus. I then requested that four or five of these specimens affected with the fungus should be taken from the tank and sent up to me to be treated with a salt bath. I prepared the bath by placing three or four handsful of coarse salt in a small quantity of water, and then heated it over the fire until the salt was all dissolved.

Cold water was then added until the whole was a temperture of about 60 degrees, when the fish were taken very gently out and placed in their new location. At first the change was not apparently agreeable, as they darted about in a furious manner, but some became quiet and were taken out after an immersion of about one minute and returned to fresh water; but not to the same from whence they had been taken. In the course of half an hour or an hour the fungus began to loosen from the body in quite large patches, showing that the connection of the hyphæ, or rootlets, with the skin had been destroyed, and the next morning I picked out quite a large number of these discarded fungus flakes which the fish had thrown off into the water during the night. In order to make sure that the hyphæ should be entirely destroyed, and not leave relics from whence new crops might be generated, I gave each fish two additional baths of the strong salt water, and until they were moved from their aquarium and injured at a later period, I found no traces of fungus on any of them. It is true that in some of the cases experimented upon, the salt water did not cure the fish, but the salt water certainly killed the fungus, and undoubtedly if the fishes had not been very much debilitated before the bath was given them, their lives might have been prolonged as in the case of some of the others. The black bass which was experimented with, was literally loaded with a fluffy plating of fungus when

it was first placed in the bath. It acted much in the same manner as did the goldfish, except that from its size and strength it produced a much greater commotion in the water. It was left in the bath about ten minutes and then replaced in the tank from whence it had been taken. The next morning the entire surface of the body looked as if a card had passed over it and had raked the fungus out into long filaments and strings and streamers ready to be pulled off with scarcely an effort. Two days after a second bath was administered, but while still more of the fungus was loosened, the parasite had evidently been too long at work, the hyphæ had penetrated too deeply and drawn for too long a time upon the tissues of the flesh for it to recover, and in two days more it ceased to move.

The next animals to be experimented with were nine specimens of the mud puppy, or *Necturus lateralis*. These had all been more or less injured about the mouth with the hook in their capture, and two or three had their tails badly mutilated. Some of them were very much matted with the fungus when they arrived, while others were only slightly attacked. They were all placed in the bath and the fungus was loosened or killed upon all of them, but the salt water had the effect, in the cases of those severely injured, of aggravating the injury, and by increasing the rawness of the wounds, prepared the field for a new crop of the fungus, since the water was full of the *saprolegnia* spores, ready, and indeed anxious to continue the old condition of affairs whenever opportunity offered. In such cases the new crop of fungus sprang up with a rankness and a velocity which was truly surprising, and if I had not known that the salt water would kill the fungus, I should have been inclined to think that in these cases salt water acted as a fertilizer for the hyphæ. I am inclined however to think that the true condition of affairs was that the salt water killed a part of the hyphæ, and at the same time rendered the wounded surfaces much more suitable localities than ever they were before, for the growth of the fungus, and then when the animals were replaced in the fresh water, the spores, which were there in countless numbers, finding suitable territory in which to develop, took root, and, together with the rem-

nants of the old hyphæ, grew with wonderful rapidity. At any rate I succeeded in destroying the fungus only on those animals which were not badly wounded. The rest died.

In the spring of 1877, while engaged in studying the embryology of the smelt at New Brunswick, N. J., under the auspices of the Maryland Fish Commission, I found that one of the most serious drawbacks in the manipulation of the jars in which the eggs were placed, was the collection and growth of the *saprolegnia* upon the trays and upon the eggs, especially whenever the eggs were much massed together, as they often were in clusters of the size of a large walnut or larger. With the arrangements which we then had, we could not try the effect of salt upon this growth of fungus, but in my report to the Commission I expressed my opinion in favor of testing the salt-water bath, as soon as arrangements for its use could be made.

An opportunity to test this method with the smelt eggs did not occur until this spring, when in talking with Mr. Ricardo, who was then engaged in manipulating smelt spawn upon the Hackensack, I suggested that he should try the effect of immersing the small eggs in strong salt water, particularly such of them as had any fungus attached to them. The method employed by Mr. Ricardo in attaching the smelt spawn, which is similar to that employed by Mr. C. G. Atkins in Maine, some years ago, that is by taking blades of sedge or water grass and dipping them into the pans of milted spawn, prevents to a great extent, if not entirely, the massing together of the eggs, since the rough surface of the blades allow only a single layer at most to adhere to the surface; the result is a pretty even distribution of the eggs over the blades, and not much change for the attachment of the fungus, except on the dead eggs and the dead portions of the grass. Still there always is a greater or less amount of fungus present, and vary much in proportion to the greater or less flow of water over the eggs.

Acting upon my suggestion, Mr. Ricardo prepared some salt water, strong enough, as he said "to bear up a potato," and placed some of the egg-bearing grass blades in it. He took those blades which had considerable fungus upon them, and after leaving the blades in the water for fifteen or twenty minutes, he took

them out and found that the fungus had been killed so completely that it could be stripped from off the eggs like a slough, leaving the eggs nearly, if not quite as clean as when first taken. From that time on until the eggs hatched out, which was, I believe, a period of about two weeks, he gave them a bath every day or every other day, and no more fungus appeared, and only about five per cent. of the whole number failed to hatch. Every experiment which he tried seemed to show the advantage of the salt bath in the destruction of the fungus, and that little or no harm resulted to the embryo fish. In order to test the effect of continued immersion upon the embryo, he placed some ova in the salt water and kept them there for forty-eight hours. At this time they were all in good condition, and it was not until they had been kept constantly immersed for from sixty to seventy hours that the embryos were unfavorably affected.

Short immersions seem to have very little effect upon either the embryo or the adult fish, and, while there is a point beyond which we cannot safely go in our experiments with either the one or the other, yet of the two the embryo seems to be able to stand a longer immersion than the adult, especially than these species which are not anadromous. Short and moderately frequent immersions, then, will in all probability accomplish what is desired, so far as the destruction of the fungus is concerned. This, at least, seems to have been the case in my experiments, but it is much better, in every case where it is practicable to do so, to give this salt bath as soon as any fungus is discovered and before the hyphæ have penetrated very deeply into the tissues, for it seems to be beyond question that the *saprolegnia* is one of these parasites that causes tissue destruction, as I have seen in numerous instances the gradual extension of the velvety carpeting of hyphæ branches, from some minute wound on one side of the body of an animal, until the entire body was girdled. By taking the animal in hand early, and, in case there is no serious wound to be aggravated by the salt, by using a strong solution and using it for a short time and often, it seems to me that salt may be a valuable agent in the hands of those who wish to rid their aquaria or their hatcheries of what is often an intoler-

able pest. And above all must it be borne in mind, that when water is used that comes from rivers and lakes, like the Croton water of New York city, no matter how clear of fungus they may get their tanks or aquaria, the spores are in the water, and any wounds in the fishes, or decaying or dead matter which may at any time afterward get into the water, offer fertile fields for renewed growths, which can only be disposed of by a new resort to the salt wash.

THE ARTIFICIAL PROPAGATION OF SALMON IN THE COLUMBIA RIVER BASIN.*

BY LIVINGSTON STONE.

Every one has heard of the immense quantities of salmon that are annually canned on the Columbia river. It is not necessary to go into details. The general facts known to all prove that an enormous number of salmon have been accustomed to ascend the Columbia river every year, and it is probably safe to say that the Columbia has been the most productive salmon river in the world.

This is one side of the subject. The other side is this: Such enormous quantities of salmon taken from a river must ultimately endanger the productiveness of it. The situation is not, however, quite as bad as it looks, for it seems at first sight as if the stock of a salmon river would be diminished in proportion to the number of salmon taken out of it, but this is not wholly true, for a compensating element of great weight comes in to disturb the calculation. Nature, perhaps more aptly speaking, Providence, in the case of fish, as well as numberless other creatures, produces great quantities of seed that nature does not utilize or need. It looks like a vast store that has been provided for nature, to hold in reserve against the time when the

*The salmon referred to in this paper is the *Oncorhynchus chouika*, the spring salmon of the Columbia, the chinook salmon, quinnat salmon, the common salmon of the Sacramento river.

increased population of the earth should need it and the sagacity of man should utilize it. At all events nature has never utilized this reserve, and man finds it already here to meet his wants.

If this were not so, if there were no reserved stock of seed provided beyond what nature uses every year, or to apply the hypothesis to the subject before us, if the salmon produced no more eggs every year than what are needed to keep the places of the parent fish filled, then it would be time that a river's stock of salmon would diminish just in proportion to the number of salmon or salmon eggs taken out of it. As it is, the parent salmon in a state of nature, probably produce three thousand times as many eggs as would be needed if all became full-grown reproductive fish. The calculation is a very simple one. For instance, the quantity of salmon in any specified river, before they were molested at all by man, unquestionably remained constant from year to year. Making allowance, of course, for exceptional years, the average of any one decade has been, without doubt, about the same as that of the previous or next succeeding decade. It follows, of course, that evey pair of full-grown fish have produced during their lives just two, or their own number of full-grown fish of the next generation, in order to keep the whole river supply good from year to year.

If they produced more uniformly, the salmon in the river would increase till the river would ultimately become full of fish; if less, the stock for the reverse reason would be ultimately exhausted.

Now, as one pair of salmon produces yearly, say six thousand eggs, it follows that there are deposited each year three thousand times as many eggs as would be needed, supposing that every egg became a full grown, reproducing parent. I should add that this computation is based on the supposition that all the parent salmon die after spawning and never reproduce again. This is true of the bulk of the Pacific coast salmon. If any do live to get back to the ocean after spawning and reproduce again, it increases the ratio of the number of eggs deposited to the number of salmon that reach maturity.

The value to food-requiring man, of this reserve seed stock,

becomes particularly apparent when we consider the effect of the fishing of a salmon river. The first thousand fish taken out of the river, though it deprives the river of three million eggs, makes no perceptible difference with the future supply, because there are so many eggs left that this abstracted quantity, great as it is absolutely, is relatively insignificant—the number of eggs left being so vastly greater.

The first hundred thousand salmon taken from the river makes no difference, partly because there are so many eggs left, and partly because one of nature's compensations comes in by making the struggle for existence among the diminished number so much easier, that the eggs that are left go as far toward replenising the river's stock as the larger number did under the less favorable conditions of a comparatively over-crowded river.

So great is the reserve stock of seed originally provided, and so effective are the compensations of nature, that even the first million of parent salmon taken from a great river like the Columbia seems to make no difference in the annual run of salmon up the river.

We might go further, perhaps, and say that the first two millions would make no difference, but we need not take the trouble to prove this, for it would not help to illustrate the point if we did; the point being that if the annual catch goes on increasing, the limit will ultimately be reached when the number of eggs in the fish that are left will not be enough, even with the help of nature's compensating agencies, to keep up the river's stock.

I need hardly remind a body of fish-culturists and Commissioners that when this limit is passed, the decrease of the fish proceeds at a rapidly accelerated rate. It is burning the candle at both ends, for while the diminished stock of the river keeps diminishing from an inadequate supply of seed, the destructive capacity of the engines of capture are constantly increased to offset the poorer fishing that results.

Then begins a geometrical ratio of yearly decrease which is startling, and of which the end is complete extinction.

Some intelligent people thought that the limit just mentioned had nearly been reached in the Columbia several years ago. Many more persons think it has now. Still, the resources of

the great Columbia are so wonderful that, although upwards of two thousand million eggs are annually abstracted from the river, there seems to be a doubt remaining yet whether the eggs that are left are not sufficient to keep up the stock.

However, if the fish-eating world does not go backward, the danger limit will soon be passed, if it has not been already, and it is none too soon to consider the question of taking measures to guard against the danger by artificial propagation.

What has been done in the Sacramento in this direction is well known. I take the liberty to quote from an article bearing on the subject, by Mr. C. A. Smiley, of the United States Census Bureau. Mr. Smiley, after mentioning some of the difficulties of fish-culture says:

"I will close with citing one of the most remarkable of the successes thus far attained. The salmon canneries of the Sacramento river annually increased in number until by 1870 the entire run of salmon was being caught and utilized. The greatest natural capacity of the river under these circumstances may be considered to have been reached in 1875, when the yield to the canneries was 5,096.781 pounds.

"The first possible fruits of fish-culture were in 1876, when the young of 1873 may be supposed to have returned.

"The United States hatchery was established in the latter year at Baird, Shasta County, California, and a half a million young released in 1873 and again in 1874.

"In 1875 the number was increased to 850,000, in 1876 to 1,500,000, and during each of the years 1878, 1879, 1880, 1881, two million young fry were placed in this river. From an annual catch of 5,000,000 pounds the river has come up to the annual catch of over 9,500,000 pounds, which figure has been maintained during the past four years.

"The figures were:

	Pounds.
1880	10,837,000
1881	9,600,000
1882	9,605,000
1883	9,586,000

"Allowing the three years which it takes for salmon to come to maturity and enter the river for spawning purposes, the increase in yield to the canneries for ten years has been almost exactly proportionate to the increase in the disposition of fry. Taken into consideration the cost of hatching 2,000,000 salmon annually, and the value of the increase of 4,500,000 pounds, it will be seen," Mr. Smiley

concludes, "that there is a very large per cent. of profit in artificial fish-culture, when conducted under circumstances as favorable as these."

What man has done man may do, and what has been done in the Sacramento can be duplicated in the Columbia, and in as much larger proportion as the Columbia is larger than the Sacramento.

An effort was made in 1877 to hatch salmon on the Clackamus river, a tributary of the Columbia.

This location seemed to combine every advantage for the hatching of salmon on a large scale. The river heads, as you are aware, in the perennial snows of Mt. Hood, and the coldness of its snow-fed waters is very attractive to the ascending salmon. Just above its mouth, on the Wilhamette, into which it empties, are the impassable falls of Oregon City, which prevent the salmon from going up the Wilhamette any further, and naturally turns them back into the Clackamus, if they missed that river in the first place. Then, if necessary, the Clackamus can be so obstructed that every salmon coming up can be stopped in front of the fishery. The river is a favorite resort of the salmon, as it must necessarily be, with its cold, clear, and swift running water; and before canning on the Columbia began, the Clackamus was famous for its hundreds of thousands of magnificent spring salmon that used to swarm up its channel to spawn.

But the establishment of the station came too late. Already—this was in 1877—there were fifteen or twenty canneries on the Columbia below the mouth of the Wilhamette, and with their thousand miles, or nearly, of drift nets waylaying the ascending fish, the main river became so depleted of parent salmon, that those that reached the Clackamus in 1877, were but a sorry fragment of the immense shoals that originally came up the stream to spawn.

It was too late. Had the station been established twelve years before, twenty million eggs of the best variety of salmon in the Columbia river could have been taken there every year. The time has now gone by for that, and only a few million eggs can be taken in a season on the Clackamus, until some legisla-

tion allows a larger proportion of the parent salmon to reach the river.

This station was partly destroyed by a hurricane a few years ago, and has been abandoned for the present.

Unfortunately the same objection which applies to the Clackamus river as a hatching station, for producing young salmon on a large scale, viz., the enormous yearly catch of salmon on the Columbia below the Clackamus, also applies to all other good locations in the Columbia river basin, or rather what were originally good locations. Twenty years ago there were scores of places on the affluents of the Columbia where ten to twenty million salmon eggs could have been obtained annually, because such an enormous quantity of salmon ran up the Columbia that they swarmed in thousands into each of these spawning streams to deposit their eggs.

Now that every season as the salmon come up to spawn, hundreds of thousands of them, I might almost say millions, are caught for canning, there are not enough left to distribute themselves in very great numbers in each of their thousand spawning-beds up the river, and it will never again, in my opinion, be very easy to find more than one or two places in the Columbia river basin, where twenty million salmon eggs can be annually obtained, unless some legislation protects the salmon on their upward journey, or artificial hatching, simultaneously carried on at various independent localities, increases the number of salmon in the river.

I have made three explorations of the Columbia river for the purpose of finding a good place for getting salmon eggs on a large scale; (the last time under the direction of the United States Commissioner of Fisheries). Following the Columbia, except around the Great Bend, all the way from the Rocky Mountain divide, where you can step across it (here called Deer Lodge river), to the bar as its mouth where it is fifteen miles across, and I am convinced that the salmon do not now come up to any one of their famous original spawning grounds in such quantities as to make it an easy thing to get twenty or even ten million eggs a year from any of them.

I must except some places (notably the foot of Shoshone Falls

in Idaho) on the tributaries of the Snake river, now difficult of access, where it is possible, perhaps, if the attempt is made soon enough, to obtain sufficient spawners for large operations in hatching. I will also except the mouth of the Little Spokane river in Washington Territory, where there is a most excellent location for a hatching station, and where perhaps ten million eggs a year could be collected, if the statements made about the number of salmon that come up the river are at all true. These statements have not been substanstiated yet for want of opportunity, and all we can say is that thousands and thousands of breeding salmon used to frequent this natural and favorite spawning ground, and perhaps the canners leave enough now in the Columbia to still make the Little Spokane a good collecting place for their eggs. As my report to Prof. Baird recommends this point as a favorable location for a hatching station, a description of some of its advantages may not be out of place here, and the first I will mention is its accessibility. Eight miles from the mouth of the river, over a remarkably hard and level road, is the town of Spokane Falls, a new, but thriving and promising settlement of, perhaps, 3,000 inhabitants. This town is situated on the line of the Northern Pacific Railroad, and is in daily communication with the rest of the world by mail, telegraph and railroad, the railroad being one of the great transcontinental thoroughfares of the country.

These general facts alone are sufficient to show the accessibility of the location without the necessity of mentioning details.

The water supply at the mouth of the Little Spokane for hatching the eggs is practically unlimited. As there is a strong current in the river, and as the water does not rise till after the spawning season and hatching season are over, the water can be safely raised from the river itself by a current wheel, as at the McCloud river station, and this being the case, any required quantity of water can be brought to the hatching house at a small expense. The location is also favorable for obtaining water conveniently. The river does not ever rise more than a few feet, and consequently the hatching house can be erected not very far above the low water mark. A small current wheel will,

therefore, be sufficient to raise the water to the hatching house, and the adjacent land is so favorable for building on, that the wheel can be placed very near the hatching house, which will render unnecessary the construction of a long flume from the wheel to the hatching house. As the river does not rise till the hatching season is over, the wheel need not be protected from drift wood, nor arranged with reference to the rising and falling of the water.

These are great conveniences, and on the whole it may be said that the water supply may be safely depended upon in every respect. The location is also remarkably favorable as to availability. Fortunately, the adjacent country is still in its primitive state. When I visited the place in July, 1883, many Indians were encamped on the river bottoms; but I saw no white men. It is true some claims near the river have been taken up by white men, but they are not valuable, and could be bought without much expense. It is, therefore, very probably that the site of a salmon building station could be obtained without much cost; and as there are very few settlers up the river, and no towns or villages, no objection would probably be raised to collecting the parent salmon during spawning season by means of a dam across the river.

The Little Spokane, is also of such a character that it would be an easy matter to capture the breeding fish. Indeed, I think a seining ground could be arranged, so that nearly all the spawning fish that come up to the river could be caught; and furthermore, it being close to the main Spokane river it would not be difficult to run two seining grounds, one on each side, which would undoubtedly somewhat increase the yearly catch of breeders.

It would be a very easy matter to build a dam or salmon rack across the river to keep the breeders on, or near the seining ground. Indeed the frail structure that we saw the Indians successfully erecting across the river, shows how easy it would be for white men, with their superior appliances, to put a salmon rack across the river, such as would be required to answer the purpose of a breeding station. There being no drought or freshet on the river during the season's operations at the station,

and, indeed, no material change at all in the river, a very simple and readily-constructed dam would be perfectly safe. This is a great advantage, as it often proves a very difficult matter in a river subject to freshets in the hatching season, to put in an obstruction that is perfectly safe.

And last, but not least, the maximum rise of the river during the year is so inconsiderable, that there will never be any danger of the hatching house and other buildings being washed away, even if they are placed, as it is desirable that they should be, close to the river.

Besides possessing the essential qualification just enumerated for a salmon breeding station, the Spokane location has many convenient features about it to recommend it. In the first place, it is in a good timber country, where lumber can be easily and inexpensively obtained for building. Then the roads in all directions are hard and good, even during the rainy season, which is a merit which can be fully appreciated only by those who have lived in other parts of the Pacific coast, where the roads become practically impassable during the rainy season, on account of the great depth of the mud. The ground is also almost level from the mouth of the Little Spokane to the town of Spokane Falls, which would make communication with the town, and freighting to and from the breeding station, very easy. The climate is also a great recommendation to this place. It is never very cold nor very hot, but the temperature is quite even, and consequently very favorable for work of any kind.

By glancing over what has just been said about the mouth of the Little Spokane, it will be seen that it is known to be in all essential points an unusually favorable location for a salmon breeding station. If it should prove to be capable of furnishing an abundance of breeders, I should not hesitate to recommend it emphatically as one of the best situations to be found anywhere for taking and distributing salmon eggs. If, however, it should fail to supply the required quantity of spawning salmon, I do not know where we could look for any one place on the Columbia river, or its north fork, which, by itself, would be adequate and satisfactory, and I think we should be reduced to

the necessity of going further from the railroad, or erecting two or three separate stations at different points.

Before closing, allow me to mention a fact which may possibly be as much of a surprise to many of you as it was to me. It is that there are no salmon in the whole of that portion of the North or Clark's Fork of the Columbia, which flows through Western Montana and Idaho, including that magnificent body of water, Lake Pend d'Oreille in Northern Idaho.

This fork of the Columbia known as it flows westward under the various names of Deer Lodge river, Hellgate river and Missoula river, has a length of about three hundred miles before it reaches the falls of Senniacwateen, just below the outlet of Lake Pend d'Oreille, where it is believed the ascending salmon are finally stopped from going any further, and in the long stretch of river above this point clear to the Rocky Mountains no salmon whatever are found. I was not aware of this fact, and when we had crossed the continental divide, which was accomplished then in a wretched mud wagon (called by courtesy a stage), and had descended the western slope of the Rocky Mountain range far enough for the Deer Lodge brook to have become a respectable river, I expected to find salmon very abundant, but to my great surprise the people there were as unfamiliar with salmon in their natural haunts as the people of this city are, and were nearly as far from them.

I found that there were three principal obstructions which kept the salmon from ascending the river. The first one from the ocean is Kettle Falls, in Washington Territory, on the main Columbia, 711 miles from its mouth. These falls are about twenty-five feet in height at low water, but they are not wholly impassable, for on the east side they are broken into a series of cascades, through which the salmon can and do get above the falls at certain stages of the water, and possibly at all times.

Forty-two miles above Kettle Falls, the Pend d'Oreille river (Clark's Fork of the Columbia from Lake Pend d'Oreille to the main river is called Pend d'Oreille river) empties into the main Columbia. Near its mouth, at a distance variously stated from a few rods to twenty miles, is another fall which is undoubtedly a serious obstruction to the salmon. This fall (it being on the

Great Bend, I did not see it myself) is said to be ten or fifteen feet in height.

I heard of salmon being caught all the way up to the falls of the Senniacwateen—so the salmon are obviously not all stopped at the falls of the Pend d'Oreille, though probably not a very large proportion get by them.

About one hundred and fifty miles above these nearly impassable falls, and not far below the outlet of Pend d'Oreille lake are the falls of the Senniacwateen, which, though not over eight or ten feet in height, probably head off the comparatively few salmon that reach them and mark the highest point, the *ultima thule* of the upward migration of the salmon of Clark's Fork of the Columbia. I mention these facts, partly because when I was in Idaho and Montana, there was a strong feeling among some of the residents on Clark's Fork in favor of opening a way for the ascending salmon through the obstructions just mentioned, and allowing them to come up into Idaho and Montana, which they would undoubtedly do if they could, although it is nearly twelve hundred miles from the mouth of the Columbia to Deer Lodge City.

I will merely add in this connection that a movement has been started for obtaining the intervention of the territories interested, and if possible of the United States, for the purpose of opening a passage for the salmon through the formidable obstructions at the mouth of the Pend d'Oreille river, but in my opinion these falls will be found to lie in British territory, and the undertaking mentioned will require the co-operation also of the Dominion government.

I need hardly say in conclusion, that in my judgment the sooner we get about this work of hatching salmon on the Columbia the better. We have waited too long already. The great opportunities of twenty years ago are all gone, and every year makes the matter worse.

Mills are going up, settlements are forming, railroads are being built in this trans-Rocky Mountain region with surprising rapidity—all accelerating the decrease of the salmon—and in a short time we may be glad to even get opportunities that we scorn now. A great industry as well as an immense food supply is at stake, and something ought to be done very soon.

THE WHITE FISHES OF NORTH AMERICA.

BY TARLETON H. BEAN, M.D., M.S.

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The white-fishes, properly so-called, all belong to the genus *Coregonus*, which, however, admits of division into several minor groups, based chiefly upon the character of the mouth and the form of the body. We have, in North America, twelve recognizable species, one of which is now apparently for the first time distinguished by name. These species are usually of wide distribution, and subject to great variation with age and surroundings, making it difficult for the student to sharply define them by the use of characters which are generally believed to have specific value. An attempt is made, on a subsequent page, to set forth the relations of these twelve species by calling attention to the peculiarities which seem to be most important and least subject to variation. The form of the mouth, the structure of the gill-rakers, the size of the species, and, in some cases, the length of the fin-bases, appear to serve the purposes of classification best; but it is difficult to apply any fixed formulæ of definition and little to be wondered at that most of our common forms have been described over and over again since they were originally introduced into the literature.

I have placed along with the white-fishes that magnificent species, the finest of all the fishes closely related to *Coregonus*, the *Inconnu* of the McKenzie and Yukon regions. This well-flavored species grows to four feet in length and is known to have reached fifty pounds in weight. From an examination of the Russian *Stenodus leucichthys*, I am inclined to think that the American *Inconnu* is identical with the species of Güldenstadt, and, if so, the range of the species is much more extensive than we have supposed. It may be, also, that several of the Alaskan species of *Coregonus* will prove to be identical with Siberian forms; but we are unable to state anything definite about this at present.

The white-fishes are among the most important, economically, of all fishes. I need refer only to the fisheries of our great lakes

to verify this statement. In the northern regions of America, also, they constitute one of the chief sources of food supply. These fishes possess many natural advantages over other inhabitants of the waters—they do not prey upon one another and their movements are not checked by dams and similar obstructions. They yield vast numbers of eggs, which are readily developed artificially, and it has recently been demonstrated that the young fry can be reared in confinement. All of the species but two have excellent food qualities and they exist in great abundance. We may well protect and cultivate these fishes whose importance and possibilities can scarcely be overestimated.

North American Species of Coregonus.

A. Lower jaw included; gill-rakers about thirty or fewer, moderately long, or short and thick.

- *a.* Gill-rakers moderately long; maxilla ¼ head, or more.
- *b.* Tongue with teeth; gill-rakers 23 . . . . . *labradoricus.*
- *bb.* Tongue toothless, or nearly so.
- *c.* Nape arched and thick; gill-rakers 26-29. *clupeiformis.*
- *cc.* Nape arched and much compressed; gill-rakers 26 . . . *nelsonii.*
- *aa.* Gill-rakers short; maxilla ⅕ head (¼ in *williamsonii.*)
- *d.* Mouth inferior.
- *e.* Body elongate; maxilla about ⅕ head; gill-rakers 17 . . . *quadrilateralis.*
- *ee.* Body oblong; maxilla about ¼ head; gill-rakers 23 . . *williamsonii.*
- *dd.* Mouth not inferior; jaws nearly equal; maxilla about ⅕ head; gill-rakers 22 . . *kennicottii.*

AA. Lower jaw projecting, or jaws subequal; gill-rakers more than 30, long and slender.

- *f.* Body deep; scales little convex behind; gill-rakers 48 . . . . . *tullibee.*
- *ff.* Body oblong or elongate; scales strongly convex behind.
- *g.* Eye moderate (¼ to ⅕ length of head).
- *h.* Dorsal base longer than post-orbital part of head; gill-rakers 36 . . . . . *laurettæ.*
- *hh.* Dorsal base shorter than post-orbital part of head.
- *i.* Teeth on premaxillaries and tongue; gill-rakers 39-44 . . . . *nigripinnis.*

ii. Premaxillary and tongue toothless; gill-rakers 46-52 . . . *artedi.*

gg. Eye large ($\frac{2}{5}$ to $\frac{1}{3}$ length of head); size small.

k. Anal rays 10; gill-rakers 55 . . *hoyi.*

kk. Anal rays 14; gill-rakers 45 . . *merki* subsp.

1. *Stenodus mackenzii* Rich. Inconnu.

Luciotrutta Mackenzii Gunther, Cat. Fish. Brit. Mus., vi., 1866, p. 164. Mackenzie's River and its tributaries; Yukon river, Alaska.

A food-fish of great value; the largest of the white-fishes.

Growing to four feet in length, and reaching 50 pounds in weight. "It is full of spawn from September to January, when it disappears."—Dall.

2. *Coregonus labradoricus* Rich. Lake Whiting.

Great Lake Region; lakes of the Adirondacks, of mountains of New England and north-eastward, preferring clear, cold lakes.

It is abundant in cold, clear lakes, and in Labrador the species frequently reaches the length of eighteen inches, but in New England the average size is somewhat below this. This species may be regarded as certainly nearly related to the common white-fish, *C. clupeiformis*, from which it differs chiefly in its somewhat more decided lingual dentition and its slenderer body. It seems besides never to reach so large a size as the typical great lake form. It would seem that the size of the species increases somewhat in the northern portion of its habitat. This species has been erroneously placed in a group characterized by numerous long and slender gill-rakers; as a matter of fact the gill-rakers are not more numerous in this species than in *williamsonii* and *kenicottii*. The oldest name for this species is the one here employed, but the New England form has since been described by Prescott in the American Journal of Science and Arts, 1851, under the name of *Coregonus eohantoniensis.*

3. *Coregonus clupeiformis* (Mitch). Milner. Common white-fish. Great lakes. British America.

This is the most important of all the white-fishes; it has been extensively reared by artificial methods and distributed as widely as New Zealand. The Otsego lake form is said to be the most southerly in the United States, but *williamsonii* occurs in rivers of Utah.

This is the common white-fish, and is the object of the most important of the fisheries of the great lake region. We have the typical form of this species from Lake Champlain to the eastward, and from Manitoba to the westward. The range of this species has also been greatly extended by artificial introduction. The maximum weight of the species is said to be twenty-two pounds, but the average weight will perhaps scarcely reach ten pounds. The reported occurrence of this species in the Yukon river, Alaska, is apparently unwarranted, a re-examination of our Alaskan material showing that the supposed *C. clupeiformis* of the Yukon is really *C. kenicottii*, a species which grows to even a larger size than *C. clupeiformis*, but which is really not very closely related to that species.

It is worthy of mention that the young of *C. clupeiformis* have a much greater number of scales in the lateral line than the adult, some examples of which are here exhibited showing as many as ninety scales while the average number in the adult is but seventy-five.

The following additional information about the white-fish has been extracted from the published writings of Mr. J. W. Milner:

The fishes are not evenly distributed throughout the lake, but range in large colonies and run near the shore at different points, while the majority of localities may be destitute of fish.

The statistics of nine principal fish-markets on the lakes show the proportion of lake-herring handled to be one-sixth, while the low rates herring command in the markets would produce only about one-thirtieth of the amount realized from the whole quantity of fish handled. This shows the small value of the herring to the fishermen, in the herring localities. In the whole product of the lakes it would be of much less consequence.

The white-fish is found in all depths in more or less abundance, not only in the spawning season, but at all times. Young white-fish seek the surface, and they are strong and vigorous from the time they leave the egg. In their early life, therefore, they are not much preyed upon by voracious fishes, and the swarms of cyprinoids and *Chirostoma* (?) which are abundant at

the surface at the same time, form a large part of the food of such predaceous species as do come to the surface.

4. *Coregonus nelsonii* Bean. Hump-back white-fish. Bean, Proc. U. S. Nat. Mus., VII., 1884, p. 48.

Known from Alaska only, occurring from the Bristol Bay region northward to the extremity of the territory.

This species which was until recently undescribed, has long been known from Alaska, but it has been confounded with a Siberian species, *C. syrok*, from which it is really very different. The Russian name of the species is "*Korabati.*" The Tinneh tribes of the Yukon call it "*Koloküh.*" Mr. Dall, in the report of the Commissioner of Agriculture for 1870, p. 386, speaks of it as a common species characterized by the strongly arched back and broad tail. He says it is rather bony and inferior in flavor, and that it is generally used for dog food, except in times of scarcity.

This species is related to *C. clupeiformis* and *C. labradoricus*. From *clupeiformis* it may readily be distinguished by its greatly arched and much compressed back. The body is oblong and compressed; the head is one-fifth as long as the fish without the caudal; the maxilla extends to the front margin of the eye and is about one-fourth as long as the head; the gill-rakers are only moderately long, the longest a little more than one-half length of eye, and their number is about twenty-six. The greatest height of the body is a little more than one-fourth of the total length in the typical example, which is about fourteen and one-half inches long to caudal base. The adipose fin is large and scaled for nearly half its height. The ventrals are a little nearer the tip of the snout than to the root of the caudal. They are about as long as the head without the snout; D. 12; A. 12; scales 10—88—10. The type of the species is No. 29,903, taken at Nulato, Alaska, by Mr. E. W. Nelson, to whom the species is dedicated in recognition of his important zoological researches in that territory.

5. *Coregonus quadrilateralis* Richardson. Round white fish. (?) Krug (Russian). Shad Waiter; Round-fish.

Lakes of New England Upper Great lakes; Slave Lake; Kodiak; Yukon River; rivers of Arctic North America. (Gunther).

C. quadrilateralis is apparently the most widely distributed of all the white-fishes and naturally is subject to much variation. In the Yukon river region the form of the head is somewhat different from that of the ordinary eastern type, and, strangely enough, this variation of the head is repeated in some of the Maine lakes. The appearance of this species on the Island of Kodiak which is separated from the mainland of Alaska by a wide and deep ocean channel is one of the most interesting of recent discoveries in the ichthyology of Alaska. *C. quadrilateralis* is a small and slender species, seldom exceeding fifteen inches in length, but its quality is excellent. It is noteworthy that this species has a smaller number of gill-rakers than any other species of the North American white-fishes. Prescott, in the journal already referred to, redescribed this white fish under the name *Coregonus novæ-angliæ.*

6. *Coregonus williamsonii.* Girard. Rocky Mountain white-fish; Chief Mountain white-fish.

Coregonus couesii. Milner. Rept. U. S. Comm. Fish. for 1872—1873 (1874), p. 88.

Clear streams and lakes from the Rocky Mountains to the Pacific, northward to Oregon; found also in tributaries of the Saskatchewan and of the upper Missouri. Recently received from Mill Creek, Oregon, whence it was sent by Col. I. R. Moores. This is an abundant and valuable food-fish.

The size of *Coregonus williamsonii* is small, about equal to that of *C. quadrilateralis*, which it closely resembles; it has, usually, a larger maxilla and less elongate body, and the number of gill-rakers is somewhat larger. The Chief Mountain white-fish (*C. couesii*, Milner) is now known to be identical with *Coregonus williamsonii.*

7. *Coregonus kennicottii.* Milner. Broad white-fish.

Known in Alaska from the Kuskoquim basin to Meade river in the extreme northern part of the territory.

This is the *Muksun* of the Russians, a name transferred from a Siberian species of similar appearance. The broad white-fish reaches the weight of thirty pounds, ranking next in size to the *Inconnu* only. It has a short head, remarkably small, subequal jaws, and its body is very thick. It is a food-fish of great excel-

lence. Dall states that it is abundant in both winter and summer, spawning in September in the small streams falling into the Yukon.

8. *Coregonus tullibee* Rich. Tullibee.
Great lakes and northward into British America.

This singular and handsome species is said to grow to a length of eighteen inches. Its body is deeper than in any of the other white-fishes, and the scales are deep but very narrow, giving the fish a unique and unmistakable appearance. Richardson had a specimen from Pine Island lake, in north latitude 54 degrees.

9. *Coregonus laurettæ.* Bean. (?) *Morskoi ciga* (Russian).
Kuskoquim region, and northward to Point Barrow, Alaska.

This species is not large, rarely exceeding three pounds in weight, but it is a very important source of food wherever it occurs. It resembles the lake herring, *C. artedi*, somewhat, but has fewer gill-rakers and a much longer dorsal base. In the Yukon it is particularly abundant and is one of the best-flavored of the *Coregoni*, becoming the staple article of food in winter, according to Mr. Dall.

10. *Coregonus nigripinnis* (Gill) Jor. Blue-fin; Black-fin.
Lake Michigan, in deep water; deep lakes of Wisconsin, known from the vicinity of Madison, Wisconsin, whence it has been sent by Fish Commissioner Welch.

This species is locally abundant, as, for example, in Grand Traverse bay. Milner reported as follows concerning it: *Coregonus nigripinnis* is most abundant in seventy or more fathoms and is seldom taken in the fishing season, even in as great a depth as fifty fathoms. At Grand Haven, Mich., where a line of steamers keeps the harbor open throughout the winter, the fishermen take the black-fin in quantities within thirty or forty fathoms in the month of December.

The black-fin grows to eighteen inches in length, surpassing *C. artedi* in size and differing from it, also, in having evident teeth on premaxillaries and tongue.

11. *Coregonus artedi* Le Sueur. Lake herring; Cisco; Michigan herring.

Great lakes and northeastward to Labrador, the eye becoming larger and certain other characters varying to the northeastward. This species has considerable commercial importance.

12. *Coregonus artedi*, var. sisco Jordan Cisco.
Small lakes of Michigan, Wisconsin, and Indiana.
A form of the preceding modified by residence in small, deep lakes.

13. *Coregonus hoyi* (Gill) Jordan. Lake moon-eye; Cisco (Lake Michigan); Smelt (Western New York).
Lake Michigan and Lake Ontario, in deep water; lakes of Western New York, where it sometimes dies mysteriously in great numbers.

14. *Coregonus merkii* Gunther, subsp. *Nulatoski ciga* (Russian).
Known from Yukon river and Hotham Inlet, Alaska.
A small species, thin and bony, rarely exceeding a half pound in weight; little used as food in Alaska. It differs from typical *merkii* in several particulars.

15. *Coregonus lavaretus* L. Maræne.
Great lakes of Switzerland, Tyrol, Pomerania, Mecklenberg, and Sweden.

This fine, large species, the type of the genus *Coregonus*, comes into the series containing our common white-fish (*C. clupeiformis*). It has about thirty gill-rakers of moderate length, and the lower jaw is included. In size and in extent of distribution as well as in amount of variation, as expressed by the numerous synonymes of the name *lavaretus*, the two bear a strong resemblance to each other. The maræne in its adult condition is readily distinguished at sight by its numerous and rather deep scales; but I suspect that it will be difficult to separate the young of the two, especially since we have common white-fish from Lake Superior with as many as ninety scales, the usual number in some of the variations of *lavaretus*.

Four hundred and nine were placed April 14th, 1877, in Lake Gardner, Otsego Co., Michigan. The history of the maræne since its introduction into America by the U. S. Fish Commissioner is not known to me.

NOTES ON LAND-LOCKED SALMON.

BY CHARLES G. ATKINS.

NOMENCLATURE AND RANGE.

The term "land-locked salmon," though it may be, and probably is, a misnomer so far as it implies any forcible detention of sea-going salmon in fresh water, has come to be generally accepted as applicable to all those salmon of Eastern North America and of Europe that pass their entire lives in fresh water. They are all, according to the most recent conclusions of our American ichthyologists, members of the great species, *Salmo salar*, the common river salmon of the tributaries of the North Atlantic. In America they are found in a number of restricted localities, of which, besides several in the Canadian provinces, there are four in the State of Maine; namely: 1st, the waters of the Saint Croix; 2nd, of one branch of Union river, Hancock County; 3rd, of Sebec River, a tributary of the Penobscot; and 4th, of Lake Sebago and tributaries, in Cumberland County.

The results of some inquiries that I have made relative to the salmon of Lakes Champlain and Ontario indicate that these, also, should be added to the list, though I believe that the salmon of Lake Champlain are now extinct.

I have little knowledge of the salmon of any of these localities but those in the State of Maine, and their descendants in other States, and any general remarks I may have occasion to make, must be understood as applying especially to them.

A COMPARISON WITH ANADROMOUS SALMON.

To the anatomy of the land-locked salmon I have given none but the most superficial attention, and am not able to say whether there exist any distinguishing marks by which they may be unerringly separated from the normal *Salmo salar*, or from each other. The general impression made upon the fish-culturist who views them in their separate haunts is that the external difference of form and color are sufficient to enable him easily to separate those of the several districts should they be presented in a promiscuous heap, but I confess that I should not dare to

indicate the points of difference; and granted that the impression of dissimilarity is correct, it still remains in doubt whether when bred in other waters, either variety will retain its peculiarities.

However, when we came to place the land-locked salmon of either district by the side of the normal form of *Salmo salar*, and to include in our survey other than anatomical features, there are not wanting data for an interesting comparison.

In the first place, we find a general resemblance in form and color. The young fry are so closely alike that the eye fails to separate them if mixed together. As they grow we find further that the reproductive functions of the males are in both forms active at a very early stage, while yet in what is known as the parr-stage, marked externally by the presence of bright red spots and dark transverse bars or "finger-marks" upon the sides; and at Grand lake stream may be observed several other stages of growth closely resembling those of the migratory salmon. The adults have identical habits in the spawning season, and the same remarkable external changes take place in the adult males at that season of the year,—the deepening of the body, the lengthening of the head, the curving of the jaws, the growth of the wonderful hooked bony process on the tip of the lower jaw, the assumption of brighter colors—though these changes are generally not quite so marked in the land-locked as in the anadromous varieties. The color of the flesh is also the same, and there is a similarity, though not an identity of flavor.

On the other hand, we find certain well marked differences. Some things favor the theory of an arrested development. For instance, the dark bars on the sides, which are very prominent marks in the young fish, but entirely disappear in the adult migratory salmon, are always retained on the inner skin of the land-locked fish and may be found by stripping the skin off. I have also observed among the Sebago fish, some cases of a retention of the external bars in at least one individual thirteen inches long; whereas, normally they become invisible from without when the fish is about eight inches long.

As might be expected, the inferior size of the land-locked salmon is accompanied by a lower rate of fecundity, but this

would not lead us to expect the individual eggs of the smaller fish to be of a larger size. This is, however, the actual fact, the difference being quite noticeable, and amounting to say twenty per cent. in weight. Among the migratory salmon of the Penobscot, ovarian disease is very rare; but with the land-locked salmon of the Schoodic lakes it is very common. In 1883, by careful observation we learned that 18 per cent. of the female fish were affected with some disease of the ovaries, resulting in defects of the eggs which were apparent to the eye,—in some instances involving the entire litter, but in general a very small number of eggs. This phenomenon was observed before artificial breeding began at Grand lake stream, and does not appear to be influenced thereby.

The habits of the two forms of salmon afford the strongest contrasts. The anadromous salmon has its home in the sea, and there, exclusively, are its feeding grounds; it visits the fresh water only for the purpose of breeding, and during its stay there abstains from food and constantly falls away in flesh. Its young on attaining the age of one or two years and a weight of two or three ounces, descends to the sea to complete its growth. The land-locked salmon never visits the sea except accidentally, and makes its home in the fresh water lakes. It has its feeding grounds in the lakes and rivers, and instead of fasting six months or a year at a time, curbs its ravenous appetite for but a few weeks at the spawning season.

My observations on the date of spawning lead to the conclusion that it is a week later with the land-locked than with the anadromous salmon. In approaching the spawning ground, the land-locked salmon move either up into an affluent stream or down into an effluent stream, being governed, so far as I can see, by the peculiar circumstances of each case. There are not wanting some indications that they prefer an effluent, but I think that the phenomena admits of a different explanation. The young fry in most instances move up the stream to gain the lake which is to be their future home, but in some instances quite the reverse. It does not appear that in any of these phenomena we have uncovered any essential difference in habits and instincts, but when the sea salmon attains the age for the seaward migration, an in-

stinct begins to govern his actions to which the land-locked is forever a stranger.

Of less theoretical but more practical importance is a comparison of size. The average of adult Penobscot salmon is about thirteen pounds, though there are some fluctuations from year to year—the mean for a season being sometimes above sixteen pounds, and sometimes below twelve pounds. If we excluded the Ontario and Champlain salmon, we know of no land-locked salmon in America that average half as large. The Sebago fish are the largest; a score of thirteen taken with hook in the Sougo river in 1880 averages five pounds, and this is probably about the usual size, though individuals of great weight are sometimes taken. The above score contained one weighing 10¾ lbs. One thirty and a half inches long and weighing 15½ lbs. was taken with hook in May, 1883. One found stranded and dead in Rogers brook in Bridgton in 1883, was thirty inches long and weighed twenty five pounds. The Reed's pond salmon are next to those of Sebago in size,—indeed, possibly, are fully equal. The salmon of the Sebec region vary much in the different waters of the system, as do also those of the St. Croix, but the average growth may be taken to be about the same as at Grand lake stream, where some hundreds were measured in the autumn of 1883, with the result that the mean weight of the males was 3.2 lbs., and of the females 3 lbs., while the salmon taken in May and June are perhaps a quarter of a pound lighter

AN AUGMENTATION OF MEAN SIZE.

In connection with this part of my subject I have some very interesting statements to present, with reference to a dreaded change in the mean size of the Grand lake salmon.

A Philadelphia sportsman who fished at Grand lake stream nearly thirty years ago, furnished Mr. Thaddeus Norris memoranda from which the following averages may be deduced. In June, 1856, the average weight of 634 salmon was 1.38 lbs.; in June, 1857, the average of 432 salmon was 1.49 lbs.; in the same month of 1858, the average of 575 salmon was 1.42 lbs. In May, 1865, Hon. Harvey Jewell with one companion took 379 salmon weighing 502¼ lbs., and averaging 1.33 lbs., and remarks that

this was the average weight of those taken by other parties in each of the years 1864 and 1865.

In 1867, I personally visited the fishing ground and know that the size of the fish had not materially changed since 1858. The maximum was then believed to be four or five pounds, but the capture of so large specimens was extremely rare. The autumn weight may have been a little above that of June, (which corresponds to a length of 16½ inches) but did not exceed 1¾ lbs.

In 1875-6, the average weight of some hundreds of males taken at the spawning season was 1.6 lbs. and 1.8 lbs respectively, and of the females 1.9 lbs. each year. In 1878, the males averaged 2.3 lbs. and the females 2.2 lbs.

In 1882, the males and females weighed respectively 3.1 and 3.08 pounds; in 1883, 3.2 and 3.0 pounds. There has been a corresponding, but perhaps not equal augmentation in the size of the fish caught in May and June; seventy salmon taken in May, 1883, averaged 2.7 lbs., a little more than double the weight of Mr. Jewell's fish of 1865. Accompanying this increase in size, we have found a corresponding improvement in the fecundity of the salmon. The eggs are no larger, but nearly twice as many are now obtained from a single fish.

These figures apply only to the salmon of Grand lake stream. In other parts of the Schoodic waters the fish are of various sizes —some larger and some smaller than those described. At Dobsis stream, in the spring of 1872, a score of Mr. Jewell's shows that twenty-six fish taken below the dam in water communicating with Pocumpus lake, averaged 1 4-10 pounds, while eighteen taken above the dam, in the waters of the Dobsis lake averaged 2 6-10 lbs. In after years this distinction was maintained and indeed emphasized. In the Dobsis lake in 1876, they were about as heavy as they are now in Grand lake. In West Musquash lake they are larger than in either of the above. In the lakes of the east branch of the Saint Croix (the Chepedneck lakes) they are generally larger than in any of the waters of the west branch, with the possible exception of West Musquash, and there has been known a single specimen of 10½ pounds. In Pleasant lake, on the west branch, are the smallest specimens of all the Schoodic region. In February, 1883, I obtained thirteen

specimens said to represent fairly those that winter, through the ice, except that some very small ones had been excluded from the lot. These had the form and color of adults, but the largest of them weighed only eighteen ounces and measured only fifteen inches in length, and from this size there was a very regular descending series down to 10¼ inches in length and 5 ounces in weight.

It is much to be regretted that we do not possess the data requisite to the discussion of the causes that have led to this diversity of size between the fish of different parts of the same lake system, or to the recent increase in the size of the Grand lake fish.

RATE OF GROWTH.

At Grand Lake Stream, at the spawning season, we have found six distinct classes of salmon, distinguished mainly by size, as follows:

First class. This is equivalent to the "parr" or "pink" stage of anadromous salmon. It is characterized by the presence of dark transverse bars and brilliant red spots on the sides. In size they are very uniform. Of nineteen of them captured October 15th, the smallest was 2 9-16 inches long, the largest 3⅝ inches long, and the average 3¼ inches. Their weight was not ascertained but must be about 2-10 ounce. They have thus far been observed only on the gravelly shallows of the stream. They were present before artificial breeding began, and undoubtedly represent a normal stage of growth. Parr of about the same size are also found in the stream at the beginning of summer, and occasionally in great numbers. Such was notably the case in 1882, and also, though not to an equal extent, in 1883. Mr. Munson, our foreman, who is very careful and exact in his statements, reported that in June, 1882, at the time when the driving of logs through the gates was in progress, there were great numbers of these little fish below the dam. While the gates were open and the stream full of water, they were little inclined to bite, but when the gates were closed and the water fell they eagerly pursued any line, crowding each other and leaping out of the water after an approaching fly or other bait. Meeting

one day a young fellow crossing the dam with a long string of these little fish that would more than fill a peck measure, Munson took out his rule and measured about half a dozen of them, and found them to vary little from three inches in length. These young fish were taken that season in numbers that threatened to seriously affect the abundance of the adults, and upon petition, the legislature at its next session forbade their capture. The occurrence of parr of the same or nearly the same size in the fall as in the spring, is a noteworthy and at first a puzzling circumstance. Spawning takes place but once a year, that is beyond question. Do the young fry grow unequally, part of them attaining in six months the same size that others do in a year, or is there a lapse of six months in their lives without any considerable growth? I think the first supposition is not admissible, because we have never met with the intermediate sizes that must have been present. It seems possible, therefore, that their growth is almost wholly accomplished in the warm season and is nearly suspended in the winter.

Second class. Seven to eight inches in length and weighing three to four ounces; bars and red spots still plainly visible, and nearly as distinct as in the first class. They yield a copious supply of milt, and a few of them are found commonly on the spawning beds, attending or seeking to attend the female salmon in the act of spawning. They occur at the same time, though not commonly in company with the smaller fish of class one, both in fall and spring.

Third class. A little larger than class two, measuring about ten inches, and weighing seven or eight ounces. Bars and spots still visible but very faint. All males, and yielding milt copiously. Observed occasionally in October and November. This form approaches closely the "smolt" of the river salmon.

Fourth class. About thirteen inches in length and one pound in weight. Reproductive functions dormant, organs little developed and sex unknown. They are uniform in appearance as well as size, but are not numerous and appear irregularly, rarely more than half a dozen of them in a single season. Barren individuals of larger size, sometimes as large as seventeen inches in length, and thirty ounces in weight, met with rarely, and only

in autumn. Whether there is a corresponding class in May and June, I am unable to say, but judging from the weights of captures shown by some scores submitted to me, I think it quite likely.

Fifth class. Adults. There is a great range in size, and doubtless some are of advanced age and belong to an additional class, but as there seems to be an unbroken series from the smallest to the largest, I am unable to separate them, and were a separation possible and the fish classified according to age it is not unlikely that the different classes would be found overlapping each other in respect to size,—that is, the larger fish among those that are in their first year of adult-hood may be larger than the smallest of those that are a year older than the smallest adults on my record were.

Now what conclusions are we to draw from these data? On the supposition that each of the first four classes represents a separate stage of growth, with intervals of one year in each case, the fifth or adult class must be, when caught in November, five years of age from the date of the deposit of the egg, or four and a half years from the date of hatching. I have, however, some doubts as to the validity of the distinction between classes two and three, the former being equivalent to the male parr of the British salmon and the latter having not yet fully attained to the "smolt" stage, which should be distinguished by entire absence of any external bars or spots. The position and significance of class four (13 inches, barren) is also not entirely free from doubt. It is possible that such fish are of adult age, but barren from some unknown cause, and on the supposition that such is the case there will appear to be no intermediate form between the third class (that has almost reached the smolt stage) and the adults, and hence the interval of time separating these two becomes more than ever a matter of conjecture; but as we are tolerably certain that a year (from impregnation) is required to attain three inches in length, and another to attain eight inches, it is hardly reasonable therefore to suppose that the growth from eight inches to the adult stage would be accomplished in a single year.

My conclusion is that the following is the most probable

outline of the life of the salmon of Grand lake; taking the time of impregnation as a starting point, the embryos hatch at six months of age, attain a length of three inches at one year; of eight inches at two years; of thirteen inches at three or four years; and of complete maturity (fifteen inches or more in length) at four or five years. Specimens twenty inches or more in length and weighing three pounds or upwards, I am inclined to regard as fish on their second visit to the spawning grounds, and on the assumption (of which there is, however, no direct proof) that they are like the anadromous salmon, biennial spawners—such fish are six or seven years old.

Whether the same rate of growth prevails among the land-locked salmon in their other native haunts, there are no data to determine, but it is very probable that the entire period of growth is about the same, and accordingly that, in the case of the larger salmon of the Sebago the rate is greater.

GROWTH IN NEW HOMES.

When introduced to new haunts they have often grown to an unwonted size and sometimes at an accelerated rate. I will cite some instances:

In Saipsic lake, Connecticut, in May, 1881, was captured a specimen twenty-two inches long and weighing 3 lbs., 14 oz. This was the growth from Schoodic fry, the first of which were planted in 1874. If this specimen was from the first planting it had grown to an unusual size for Schoodic fish. September 23rd, 1881, another specimen was taken in the same lake, weighing 6 lbs., 2 oz. One of 6 lbs., 8 oz. was reported to have been taken about the same time from one of the Twin lakes in Salisbury.

In Shrewsbury pond, near Rutland, Vermont, specimens have been taken, I am told by Dr. C. H. Barber, weighing 6¾ lbs. One party caught twenty-three in one day, the smallest of which weighed 1½ lbs., and the largest 6¼ lbs. This lake is one mile long, one-half mile wide and 160 feet deep.

Woodhull lake, Herkimer County, N. Y., was stocked with fry of Schoodic salmon, in the summer of 1879. In the spring of 1881, soon after the disappearance of the ice, several specimens

were taken, one of which weighed nearly a pound. In the winter of 1882, a number of specimens were taken by fishing through the ice, and some of them were eighteen inches long, probably weighing two or three pounds In the fall of 1882, a specimen weighing over four pounds was taken in the stream below the lake—this fish was thus four years old from impregnation, and had attained a size double that calculated for a Schoodic salmon of that age in Grand lake.

In the Rangely lakes in Maine, about fifty domesticated Schoodic salmon about two years of age. were introduced from breeding ponds in Alna; fry of Sebago salmon were introduced as follows: 2,000 in 1874; 5,000 in 1875; 3,000 in 1877; 18,000 in 1877. In 1877 a single specimen weighing five pounds was captured. As to further results I will quote Mr. Stanley's letter to the *Forest and Stream*, October 26th, 1882: "I am happy to state that the salmon put in an appearance in the Rangely stream this fall in considerable numbers and for the first time. Some of them were very large. I saw five of them in a pool which I estimated would run from four to ten pounds each. Over forty were taken last June in the Rangely lake alone, of from 2½ to 4½ lbs. each. They have also been taken in the lakes below. For the short time that has elapsed since they were introduced, and the small number of eggs, the success has been remarkable." As it is impossible to determine absolutely whether these captures came from the early planting of Schoodic fish, or the later planting of Sebago fish, nor yet their age, we can only remark that the size attained is very satisfactory, and from the numbers captured and seen, it is quite evident that the species is established as an inhabitant of the Rangely lakes.

Another instance from the same State may be adduced in the case of the Weld pond, which I will give in Mr. Stanley's language:

"The most reliable information I have in regard to growth of land-locked salmon or the time it takes to reach a certain size is what I get from the Weld pond in Franklin County. This pond is about five miles long and two miles wide; is fed by numerous large brooks which take their rise back in the wilderness among the mountains, to which the trout and salmon (the former

are plenty) have free access to their head waters. Also the outlet of the pond, Webb's river, about the size of the Presumpscot, is a rapid stream, five miles after it leaves the pond, with clean, gravelly bottom, and unobstructed by dams. This pond is famous for its trout and pickerel—the angler catching about as many brook trout as pickerel. It is plentifully stocked with smelts and minnows. * * * * I give you the number and dates of the plantings below:

1875,	2,000	Sebago salmon.
1876,	3,000	" "
1877,	10,000	" "

The first 2,000 were put into the Bowley brook; the other two lots were turned into the river, with the exception of perhaps about 2,000 more, which were put into the above brook. A friend of mine who is reliable, told me he saw weighed one that was caught in this brook that tipped the scales at eleven pounds. Last fall they came into the brook and river also in considerable numbers, and of large size, some, undoubtedly, of ten or twelve pounds. Last summer the small salmon six to eight inches long were quite plenty in this brook, also some in the river. Parties fishing for brook trout, would in half a day's fishing catch fifteen or twenty of these little salmon, which, however, they put back. None have been taken in any of the streams except the river and Bowley brook, and the pond. Quite a number have been taken fishing through the ice this spring, but none over three and a half pounds.

Quite remarkable results have been observed in some of the waters of New Hampshire. I will quote Commissioner E. B. Hodge. Under date of April 25th, 1885, he writes as follows:

"In regard to the Schoodic salmon in this State, I am happy to state that they are doing well, and good reports are being received from various parts of the State. In some waters their growth has been remarkable, particularly in Squam lake. The first plant was made in this lake by Col. S. Webber, in 1877. In June, 1880, a land-locked salmon was taken in the outlet of the lake that weighed 6½ pounds, and one was killed by going through a mill-wheel that measured twenty-seven

inches; weight not taken, as it was decomposed when found. In November of 1883, six years after the lake was stocked, two salmon were speared on their spawning beds at the outlet, one of them weighed ten pounds, and the other fifteen pounds.

"In Lake Sunapee their growth has been greater than in Squam. First stocked in 1880, by Commissioner A. H. Powers. The largest fish taken in 1883, weighed 7½ pounds., and one reported to weigh 8¼. Several of five and six pounds were taken during the season, *and the large ones all got away.*

The figures I have given you are all from reliable persons and are authentic. Even in small ponds I have seen fish that weighed 2¼ pounds, when two years and two months of age. I could give you many other instances where large land-locked salmon have been reported to have been taken, but the above is enough to show that they are a success in this State, and to warrant the commissioners in following up the planting of them in such waters as are adapted to them."

Under date of April 28th, 1884, Mr. Hodge writes further:

"Since my letter to you of last week, there has been taken at the outlet of Squam lake, a land-locked salmon twenty-eight inches in length, and weighing nine pounds. This fish was measured and weighed in presence of several reliable persons."

REQUIREMENTS OF LANDLOCKED SALMON.

It is to be regretted that there are no adequate data at hand from which to discuss the question of the requirements of Schoodic salmon. We ought to know definitely the size and depth of all the lakes that they naturally inhabit; the quality of the water; its temperature at surface and bottom during the heated term; the quantity and variety of food afforded; what enemies they have successfully combatted, and to what ones they have succumbed; the character and extent of their spawning grounds, etc. The data at hand will enable us to lay down only general rules, which will, nevertheless, it is hoped, be of some service in directing future effort.

It does not appear that the matter of area is important. Land-locked salmon appear to thrive as well, other things being con-

sidered, and attain as large size in lakes of a few hundred acres area as in those covering thousands of acres. For instance, the largest salmon of the Grand lake region are found in West Musquash lake, whose area is less than a thousand acres; and among new localities we may instance Shrewsbury lake, in Vermont, only one mile long and one-half mile wide, where such signal success has attended the introduction of these fish.

The depth of water is apparently a more important matter. I think the rule will hold good that large fish of the salmon family generally inhabit deep lakes. Of the native haunts of the land-locked salmon, the deepest is Lake Sebago, where 410 feet of water have been found, and in this region we find the largest land-locked salmon in Maine; it must, however, be noted, as a possible exception to our rule, that the salmon of Long pond, a tributary of Lake Sebago of much smaller size, and, it is supposed, much shallower water, are not much, if any, inferior to those of Sebago itself, and have actually furnished the largest individuals on record. West Musquash lake, which produces the largest salmon of that region, is known to be in some places over 130 feet deep, while Grand lake is not known to be over 115 feet. Shrewsbury lake in Vermont, is 160 feet deep.

I am not, however, prepared to say that there can be no success in lakes of moderate depth. It is known that land-locked salmon were once abundant at Princeton, at the outlet of the lower lakes of the Schoodic chain. They must have inhabited Lewy's, Long or Big lakes, all of which are in general, shallow, and in which there is good reason to believe, though by no means certain, that a depth of more than sixty feet cannot anywhere be found.

As to temperature, I am only able to say that the phenomena observed indicate that on the approach of hot weather the salmon forsake the streams and surface waters, and retire to the depths, where it is always comparatively cool. It is likely that they will not permanently thrive in waters where they are compelled to endure through the summer a surface temperature, or say upwards of 70 degrees Fahrenheit. Very likely this limit will have to be moved a few degrees up or down, when data are obtained. The latitude in which nature has placed these fish,

indicates roughly the climatological conditions required. It is not likely that they will thrive much further south than their natural range, unless in elevated, and therefore cool regions.

As regards qualities of water other than temperature, I do not think land-locked salmon are specially fastidious. Muddy water is undoubtedly objectionable, but among their native haunts are many lakes whose water is strongly colored with peaty and earthen solutions.

Gravelly shores and bottom are not essential, except on the breeding grounds, which must be ample to insure a great degree of success. A good sized brook, abounding in gravelly rapids, will meet the requirements. Whether it should be an inlet or an outlet may be properly brought in question. It seems to me well proven, that these fish are endowed with instincts of locality that impel them to deposit their eggs in their native streams, to the extent of selecting one among several streams connected with the same lake. On no other supposition can we explain certain pnenomena at Grand lake. Junior stream, at the head of the lake, is a fine, gravelly stream, offering excellent locations for spawning beds, and more easily accessible from the lake than is Grand lake stream, and was formerly much resorted to by the salmon. Of late, however, it is almost entirely deserted, notwithstanding the salmon are abundant in the lake, and thousands of them yearly resort to Grand lake stream at the other extreme of the lake. Whether this instinct will interfere with the use of fry from Grand lake eggs for the stocking of waters whose only spawning grounds lie in their affluents is a question deserving consideration, but which we shall doubtless have to leave to the solution of experience. It is interesting to note that in many of the lakes where they have been introduced we hear of them first in the outlets. Such is the case at Woodhull lake in New York, and at Squam lake in New Hampshire. Some of the new inhabitants have made themselves known by running down into mill-wheels. At Woodhull lake, "from appearances," writes Gen. R. U. Sherman, "the whole stock went out of Woodhull dam through the open gates, and gathered in the stream below to spawn."

The question of enemies must be regarded as one of the first

importance. I am inclined to attribute the disappearance of land-locked salmon in recent times from some of their old haunts in different parts of the Schoodic lakes, to the attacks of pickerel which were introduced from the Penobscot waters. I think it is capable of demonstration that in each instance where this has occurred the existing conditions were more favorable to the growth of pickerel than of land-locked salmon. A case in point is that of Junior stream mentioned above. The lower course of this stream is a broad, weedy, semi-stagnant piece of water, full of aquatic weeds, a most admirable place for the reproduction and growth of pickerel, which could here lie in wait for the young parr, and down whose capacious throats the entire brood may have slipped. The presence of pickerel is not, however, necessarily fatal. If the conditions are sufficiently favorable the salmon will maintain themselves, as at Grand lake stream. In general any lake in which trout maintain themselves against pickerel may be considered suitable for land-locked salmon. It is quite possible that in some cases the salmon will succeed where trout have yielded to their foes, but there is nothing in experience to warrant the expectation.

The growth attained in some of the instances cited above, lead to the hope that introduced to conditions more favorable than those of their native haunts, they will become permanently increased in size and in importance. It is not too much to hope that in suitable tributaries of some of the great lakes, especially those of Lakes Superior, Michigan and Huron, they may even become what they have never yet been in their original homes in Maine, the objects of pursuit of an industrial fishery.

Prof. Goode: Mr. President, I am sure we have all listened with great interest to the paper read by Mr. Atkins. It certainly is a magazine of new facts concerning the land-locked salmon. I should like to take advantage of the presence of Mr. Atkins to ask one or two questions. The land-locked salmon is, I suppose, universally admitted to be a descendent, through modification in habit, of the sea-running salmon. (To Mr. Atkins) Have you in your studies of this fish been enabled to judge how long

it has been since the land-locking took place; or, rather, when the oldest and most recent land-lockings occurred? I would also ask whether, in your opinion, the land-locking has produced an hereditary tendency in the fish to remain in the head waters of streams, so that if obstructions are removed, fish descended from land-locked fish will also be likely to remain in the head waters. I would also ask in the special interest of the fish-culturists of England, who at the present time are doing a great deal of work in the way of hybridizing various species and races of salmonidæ, etc., whether our land-locked salmon could not be transported to England and crossed with the large brook trout or the char? It would be a great advantage, for they would thus secure a heavier and better fish than the trout which they now have; and, moreover, a fish which would be likely to remain in the head waters of the streams. Such is the theory of certain English experts, but it occurs to me that their theory is without very good foundation. If Mr. Atkins can throw any light on any of these questions, we shall all, I think, be greatly interested.

Mr. Atkins: I do not think we have any evidence that the land-locking of the species under consideration has occurred during recent geological periods. There is nothing at present to prevent any of these salmon from going out to sea from any of those waters where they are now found. There are obstructions to their coming back, if they once went to the sea, and these same obstructions would hinder the sea salmon having access to the upper waters where the land-locked salmon now live. It is possible that at some very remote period there were obstacles which prevented their descending to the sea. I think it possible, also, that the change in their habits and instincts occurred gradually. The male salmon will live in fresh water until their reproductive organs are developed, which occurs at an early stage of their existence. I do not know that it has been proved (excepting in the case of some other species than *Salmo salar*) that salmon can be kept from making migrations to the sea until the eggs of the female become pretty well developed; but I think it possible that such proof may be furnished. One salmon may have stayed over the proper time—perhaps

from compulsion—perhaps from some natural weakness of instinct—and she may have developed eggs without going to salt-water, and her descendants may have inherited the tendency to remain in fresh water. That is, of course, mere speculation, without any observation to base it upon, excepting the absence of obstructions at the present time. That the lack of instinct to migrate seawards is hereditary, is unquestionably true. The salmon have an opportunity to go to sea, and do sometimes run down as far as the mouths of weirs, but apparently not with the intention of going to sea. As to the hybridization suggested, I have never seen any evidence of its occurrence naturally among the salmon or any other species of fish. I have had no experience in the matter of artificially breeding hybrids, but the general testimony from those who have attempted to raise them, is that they grow well and probably make good fish.

The President: Is a great depth of water necessary to the welfare of the fish? I ask this because I have noticed that on Long Island in some small ponds they never came to anything.

Mr. Atkins: I think that probably the depth of water is the most important point to be considered. They will not thrive if compelled to sustain a high temperature of water. They must in the heated season be allowed to go into deep water where they can keep cool.

Prof. Goode: Mr. Atkins, have you ever seen any indications of hybridization under natural conditions between sea salmon and land-locked salmon?

Mr. Atkins: I never had an opportunity to observe anything of that kind. I have taken only four or five anadromous salmon in company with land-locked salmon. In Grand lake stream we have on several occasions taken sea salmon that ascended to the lake, and came to the same ground as the land-locked salmon for the purpose of spawning. Two of the above four or five were mated—male and female, and the others we took and made use of without waiting to see what the action of the fish would have been if left alone.

BLACK BASS IN MAINE.

BY GEORGE SHEPARD PAGE.

It is often difficult to determine the exact date, or obtain reliable information as to the original introduction of a new species of food fish into a river or lake, and particularly to ascertain the facts relative to the stocking of the water of a State for the first time. This is important, not only that the agents in the work shall be placed on record, but chiefly that we may know definitely the time required to disseminate fish over a large territory in such numbers that the people can rely upon them for food and sport. Experience with the black bass in Maine is one of the most pertinent and effective illustrations of the value of such labor.

In August, 1869, accompanied by four friends, I left New York by Hudson river afternoon steamer for Newburgh. Arriving there about 7 P.M., my transportation box was conveyed to the small private pond of Mr. Walter Brown. At daylight the next morning we literally surrounded the pond and began casting the fly. In an hour, thirty-five small-mouthed bass were placed in the box, and at 7 A.M. the steamer Mary Powell started with us for the metropolis. Arriving there at 11 A.M., the box containing forty gallons of water and thirty-five bass from one-quarter pound to a pound weight, was taken to the dock of the Fall River line, and a stream of croton water turned on until 5 P.M. Arrangements were made with the night watchman to work the air pump at intervals. Arriving in Boston an express wagon conveyed the box to the Eastern Railroad, and during the journey at intervals of fifteen minutes I ærated the water by the use of the air pump. At 3 P.M. the train reached Monmouth, in Maine, about fifty miles northeast of Portland. Very near the station is Cochnewagn pond. I selected twelve bass and quickly transferred them to the pond. The train moved on, and a few minutes later arrived at Winthrop. A wagon was hired and the box taken to East Winthrop, four miles distant, and twenty-one bass were liberated at the head water of the famous Cobosseecontee pond, the largest of a chain of lakes thirty miles in length. Placing

the remaining pair of bass in a three-gallon pail, I started by team for Phillips, Franklin County, forty miles away. On the route one of them died. The remarkable vitality of the bass is exhibited in a strong light in view of the mode of capture, long and difficult transportation and mid-summer temperature.

The following October, Mr. Charles G. Atkins, then Commissioner of Fisheries of Maine, procuring my transportation box, took thirty-nine bass from Mr. Brown's pond, which he placed in Duck pond, near Portland, Me. So far as I know these seventy-four were the first and only black bass deposited in Maine waters. Fourteen years have elapsed, mark the gratifying results: The report of Hon. Henry O. Stanley, Commissioner of Fisheries for Maine for 1881, contains the following: "The black Bass, owing to its very game qualities, continues to be a favorite fish with anglers, and applications for introduction are received beyond the powers of the commissioners to gratify. It should never be introduced into any waters where there are trout, or from whence it can gain access to trout streams. For ponds, whose stock of trout has been exhausted by poachers, who murder the fish in their spawning beds, and where only yellow perch, bream and pickerel are left, it is invaluable. Trip pond, in Minot, Gardiner's pond, in Wiscasset, Gun Point Ice Company pond, in Harpswell, Hosmer pond, in Rockport, Keazer's Heald and Cushman ponds, in Lovell, and Little Pushaw, in Corinth, have all been stocked with bass this past year."

Messrs. E. M. Stillwell and Hon. H. O. Stanley, in the report for 1883, report as follows: "The black bass is still growing in popular favor. We have had more orders this year for stocking ponds than in our power to fill. The great success met with at Pushaw lake; the number and size of the fish taken, some turning the scales at four and one-half pounds, tend to popularize fish protection and fish planting; the increase in the product of fish, the result of the suppression of netting, all tended to produce a great and beneficial change in the public mind, giving firm and even enthusiastic support, where hitherto we have been met by active opposition. Newport and Glenborn can now boast of two of the most beautiful and productive lakes in the State, destined in the future to become popular places of summer re-

sort for devotees of boating and angling, and where pretty cottage residences may be built for family homes at but trifling cost, and where easy access to telegraph and railroad would render their occupants scarcely conscious of absence from city comforts. Cobosseecontee, Snow and Belgrade lakes are places of marked beauty and healthfulness, easy of access and where facilities for boating and angling are unsurpassed. Homes for hundreds whose lives are dependent upon country air and exercise can be made in cottage and tent, while the expense of the more fashionable places of resort bars them from all but those of large means. We often wonder that our city residents do not appreciate at how small a cost a pretty summer cottage can be built upon the shore of any of these beautiful lakes, abounding in fish, with health and exercise, and freedom from all the cares of city life."

In a letter dated Dixfield, Me., April 27th, 1884, Mr. Stanley writes: "Yours of the 24th received. With regard to black bass, I know we have them here in great abundance, the number of ponds we have stocked (all pickerel ponds) I think will reach to the hundreds. Wherever you put half a dozen, they are sure to take and will be heard from in two or three years. I have taken bass of two and one-half pounds in a pond that had only been stocked two years, and with young fry, so they could not be over two and one-half years old. There has been a great demand for them in our State, and in many ponds there is good bass fishing where there was none whatever before. I think they are a fish that cannot be thinned out by fishing with hook and line. I have met with the best success with the fly, from dusk till ten at night, fishing close in shore in very shoal water, have caught large fish when it was so dark I could not tell, casting from a boat, whether my fly struck on shore or in the water, and only knew I struck a fish by feeling the tug or hearing the splash. The Winthrop ponds, Cobosseecontee, one of the ponds you stocked, Lake Maranocook and in all that chain of lakes, is good. I have taken in one afternoon in Cobosseecontee, sixty pounds of from two to three and a half pounds each. There is also fine fishing in Belgrade ponds, Pushaw pond, Bangor, and in scores of others. I mention these as they are easy of access

by rail, and good accommodation can be had at hotels and farm houses, and at low rates. Also pleasant places to camp. The inhabitants are always glad to welcome sportsmen and visitors, and accommodate them with boats and information at low rates. I think the black bass are a great benefit to Maine."

IS LEGISLATION NECESSARY FOR THE PROTECTION OF THE OCEAN FISHERIES?

BY EUGENE G. BLACKFORD.

Commissioner of Fisheries, State of New York.

One of the questions that frequently perplexes the mind of the fish-culturist and the legislator is, how to protect in the best manner the valuable food fisheries of the sea coast and ocean.

On the one hand, there are the market fishermen, who use sailing vessels, and work either in the deep outside waters, or with net and hook, gather their prey along the shores and in the bays of our coast. This industry gives employment to over 85,000 men, and a capital of over $30,000,000.

On the other hand we have the large fleet of steamers that patrol the ocean catching the menhaden, and from them manufacture oil and fertilizers. An occupation involving nearly $3,000,000, and giving employment to over 2,000 men. These facts give some idea of the magnitude of the interests involved, and of the importance of the question under discussion.

For the last five years a large number of the former class of fishermen have claimed that the steamers seriously affected their business, stating that many kinds of fish that were formerly abundant, are now scarce, and that, unless laws are passed, prohibiting the menhaden steamers from fishing within three miles of the shore, or in some way restricting their operations, many kinds of the valuable fishes will be exterminated or driven from our shores. In pursuance of this idea, they have petitioned both State and National legislatures to that effect.

The question has been largely discussed by the press, the State and National Fish Commissions, and in the United States Senate. The latter has appointed a Committee on Fisheries, with Hon. E. G. Lapham as chairman. This committee has for the past two years taken the testimony of all classes of fishermen, and obtained the views and theories of fish-culturists and ichthyologists. And, in addition to this, we have the valuable information and statistics gathered with great care by Prof. S. F. Baird, the eminent Commissioner of Fish and Fisheries of the United States.

It has been my privilege to assist in obtaining information on the subject for the Senate Committee, the United States Fish Commission, and the New York State Fishery Commission, and I have read with great interest all of the evidence that has been taken by them bearing on this subject. And now, in discussing the question as to the advisability of any legislation to protect the ocean or sea fisheries, it is best to look over the facts which have thus far been brought out and see what would be the best way to provide for the continuance of the abundant supply that we now enjoy.

The first thing that we want to ascertain is whether what we know as salt-water fish, are scarcer now than in former times, and I would say here, that the absence of statistics covering any considerable space of time, makes an answer to this question somewhat difficult, but, thanks to the New York Fishmongers' Association, and to the Boston Fish Bureau, a beginning has been made to supply this hiatus, and it is hoped that the National Government will very soon take definite measures for the purpose of getting, annually, correct statistics of the amount of fish caught in the waters and on the coast of the United States. Having been a dealer in fresh fish in Fulton Market, New York, for the past seventeen years, I have had the opportunity of noticing during this period, the varying supply of various kinds of fish, and I beg leave to submit my views as to the scarcity or plentifulness of some of these various species.

First and most important of all our fishes is the cod. I believe that there has been no considerable diminution in quantity in the last decade, judging from the quantity brought to market and

the prices obtained; and as some indication of the range of price, I may say that during the year 1883, cod sold as low as one dollar per hundred weight. In some years there has been a perceptible decrease in the catch, but it has been followed by such enormous catches that the markets have been glutted. The statistics of the Boston Fish Bureau show the catch of the New England fleet to be: for 1881, 775,027 quintals; for 1882, 898,904 quintals; for 1883, 1,061,698 quintals, showing an absolute increase in two years of nearly 300,000 quintals. Surely these figures need not occasion any alarm or fear that codfish cakes will be beyond the reach of the most impecunious fish-culturist.

Next, and hardly second in importance, is the bluefish. It is a matter of historical record that these fish disappeared entirely from our coast in the year 1764, and did not make their appearance again for several years, and then they were taken in vast numbers. Suppose such a disappearance should take place this summer. How quickly the fishermen would appeal to the legislatures to abolish the menhaden steamers, and the angler would cry out for the destruction of the pound and trap nets. Each would probably claim that the scarcity was owing to these instrumentalities. This one instance of the bluefish in 1764, should lead us to be careful and conservative in regard to legislation, and to carefully consider whether there are not some great natural laws that determine the appearance and disappearance of fish on our coast, rather than attribute it to the comparatively puny efforts of man to affect the supply.

But let us turn to the question as to their present apparent scarcity or plentifulness. During the year 1882, bluefish were scarcer than they had been for some years, and the wholesale price did not go below five cents. This scarcity was particularly noticeable on the New Jersey coast. But the season of 1883 was unusually productive, and bluefish sold as low as two and a half cents per pound, and, had it not been for the large quantities that were taken out of the market and stored in refrigerators for winter use, the price would have declined to one cent per pound.

It would seem to be a fair inference that the bluefish needs no protection at present.

The fresh mackerel is another important factor in the food supply of the people. It has attracted a great deal of the attention of fish economists, and it is one of the fishes in regard to which, through the statistics of the Boston Fish Bureau, we can speak somewhat intelligently.

In 1825, the New England catch was 260,000 bbls; in 1826, 160,000 bbls.; in 1827, 200,000 bbls.; in 1828, 240,000 bbls., and in 1831, the largest quantity on record was taken, amounting to 390,000 bbls. After this wonderful catch the number steadily declined until the year 1840, during which season only 55,000 bbls. were taken. In 1851, there was another wonderful catch of 330,000 bbls.; in 1859, only 100,000 bbls.; in 1863, 310,000 bbls ; in 1868, 180,000 bbls.; in 1870, 320,000 bbls.; 1877, 110,000 bbls.; in 1880, 245,000 bbls.; in 1881 and 1882, the number is the same—260,000 bbls.; in 1883, 160,000 bbls. These figures, covering a period of fifty-eight years, would seem to indicate that their plentifulness or scarcity is not governed materially by the purse seines of the Gloucester fleet.

In my own experience in the New York markets I have seen just such fluctuations in the quantities brought to that city, and whenever there occurs a bad season the fishermen and others interested, talk of the probability of the mackerel being all caught up, and of the necessity of some protection for the mackerel fisheries.

The opening of the present season has been a remarkable one. The first vessel arrived March 24th, and the mackerel were so small that the captain refused to take off his hatches to show the fish, and insisted on selling them "unsight unseen," and he was fortunate enough to find a purchaser on those terms, at two and a half cents each. There were something like 100,000 fish in the load, and they were so small that it took five of them to weigh a pound. The firm that bought them succeeded in selling a few hundred at four cents each, and then the price rapidly declined, until the larger portion of the cargo was sold at 50 cents per 100. About that time the unfortunate buyer called my attention to the fact that it was a great shame that such small mackerel were caught, and that Congress ought to pass a law to prohibit such a wicked waste.

The first load of mackerel was followed by several loads with fish a very little larger in size, but about the 20th of April a new school made its appearance, the average weight of the fish being about one pound each, and at least 1,500,000 of this size have, up to the present time, been marketed, and a large portion of them have been sold as low as two cents each.

The porgy, or, as it is sometimes called, the scup, is another important fish that furnishes abundant and cheap food, and about which considerable controversy has been had during the past few years, between the net men on one side and the hook and line men on the other, the latter claiming that the pounds and traps of the former were exterminating these fish, and efforts were put forth to have laws enacted that should restrict or abolish pound and trap fishing. But nothing came of such endeavors. This was in 1871, and fishing has been carried on in the same manner ever since, and in the New York market last week porgies sold as low as 75 cents per barrel, or about one-half a cent per pound.

I might continue on through the list of food fishes, and occupy your time, and possibly your attention, but I think I have said enough on this branch of the question.

Now, let us consider the menhaden fisheries, against which is brought the charge that they are prosecuted to such an extent, by both sail and steam vessels, that they have materially decreased the numbers of menhaden, and seriously impaired the catch of food fishes. You will find, by referring to the reports of the United States Menhaden Oil & Guano Association, that in 1875, with 283 sailing vessels, and 25 steamers, 492,878,000 fish were taken, that in 1881, with 286 sailing vessels, and 73 steamers, 454,192,000 fish were caught, and in 1882, with 83 steamers, and 212 sailing vessels, only 346,638,000 were caught, and last year, 1883, with 136 sail and 69 steamers, there was the enormous catch of 613,461,000 fish. These figures, taken in connection with the statements that have been made to me by captains of merchant vessels and fishing smacks, that during the fall of 1883, they sailed through miles of menhaden, would warrant the belief that this fish is very far from being exterminated, and that, with them as with the food fishes that are taken for market, there are seasons

of great abundance, and seasons of scarcity, and that up to the present time, these seasons have not been affected, either one way or the other, by human agency.

Another significant fact is, that during the early part of the menhaden season of 1883, and up to nearly its close, the fishing was so poor and unprofitable, that the fishermen themselves began to think they had "killed the goose that laid the golden egg," when all at once the fish appeared in countless numbers, and in a few days they had taken enough to turn what had promised to be a most disastrous season into one of large profit to all concerned.

Now, having presented these facts to you in a crude and disjointed form, permit me to say in closing, that although what are known as the hook and line fishermen, almost without exception, testify (and I believe truly) that they find their occupation and means of living seriously impaired, yet, from my experience and observation in the markets, I believe the facts to be that, with the exception of striped bass and lobsters, all kinds of sea food fishes are as abundant now as they were fifteen years ago, and, believing this, I am forced to the conviction that any legislation looking to the restriction of the fishing by the menhaden fishermen is unnecessary, and that any laws prohibiting pound and trap net fishing would cut off a large proportion of abundant and cheap food for the people, and nothing would be gained.

But I do hope that Congress will take some action that will provide for the collection of statistics as to the quantities of fish taken, so that in future, when questions affecting these vast industries come before them, they will then be able to frame legislation that will protect the fisheries, and not oppress the fishermen.

Mr. Endicott: I would like to ask Mr. Blackford to state whether in his opinion the pollution of the waters by gases and oils has a detrimental effect upon the fisheries.

Mr. Blackford: That is a question which, I believe, received some attention at the last meeting of the Association in the Cooper Institute, New York. On that occasion some action was taken, which looked towards a petition for legislation to

prevent the pollution of the water. I think it was admitted by all that it had been a source of great detriment to the fishing in our bays, and especially in New York harbor. I will quote from the Report of the Association for 1883, page 75:

"Mr. BENKARD: I would like to bring up the subject of the pollution of our waters, which brings many of our fish-cultural efforts to nought. I would respectfully offer the following:

"*Whereas*, It is the sense of this Association that the continual and increasing pollution of the waters of New York bay from the refuse of certain factories, threatens eventually to kill or drive away all fish, shellfish and bivalves natural to said waters:

"*Therefore*, Be it resolved that this Association beg to call the immediate attention of the Fish Commissioners of the States of New York and New Jersey, also of the members of their legislatures, to this impending calamity."

I seconded that resolution and made a few remarks to the effect that a great many fish, which had formerly been abundant in the bay, were no longer to be found there. Striped bass, and particularly lobsters, had been driven out entirely. These latter used to be taken abundantly on the Jersey flats. Shrimps, too, which were very numerous and formed food for larger fish, were almost exterminated, and what few remained were tainted with a flavor of kerosene. Oysters and clams have been killed by thousands in the vicinity of Rockaway. The water has been so polluted by the factories of Barren Island as to render a number of oyster beds, that used to be considered valuable, of no importance whatever. I think, though I am not certain, that the New Jersey legislature has taken some action, and I am of the decided opinion that if our Association moved in the matter, legislation could be brought about which would be able to control this matter at least in our own State of New York.

THE FLORIDA SPONGE FISHERY.

BY JOSEPH WILLCOX.

Mr. President: Professor Goode has asked me to say something about the resources of the coast of Florida, and I see that I am set down on the programme for a paper on the sponge fishery. I do not feel able to give an exhaustive paper on the sponge fishery, and not having expected to have been called upon until to-morrow, I am not well prepared, but I will do the best I can:

The geological formation of Florida, at least in the central and western portions, is lime-stone overlaid with sand. This limestone is tertiary; and judging from the fossils that have been collected by several, myself included, it is referred to the Oligocene age by Prof. Heilprin, of Philadelphia. The west coast at one time, not very remote, undoubtedly extended farther into the sea than it does at present. The rocky surface, under the water, not having been eroded to a great extent, now forms great shoals along the coast from Cedar Keys nearly to Tampa Bay. I know nothing of the coast north of Cedar Keys, but south of that place these shoals extend into the gulf many miles, interfering materially with the navigation of even small boats.

North of Tampa bay, for the distance of about thirty or forty miles, there is a series of long, narrow, low islands, two or three miles from the mainland, very similar to those on the coast of New Jersey. They enclose a shallow bay, the northern portion of which is called Clearwater harbor.

The same features may be seen south of Tampa bay, forming for a distance of about thirty miles, Sarasota bay. Still farther south, enclosed in the same manner, is the large expanse of water called Charlotte harbor. The same condition still exists farther south, but I have not seen them. The shoals on the west coast of Florida are admirably adapted for the existence of great varieties and quantities of forms of life suited for food of fish, which exist there in corresponding abundance. The enemies of these fish also occur there in vast quantities.

Presuming that all the living productions of the sea, of com-

mercial importance, might be classed within the legitimate province of the American Fish Cultural Association, I will relate some matters connected with the marine resources of the west coast of Florida, at the request of Mr. Goode.

A large portion of the gulf coast of Florida consists of shoal water, the bottom being limestome rock, which is usually covered with mud, a few inches deep. Upon the bottom many species of sea weed grow in great abundance, affording both food and shelter to a vast amount of animal life, such as molluscs, worms, crabs, and other crustaceans and fish.

The annual consumption of the latter especially, from natural causes alone, is very great, as vast numbers of aquatic birds may be seen there, attracted by the abundance of animal food existing in the shoal water.

The most numerous of these birds are cormorants, which live chiefly upon fish; though I have sometimes found shell fish in their stomachs. Being gregarious, they habitually roost at night in large colonies; selecting one or two islands for that purpose, from among a large cluster, without any apparent reason for such preference; and they do not abandon them unless greatly disturbed by man. I think two or three thousand cormorants would be a moderate estimate for the number resorting to one of those islands; and I consider a half pound of fish for each, per day, within the limits of their consumption, as they are very voracious.

I have frequently examined their stomachs, which were always found to be well supplied with fish. Near the mouth of Crystal river I have lately seen four of those island rookeries, and I believe the cormorants in that vicinity consume more than five thousand pounds of fish daily.

In addition to the cormorants great numbers of herons of several species resort to the same islands, presumably considering that there is increased safety in great numbers. These birds are also great consumers of fish.

While cruising lately along the coast between Cedar Keys and Punta Rassa, I hurriedly collected some specimens of sponges for the Museum of the Academy of Natural Sciences, in Philadelphia. Many of them were collected while living, in shoal

water in the bays. At low tide they could be seen spouting out water vigorously. When approached they became alarmed, and ceased spouting water; and when they were touched, they closed the orifices through which the water escaped, manifesting a surprising amount of activity of life. Though I collected more than fifty species of sponges, none of them possessed any commercial value. When I witnessed the great extent of the bays on the west coast of Florida, and saw on the bottom so many specimens of sponges, and so many species, I was forcibly impressed with the idea that these waters were capable of future possibilities of great commercial importance. If sponges of no market value can thrive there in abundance, there are reasonable grounds to expect that some of the desirable species may also grow there by cultivation. I was informed that the sponge crop in Florida is rapidly diminishing, and that their value is now much greater than in former times. If they can be cultivated artificially, a great industry might be established on that coast in the sponge trade, which does not appear to be capable of much extension in any other manner. It way be asserted that if valuable sponges could exist in the bays of Florida, they would be found there now. We should not be unmindful that, as a general rule, animals have a wonderful faculty for accommodating themselves to changed conditions in their life; not only when produced by the agency of man, but often by natural causes; or by voluntary altered conditions. I will give a few illustrations. We often find that oysters thrive well when transplanted upon new grounds, even where they do not subsequently multiply well, the conditions for spawning not being suitable.

I once saw a dog, in Nova Scotia, that refused to eat fresh meat which I offered to him. His master told me that he (the dog) never saw meat while he was young, and would not eat it. He ate fish only; chiefly dried codfish.

The sheephead fish, on the west coast of Florida, inhabit the fresh water streams in great abundance. There is practically little animal food there suitable to their tastes, such as molluscs and crustaceans, for eating which their mouths are specially adapted. So they accommodate themselves to their circumstances, and eat grass. Except in the rapid channels, the bottoms

of the rivers are covered with aquatic grass, every leaf and stem of which supports a growth of mosslike confervæ. The sheephead live upon this confervæ almost exclusively. I sent the contents of the stomach of one of these fish to Prof. Leidy, who said that in addition to the confervæ, he found multitudes of diatoms. In the case of the sheephead, the changed condition in their food is voluntary as, in the gulf of Mexico, into which they could go at any hour, abundance of molluscs and crustaceans may be seen in every handful of sea-weed taken from the bottom.

It is a surprising fact that many species of fish live in the fresh water in Florida, which inhabit salt water exclusively in the North. The sheephead, which are considered deep-water fish in the North, habitually feed with their dorsal fins out of the water, while in the fresh water rivers in Florida.

Mr. Willcox added: I lately witnessed the manner in which the saw-fish use their saws, while in Clearwater harbor. Several young saw-fish, not more than two and a half feet long, were observed in the water where it was only a few inches deep. When they saw me they ceased swimming, and remained on the bottom, where, by a gentle motion of their fins, they were nearly obscured by the sand which settled upon them. Imagining themselves secure, while thus covered, they permitted me to approach near enough to spear one. The wounded fish immediately elevated its head out of the water, thrusting the saw back, and moved it about, seeking for an enemy. Having felt the handle of wood, the saw-fish at once pulled its saw against it, using much force, and repeating the operation rapidly, always pulling, never pushing. It thus cut gashes in the handle. Two other saw-fishes performed the same operation when speared. None of them permitted an approach until it had partly concealed itself in the sand.

At the close of the morning session the members inspected some fine specimens of European trout, from the ponds of the New York Fish Commission at Cold Spring harbor, and then went in a body to view the national carp ponds, which have been greatly extended during the past year.

THE EVENING ADDRESSES.

In the evening at 8 o'clock, an address was delivered by Hon. Theodore Lyman, of Massachusetts. Hon. Elbridge G. Lapham occupied the chair. The hall was well filled by an appreciative audience, of which about one-fourth were ladies. Mr. Lapham, in introducing the orator of the evening, spoke as follows:

"LADIES AND GENTLEMEN: I am thankful for the honor of having been selected to preside over the ceremonies of this evening. The subject which has called us together is one of far greater importance than the mass of the public conceive it to be. The question of the propagation and preservation of the food fishes of our streams and along the ocean coasts, is second only in importance to the propagation and preservation of animal food. Indeed, the food which is furnished by the fish of our waters is free from many of the difficulties and dangers connected with the subject of animal food. We have in the former no trachinæ, pluro-pneumonia, foot-rot or mouth disease. Fish are not controlled in their habits by man as animals are. The demand for fish as an article of food has of late years been rapidly increasing. Indeed, such demand far exceeds the supply, and every year the interest taken in the subject is increasing, and this is the case not only in this country but in almost every civilized country of the earth. This subject has of late attracted special attention through the international exhibitions held at Berlin in 1880, and at London last year, where I am proud to say the United States bore off the honors for having the best and largest variety and most perfect exhibits which were made. It is a subject, I repeat, of vast and deep importance to everybody. A little more than two years ago the State of New Jersey undertook the passage of a law to regulate the fisheries in the waters of the ocean, over which she supposed she had control. The Attorney

General, however, decided that the State had no jurisdiction over the subject beyond low water mark on the ocean coast. A bill was introduced by Hon. Mr. Sewell, of New Jersey, looking to the passage of a national law regulating this subject. This was referred to the Committee on Foreign Relations, to consider whether such a law would interfere with our treaty obligations under the Treaty of Washington. For two seasons a sub-committee of that committee has been investigating the subject, and has visited many of the principal points along the ocean coast from Fortress Monroe, Virginia, to Portland, Maine. A volume of valuable testimony has been gathered on the subject, and I confess that I had no conception of the importance of this question until I entered upon that investigation. It is almost as fathomless as the ocean itself. We have met this evening to consider this grave and important subject, and I now take great pleasure in introducing to you the Hon. Theodore Lyman, of Massachusetts, who will deliver the annual address of the Association."

Speech of Hon. Theodore Lyman.

Old Rondelet wrote a great work at the beginning of the sixteenth century on sea fishes. His breadth of view included under the term "Fishes" almost every living thing that he found in salt water. It is in relation not to a fish, but to the radiated Medusa-head that he uses these fine words, more familiar, perhaps, to our older naturalists than to those of the rising generation: *Immensa et summe admirabilis dei potentia atque solertia in rebus cœlestibus iisque quæ in aere et terra fiunt, maxime vero in mari, in quo tam variæ et stupendæ rerum formæ conspiciuntur ut quærendi et contemplandi nullus usquam futurus sit finis.*—"Vast and highly admirable are the power and skill of God in things heavenly and earthly, and in those of the air, but more especially in the sea, where are beheld shapes so various and stupendous that the study and contemplation of them shall never end."

He spoke thus in a spirit of prophesy. Three centuries have passed and we are still contemplating and investigating the things of the sea. We have skimmed its surface with muslin nets in search of its infusoria, and we have let down dredges and

scraped its valleys three miles deep, and still the shapes various and stupendous continue to multiply. The more workers there are, the more work remains to be done. Humble clams, worms and urchins take on great importance and become marine Sphinxes, asking riddles that no one can answer. Creatures that once were conveniently dismissed as gelatinous, or gristly, now advance claims to an intricate circulatory system, to muscular fibres and to nervous ganglia. Nay, they proudly look down on the vertebrates, in the matter of reproduction, as they pass gracefully through the varied stages of alternate generation and self-division.

Rondelet lived near a sea whose inhabitants were well calculated to excite his wonder and delight. He was professor of medicine at Montpellier, not many miles from Aigues-Mortes, the port whence St. Louis embarked for his crusade, and whose walls, now surrounded by dry land, were in the middle of the sixteenth century, still bathed by the waters of the Mediterranean. The shallows of the bay teemed with the smaller crustacea and shells, while the open sea beyond was then, as now, the home of many fishes, varied in form and brilliant in color —the whiting, the red mullet, and the tunny, celebrated by classic writers. There, too, were found the darting squids and the great-eyed octopus, while from its depths came the rosy coral.

In the ancient medical school of Montpellier, still hangs the portrait of Rondelet in his red gown. He has the grave and placid look of a man who was master of his studies, and who stood well with science and with the Church. For had he not as a patron, Bishop Pelicier? and was he not the first authority in zoology and medicine, at a time when a good scholar could acquire all that was known of these and many things besides?

Every gain in knowledge has a loss that balances it. As the current of human thought grows wider, it becomes also more shallow, and splits into that infinitude of little channels which now are called specialties. In each of these channels may be seen a diligent investigator urging forward his little skiff, and well content to be navigating what to him seems the great river of truth.

Learning has grown so great in our day that the genius of one man can grasp no more than a part of it; so that in proportion as learning becomes larger, generalization, which is the final end of learning, grows more difficult. Worse than this, the mind employed on particular investigations gets unsymmetrical. The side that is used is strengthened; the disused side fails. and there results a scholar who believes in one set of ideas only.

After all then, we must look with a certain envy at the state of mind of old Rondelet. Like most men of his age he had that richness of thought and expression which comes of many-sided culture, and a strong faith in things both material and immaterial. When he said "Dei potentia," he distinctly meant power of God, and not "potentialities" or "molecular environment" or "power that works for righteousness," or any of those modern euphuisms which taste in the mouth like weak boiled arrow-root. Nevertheless, if we look closely, we can find the beginnings of that skepticism which plays so great a part in our day. For both he and his Bishop Pelicier were strongly suspected of favoring the Reformation. As to his colleague, Rabelais, he was noted for his unorthodox opinions, and went so far as to describe the future life as a "great perhaps."

But it is high time to leave Rondelet, and turn our attention to his sea-fishes. Their importance was great then—it is greater now. We might know by analogy, did we not know by actual research, that fishes have ever been of the first importance for man's food. Their natural abundance and the easy capture of shallow species put them within the reach of the primitive savage. The skeleton of the pre-historic chief, found in the cave of Mentone had as a head ornament, a net strung with Trochus shells, showing that he had walked the beaches of the neighboring Mediterranean, whose waters doubtless furnished his food.

The shell heaps of Scandinavia and of America, contain abundant bones of fish. Morton, of Merry Mount (1628), gives us a good idea how these shell heaps were formed, when he tells how the Indians came each year to the shore near Quincy, in Massachusetts, and there camped for a long time, feasting on the plentiful clams and lobsters, and alewives and striped bass, whose

shells and bones combined with the camp offal to build those deposits that we call shell heaps.

In New England, it must have been the fish that furnished the surest support to the native savages. Even in the depths of its Arctic winter there was a chance to get eels, smelts and clams and at the first approach of mild weather the waters teemed with abundance. "It (Pawtucket Falls) is excellently accommodated with a fishing place," wrote good Mr. Gookin in 1674, "and there is taken a variety of fish in their seasons, such as salmon, shad, lamprey eels, sturgeon, bass, and divers others. And this place being an ancient and capital seat of the Indians, they came to fish; and this good man (Mr. Eliot) takes this opportunity to spread the net of the Gospel to fish for their souls."

That child of Belial, Morton, of Merry Mount, as keen a sportsman as any of our Bohemian backwoodsmen, gives enthusiastic accounts of the abundance and excellence of the fish which were in the sea convenient to his house. He is the first author that mentions cod-liver oil, which now plays so beneficent, though nauseous a part in medicine.

He writes: "The coast aboundeth with such multitude of codd that the inhabitants of New England doe dunge their grounds with codd, and it is a commodity better than the golden mines of the Spanish Indes. * * * Greate store of train oyle is mayd of the livers of the codd and is a commodity that without question will enrich the inhabitants of New England quickly."

Almost coincident with the establishment of Plymouth Colony, we find laws concerning the fisheries, proof positive of the esteem in which they were held.

In 1633, was passed what I take to be the first law for the encouragement of fish-culture, in these words: "It is enacted by the Court * * * but if any man desire to improve a place and stocke it with fish of any kind for his private use, it shal bee lawfull for the Court to make any such graunt and forbid all others to make use of it."

In 1637 the same court enacted, with the contrary-mindedness of our Puritan forefathers, that six score and twelve fishes shall be accounted to the hundred of all sort of fishes.

In 1670, it was set forth with pious teleology that "the provi-

dence of God hath made Cape Cod commodious for us, for fishing with seines"; implying that it might not be commodious for less religious persons. The act goes on to say that "careless persons" must not interfere with the said providence, "by leaving the garbage of fish to lie there."

The country had not been settled a half century before there was complaint of the diminution of fish. The act just quoted goes on to speak of the great inconvenience of taking mackerel at unseasonable times, whereby their increase is greatly diminished, and a law was passed prohibiting the catching of fish before they have "spaumed." This shows that our ancestors were not more logical than most of their descendants, who still hold, that to take a fish when ripe for spawning is in some peculiar way destructive to the species. It is almost needless to say that fishes taken at any time of the year are killed before they have "spaumed." The only reason that it is more destructive to take fish during the spawning season is because they are then tamer and are crowded together, so that greater numbers are likely to be captured.

The river fisheries, too, call aloud for protection. In 1709, it was enacted "That no weirs, hedges, fish garths, stakes, kiddles or other disturbance or encumbrance shall be set, erected or made on or across any river, to the stopping, obstructing or straightening of the natural or usual course and passage of fish in their seasons * * * without allowance first had, and obtained from the General Sessions of the Peace in the same county." This law especially applied to such fishes as run up the rivers to spawn, salmon, shad and alewives. The Indians, in their day, were wont to construct weirs and the like obstructions to capture these fishes. But the Indians were few and were idle and wandering. They took only what was necessary for their present use. Now, however, had come the white men, who put up permanent abodes and increased in numbers, year by year. They were money-makers, who worked every day and all the day. They would catch fish, not for themselves only, but to sell to strangers; and so they have gone on ever since. Pawtucket Falls, on the Merrimac, where the Apostle Eliot spread his net of the gospel, now furnishes the water power for the great man-

ufacturing city of Lowell. And Merry Mount, to-day the country seat of John Quincy Adams, is a suburb of the metropolis of New England. The inhabitants no longer "dunge their grounds with codd," but are fain to buy that fish in the market at a round price per pound.

The river fish whose protection has cost most law-making in the old commonwealth of Massachusetts, is the humble alewife. In contradiction of the proverb, "mute as a fish," this one may truly be said to have made a great deal of noise in the world. Like some men they are small and humble, but persistent and numerous. In the springtime the alewives stand in from the sea, and push up the smaller fresh-water streams, seeking ponds wherein to deposit their spawn. They come in great armies and insist on entering those ponds. Nothing less than a vertical wall six feet high will stop them. Amid the clatter of mill wheels, and in the very face of the sweeping scoop net, they force themselves through rapids, over falls, and by long underground drains, regardless of their perishing comrades, who by thousands fall a prey to the fishermen and to hawks and eagles; or who run themselves ashore in their frantic efforts to get on. It may be that only a few reach the spawning ground, and these are enough to keep up the race; for one female will lay a quarter of million of spawn. They are, therefore, *par excellence* domestic and cultivable fish, and have been so regarded in Massachusetts for generations. As early as 1741, there was passed "an act made to prevent the destruction of the fish called alewives," wherein it was provided that any owner of a dam "shall make a sufficient passageway, for the fish to pass up such river or stream, through or around such dam."

It is, however, not until 1790, that the alewife fishery of Taunton Great River, first appears on the statute books, whose pages it was destined to encumber. If very few of my hearers know anything of Taunton Great River, the fact proves how miserably our system of popular education fails to instruct people concerning the most remarkable geographical features of the land. Taunton Great River was doubtless named in the spirit of contrary-mindedness already referred to as a characteristic in our puritan ancestors. The unregenerate would be inclined to

call it Taunton Small River, for it is a small stream, which heads in some ponds in the town of Lakeville, and after a short and quiet course empties into the sea at Fall River. But not the mighty Mississippi itself bears on its bosom so great a mass of legislation. The great and general Court of Massachusetts invariably spends a portion of each session in trying to regulate the fisheries of this stream. The fishermen of the upper waters always complain that those of the lower waters get all the alewives, while those of the lower waters maintain that their rivals feloniously conspire to shut the fish off from their spawning grounds. And when by some special providence, both sets of fishermen are at peace with one another, they invariably make a combined attack upon the regulations of the State Fish Commissioners. The riparian inhabitants of other alewife streams, although not so combative, are quite as much interested as those of Taunton Great River. Indeed it was in such waters that a sort of fish-culture first grew up. In some cases, where a dam owner wished to save his water power by shutting up his fishway, he would agree to catch each year so many thousand alewives at the foot of the dam, and to convey them alive to the mill pond above, and thus to keep up the crop. And it has been the custom for more than a century to regulate these little streams by special acts which govern the public sale of the fish, the days on which they may be netted, and the fishways that are to be kept open for their passage. The law goes often so far into detail as to provide that each widow of the town shall have a barrel full for nothing. I have dwelt thus long on this humble fish, because its successful culture gives encouragement to attempt that of others more difficult.

I shall follow briefly the decline of the fisheries in New England, because it is there that an organized system of fish-culture first in this country took its origin. That region has two rivers of considerable size—the Connecticut and the Merrimac. Both rise in the cold streams of the White Mountains. The Connecticut, flowing south, empties into Long Island Sound, and the Merrimac, by a southeasterly course, reaches the Atlantic Ocean. A century ago both rivers abounded in shad, salmon and alewives, and would doubtless have continued for many years to

give a fair yield in spite of over-fishing, had it not been for the erection of impassible dams, which were intended to give water power to the manufacturers, or to furnish slack water navigation to lumber rafts. As early as 1798, the Connecticut river was thus barred at a point just within the northern limit of Massachusetts, but it was not until 1847 that the Merrimac was in a like manner shut off by the great dam at Lawrence. In both cases the salmon, stopped on their passage to the spawning grounds, became extinct after a few years, while the shad and alewives, which could be bred in the lower waters, continued annually to revisit these rivers.

What happened on the Merrimac and Connecticut happened equally on almost every lesser stream in that region. The people of New England, lacking advantages for farming, turned all their attention to manufacturing. Water power was then much cheaper than steam, so that before long there rose a dam wherever there was a fall great enough to turn a millwheel. Except some simple trenches for the passage of alewives, no fishways were then known. The complete ignorance of this subject may be illustrated by the great dam twenty-seven feet high at Lawrence. The charter of the company permitted the building of a dam, provided a pass were furnished for salmon, which should be satisfactory to the County Commissioners. Before the dam was finished, a solemn council of the best ichthyological and engineering talent was held to determine what kind of a pass would be suitable. The council based its judgment apparently on the cheap woodcut in the primary geographies of half a century ago, which represented a salmon briskly leaping over falls at least fifty feet high. At any rate, the salmon pass finally approved by the learned Commissioners consistedof a simple plank trough, sloping from the crest to the foot of the dam, at an angle somewhat steeper than forty-five degrees. It is needless to say that the salmon declined to exhibit any of the feats of agility portrayed in the wood-cut of the primary geography.

There soon came to be a general feeling, and one under the circumstances quite natural, that manufactures and fish mutually excluded each other, and so things were allowed to drift at their pleasure. The streams that emptied into salt water no longer

furnished such abundant swarms of small fry, as had in former days served to toll the sea fishes toward the land, while the passage of boats and steamers and the increase of population and of fishing tended to destroy or to scare away the fish of the small bays and coves. The balance of nature had thus been changed, and one part had reacted against another.

The steady diminuition would have gone uninterruptedly on but for the revival of fish-culture.

The discovery of artificial impregnation of eggs is such a simple one that the only wonder is that it was not practiced long ago. Country boys who watch the brooks in autumn, know how trout deposit their eggs; and fishermen, after hauling their seine ashore, are familiar with the spectacle of spawn and milt flowing from the ripe fishes. It is more than likely that many persons have in the past times practiced the artificial fecundation of ova. The process was described in 1420 by Dom Pinchon, a monk of the abbey of Réome. It was re-discovered by Jacobi, of Westphalia, in 1763, and several naturalists availed themselves of this method in their embryological researches. Among others, Louis Agassiz, who, in 1838, hatched the impregnated eggs of Swiss white-fish by tying them in a muslin bag, and sinking it on the margin of the lake of Neufchatel.

In 1843, two fishermen of the Vosges, Joseph Rémy and Antoine Géhin, not only hatched a large number of trout, but devised means of feeding them artificially. They succeeded in stocking several water courses in their neighborhood with these trout fry. Seven years later their results had become known to the scientific men in Paris. Napoleon the Third had already begun his elaborate measures for the material aggrandizement of France, and he took up fish-culture and the acclimatization of new animals among other schemes. He disliked the professors of the Garden of Plants, because of their Orleanist sentiments, and he set up a rival under the name of the Garden of Acclimatization, of which fish-culture was in some sort a branch. Its apostle was Professor Coste. With large appropriations from the central government he established at Huningue, near the Swiss frontier, a large and elaborate station for fish-culture. His enthusiasm was great. He estimated that the yield of fresh

water fishes in France was not worth more than $1,200,000 annually, which he was confident could be raised by artificial fecundation to $180,000,000. Like many another inventor, Professor Coste was doomed to opposition and disappointment. M. Rimbaud, Secretary of the Fishery Board of Marseilles, ridiculed what he called the unnatural water-culture. He said the machinery and labor for hatching and the artificial food would cost more than the fish would come to. He was not far from right. With plenty of money to work with, it was not difficult to build hatcheries, dig ponds, set up apparatus, and put in turbine wheels for pumping. The working of the establishment was more difficult. The spawn, collected at distant points and sometimes in a careless way, often failed to hatch. The fry, carefully placed in suitable pools, disappeared in a way considered mysterious, until it was discovered that several large pickerel had found their way into the pools. The eminent engineers of the *ponts et chaussées* contended in vain with the waters of the Rhine, which sometimes backed up and flooded the pools and tanks, and anon receded, leaving the turbine wheels high and dry. Years rolled on, and Professor Coste was still struggling to make fish plenty in France, when the Prussian armies crossed the Rhine and appropriated Huningue to the use of the German Empire.

All these disappointed hopes had not been quite in vain. Many valuable experiments had been tried and precious information published, and, above all, it had been discovered that certain things could not be done. Meanwhile, knowledge of these discoveries had crossed the Atlantic, and in 1853, Dr. Theodatus Garlick hatched the artificially-impregnated eggs of trout. Three years later commissioners appointed by Massachusetts published a valuable report on the general subject of fish-culture, and attempted unsuccessfully to hatch trout. In the same year an admirable report on fisheries was written by the eminent scholar, George P. Marsh, who had been appointed a commissioner by the State of New Hampshire.

The true beginning of fish-culture, however, under the auspices of State governments, was in July, 1864, when New Hampshire and Vermont passed legislative resolves calling on Massa-

chusetts to re-establish a free passage for migratory sea fish through the dams on the Connecticut and Merrimac rivers. To the late Judge Henry A. Bellows, of New Hampshire, this country owes the successful beginning of the undertaking. He was an advocate learned in the law and full of enthusiasm for the restoration of the former runs of salmon and shad in the cool waters of the Pemigewasset and the broad expanse of Lake Winnepiseogee. He appeared before a committee of the Massachusetts legislature, and by their recommendation two commissioners were appointed, of whom I had the honor to be one. This was in 1865. Within a year every New England State was represented by Fishery Commissioners. They were accustomed to assemble from time to time for the discussion of their mutual interests. These modest gatherings, whereat the assembled authorities failed not to test the excellence of their own fish, were the prototypes of the national gathering which we celebrate this evening.

The opening of the great dams by fishways led to several important results. In the first place the decision in the case of the Massachusetts Commissioners against the Holyoke Water Power Company, has settled the law in regard to the rights of migratory fishes in rivers. This decision, which was confirmed by the United States Supreme Court in 1872, sets forth that a river was a public way, and the passage of migratory fish in it a public right. Therefore,whoever builds a dam across a river must furnish a passage to its migratory fish unless expressly exempted by the legislature.

It thus became easy to open the streams, and hundreds of owners of dams, who, by adverse possession had considered themselves safe from intrusion, now found themselves obliged to construct fishways at their own expense.

The second important step was also a legal one. It was the passage in 1869, by Massachusetts, of an act to encourage the cultivation of useful fishes, which was intended to embody in one law all necessary regulations. Before that time the fishery laws of that State, to the number of nearly four hundred, were for the most part special enactments. The new statute substituted general provisions. It established a board of fish-

ery commissioners, and gave them suitable power; gave to the riparian proprietor the control of ponds not exceeding twenty acres in extent, and regulated the times and methods of taking fish.

In attempting to restock the Merrimac and Connecticut, the most difficult problem possible was the one first encountered, that of building a fishway which would carry salmon, shad and alewives over a vertical dam near thirty feet high. In this country we had nothing to go by save the salmon passes of Great Britain, or the little water-steps over the low continental dams. Through successive improvements we have now attained a fishway that will with certainty carry salmon, alewives and the common river fishes over the most difficult dams. But the shad, with his love of the broad, gentle stream, and his suspicion of artificial contrivances, still remains rebellious. There is, however, a strong belief that the ingenious Colonel McDonald will irresistibly inveigle the shad into his mysterious pass. It is, indeed, a truly Irish pass, in which more water runs in than runs out; and the steeper is the incline, the more rapidly the water runs up hill; so that a shad would think that he was swimming toward Fortress Monroe when he was in reality going over the falls of the Potomac. From the outset, the Massachusetts Commissioners had foreseen that the building of fishways on the Merrimac river was but a half remedy. It was further necessary to breed salmon and place them in the upper waters, that they might thence descend to the ocean, and return as marketable fish to their native river. To obtain impregnated eggs of salmon was at that time a work of great difficulty and expense. In the autumn of 1866, Dr. W. W. Fletcher, of New Hampshire, placed 15,000 New Brunswick salmon eggs in the Pemigewasset; but it was not until 1872, that 16,000 young fry were let loose in its waters; and in 1873, 185,000. Occasional captures of salmon in nets at various points on Massachusetts bay were soon after reported; and on the 31st of May, 1877, two full-grown salmon were discovered mounting the Lawrence fishway. Since that year, salmon have been artificially bred at the headwaters of the Merrimac, and the full-grown fish have annually ascended a river in which for twenty-five years they have become extinct.

The other chief river of New England, the Connecticut, was the scene of the first artificial hatching of the shad. With the encouragement of the Massachusetts Commissioners, Seth Green, of New York, began, in the summer of 1867, his experiments in shad hatching at Holyoke. His simple and ingenious invention of a hatching box, which kept up a constant current by floating, not horizontally but at an angle, has become a matter of familiar history. Great was the ridicule directed against Green, as he painfully waded about in the river under the hot June sun. But when, a few seasons later, the shad appeared in unusual numbers at the mouth of the river, ridicule was changed to admiration, and the great crop of that year was called "Green's shad."

In the following year, 1868, shad-hatching was established on the Merrimac and daily record was kept of the temperature of the air and water, of the number and sex of the fish taken, and the quantity of eggs hatched. These tables were the first of the kind published in this country.

The progress of this slight sketch has brought us to the question which underlies the subject of fish-culture in its broadest sense; it is the question of the possible exhaustion of great fisheries, and especially those of the sea.

We have seen that soon after the first settlement of the country, complaints of the decrease of fish began to arise. It is very likely that these complaints came rather from the accidental differences of seasons than from any real decrease. Nevertheless, they indicate that the relation between overfishing and decrease of the crop was one that was early suggested to our people. The entire subject was brought into prominence in our own day by the report of the English Commissioners to inquire into the sea fisheries of the United Kingdom in 1864. Of these Commissioners it has been said: "Their industry was so extraordinary, and the piles of evidence were such as to leave the impression that every fish-wife in the three kingdoms had had her say. The trawlers were vehement against the set-hook men, and the set-hook men were furious against the trawlers. The Commission decided that they all were right, and might fish when, how and where they pleased. But just then Mr. Bertram comes

out with his "Harvest of the Sea," in which by fact and figure he aims to show just the opposite, namely, that the open sea fish had decreased by overfishing.

The question of the progressive exhaustion of sea fisheries came up six years later in America, in the form of a monster petition presented to the Massachusetts legislature, which was asked to pass a law restricting fishing with weirs, seines and gill nets. The petitioners alleged that valuable fishes, such as the scup, the tautog and the striped bass, were taken by the above mentioned contrivances in so wholesale a way as to threaten their speedy extinction. The complaints applied chiefly to the southern waters, including those of Narragansett bay, where the inhabitants of Rhode Island were equally interested, and both States proceeded to investigate the subject. Their methods, however, were no better than had been those of the English Commissioners, and consisted chiefly in the examination of numerous witnesses. It was the same story over again. The weir men swore against the hook-and-line fishermen and the hook-and-line fishermen swore against the weir men. The moment had evidently arrived to abandon the methods of the court-room and to take up those of scientific investigation.

To this end the Massachusetts Commissioners, in the spring of 1881, hired a weir at Waquoit, on the south side of Cape Cod, and put it in charge of an observer, who kept a daily record of the fishes taken, of the wind and weather, and of the temperature of air and water. At the end of the season the results were embodied in a report, entitled "Third Notice upon the Possible Exhaustion of Sea Fisheries." It was shown by this investigation that the moment at which fishes leave the ocean to enter rivers is determined by the temperature of the water. It further appeared that these so-called anadromous fishes are usually caught in weirs and in similar traps when hurrying along the coast in their northward migrations, whereas those that arrive near or at the mouth of their native river slacken their pace and cautiously feel their way, like a ship standing into a harbor These last are more apt to avoid the nets ingeniously set for their capture.

Up to this time the movement in favor of fish-culture had been

confined to New York and New England, and chiefly to the State of Massachusetts. Dams hitherto impassible had been opened to the passage of anadromous fishes; fish-ways of an improved form had been built; a decision of the Supreme Court had given to fish the right of way in rivers; acts for the encouragement of the cultivation of useful fishes had been passed; the artificial hatching of shad and salmon had begun, and an investigation into the exhaustion of sea fisheries had been set on foot. All these measures were, however, partial and on a small scale. The moment had arrived for the interposition of a power stronger and more general in its character.

That democratic and gregarious fish, the scup, was the founder of the United States Commission of Fish and Fisheries. It is a fish coeval with the first white settlements. In 1621, on the shores of Buzzard's bay, the hungry Englishmen were entertained by Massasoit with "two fishes like bream, but twice as big and better meat," and Roger Williams says, in 1642, "Mishcup, the bream. Of this fish there is abundance, which the natives dry in the sun and smoke; and some English begin to salt." With the first warm days of spring, the scup were wont to push into the bays and fiords and salt ponds in great multitudes, standing in from the off shore depths which had sheltered them, and furnished them abundant food during the winter. Then followed a jubilee for poor and rich. Anybody who had a hook and line could catch a "mess of fish" before breakfast; scup, he was sure to get, and he was likely to get a fat tautog or a striped bass. But when did a Yankee ever allow any peace either to himself or to his neighbor, or when did his mind, sleeping or waking, ever cease to dwell on the invention of some labor-saving machine? Hook and line was too primitive a method to be permitted in this age of improvement. About the year 1846, one Benjamin Tallman, being doubtless moved and abetted by the evil one, conceived the idea of driving posts in a straight line running out to sea and stretching thereon netting so as to make a fence; and constructing at the end thereof a sort of enclosed yard. The schools of scup, as they coasted along the shore, ran against the fence, and turning their heads seaward, were captured in the said yard. The inventor, in the pride of

his heart, named this engine a "trap." He little knew that he had only made a small copy of a contrivance that was known to the Phœnicians, who used it along the shores of the Mediterranean and even on the coast of Spain. There, in later days, the Moors called it the *almadraba*, whence is derived the modern French word *madrague*. If the Moors created as much popular indignation with their *almadrabas* as Benjamin did with his "traps," the fact may account for their expulsion from Spain by the Gothic tribes. For twenty years, war and recrimination prevailed between the trappers and the hook-and-line men, until at length, both parties, like the Jewish factions, determined to appeal unto Cæsar, or as he is now called, Uncle Sam.

On the 19th of February, 1871, was passed a joint resolution of Congress, the preamble of which says: "*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*, resolved, that the President be authorized to appoint a Commissioner of Fish and Fisheries."

It has been truly said that when the critical moment arrives, the man appears also; and this critical moment made no exception to the rule. A man—nay, *the* man, was at once found in the person of Professor Spencer F. Baird. The Cæsar to whom the warring factions had appealed could not have sent forth a more judicious prætor. Mercifully he was not one of those self-taught men (of whom, for some occult reason, we are so proud), but a man of careful scientific training; and one as industrious in collecting facts, as in arranging them. Also, was he a man of a pleasant countenance and conversation, and well calculated to assuage the irritated feelings of the hook-and liner, or to soothe the exasperated nerves of the trapper. Indeed, he seems to be the only individual in history who ever intervened between two combatants without receiving the blows of both.

Henceforth the history of American fish-culture is contained in that of the United States Fish Commission. Its work, widespread and pushed with extraordinary energy, attracted the attention of the whole country. A greater part of the States appointed fishery commissions, which co-operated with, and were

assisted by that of the general Government. Its rapidly increasing value and power culminated in the great fishery exhibitions of Berlin and London, where the United States exhibits gained the chief prizes.

The history of the movement for the restoration of our fishes may seem like a triumphal march; but in summing up its results we cannot in honesty avoid the cold question *cui bono?* of what good is all this?

Up to the year 1880, the fishery commissions of the States and of the general Government had had appropriated $1,306,378. Has the country got a return of a million dollars' worth of additional fish?

In 1880, the total value of the fishery products of the United States was $43,000,000, a less sum than that of the manufactures in a single Congressional district in the little State of Massachusetts. The two products show that real value is not always to be measured by money. The people of this country could have been deprived of the manufactures of that district, without recognizing their loss, but what an outcry would arise were they cut off, even for a month, from cod and white-fish, lobsters and oysters!

Did the expenditure of $1,300,000, since 1866, add anything to the $43,000,000 which our fisheries produced in 1880, or did it pave the way for an increase?

To answer these questions we must define what we mean by a decrease in fisheries.

When so many fish are annually taken from the waters, that the remainder are not numerous enough to produce a new crop equal in numbers to the old one, there must be a progressive decrease in the yield. It is a very simple matter to demonstrate such a decrease in ordinary rivers or in lakes of moderate size, where it is easy that spearing and netting of the trout on their spawning beds has diminished their numbers, or that the establishment of weirs has made white-fish scarce. In the bays and coves of the sea, also, where the waters are shallow, it is not difficult to show that the use of numerous fykes and trawl-lines destroy the local fish, like tautog, rock-bass and flounders. But, when we come to the schooling fishes of the open sea, it is very

difficult to tell how much effect the hand of man has in lessening them. If, for example, we argue that traps and purse seines diminish the crop of menhaden by capturing them in enormous numbers, we leave out of mind the fact that these same traps and purse-seines also capture blue-fish and small sharks, which are thus taken from their daily occupation of killing menhaden. Again, when menhaden entirely disappear from a long stretch of coast, they are, in reality, no scarcer than before. They refuse to come to their wonted waters either because the temperature is too low, or because their favorite food is not to be found. They are not destroyed, only absent. There are familiar instances of such disappearances. The scup was plentiful when the whites first landed in New England; they afterwards disappeared, and re-appeared about the beginning of the present century. The blue-fish was caught on the southern coast of New England from 1659, for more than a hundred years. In 1764 they disappeared, and after an absence of sixty-six years, they re-appeared about 1830.

Another element that must be borne in mind in estimating the total catch of fish is the number of men and the kind of engines employed. If, for example, the population of a coast is scanty, and only a dozen men go a fishing, each of them is likely to have a good catch; but when the coast becomes thickly settled, a hundred men will fish, and though each one may take but few, the catch of the hundred will be much greater than that of the twelve.

In the light of the patient investigations of the past dozen years, it is safe to assert, first, that our fresh water fisheries have in general, greatly diminished since early times, and have, in some cases, been destroyed. Secondly, that the local coast fisheries have also to a greater or less degree diminished.

What have our fishery commissions done to remedy or to palliate these evils? It is fair to say that they have done a good deal, and are in a way to do more.

Their first, and perhaps most valuable service has been to excite universal interest in our fisheries, and to draw general attention to their importance. The second great step in advance has been the accumulation of a vast amount of accurate inform-

ation concerning the numbers and variety of our fishes, their food, manner of breeding, condition of life, migrations and stages of growth. The third degree of progress has been fish-culture, which may be called negative and positive; negative when obstructions to the increase of fish, such as improper apparatus and impassible dams are removed; positive when fishes are artificially bred, or when new species are introduced from distant countries.

It may be fairly said that both forms of culture have already given considerable results. Of the success of negative culture, a familiar example is that of the smelt, which a few years ago had grown scanty in numbers and small in size on the Massachusetts coast, because the breeding fish were captured in the brooks, when crowded together on their spawning beds. The prohibition of this kind of fishing was followed within three years, by the restoration of the smelts to their former numbers and size.

The best instance of positive culture is that of the California salmon in the Sacramento river, where Livingston Stone, by annually turning into the river 2,000,000 young fry, artificially hatched, increased the yearly catch from 5,000,000 pounds to 9,500,000 pounds.

Wide experience in the hatching of shad and white-fish proves pretty clearly that a marked increase may be obtained, if the work be done on a scale large enough, and that an amount of work insufficient to produce a positive increase will, nevertheless, check the decrease of these species.

In a word, artificial breeding by greatly augmenting the proportion of eggs impregnated and by protecting them until hatched, presents a great advantage over the natural process, and gives us an available method of preserving many important fisheries. But to produce results of commercial value, this waters culture must be practiced as universally and methodically as is agriculture.

It is not the custom of Americans to stop half way in a profitable enterprise. Therefore I do not doubt that in the next generation some of our chief fisheries will be maintained by an established system of artificial culture.

Perhaps, in that day, the honorable guild of fish-mongers will erect a monument of their gratitude, and will inscribe on its tablets the names of scientific men, who have in our time labored to create a new industry.

Speech of Hon. S. S. Cox.

Ladies and Gentlemen: It is my pleasure and privilege this evening to move a vote of thanks to the Hon. Theodore Lyman, for his very felicitous and learned address upon this annual occasion. I am told that by a custom which now obtains in this museum, I am expected to speak to my own motion. If I were in another body I think I should rule it out of order, but I have a special gratification this evening in having a Congressman appear here so thoroughly learned in marine zoology. There is sitting before me, I notice, an ex-member of Congress, the Hon. Mr. Roosevelt (and I beg to say that in this particular province an x is not an unknown quantity), who has also devoted his services, his intellect, and sometimes his sportive nature to the same object as my distinguished friend from Massachusetts. But a New York man has not the same right to talk fish as a New England man. It is the privilege peculiar of the latter, as any one can see who will examine the last census, and you may have noticed all through the remarkable address of our friend that he is associated with the fish interest and with the dams of Massachusetts. I cannot say that I was shocked or astonished at his description, and at hearing the names of the various little streams of that State. We have always heard of them in the River and Harbor Bill. [Laughter.] But I was struck by one thing, namely, that he took very good care in his discussion to connect science with religion. And even at the falls of the Pawtucket, where he said the manufacturing interests did not harmonize with those of the fisheries, he associated the old Puritan doctrine with religion, revelation, science and fish-culture, which were almost one and the same thing. And it is simply true. If you look at the escutcheon of the State of Massachusetts you will find it to be a codfish, and nearly all the quarrels of that

Puritan State have arisen from the same question that vexed the old Hollanders in early days, as to whether the codfish took the hook or the hook took the codfish. [Laughter.] I do not know whether that point is settled yet. The State of Massachusetts should be proud of her fisheries. I remember having the honor of being arrested at 3 o'clock in the morning with General Butler, in the House of Representatives, in my attempt to break down the proposition to pay over to England the $5,500,000 growing out of the fishery award. I heard Mr. Rice, another member from Massachusetts, contend for the abrogation of the fishing treaty, which now allows fish to come in free from the Dominion of Canada. I sustained him in that, not because I was unwilling to have fish come in free to this country, but because I did not want fish to come free from Canada or Great Britain, who had cheated us out of $5,500,000. Throughout this whole subject Massachusetts has played a most prominent part. Why not? New England is the home, if not the mother, of invention. The feature which most interests us here to-night is the inventive faculty. It has been shown in such a remarkable degree in fishing, and chiefly in New England, in connection with improvements for the catching of fish. These were displayed on a magnificent scale at Berlin, in 1880, and in London in 1883.

You may remember that a certain weaver at Lyons invented his famous net, which revolutionized fishing. They arrested him, and the great War Minister Carnot, sent for him to come before the great Napoleon. The Minister said: "Are you the man that can do what God cannot?—tie a knot on a stretched string?" And they put him gently under arrest, for fear he would go to England and there introduce his net.

Since then we have made remarkable strides in the invention of fish apparatus. We now use steam as an adjunct and the great purse-seine. In the whale fisheries the harpoons are no longer of the old sort, but explosive. Not satisfied to blow up dynasties with dynamite, we blow up whales with it. [Laughter.]

But the great element of advancement was not discovered perhaps as early as some think—in Japan or China. Our learned friend fixed it at about 150 years ago, but I have data to show

that this discovery of fish-culture was made in *Ohio!* [Laughter.] I know the man! [Prolonged laughter.] His name was Dr. Garlick, of Cleveland. His discovery like others was not complete at first. It was necessary that New York should perfect what Ohio had begun, and with the aid of several New York men, prominent among whom was my honorable friend in front (Hon. R. B. Roosevelt), this science was brought to perfection. By aiding nature, and with the skill of such men, these investigations have been prosecuted. Congress has been enabled to see something of the inestimable value of food fishes. Out of these investigations came the United States Fish Commission in 1871, for the creation of which I had the honor to vote. We should in a body pass a vote of thanks to Congress. From it came the appropriations that warmed up the hatching places. They helped on the grand results. So that now we can send from one end of the country to the other over car-wheels, tanks of fish. We all have, I trust, or ought to have, a deep interest in the fisheries.

The fishery interest is one which the last census shows to be of immense importance. Perhaps it is most important to New England considered in its deep-sea bearings, and for purposes of commerce; but since the plans of the commission have been replenished and multiplied food fishes in our estuaries, bays and streams, it is of great importance to the inland as well as to the coastwise States.

THE GOOD PURITAN FOLK.

It was especially fitting that the sons of Massachusetts should have made a defense of our fishing interests upon that occasion. The early culture of her aristocracy was fish-culture. Indeed, her religion is allied with the piscatorial calling. Adventurers to New England of the "Northern Company" were not altogether inspired by the promised yield of gold and silver, though visions of bonanzas were not wanting. Their fancied treasures lay in the sea. Their divining rod held its hook, line, bob, and sinker. It is of record that when the Pilgrims went to King James for their charter, they said to him that they desired to go to the New World to worship God—and catch fish. "What

profits do you intend?" asked the king. On being told—"those from fishing," he replied ironically: "So God have my soul, 'tis an honest trade; 'twas the apostle's own calling." These good Puritan folk expected to find miraculous argentiferous draughts in the mouths of the fishes. They have ever since "sacrificed to their net and burned incense to their drag; because by them their portion is fatness and their meat plenteous." No wonder, then, that this godly class broke forth into hymning praise to the Creator for the blessings they received from the sea:

> Ye monsters of the bubbling deep,
> Your Maker's name upraise;
> Up from the sands, ye codlings peep,
> And wag your tails always.

SACRED ASSOCIATIONS.

However irrevelant to this discussion the connection between piety and angling, it does not detract from the dignity of this calling to know that it has high authority, great antiquity, and sacred associations. Was it not the Psalmist of Israel who said —"They that occupy themselves in deep waters see the wonderful works of God?" Did not our Saviour choose for the great work of the Gospel the prudent, peaceable and devout fishermen? Of the Twelve, were not four of this simple craft? While reproving the scribes and moneyed men for their peculiar employment, the Saviour gave to these simple disciples the power to speak all tongues, to persuade by their quiet manners and sincere eloquence, and to perform wonders unheard of before upon the chosen soil of Palestine. Peter, Andrew, James, and John, the four fishermen, as the good Izaak Walton has said with great felicity, were men of mild and sweet and peaceable spirits, as, indeed, most anglers are—

And it is observable that these our four fishermen should have a priority of numeration in the catalogue of the twelve apostles. And it is yet more observable that when our Saviour went up into the mount, when he left the rest of his disciples and chose only three to bear him company at his transfiguration, that these three were all fishermen. And it is believed that all the other apostles, after they betook themselves to follow Christ, betook themselves to be fishermen, too, for it is certain that the greater number of them were found to-

gether fishing, by Jesus after his resurrection, as it is recorded in the twenty-first chapter of St. John's Gospel.

The Bible has many references to this quiet, contemplative calling, to which it is not necessary here and now to refer.

Whatever may be the controversy between theology and science, or revelation and reason, it is certain that in early New England revelation and science met on common grounds—the fishing grounds! Practicalness went hand in hand with Science, and Science meekly worshipped at the shrine of Faith.

FISHING AN ANCIENT CALLING.

Fishing and fish-culture are not new discoveries; nor are the present modes, especially by line and spear, novel. Necessity was the mother of these as of other arts. It is said that Deucalion, just after the flood, invented angling for food to save his starving family. Seth taught it to his sons. It is believed by some that Japan and China early understood artificial propagation. Fishing runs into mythology; for, is not the trident of Neptune the fish spear, thrice armed? As an ancient and most fish-like muse sings:

> Then darts the trident, and the briny flood
> Is crimsoned with the incautious victim's blood.

Do we not read in the Bible about putting a hook into the jaws of Leviathan? Is this not a clear reference to angling on a large scale? The Ichthyophagi are as old as the Strabo who records them.

The fishermen of the past may have been poor, but they were never cowardly. They may have been ignorant, but they had an eye for beauty, which was improved by the iridescent hues of the finny tribes, and by the rare views of nature on sea and shore. They may have been simple, but it was from their humble guild that the grandeurs of the New Dispensation came to a sinful world, to improve and bless.

We may go back to Egypt—that ancient mother of spiritual and temporal empire, and read upon her monuments and paintings, the designs and modes by which fish were taken and preserved for the chief butlers and bakers of the Pharaohs. Worshipping, as they did, animals of various kinds, it was not infre-

quent that one tribe in Egypt declared war against another for eating up her deities! Even the fun on a fishing excursion which our urchins now enjoy, Cleopatra, herself, practiced on Antony in her frolicsome mood, when she ordered her divers to put a salted fish on his hook, whereat he pulled with vehement agitation.

> Thus she was used to take delight with her fair hand
> To angle in the Nile.

PISCINE LORE AND LUXURY.

I have made a pilgrimage to the tomb of Izaak Walton in Winchester Cathedral, and have made my homage to that "grand old man" and rare old fisher. I found that his remains were under a large black slab, in a chapel in the south aisle called Prior Silkstead's Chapel. It was evening when I endeavored to decipher the poetic tribute to the ancient angler—"crowned with eternal bliss."

The cheerfulness of his disposition and the serenity of his mind gave to him ninety years of felicity, in the midst of great and good and yet sportive scholars and churchmen. I honor him as well for his pen as for his hook and line; as well for his grace of diction and his genial muse as for his many-colored flies; and, above all, for that lesson of equipoise which he teaches in his rambles after his favorite recreation. He teaches the contemplative as well as the sportive quality of the art.

But if any one should think that the literature of fishing began with Izaak Walton let him read classic lore. It is as full of the details as it is of the fun and poetry of fishing. Arion rides upon a dolphin as easily as the bold Viking darts out of the Norse *fjords* in his war *jægt*. But neither the classic nor the romantic past has any history or fancy equal to the reality of our deep-sea fishing, or to our artificial reproduction from the *ova*. It is said by a clever writer on this theme, that the luxurious Romans achieved great wonders in the art of fish-breeding, that they were able to perform curious experiments with the piscine inhabitants of their aquariums, and that they were well versed in the arts of acclimatization. This writer alleges—that "the value of a Roman gentleman's fish-pond in the palmy days of

Italian banqueting, was represented by an enormous sum of money. The stock kept up by Lucullus was never valued at a sum less than £35,000! These classic lovers of good things had pet breeds of fish, as gentlemen in the present day have pet breeds of sheep or horned cattle. Lucullus, for instance—to have such a valuable stock—must have been in possession of unique varieties derived from curious crosses. Red mullet and fat carp, which sold for large prices, were not at all unusual. We can ascertain that £60 were given for a single mullet, and more than three times this sum for a single dish of that fish. Enormous sums of money were lavished in the buying, rearing, and taming of the mullet; so much, indeed, that some of those who devoted their time and money to this purpose, were satirized as "mullet millionaires." These old Romans are the archetypes of our cod-fish aristocracy. Social life repeats itself.

ICHTHYOLOGICAL MYTHOLOGY.

How fancy has sported with the fishes! Strange stories about sea-monsters fill the pages of ancient lore and modern fish-gossip. These stories culminate in the mysterious kraken, the apochryphal sea-serpent, and the real octopus. These narratives of sea-monsters are not surprising when we think of such oddities of the sea as the cuttle-fish and other armed brigands of the deep. The inhabitants of the sea are, perhaps, more curious, if not more numerous, than those upon the land. Our deep-sea dredging is bringing to the surface and light such *outre* forms of marine life as to make the prehistoric monsters respectable in fashion and form.

The heavens in their remote and strange phases declare the glory of the marine life. Are not the four principal constellations called after the marines? Does not the zodiac connect astronomy with sea-monsters? In one of the tractates of the London Exhibition, Mr. Phil Robinson thus revels in the imagery of sea-things as translated to the sky:

What antiquities, then, they are, these sea-myths of our stellar hemispheres! Tumbling in open space, the happy Dolphin, belted with stars, the gift of grateful Olympus; the luminous sea-lizard; Cetus, the shaggy whale, spangled from twinkling snout to twinkling tail,

that, but for the strong, bright-fronted Ram that intervenes, seems agape to swallow the suppliant Andromeda; Hydra, dripping stars as it goes, and trailing its gem-lit convolutions across the hemispheres; the Flying-fish, feathered and beaked, darting its brief flight from the pole of the southern ecliptic; the Austral-fish, with radiant eyes uplifted to the grateful flood that the Waterer forever pours upon it; the Sword-fish, cleaving its bright way to encounter in the ocean of the firmament its hereditary foe; the Tortoise, that in its starry concave holds the lyre whence Mercury first struck the music of the spheres.

And, above all, the fishes of the zodiac,

> "The double Pisces, from their shining scale,
> Spread wat'ry influence and incline to sail."

foster the sailor-spirit in men and teach navigators to be boldly self-reliant, preside over sea-fights, and are the patrons of fishermen.

But the children born under the sign are, by a poetical extension of the Venus tradition, hot-blooded, given to jealousies and strife; for the tradition is that "when the skies grew weak and the giants strove, and snaky typhon shook the throne of Jove," Venus fled the tumultuous scene, and hiding herself in the Euphrates as a fish, inspired the scaly tribes with new passions, "and with the ocean mixt her fire." So, too, the Southern fish claims Aphrodite's favor, for the legend says that it saved her daughter from drowning in the Lake Boethe; and yet another claims for it that it is the progenitor of all the fishes in the firmament. Next "glowing" Cancer,

> "As close in 's shell he lies, affords his aid
> To greedy merchants and inclines to trade."

But over births his influence is hardly more auspicious than the Fishes', though in omen it is happy—

> "The dream's good;
> The Crab is in conjunction with the sun."

These whimsies of astrology still keep their places in our astronomies. They show how the unknown has ever been regarded as the supernatural or marvellous.

From gems taken from the heads of fishes, rare wonders were worked by the Magi. Helen won suitors by a jewel out of the belly of a fish. Amphitrite rode about at her own sweet will in a sea-shell. And a thousand other figments indicate that in the twilight of history the unknown above the earth was in strange association with the marvels beneath the sea. As the gentle Elia says:

Gorgons, and Hydras, and Chimeras dire—stories of Celæno and the Harpies—may reproduce themselves in the brain of superstition, but they were there before. They are the transcripts, types—the archetypes are in us and eternal.

> ——Names, whose sense we see not,
> Fray us with things that be not.

Lamb's fancy ran strong on marine spectra:

Methought I was upon the ocean billows at some sea-nuptials, riding and mounting high with the customary train—of tritons and nereids gamboling around—sounding their conchs before me, and jollily we went careering over the main, till just where Ino Leucothea should have greeted me with a white embrace.

IMMENSITY OF THE NUMBERS OF FISH.

Figures of speech and arithmetic fail to show the immensity of the numbers which the sea gives us of its finny life. Juvenal said that the sea was over-fished. This may have been true of the Lavinian shores, as it is of some of our rivers, like the Potomac, when swept with destructive nets. But Juvenal had not seen or heard of the banks of Newfoundland and their opulence of fish, nor of the Lofoden Isles with their mountains of piscatorial wealth. The teeming Arctics were unknown to the Roman conquerors of the world. Could Juvenal have heard Professor Huxley dilate on the cod mountains—one hundred and twenty to one hundred and eighty feet in vertical thickness, in and around those waters, or the stroms of Norway which affrighted our youthful fancy, he would have modified his own poetic idea as to over-fishing the sea.

THE CENSUS OF THE SEA.

A shoal of codfish one mile in superficial extent contains 120,000,000 fish! Yet not more than half of that number of codfish are taken in one year on the coast of Norway. The cod lives on herring, hence such a shoal will eat 840,000,000 herring in a week! The idea that sea-fisheries are being overworked is almost a joke, when we remember what science reveals. Science tells us that our fixed fisheries contain only five per cent. of the fish of the sea.

Nor is this swarming of marine life a marvel, when we know

how fish yield their eggs by millions. The queen bee, it is said, has her 50,000 eggs a season. But the fecundity of fish might as well be expressed by some algebraic formula as this—$x \times y = \infty$ —. Bertram in his "Harvest of the Sea," say that he counted the separate eggs in the roes of some of our fish. He counted exactly 7,000,000 eggs in a sturgeon. In codfish he gives 3,400,000; in flounders, 1,250,000; in soles, 1,000,000; and in mackerel, 500,000.

We cannot too much admire the nice accuracy of scientific scrutiny and enumeration. Let us take a glance at these strictly accurate figures. We will estimate the value of herring—in the raw state—at one dollar a hundred. We have to pay at retail in the markets five or six cents each for the manufactured (smoked) article. At a dollar a hundred, a little school of codfish of the area of Rhode Island consumes, in one year, herring to the value of $473,928,000,000! Gentlemen can see at a glance that the annual appropriations made by the sub-marine directors of schools, must exceed this sum many thousand times for the codfish establishment alone! What has Congress done that is in any degree comparable with this encouragement of fish-culture? We call ourselves a wealthy nation; yet we spend less than $80,000,000 a year for our schools—while one little codfish school costs for its support every year, nearly thirty times the assessed valuation of all our real and personal property! But I will not mortify you with any more humiliating calculations. Let these give you some incentive towards the important work of fish-culture.

Where do the fish go? Comparatively few of them reach our tables as food. They have the delight of eating each other. The smaller pass their time in guarding against being eaten by the larger fish. If one-half survived there would be no need of restoring our shipping—navigation would cease.

FISH AS ICHTHYOPHAGI.

This reminds me that fish are cannibals, as my motto indicates. Fish prey on fish, and live fish like live fish; so that we need have no compunction when preying on them.

Professor Rice, of the New York Commission, has designated

the kind of fish on which different fish feed. Some are select, like the striped bass; others omniverous, like the bluefish; and all are enormous feeders. Eight alewives of three-quarters of a pound each, were found in a sixty-six pound striped bass! Forty mullets were found in a thirty-pounder! I have seen in the *fjords* above the Arctic Circle, in the swift tide-currents, endless flocks of birds, ready to devour the fish that congregate to destroy other fish. Sharks, porpoises, and other fish of prey know when and where to find the weak "Innocents Abroad."

SPORTIVE ELEMENT.

No Bergh has yet appeared to prohibit the fish in their gambols after other fish, or to enjoin men from gamboling after them. Indeed, a part of the sport of fishing consists in decoying the wriggling beauties upon the hook. In the North Sea they double the sport, for they have hook so shaped as to catch a small fish, whose wriggling and struggling attracts the larger fish. It is said that the first admirer of our American beauty, the traditionary husband of the original Mrs. John Smith—*nee* Pocahontas—who settled the earliest English colony on this continent, often fished in the waters of this District; and that he assisted greatly to develop the fishing industry of the rivers round about Jamestown. He fished along our sea-shore as far up as Maine, and gave to his occupation its useful and delightful harmony when he said:

> And is it not pretty sport, to hale up two pence, six pence, and twelve pence as fast as you can hale and veare a line?

The sportive element which comes out of the same game of chance, with which statesmen of former days pursued horse-racing or poker, gives to its uncertainty and luckiness to the toiler of the sea the charm with which no other laborious pursuit attracts. Is it not a sort of gratification to watch the unwary fish, to entrap and entice him, not merely by studying his habits and migrations, the weather influences, and the nature of the ground, but by copying the qualities of the fish, its courage, vigor, velocity, and cunning? Thus the sportsman may render

his pursuit exciting. With nicest skill and judgment he "tackles" the subtle salmon and the wary trout, whose pluck makes the sport so gameful and the flesh so toothsome.

THE GENTLE ART.

I have had some experience in fishing. May I be pardoned if I refer to the fact that I have fished under the shadows of our Sierras in Tahoe, lake and stream; that I have followed the mountain rivulet Restonica in Corsica, where the waters blanch the bowlders into dazzling whiteness, and the associations of the vendetta and the Bonapartes give a ruddy tinge to the adventure; that I have caught the cod in the Arctic around Cape Nord, under the majestic light of the midnight sun; that I have angled in the clear running Malaren Saltsjön, which circulates healthfully amid the splendid islets of stately Stockholm; that I have flecked the waters of the Bosphorus, in sight of the historic Euxine and the marble palaces and mosques of two continents; that I have been tossed in shallops along with the jolly fishers of the Bay of Biscay; that I have sauntered near the pillars of Iskanderoon which were erected by a grateful Mediterranean people on the spot where Jonah was thrown ashore by the whale; but where'er I wandered, whether I cast my line—

> —— under hanging mountains,
> Or by the fall of fountains,

my thoughts have always bounded o'er the main to ride the league-long rollers on the shores of New Jersey along with my favorite life-savers—to see and feel "the bluefish wriggling on the hooks." But, notwithstanding these widespread endeavors, I am not prepared to say there has been any perceptible diminution of the quantity of fishes in the waters of our planet!

ADVANCEMENT IN FISHING.

Marine fishing, from small beginnings in upon the rock-bound coast made its way down to the Chesapeake and James river, where the mollusk helped to swell the gains of our ancestors of eight generations ago. The ventures for cod, mackerel and

whale carried the pioneers of this trade far out upon the banks of Newfoundland, and into the waters around Nantucket.

But it was not until after our civil war that the fisheries began to grow with steady increment. Professor Goode estimates the value of our products now at more than $100,000,000. Our Census bulletins amplify and specify, by States and localities, the products of our fisheries. They show the capital invested in 1880 to be $37,955,349; and the number of persons employed at 131,426. For the variety of this and kindred industries I refer to the table prepared by Professor Goode, which I shall append to my remarks. Its figures are more significant for our legislative action than any ancient, classic or hallowed relations which the curiosities of profane or sacred literature may furnish.

NEW INVENTIONS.

Beyond all the dreams of poetry, the fables of mythology, or the enthusiasm of such dreamers as Izaak Walton, has been the progress of our fishing industry under the advanced conditions and inventions of our time.

It was a great step when Jacquard made his famous net. It astounded the dullards of the age, and made him for a time a demi-god among the astonished fishermen of France and England. But it was only a step compared with the strides now being made by the improved, and less expensive apparatus invented to capture, preserve, and transport fish. Our newly fashioned trawling nets, recently on exhibition in South Kensington, are marvels. Our unrivalled fishing-schooner, with its special advantages, captured the admiring thousands who gazed on her model in the British exhibition. The steam-vessels rigged for the whale fishing; the purse-seine and its machinery; the new and deadly explosive harpoon and bomb lance for the monsters of the deep and the deeps below the depths, which our scientific plummets are sounding—all these new modes of force, thus harnessed by mechanism, have received incentive, inspiration, and aid from the efforts of voluntary and State associations, as well as from home and foreign exhibitions under Federal patronage and appropriations.

MARVELS OF TRANSPORTATION.

We may not indulge in the dainties of the Roman epicure who displayed his many hued beauties alive to his guests, before cooking and serving; but for abundant food and plucky game, for marvellous breeding and wonderful distribution, no devices compare with those of our own time and country. By new modes of transit, frozen mullet are brought from New Zealand to be sold in old England, and live carp are sent in tanks over car-wheels from Washington to Dakota and Texas. Under the name of Kennebec salmon, large quantities of salmon from rivers of the Pacific slope are being sold at this moment in New York, and even by dealers in Washington markets. The little blue-back (*Oncorhynchus nerka*) and the quinnat (*Oncorhynchus chovicha*) are now sold in this city at the price of 50 cents per pound. These are brought in refrigerator cars from the Columbia river, Oregon, and are in such a good state of preservation as to pass readily for Maine salmon.

By telegraph to-day, we learn that a car-load of 20,000 salmon from the Dalles, Oregon, is *en route* for New York, and is to arrive in eight days. This is what may be called the fruit of an enterprise by means of water frozen and water vaporized,—ice and steam,—for the preservation and transportation of this rarest of fish, fresh from the grand river of our Pacific coast.

OTHER ELEMENTS OF ADVANCEMENT.

The demand for fish-food has been greatly increased by the enhancement in the minds of people of fish as a healthful diet, by the extension of railroads in our country, and by the utilization of ice in transportation and of cans for preservation. I need not refer to the manufactories for oil and guano, now grown into a great business on the Long Island and New England coasts. Even the skin of the fish taken is made into glue and isinglass, and has resulted in a large and valuable trade.

RANGE OF THE INTERESTS.

From Cape Hatteras to the Gulf of Saint Lawrence, where mackerel and menhaden are taken; from North Carolina to

Massachusetts, where the oyster and other mollusks abound; about the keys of Florida, where the red snapper is caught in abundance; from the fur-seal fishery of Alaska to the North Pacific, which our whalers penetrate; from the waters where rolls the Oregon that once heard no sound save its own dashing, but now hears the hum of men engaged in a great industry, to the great lakes, where white-fish play around the isles made memorable by Perry's victory; from one end of our land to the other, over one hundred thousand of hardy men pursue this interesting and adventurous industry. A million souls depend upon the pursuit. Their fleet is nearly 7,000 vessels and 45,000 boats. We may signal from this Capitol and District to these toilers of the sea our interest in their avocation, and elevate and protect it without detracting from or burdening other interests. Here there can be no "over-production."

POPULAR AND SCIENTIFIC NOMENCLATURE.

I sometimes wonder whether we would not popularize the interest in this industry more, if we could only interpret to the people the remarkable names of the fishes we catch and consume. The dead Latinity of their nomenclature is more terrific than some of the monsters of the deep of which poetry and fable are full. I hold in my hand a treatise by Professor Goode and Mr. Bean. It is a part of the proceedings of the United States National Museum. It says that in a paper on the fishes of Nova Scotia and Labrador, Mr. R. H. Storer described a species under the name of *Platessa rostrata.* "This species," it is said, "has been a puzzle to ichthyologists." Dr. Gunther, in 1862, ventured to remark that it appears to be allied to the *Pleuronectes rostrata.* Professor Gill, in 1861, referred it to his nominal genus *Myzopsetta*, and in 1864 to *Limanda.* All of which is quite puzzling to those who are not ichthyologists; but the classification appears clear when we find out that the fish thus clad in this bewildering Latinity is—a flounder! But it is none the less a delight to know that when one is tasting the luscious shad at this, its season, that it is of the *Anadromous* kind, of the herring family, known as *Clupea sapidississima;* or that we may alternate

our worship in Martha's Vineyard in midsummer with a quahaug bake of the *Venus mercenaria!* That's a clam! [Laughter.] What a joy to know, when meandering around Tom's river, in New Jersey, that we can perceive the backward movement and shadow in the water of the *Callenictes hastatus.* That's a crab! [Laughter.]

Perhaps this refinement in terminology is the rebound from the peculiar patois of the fishmonger from earliest times. In Greece and Rome, later in Italy and Spain, the fishermen or fish dealers—especially mongers of the gentler sex—were noted for their uncontrollable vivacity of tongue. Billingsgate has survived the demolition of other famous gateways into London It is to-day an illustration of a business that runs up to £120,000 and is growing beyond precedent. How picturesque is the description given of this famed locality:

If without the trouble of taking a long journey we desire to witness the results of the British fisheries, we have only to repair to Billingsgate to find this particular industry brought to a focus. At that piscatorial bourse we can see in the early morning the produce of our most distant seas brought to our greatest seat of population, sure of finding a ready and profitable market. The aldermanic turbot, the tempting sole, the gigantic codfish, the valuable salmon, the cheap sprat, and the universal herring, are all to be found during their different seasons in great plenty at Billingsgate; and in the lower depths of the market buildings countless qnantities of shell-fish of all kinds, stored in immense tubs, may be seen; while away in the adjacent lanes there are to be found gigantic boilers erected for the purpose of crab and lobster boiling. Some of the shops in the neighborhood have always on hand large stocks of all kinds of dried fish which are carried away in great wagons to the railway stations for country distribution. About four o'clock on a summer morning this grand piscatorial mart may be seen in its full excitement—the auctioneers bawling, the porters rushing madly about, the hawkers also rushing madly about seeking persons to join them in buying a lot, and so to divide their speculation; and all over is sprinkled the dripping sea-water, and all around we feel that "ancient and fish-like smell," which is the concomitant of such a place.

There has ever been a deal of satire against the frugal and hard-worked fish-wives; not merely those who congregate in Billingsgate, but in all fisherland, and in every market where

grotesque repartee, "shapely shanks," and dulcet voices are at a premium. We know how the humorous sally of Daniel O'Connell silenced the furious fish-hawker of Dublin. He called her a "parallelopipedon," a regular solid, a prism, whose base was a parallelogram! She succumbed before his transcendent power of vituperation. Had he been compelled to go through the ordeal of a whole fish market as I have seen it in France, where all—

> Were mad to speak, with none to hearken,—
> They set the very dogs to barking,

he would have prayed for the extension and advancement of a scientific nomenclature, rather than endure a jargon of Babel and Bedlam combined.

A NEW CLASSIFICATION.

It would seem a safe remark for a layman in this fishing business, to say that fish live in water. But when I meet with the fact that a species is found in Ceylon that lives in the earth or exists in mud, not to mention others that fly in the air and perch on trees, it will be confessed that a classification under the head of water-animals is less scientific and certain than under that of vertebrate. Perhaps I may say that fish are the only animals, except the rhetorical man, whose breathing apparatus requires to be kept moist by fluid saturation!

REASONS FOR LEGISLATION.

We find in Bertram's "Harvest of the Sea" this very pertinent question: "Why should not an acre of water become as productive as an acre of land?" If this is suggestive for Europe, how much more suggestive as applicable to our own country! The answer given on this point with reference to France, Germany, and England is—that fish-culture in those countries is essentially practical, hence, it is not much wonder that in France it has been taken under the protecting wing of the State.

But I forgot that I am speaking on a mere motion of thanks. Besides, I yesterday had occasion to speak at length in Congress in favor of Professor Baird's bill for the preservation of

the shad and herring of the Potomac. We carried it handsomely.

I have already spoken too long. I meant merely to refer to what my friend has stated so eloquently, and to make the motion which has already been made. I cannot, however, cease without referring to one matter, which is, that in our legislative action in Congress in connection with fishing and fish-culture, we have not been behind other nations, or rather legislative bodies. It is pleasing to know that we have furnished all the appropriations necessary to enable us to meet the nations of the world, both at Berlin and at London. I believe such appropriations should continue to be made. They will enable us to solve, as no other nation can, the problem which you fish-culturists are trying to solve here, and which France, Germany and England are now solving. With scientific applications to the multiplication of fishes, we shall always, with the aid of liberal appropriations from Federal and State governments, not only be able to increase our food supply, but also to meet the nations of the world in happy rivalry and successful competition. I will say in conclusion: All honor to men engaged in this work! All honor to the Congressmen who can elucidate its value to the satisfaction of the people. All honor to the men, nay to this chief of men, Professor Spencer F. Baird, who received the grand medal from the Emperor of Germany at Berlin, as the greatest of all living fish-culturists. All honor to Professor George Brown Goode and his associates at Berlin and London, who bore away the highest prizes given in Germany and England. I want these honors to come while they are full of life, faith and hope, and can enjoy them. They are worthy of the commendation of Professor Huxley, who said that Professor Baird, Professor Goode and his associates, by their energy, patience, and scientific research, have made the world more and more comfortable for mankind. By their exertions they have advanced into high favor, the doctrine of applying science to human ends. I, therefore, ask you, Mr. President, to put the question of thanks to Professor Lyman for his very able address. I wish I could add to it that emphatic sentiment of the people,

who in their homes all through the land gratefully commend the efforts of the United States Fish Commission.

The PRESIDENT of the meeting proposed a vote of thanks to Hon. Theodore Lyman, for his eloquent and instructive address.

HON. JAMES B. GROOME, referring to Hon. S. S. Cox's statement that Ohio had originated and New York perfected fish-culture, remarked: "I beg to say also that Ohio produced and New York perfected the model Congressman." [Applause.]

The CHAIRMAN proposed a vote of thanks to Hon. S. S. Cox, which was carried unanimously.

The meeting then adjourned to meet next day.

NOTES PERTAINING TO FISH-CULTURE.

BY JAMES ANNIN, JR.

Gentlemen and Members of the American Fish-Cultural Association:

It is with keen regret that I find at the last moment that I shall be unable to attend this, the thirteenth annual meeting, especially after such care and pains had been taken by the committees in charge to make it of great interest and profit. Business prevents my preparing an extended or elaborate paper, and I but briefly call your attention to one or two subjects.

The California, or rainbow trout, are they a success in waters of the Atlantic coast? In one stream in which they were planted some five or six years ago I consider that they are not. I have reference to Caledonia Spring Creek, Caledonia, Livingston County, N. Y. This stream has contained them longer than any others east of the Mississippi river, but to-day you can catch no more, and no larger ones than you could the second or third year after the first plant was made. Where have they gone? I

have not answered it satisfactorily to myself yet. They could not have been all caught out as the stream is preserved. From observations the writer thinks that many have gone down, finding their way into the Genesee river and Lake Ontario, just as the California salmon did several years ago; they have gone as suddenly as the salmon. Stories are afloat of large ones being caught miles below. As the spawning season approaches they also run up stream just as far as they possibly can, and as the stream is generally at its best at this season they cannot get back unless they do so before the water subsides. I have often found them in water holes that had no connection with the stream except during high water and where they would die in a short time. I heard of one found in a man's garden this spring that was nearly a mile away from the stream, the fish had gone up there in a little stream that was formed by melted snow and rain, and which run dry in a week. Brook trout generally find their way back and don't get stranded. You would suppose that the natural increase would keep the stock up in a preserved stream, but it does not in this case, and here I would call your attention to the fact that at the best not more than 50 or 60 per cent. of the many rainbow trout eggs taken at the hatcheries at Caledonia can be impregnated. There is no such percentage of empty eggs of others of the trout family that are handled here.

During the past winter I made an experiment with eggs taken from a fine healthy brook trout, impregnated by a number of good males of the same. First, I took 350 of her eggs, placed the milt with them and then washing it off as quickly as possible, and forty-five seconds after taking the eggs placed them on the screens in the hatching trough. Next, I took 350 more eggs from the same fish and let them stand three minutes before washing off the milt. Next, the remainder of the eggs the fish contained, 335 in number, I let remain in the spawning pan the usual length of time—about thirty minutes. The three lots I carefully placed on trays, picking out the bad ones every day, until they were old enough to plainly show the eye spots, when I counted what I had left of each of them:

First, which had an exposure of forty-five seconds, only 6 were impregnated.

Of the second, with exposure of three minutes, 31 were impregnated.

Of the last, thirty minutes exposed, 208 remained that were good.

This is only the result in the case of one fish, but if it should prove the same in all, is it any wonder that fish-culture is a grand success?

FISH AND FISHING AT POINT BARROW, ARCTIC ALASKA.

BY JOHN MURDOCH.

I have been spending the last two years among the Esquimaux of Northwestern Alaska, and it has occurred to me that a short account of the fishes that they use for food, and the methods they employ in capturing them, might be of interest to the Fish-Cultural Association.

Point Barrow, as you probably all know, is the northwestern extremity of the Continent of North America, the place where the coast line, after running nearly northeast from Behring's Strait, turns and runs in a direction a little south of east toward the Mackenzie river and the northwest passage. The point itself is a long, narrow sandspit, continuing the northeast direction of the coast line for five miles, and then bending to the east-southeast, running on for some three miles more, thus enclosing a sheet of water known as Elson bay. Just at the elbow of the point is a little knoll of land somewhat higher than the rest, and this is occupied by an Esquimaux village. There is another village about eleven miles down the coast to the southwest. The inhabitants of these two villages together number about three hundred men, women and children. Fish forms an important article of their diet, which consists, I may say, entirely of animal

substances, and occasionally becomes their chief dependence. East of Point Barrow, and the nearest about fifty miles off, are three large rivers running into the Arctic Ocean, and to these the Esquimaux resort for the purpose of catching the white-fish and burbot with which they abound.

Early in October, as soon as the rivers are well frozen and enough snow has fallen to make sliding practicable, a number of families start out from both villages, with all their hunting and fishing gear, and proceed to these rivers, where they camp in tents, or build snow huts when they can find snow enough, and remain till the daylight gets too short for hunting, which is about the middle of November. Those of the men who are well supplied with ammunition devote themselves to hunting reindeer, while the others and the women attend to the fishing. The white-fish are caught in gill nets made of reindeer sinew, which are set through holes in the ice and allowed to remain, being visited from time to time and the fish removed.

Three species of white-fish are caught; a small species belonging to the same group as the lake herring, which has been described by Dr. Bean with the name of *Coregonus laurettæ*, the large *Coregonus kennicotti*, found also in the Yukon, and another large species, also found in the Yukon, which Dr. Bean considers to be undiscribed, and which he proposes to call *Coregonus nelsonii*. The burbot, or *titta lu*, as the Esquimaux call it, is the ordinary species *Lota maculosa*, common to all our Northern waters, and is caught with hook and line, though one will occasionally try to swallow a small white-fish which is entangled in the gill net and become "meshed" himself in the attempt.

They use a large bone squid, about four or five inches long, having either a barbless hook of iron or copper, of their own manufacture, or a good-sized cod hook, bought from some whaleship. The bait is a large piece of white-fish, with the skin and scales left on, which is carefully wrapped and sewed around the squid, much in the same way as fishermen on our own coast make an eelskin drail for bluefish. With this they fish through a hole in the ice and take a good many fish. They consume a good many fish, of course, on the spot, but the rest are carefully stored away in a little house built of slabs of ice, and at that

season of the year immediately frozen solid. When they are ready to leave camp they break up this mass of frozen fish into lumps of a size convenient to load on their dog sleds, and bring them back to the village in this condition.

The season of no sun and short daylight is passed at the village. This lasts till about the end of January, and then many families again resort to the rivers, and stay, living in snow huts always at this season of the year, till the first or middle of April. Fish do not appear to be quite so plenty at this season as in the autumn, but they still catch a good many. In the meantime those who have remained at home have not been without a supply of fish food. There is a small species of codfish, the Polar cod (*Boreogadus saida*), which appears along the coast in large schools about the end of January, or when the sun again begins to rise. We were unable to find out whether the fish really leaves the coast to return in January, but at all events the Esquimaux do not fish for them until then, and say there are none to be found. They would be likely to fish for them were any to be caught, because just at this season of the year they are apt to be pinched for food, as no deer are to be had, and if the ice happens to be unfavorable seals are very scarce.

Wherever there is a level field of this season's ice inclosed by lines of hummocks, the fish are sure to be plenty. Such a field as this, about half a mile long, practically afforded a living to most of the people in the village during the season of 1883, because that year the ice was very unfavorable for sealing, and food was pretty scarce in the village.

The fishing is carried on mostly by the women and children, though one or two old men generally go out, and one or two of the younger men, when they cannot go sealing and food is wanted at the house, will join the fishing party. Each fisherman is provided with a long-handled icepick, which he frequently leaves sticking in the snow near the fishing ground, a long line made of strips of whalebone, reeled lengthwise on a slender wooden shuttle about eighteen inches long and provided with a copper sinker and two pear-shaped "jigs" of walrus ivory armed with four barbless hooks of copper, and a scoop or dipper made of reindeer antler, with a wooden handle about two feet long.

Hardly an Esquimaux, and especially no Esquimaux boy, stirs out of the house in the winter without one of these scoops in his hand. To every party of two or three there will also be a good-sized bag of seal-skin, generally made of a piece of an old kayak cover, for bringing home the fish. Arriving at the fishing grounds, each proceeds to pick a hole through the ice, which is about four feet thick, clearing out the chips with the scoop. The "jigs" are then let down through the hole and enough line unreeled to keep them just clear of the bottom where the fish are playing about. The reel is held in the right hand and serves as a short rod, while the scoop is held in the left hand and used to keep the hole clear of the scum new of ice which, of course, is constantly forming. The line is kept in constant motion, jerked up quickly a short distance and then allowed to drop back, so that the little fish that are nosing about the white "jigs" after the manner of codfish, are hooked about the jaw or in the belly.

As soon as a fisherman feels a fish on his hook he catches up a bight of the line with his scoop and another below this with his reel, and thus reels up the line on these two sticks in loose coils till the fish is brought to the surface, when a skillful toss throws him off the barbless hook on the ice, where he gives one convulsive flap and instantly freezes solid. The elastic whalebone line is thrown off the sticks without tangling, and paid out through the hole again for another trial. If fish are not found plenty at the first hole the fisherman shifts his ground until he "strikes a school." They are sometimes so plenty that they may be caught as fast as they can be hauled up. One woman will frequently bring in upward of a bushel of the little fish—they are generally about five or six inches long—from a single day's fishing. This fishing lasts until about the middle of May, when the ice begins to soften. A good many are also caught along the shore in November in about a foot of water when there are tide cracks in the ice. At this season the Esquimaux use a little rod about two feet long with a short line and a little ivory squid at which the fish bite.

During the summer, many of the natives are encamped in tents at a place called Perginak, just at the bend of Elson bay,

and after the ice leaves the bay, gill nets are kept constantly set, and visited from time to time. In these they catch whitefish chiefly, *Coregonus laurettæ*, a few salmon, *Oncorhynchus gorbuscha*, and another undetermined species, and occasionally large individuals of a sea-run form of *Salvelinus malma*, the Pacific red-spotted trout.

This fishing lasts from the middle or end of July into September, but is never very productive. The trading parties that go east to the Colville river in the summer, also catch large quantities of fish. *Salvelinus malma* was so abundant in the summer of 1882, that the dogs were fed with it.

Another food fish appeared on the coast in the summer of 1882, which appears not to be utilized by the natives as they have not nets small enough to catch it. This is the caplin, *Mallotus villosus*, which we netted by the thousand in the outlet of the lagoon close to the station, and found most excellent eating. The natives who live on the river running into Wainwright's inlet, seventy miles down the coast, also catch through the ice a good many smelts, *Osmerus dentex*, which are as delicious as the smelt of our coast. Fish, when cooked at all, are always boiled; as, indeed, all Esquimaux food is, but many are consumed raw or frozen. Very little of a fish is wasted except the scales and perhaps the larger bones.

To close my account of the fish of this region, it may be well to say that the Esquimaux tell of a large lake between Point Barrow and the Colville, in which there are fish "as big as a kaiak." This certainly has the appearance of a "fish story."

COMPARATIVE EXCELLENCE OF FOOD FISHES.

BY DR. JAMES A. HENSHALL.

In this paper I design considering the relative merits of certain fishes as food, solely as to their comparative excellence of flavor, and not, in any sense, as to their nutritive qualities, as

commercial fishes, or as food for the masses. The inherent or innate excellence of flavor is alone considered; that is, the fish is supposed to be simply boiled, fried, broiled or baked, without the addition of extraneous substances, as sauces, condiments, etc., except the indispensable salt and perhaps a little black pepper. Moreover, I speak in the light of the ample personal experience of having eaten of all the fishes mentioned, from Montauk Point to Key West, and from Lake Superior to the Gulf of Mexico, and, with the sole exception of the salmon, of having eaten of them all perfectly fresh, or literally out of the water into the kettle, broiler or frying pan, which is the only true test of the peculiar flavor of each fish. Of course one is necessarily guided in such a matter by his own individual tastes and idiosyncracies, and due allowance must be made for this "personal equation," though I believe that most persons will agree with the conclusions drawn. But there is no accounting for gastronomic tastes likes and dislikes, which proverbially disagree, as evidenced by the old saying, "What is one man's meat is another man's poison," or to express it more appropriately in this connection, and to perpetrate an old Anglo-Gallic-ichthyc pun: What is one man's *poisson* is another man's poison. For the sake of convenience I will separate the different fishes into several groups: (1) fresh water, (2) anadromous, (3) estuary, and (4) marine. The various fishes in the several groups are arranged in their sequence according to their degree of merit.

FRESH-WATER FISHES.

The white-fish (*Coregonus clupeiformis*) is far ahead of all other fresh-water fishes in its exquisite delicacy and richness of flavor. Its flesh is pure white, firm, flaky and free from small bones; and while a "fat" fish, does not cloy the palate like the salmon, mackerel, and other "oily" fishes. But to realize the delicious savor and flavor of the white-fish, it is imperative that it be in its best condition, and that it be cooked as soon as possible after being taken from the water; for when in poor condition, or long out of the water, it loses entirely its characteristic excellence. The white-fish is essentially a broiler, being excessively fat in the fall before spawning, when it is in its best condition. Those

of Lake Superior and the Straits of Mącinac are preferable to those of other waters of the United States. I have eaten broiled white-fish at the old Mission House, at Mackinac, for twenty-one meals a week and like Oliver Twist, asked for more. It resembles, more than any other fish, the pompano in flavor, and in my opinion is second only to that peerless fish in its excellence for the table.

The brook trout (*Salvelinus fontinalis*), when freshly caught, I consider, among the fresh-water fishes, next to the white-fish for the table; but as obtained at the restaurants, I prefer the black bass or pike-perch. When served up in camp beside a trout stream (the small ones fried, the large ones boiled), the flesh is pinkish, very firm, and of a delicate, delicious flavor, though rather too dry to suit some palates. It is a fish that will not bear transportation, however carefully packed, without losing its savor; and this is likewise true of all delicately-flavored fishes. Moreover, it will retain and absorb the "twang," and smack of the packing material or the container.

The black bass (*Micropterus*).—Next to the freshly caught and cooked brook trout, I rank the black bass of either species. Its flesh is pure white, firm, flaky, free from small bones and of a rich, sapid flavor when in proper condition. Just after the spawning period the flesh has a musky taste and odor, which is disagreeable to some persons. The character of the water has much to do with the excellence of the black bass for the table, and as it inhabits so many waters of different conditions of purity and temperature, there are as many opinions of its gustatory qualities. The small-mouthed bass is generally the best flavored, as it usually exists in the purest waters; but where both species co-exist in the same water there is no apparent difference in taste or flavor. I have eaten small-mouthed bass of some waters which were inferior to large-mouthed bass of others. Contrary to a popular impression, I will state that the finest-flavored black bass I ever ate, and even superior to any brook trout I ever tasted, were large-mouthed bass of certain streams in Florida, notably the upper waters of St. Lucie river, on the east coast, and the Weckawachee river, on the west coast. These are re-

markably clear and pure waters. Black bass should be fried or boiled, according to size.

The pike-perch (*Stizostedium vitreum*) is a staple fish during the early spring throughout the West, being shipped from the great lakes. It bears transportation well, the flesh being hard, white, flaky, and of good flavor; consequently it is much esteemed during the Lenten season. It is a very desirable fish for lakes and rivers which have a good depth of water, being very hardy and prolific, and one of the best percoid fishes. The smaller ones should be fried, those of six pounds and over should be boiled.

The mascalonge (*Esox nobilior*) may be classed as a good dinner fish in the fall and winter, when it is in its best condition; it has, however, been much overrated. It has yellowish or pinkish flesh, according to season, which is of good quality and fair flavor, with fewer small bones than any of the pike family. It is never a "fat" fish, and should be either boiled or cut in vertical slices and fried.

The Mackinaw trout (*Salvelinus namaycush*) varies greatly according to size, season and locality, as to its edible qualities. In the great lakes, where it is taken with the white-fish, it is lightly esteemed in comparison. In other waters, as in the lakes of the Eastern States, it is more highly prized. The flesh is yellowish white to red in different waters, and may be classed as rather good and well-flavored when in its best condition. In good condition it is a very fat or oily fish, and should be boiled or cut into vertical steaks and broiled.

Catfish (*Siluridæ*). The various species of catfish and bullheads are good, bad, and indifferent as articles of food. Some of them are really excellent when properly cooked, and would prove an agreeable surprise to most persons who are prejudiced against them. The fork-tailed cat of the lakes and the Mississippi (*A. nigricans*), and the channel cat (*I. punctatus*), when of suitable size, and when parboiled and baked brown, are not to be despised by an epicure, the flesh being rich and savory, though not very firm.

There are a number of fresh-water "pan fish," fair in quality, which I consider best in the order named, as white bass (*R.*

chrysops), croppies (*Pomoxys*), rock bass (*A. rupestris*), the sunfish (*Lepomis*), yellow perch (*P. americana*), etc. Last and least in point of merit among fresh-water fishes (and which are just better than "no fish") are the pike, pickerel, buffalo, suckers, etc.

ANADROMOUS FISHES.

The salmon (*Salmo salar*) stands at the head of this group when "fresh run" from the sea. Its excellence is so well known that it needs no further notice here, more than to observe that after spawning no fish is more sorry or ill-flavored. The comparative excellence or worthlessness of anadromous fishes, before or after the breeding season, is more strikingly exhibited in the salmon than any other of the group.

The shad (*Clupea sapidissima*). Of the anadromous fishes, none is so well known or so much appreciated as the shad, whose rich, delicate and luscious flavor is pronounced by many to be superior to that of any other fish. Suffice it to say that he who has never partaken of that Lenten luxury, "planked shad," has an epicurean revelation in store that will surprise and delight him. The shad should never be served in any other way than planked or boiled. It well merits its name, *sapidissima*, and one can tolerate its numerous bones in consideration of its fine flavor.

ESTUARY FISHES.

This group comprises so many species, and of so wide a range, and some vary so much in edible qualities in different waters, that it is difficult to institute a just comparison.

The pompano (*Trachynotus carolinus*). Although a fish of Southern waters, the excellence of the pompano for the table places it at the head, not only of the estuary fishes, but of all known members of the finny tribe. It is incomparable with any other. While in the restaurants of New Orleans and Mobile it is the fish beyond compare, it is worth a trip to Southern Florida to realize the delectable, luscious savor of a freshly caught and broiled pompano. The salmon, white-fish, and shad alike pale before its superexcellence. A broiled pompano's head is a *bonne-bouche* to eat and dream of for a life-time. See Rome and die,

eat pompano and live! The pompano has a creamy white flesh, of a gelatinous richness, without the oily taste of most broiling fishes. It must not be confounded with the dark-meated fish called pompano on the Carolina coast, which is a crevalle (*Caranx*). The bones of the pompano are few and soft, and one can eat them "bones and all."

The striped bass (*Roccus saxatilis*) enjoys a deserved reputation as a table fish. Its firm, white and delicious flesh is so well known that it needs no further comment. The memory of its savory flavor and odor, broiled at camp fires on the Chesapeake, steals over me as I write, with a conscious yearning for the flesh-pots of Egypt.

The sheepshead (*Diplodus probatocephalus*), while excellent in Northern waters is only tolerable in those of the extreme South. North of Cape Hatteras it is justly considered a great delicacy, broiled or baked; while in Florida it is not above mediocrity, having a piquant, pungent flavor that is decidedly unpleasant.

The bluefish (*Pomatomus saltatrix*) is another fish that varies in its eatable qualities in different waters, and which, perhaps, depends on the nature of its food. North of Cape Hatteras, it is well-flavored, of good quality and much esteemed, though inclined to be too oily; while in Florida waters it is excellent, far exceeding in richness and flavor those of the North. Its flesh is firm and white, and it should always be boiled or planked.

The whiting (*Menticirrus nebulosus*) is a small, but good fish, one of the best for chowders. It has a fine, white, flaky flesh of rich flavor, and is much esteemed as a breakfast fish, broiled or fried.

The weakfish (*Cynoscion regale*) is worthless, unless absolutely fresh, when it is peculiarly sweet and gelatinous, fried or boiled. The Southern species, the salt-water trout (*C. maculatum*), is equally as good a fish for the table.

The red snapper (*Lutjanus blackfordii*) has become a popular hotel and restaurant fish throughout the South and West, where it is shipped from the Gulf of Mexico. It is also extensively shipped to Havana. Being of large size it is a good dinner fish,

its flesh being rather coarse, but very white, firm, flaky, juicy, and of good flavor. It should be either boiled or baked.

The tautog (*Hiatula onitis*) has fine white flesh, and broiled or or fried is quite toothsome, with a rich lobster flavor. It does not lose its good qualities when out of water, so soon as most fishes.

The redfish (*Sciæna ocellata*) is essentially a Southern fish, though during the summer it ranges as far north as Cape Cod, when it is in its best condition. It grows to a large size, with firm white flesh, of no decided flavor. It is a tolerable dinner fish, and should always be boiled. It is also a fair chowder fish.

Crevallé (*Caranx*). There are several species of crevallé, the *C. hippos* being the most common in Southern waters. They are dark-meated fishes, firm and flaky, with a sharp, strong flavor (similar to the bonito), which is relished by some but disliked by others. It is an oily fish and should always be broiled. It is easily cured by smoking, when it forms an appetizing dish, far better when fresh, and superior, I think, to smoked halibut. There are quite a number of good estuary "pan-fish," among the best being the Lafayette (*L. xanthurus*) and white perch (*R. americanus*.

MARINE FISHES.

The Spanish mackerel (*Scomberomorus maculatus*) stands at the head and front of the pelagic or marine fishes. It is second as a table luxury only to the pompano and white-fish. It is a creamy, white-meated fish of great delicacy and richness of flavor when broiled. By many it is thought to be the best fish that swims.

The common mackerel (*S. scombrus*), when fresh and fat, as in the early fall, is one of the best fishes for broiling. As a breakfast fish it is greatly and justly prized, and is too well known to need further notice here.

The codfish (*Gadus callarias*). I mention the codfish out of respect and sympathy for my fellow man, and not for any love that I bear for it myself. It is, perhaps, only necessary to say that at the last annual meeting of your Association, your worthy

recording secretary declared that he preferred a fresh codfish to the brook trout or black bass.*

WEDNESDAY, MAY 14TH.

At half-past ten the President called the Association to order, and announced that the election of officers would take place at the afternoon session. The following Committee on Nominations was then appointed to propose officers for the ensuing year: Messrs. G. Brown Goode, R. E. Earll, C. A. Kingsbury, C. G. Atkins, and Tarleton H. Bean. The President further stated that all names proposed for membership in the Association would be voted upon during the afternoon session.

Mr. BLACKFORD: I beg to state that there is one name which I feel that we should add to the list of honorary members, viz.: Professor Spencer F. Baird. I think that this action would be no more than a fitting appreciation of his great work, and I therefore name Professor Spencer F. Baird as an honorary member of this Association.

The PRESIDENT: Professor Baird is nominated as an honorary member of this Association. All those in favor say "Aye." (There being no dissenting voices, the nomination was carried.)

The RECORDING SECRETARY: Mr. President, I have received a telegram from Mr. W. F. Witcher, formerly Commissioner of Canada, in which he expresses his inability to attend this meeting, on account of family sickness. I have here many letters from members and others who regret their inability to be present. To read them all would consume the morning. I would, however, ask your attention to three of them. The first is from the father of American fish-culture, who writes:

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*Being a prominent member of the Ichthyophagus Club, any statement of his regarding the flavor of fishes should be be received with due caution, inasmuch as by virtue of the onerous duties of his office—"head taster"—his sense of taste has presumably become perverted or impaired.

BEDFORD, Ohio, April 25th, 1884.

DEAR SIR:—I am in receipt of the announcement for the Washington meeting of the American Fish-Cultural Association to be held in May. My health is such that it is impossible for me to be there. I feel as much interest as ever in this important industry.

What a great debt our country and the world owe to Prof. Spencer F. Baird for what he has accomplished in promoting this industry.

I have no paper to be read on that subject at the meeting. I would be glad however if a correction is made in the report of the proceedings of the meeting of 1881. On page 42, under the head of Fish-Culture in America, it is stated that my experiments were made in 1853, and that I read a paper before the Cleveland Academy of Natural Sciences, detailing my experiments, February 14th, 1854, which is correct. But it is further stated in the report, that my paper was not printed until 1857, which is incorrect, and does me great injustice, as it gives Dr. Bachman four years of priority of publication (or record). My paper was published the month and year that it was read before the Academy, in the "Annals of Science," edited by Prof. Hamilton Smith.

I am writing, or trying to write, lying on my lounge, and fear you will find some difficulty in reading my letter.

Hoping you may have an interesting meeting, I am, dear sir, very truly yours,

T. GARLICK.

P. S.—The first edition of my book on Fish-Culture was run through the *Ohio Farmer* in 1857. Prof. Ackley, my partner in the practice of surgery, never wrote nor published a line on the subject of Fish-Culture.

The next letter comes from across the water, and asks that our notices of meetings be issued earlier. It is as follows:

BERGEN-OP-ZOOM, 9th of May, 1884.

To the American Fish-Cultural Association:

Mr. CHAIRMAN:—Marshall McDonald's letter came yesterday to hand, not leaving a ghost of a chance to get a hearing for what I might have to say in the meeting, either by mouth or by paper.

Please send in future communications for meeting, if possible, sooner, to this side of the great fish-pond, to give us time to prepare if we have something to say.

I remain, dear sir, yours truly,

C. J. BOTTEMANNE,

Government Inspector of Fisheries, Netherlands.

The third relates to the lobster question. It says:

BOSTON, April 25th, 1884.

DEAR SIR:—I would say in reply to the circular received this morning that I regret that I shall be unable to attend the meeting of the American Fish-Cultural Association, which promises to be so interesting and instructive. And I earnestly hope the matter in which I am particularly interested (the best method for the preservation of lobsters), may be discussed and bring out the views of those familiar with fish-culture and protection in its broadest meaning, for I am confident of its importance as compared with other branches of fish-culture, and protection and its intelligent consideration will in the end be of great benefit to the people, for whose good the efforts of this Association are directed. With best wishes for a successful and profitable meeting, I remain,

Yours respectfully,

S. M. JOHNSON.

The President then declared the reading of papers to be in order.

THE SHELL FISHERIES OF CONNECTICUT.

BY DR. WILLIAM M. HUDSON.

Before beginning to read my paper I think it is fair to state that, in view of the papers in regard to the special matter of the propagation of oysters, etc., which we shall have from experts, I have thought it best to confine myself entirely to the relations existing between the State of Connecticut and the shell fisheries of that State, especially the oyster.

The especial object of this essay will be to consider the relations existing between the State of Connecticut and the public and private oyster beds in Long Island Sound, within the boundaries of the State. Until 1855, all the oyster grounds of the State were treated as common land, open to every one, and no one having any exclusive right to any portion of them. In 1855, the legislature enacted a law providing for the appointment of committees in towns adjoining the shore, who should have the right, for a given consideration, to designate and allot to private indi-

viduals, plots of ground not exceeding two acres in extent, for the sole purpose of cultivating oysters. Numerous applications were made to these committees, and many acres of ground, mostly in the shallow waters of the bays and coves, were designated for this purpose. The State then passed laws recognizing the right of property in these lots, and punishing depredators and thieves for stealing from them. The business of raising oysters gradually increased in magnitude, new laws were enacted for the regulation of the industry, and finally some of the more adventurous of the cultivators conceived the idea that oysters might be successfully raised in deeper water than had yet been tried. Their efforts were successful and a new impetus was given to the business. An interesting account of the industry up to and including 1880, may be found in the article contributed by Mr. Ernest Ingersoll to the tenth census of the United States. During all these years a dispute had existed between the States of New York and Connecticut in reference to the respective boundaries of the two States in Long Island Sound, and also as to that of Connecticut on the west end, and New York on the east; in the former case New York claiming to low water mark on the northern shore of Long Island Sound, and in the latter about 2,600 acres more than Connecticut was willing to concede. Commissioners were appointed by the two States to take the matter into consideration, and after due consultation they reported in favor of Connecticut conceding the 2,600 acres in dispute on her western boundary to New York, and New York giving to Connecticut about one-half of Long Island Sound, the line running practically through the center. An act carrying out the recommendation of the commissioners was passed by the legislatures of New York and Connecticut, and finally approved by Congress, February 26th, 1881, and the new boundary was finally fixed.

On the 14th of April, 1881, the legislature of Connecticut passed an Act Establishing a State Commission for the Designation of Oyster Grounds, a copy of which is here inserted:

CHAPTER CLX.

An Act Establishing a State Commission for the Designation of Oyster Grounds.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. The State shall exercise exclusive jurisdiction and control over all shell-fisheries which are located in that area of the State which is within that part of Long Island Sound and its tributaries bounded westerly and southerly by the State of New York, easterly by the State of Rhode Island, and northerly by a line following the coasts of the State at high water, which shall cross all its bays, rivers, creeks, and inlets at such places nearest Long Island Sound as are within and between points on opposite shores from one of which objects and what is done on the opposite shore can be reasonably discerned with the naked eye, or could be discerned but for intervening islands. And all shell-fisheries not within said area shall be and remain within the jurisdiction and control of the towns in which they are located, under the same laws and regulations and through the same selectmen and oyster committees as heretofore. If a difference shall arise between any town and the commissioners as hereinafter provided for, as to the boundary line between said town and the area so to be mapped, said town, by its selectmen, may bring its petition to the Superior Court for the county within which said town is situated, to determine said boundary line, and said court upon reasonable notice to the parties shall hear said petition and appoint a committee to ascertain the facts in such case and report the same to said court, and said court shall thereupon make such order as may be proper in the premises.

SEC. 2. The three fish commissioners of the State now in office, and their successors, shall also be and constitute a board of commissioners of shell-fisheries, and be empowered to make or cause to be made a survey and map of all the grounds within the said area in Long Island Sound which have been or may be designated for the planting or cultivation of shell-fish; shall ascertain the ownership thereof, and how much of the same is actually in use for said purposes; they shall also cause a survey of all the natural oyster beds in said area, and shall locate and delineate the same on said map, which survey and map when completed shall not cost a sum exceeding twenty-five hundred dollars, and shall report to the next session of the legislature a plan for an equitable taxation of the property in said fisheries, and make an an-

nual report of the state and condition of said fisheries to the legislature, and the said commissioners shall be empowered to appoint and employ a clerk of and for said board, and they shall each give a bond to the State with sufficient surety for the faithful performance of their duties, and for the payment to the State treasurer of all money that may come into their hands under this act in the sum of two thousand dollars.

SEC. 3. The said commissioners shall also be empowered, in the name and in behalf of the State, to grant by written instruments, for the purpose of planting and cultivating shell-fish, perpetual franchises in such undesignated grounds within said area as are not and for ten years have not been natural clam or oyster beds, whenever application in writing is made to them through their clerk by any person or persons who have resided in the State not less than one year next preceding the date of said application. The said application and the said grant shall be in manner and form as shall be approved by the chief justice of the State, and all such grants may be assigned to any person or persons who are or have been residents of the State for not less than one year next preceding such assignment, by a written assignment, in manner and form approved by said chief justice; and the said commissioners shall keep books of record and record all such grants and assignments therein, and the same shall also be recorded in the town clerk's office in the town bounded on Long Island Sound within the meridian boundary lines of which said grounds are located.

SEC. 4. When any such application is filed with the clerk of said commissioners, he shall note on the same the date of its reception and shall cause a written notice, stating the name and residence of the applicant, the date of filing the application, the location, area, and description of the grounds applied for, to be posted in the office of the town clerk of the town bounded on the said Long Island Sound within the meridian boundary lines of which said grounds are located, where such notice shall remain posted for twenty days. Any person or persons objecting to the granting of the grounds applied for, as aforesaid, may file a written notice with the town clerk, stating the grounds of his or their objections, upon the payment to said town clerk of the sum of twenty-five cents, and at the end of said twenty days the said town clerk shall forward all such written objections to the clerk of said commission; and in case such objections are so filed and forwarded the said commissioners, or a majority, shall upon ten days' notice in writing, mailed or personally delivered to all the parties in interest, hear and pass upon such objections at the town in which such grounds are located as aforesaid, and if such objections are not sustained and

the area of ground is not, in the opinion of the commissioners, of unreasonable extent, they may for the actual costs of surveying and mapping of such grounds, and the further consideration of one dollar per acre, paid to the said commissioners to be by them paid over to the treasurer of the State, grant a perpetual franchise for the planting and cultivating shell-fish in such ground or in any part of the same in the manner aforesaid, and where no such objections are made such grants may be made for the considerations hereinbefore named. At all hearings authorized by this act the said commissioners may, by themselves or their clerk, subpœna witnesses and administer oaths as in courts of law.

SEC. 5. The said commissioners shall, previous to the delivery of any instrument conveying the right to plant or cultivate shell-fish on any of said grounds, make or cause to be made a survey of the same, and shall locate and delineate the same, or cause it to be located and delineated upon the map aforesaid, and upon receipt of said instrument of conveyance the grantee shall at once cause the grounds therein conveyed to be plainly marked out by stakes, buoys, ranges, or monuments, which stakes and buoys shall be continued by the said grantee and his legal representatives, and the right to use and occupy said grounds for said purposes shall be and remain in said grantee and his legal representatives; *provided*, that if the grantee or holder of said grounds does not actually use and occupy the same for the purposes named, in good faith, within five years after the time of receiving such grant, the said commissioners shall petition the Superior Court of the county having jurisdiction over the said grounds to appoint a committee to inquire and report to said court as to the use and occupancy of such grounds in good faith, and said court shall in such case appoint such committee, who, after twelve days' notice to the petitioners and respondents, shall hear such petition and report the facts thereon to said court, and if it shall appear that said grounds are not used and occupied in good faith for the purpose of planting or cultivating shell-fish, the said court may order that said grounds revert to the State, and that all stakes and buoys marking the same be removed, the costs in said petition to be paid at the discretion of the court.

SEC. 6. When, after the occupancy and cultivation of any grounds designated as aforesaid by the grantee or his legal representatives, it shall appear to said commissioners that said grounds are not suited for the planting or cultivation of oysters, said grantee, upon receiving a certificate to that effect from said commissioners, may surrender the same or any part thereof, not less than one hundred acres, to the State, by an instrument of release of all his rights and title thereto, and shall

on delivery of such instrument to the said commissioners receive their certificate of said release of said grounds, the location and number of acres described therein, which shall be filed with the State treasurer, who shall pay to the holder the sum of one dollar for every acre of ground described in said release, where said sum has been paid therefor to the State. And the said release shall be recorded by the said commissioners in their record books, and in the town clerk's office in the town adjacent to and within the meridian boundary lines of which said grounds are located. For all purposes relating to judicial proceedings in criminal matters, the jurisdiction of justices of the peace of the several towns bordering on Long Island Sound shall extend southerly by lines running due south by true meridian from the southern termini of the boundary lines between said towns to the boundary line between the States of Connecticut and New York.

SEC. 7. Said commissioners shall provide, in addition to the general map of said grounds, sectional maps, comprising all grounds located within the meridian boundary lines of the several towns on the shores of the State, which maps shall be lodged in the town clerk's office of the said respective towns, and said commissioners shall also provide and lodge with said town clerks blank applications for such grounds and record-books for recording conveyances of the same, and all conveyances of such grounds and assignments, reversion, and releases of the same shall be recorded in the books of said commissioners, and in the town clerks' offices of the towns adjacent to and within the meridian boundary of which said grounds are located, in such books as are provided by said commissioners, subject to legal fees for such recording, and the cost of all such maps, blank books, surveys, and all other expenses necessary for the carrying out the provisions of this act, shall be audited by the comptroller and paid for by the treasurer of the State, and the said commissioners shall each receive for their services five dollars per day for the time they are actually employed, as provided for in this act; their accounts for such service to be audited by the comptroller and paid by the treasurer of the State.

SEC. 8. All designations and transfers of oyster, clam, or mussel grounds within the waters of Long Island Sound heretofore made (except designations made of natural oyster, clam, or mussel beds), are hereby validated and confirmed.

SEC. 9. All the provisions of the statutes of this State relating to the planting, cultivating, working, and protecting shell-fisheries upon grounds heretofore designated under said laws, except as provided for in section eight of this act and as are inconsistent with this act, are

hereby continued and made applicable to such designations as may be made under the provisions of this act.

SEC. 10. When it shall be shown to the satisfaction of the said commissioners that any natural oyster or clam bed has been designated by them to any person or persons, the said commissioners shall petition the Superior Court of the county having jurisdiction over the said grounds to appoint a committee to inquire and report to the said court the facts as to such grounds, and the said court shall in such case appoint such committee, who after twelve days' notice to the petitioners and respondents shall hear such petition and report the facts thereon to said court; and if it shall appear that any natural oyster or clam beds, or any part thereof, have been so designated, the said court may order that said grounds may revert to the State, after a reasonable time for the claimant of the same to remove any shell-fish he may have planted or cultivated thereon in good faith, and said court may further order that all stakes and buoys marking the same be removed, the costs in said petition to be taxed at the discretion of the court.

SEC. 11. Any commissioner who shall knowingly grant to any person or persons a franchise as hereinbefore provided in any natural oyster or clam bed, shall be subject to a fine of not less than one hundred dollars nor more than five hundred dollars, and if such franchise is granted the grant shall be void, and all moneys paid thereon shall be forfeited to the State; and the said commissioners shall in no case grant to any person or persons a right to plant or cultivate shell-fish which shall interfere with any established right of fishing, and if any such grant is made the same shall be void.

SEC. 12. The Superior Court of New Haven county, on the application of the selectmen of the town of Orange, and the Superior Court of any county, on the application of the oyster-ground committee of any town in said county, shall appoint a committee of three disinterested persons of the town within the boundaries of which any natural oyster, clam, or mussel beds exist, to ascertain, locate, and describe by proper boundaries, all the natural oyster, clam, or mussel beds within the boundaries of such town. Said committee so appointed shall first give three weeks' notice, by advertising in a newspaper published in or nearest to said town, the time and place of their first meeting for such purpose; they shall hear parties who appear before them, and may take evidence from such other sources as they may in their discretion deem proper, and they shall make written designations by ranges, bounds, and areas of all the natural oyster, clam, and mussel beds within the boundaries of the town they are appointed for, and shall make a report of their doings to the Superior Court, and such re-

port, when made to and accepted by said court, and recorded in the records thereof, shall be a final and conclusive determination of the extent, boundaries, and location of such natural beds at the date of such report. It shall be the duty of the clerk of the court to transmit to the town clerk of each of said towns a certified copy of said report so accepted and recorded, in relation to the beds of such town, which shall be recorded by said town clerk in the book kept by him for the record of applications, designations, and conveyance of designated grounds. Such public notice of said application to the Superior Court, and of the time and place of the return of the same, shall be given by said selectmen or oyster-ground committee as any judge of the Superior Court may order. It shall be the duty of the selectmen of the town of Orange, and of the oyster committees of other towns, upon a written request so to do, signed by twenty electors of their respective towns, to make such application to the Superior Court within thirty days after receiving a copy of such written request, and said applications shall be privileged and shall be heard and disposed of at the term of said court to which said application is returned, in preference to other causes. All expenses properly incurred by such selectmen and oyster-ground committees in said applications, and the doings thereunder, and the fees of said committees so appointed by court, shall be taxed by the clerk of said court and paid by the State upon his order. Any designation of ground for the planting or cultivation of shell-fish, within the areas so established by such report of said committee, shall be void.

SEC. 13. The selectmen of the town of Orange and the committees of other towns shall, at the expense of their respective towns, procure and cause to be lodged and kept in the office of the town clerk of each town respectively, accurate maps showing the boundary lines of their said towns in the navigable waters of the State, and all designations of ground for the cultivation of shell-fish heretofore made and that shall hereafter be made within such boundaries, and shall number said designations on said maps, and shall cause to be designated on said maps all natural oyster, clam and mussel beds lying within their several towns respectively, as the same shall be ascertained by said report of said committee recorded in said towns as hereinbefore provided.

SEC. 14. All acts and parts of acts inconsistent herewith are hereby repealed, but this act shall not affect any suit now pending.

Approved April 14th, 1881.

It will be important to recollect hereafter that while this act

was approved April 14th, 1881, yet by a general act of the same legislature, it did not take effect until May 1st, 1881, and as there was on the part of a portion of the oystermen a bitter opposition to the new commission, a grand scramble commenced to secure from the town committees all the good grounds possible, before the act should take effect. In this way, about 40,000 acres were designated by town committees before May 1st, and as this was necessarily done in the most hurried manner, great confusion arose as to the titles of many of the designations. The newly appointed commissioners immediately established an office in the city of New Haven, secured a clerk, and soon after an engineer, who, with his two assistants does all the surveying required by the commission. The first work of the commission was to establish the line known as the eye-sight line, which is demanded by the first section of the act, and which extends from headland to headland along the whole shore of the State. All the ground lying north of this line remains as formerly in the jurisdiction of the towns, and all south of it to the New York line is under State jurisdiction. The line as established with one or two amendments in certain localities, was ratified and confirmed by the legislature April 26th, 1882.

Section 3 of the act authorized the commissioners, in behalf of the State, to grant perpetual franchises for the planting and cultivation of shell-fish, in any undesignated grounds within the jurisdiction of the State, which were not and had not for ten years been natural clam or oyster beds, to any person who had lived in the State one year next preceding the date of application. The application and grant were required to be in a form approved by the chief justice of the State, and all grants were to be recorded in books kept for the purpose. Notices of applications were to be sent to the town clerk of the town within the meridian lines of which the grounds were located, and if after twenty days' posting, no objections were made, the application was returned to the office, and the commissioners for $1.10 per acre granted a deed to the applicant. If, on the other hand, objections were made, the party objecting paid to the town clerk twenty-five cents, filed his written objections, and, at the end of twenty days, the application and objections were returned to

the commissioners, who then gave all parties interested ten days' notice of a hearing in the matter. If the objections were sustained nothing further was done, but if not the grant was made as before.

By section 5, the commissioners are required to have all designations mapped and surveyed, and the grantee is required to have the ground at once plainly marked out by "stakes, buoys, ranges or monuments." The same section provides that if the grantee does not use and occupy the grounds for the cultivation of oysters within five years, the commissioners shall apply to the Superior Court to appoint a committee to examine and report, and if said committee after twelve days' notice to petitioners and respondents, on a hearing of the case, finds that the grounds have not been used in good faith for the purpose of cultivating or planting shell-fish, the court may order that said grounds revert to the State, and that all stakes, and buoys marking the same be removed, the costs in said petition to be paid at the discretion of the court. On the other hand, section 6 provides that if after occupancy and cultivation of any gounds designated, it shall appear that said grounds are not suited for the planting or cultivation of oysters, the grantee, upon receiving a certificate to that effect from the commissioners, may surrender to the State the same or any part thereof, not less than one hundred acres, and receive one dollar for each acre from the treasurer.

Section 8 provides that all designations and transfers of oyster, clam or mussel grounds within the waters of Long Island Sound heretofore made (except designations made of natural oyster, clam, or mussel beds) are hereby validated and confirmed. It is under the authority of this section that so many designations were made by town committees between April 14th and May 1st, 1881.

Section 10 provides that if the commissioners unintentionally designate a natural clam or oyster bed, they shall apply to the Superior Court of the county having jurisdiction over said grounds to appoint a committee of investigation, and if said committee find that any natural oyster bed has been so designated, the court may order said grounds to revert to the State,

after the claimant has had a reasonable time to remove any shell-fish he may have planted or cultivated thereon in good faith.

Section 11 provides that, "Any commissioner who shall knowingly grant to any person a franchise in a natural clam or oyster bed, shall be subject to a fine of not less than one hundred nor more than five hundred dollars, the grant shall be void, and all moneys paid thereon shall be forfeited to the State." Section 2 provides that the commissioners shall make or cause to be made a survey and map of all the grounds within the jurisdiction of the State in Long Island Sound, which have been or may be designated for the planting or cultivation of shell-fish, and also cause a survey of all the natural oyster beds in said area, and shall locate and delineate the same on a map. The same section provides that the commissioners shall report to the next session of the legislature a plan for an equitable taxation of the property in said fisheries, make an annual report and give a bond for the faithful performance of their duties. One of the first things to be done under the law was to designate the natural oyster beds of the State, and after long and patient hearings and consultation with the oystermen, all of the natural oyster beds have been mapped, except one about which there has been much litigation, and as one question in reference to its location is now in the hands of the Supreme Court of the State for decision, the mapping has been delayed until this question shall be decided. Eight in all have been described to the satisfaction of everyone, and they comprise 5,498 acres. Surveying and mapping the designations made by the town committees has been exceedingly difficult, caused by the fact that in many cases the survey was done hurriedly, and in many more by incompetent persons who seem never to have pretended to do more than guess at the work. The consequence is that frequently a person has a deed described in words, an accompanying map of the ground, and is in occupation of a plot of ground which corresponds with neither; the map and description also being found utterly irreconcilable. Now as his next neighbor is in a similar predicament, and the ground has become valuable, it is easy to see that ill feeling and prolonged litigation are almost inevitable.

In order to meet this difficulty the legislature April 26th, 1882,

enacted a law relating to disputes about boundaries, which is here inserted:

CHAPTER CXXIV.

An Act Pertaining to Shell Fishery Grounds within the Exclusive Jurisdiction of the State.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. All questions and disputes touching the ownership, titles, buoys, boundaries, ranges, extent, or location of any shell fishery grounds within the exclusive jurisdiction of the State may be referred to and settled by the Commissioners of Shell Fisheries, who are hereby empowered, on petition of any person interested therein, to summon all the parties in interest, so far as such parties may be made known to them, to appear before them at a time and place in the summons named, such summons to be signed by the clerk of said commissioners, and served by him or such other person as the commissioners may direct; whereupon, at such time and place named, or any other time and place to which the hearing may from time to time be adjourned, the party petitioner shall file a sworn statement of the facts as claimed by him, to which any interested party may respond by filing a sworn counter statement of the facts as claimed by him; and after hearing all the parties interested with their witnesses and counsel, the commissioners shall make their decision in writing as soon as convenient thereafter, which decision shall be recorded in the books of record in their office, and the same shall be binding on all the parties in interest so summoned or appearing, unless an appeal shall be taken from such decision to the Superior Court in and for the county where the town is situated, between whose meridian lines any portion of said grounds may be, within ten days after such decision shall be filed by said commissioners with their clerk aforesaid, and unless such appeal shall be prosecuted to judgment, and said decision reversed by said Superior Court. Said appeal may be taken in the same manner as appeals in civil cases from justice courts.

SEC. 2. Every person filing a petition, statement, or counter statement, as in the foregoing section provided, shall, at the time of such filing, deposit ten dollars with the Commissioners of Shell Fisheries, who shall return to the prevailing party the sum so deposited by him, and shall retain the money so deposited by the defeated party as a forfeit to pay the expenses of the investigation, which money so retained shall be accounted for and paid to the State treasurer for the benefit of the State.

SEC. 3. All applications, designations, papers and maps pertaining to any allotment or designations of shell fishery grounds within the area of the exclusive jurisdiction of the State, heretofore made by town officers, and all assignments of such grounds or of parts thereof which have not been recorded in the office of the town clerk or of the shell-fish commissioners, shall be left by the owner or owners, claimant or claimants thereof for record, and shall be recorded in the office of the shell-fish commissioners, or in the office of the town clerk of the town between whose meridian lines said grounds or any part thereof are situated, and they shall be so left within three months after a copy of this section shall be posted in the town clerk's office of the town where such grounds are situated; and upon failure to leave such evidences of title within such time, for record, the Commissioners of Shell Fisheries may order the alleged owner or owners, claimant or claimants, to appear before them at a time and place in such order named and show cause why said grounds should not be deemed as property of the State; and if such parties or any of them fail to appear as ordered, or, on appearing, shall refuse to produce any evidences of the title which they may have or claim to have, or shall refuse to permit the same to be recorded, or if they shall fail to produce any evidence of title, or shall fail to show any reason for such failure to produce the same, the grounds shall be treated, as against such alleged owner or owners, claimant or claimants, as undesignated grounds belonging to the State, and said commissioners may thereupon designate the same or any part thereof as provided by statute.

SEC. 4. The same fees shall be paid for recording or copying papers and maps in the office of the Commissioners of Shell Fisheries as are charged by town clerks for like services; and all fees so paid shall be accounted for and paid to the treasurer of the State for the benefit of the State; and one of said commissioners, or their clerk, shall have power to sign and issue subpœnas in all matters of inquiry before them.

SEC. 5. Sections one and two of chapter seventy of the Public Acts of 1879, are hereby repealed, so far as they may apply to shell-fish grounds within the exclusive jurisdiction of the State; and section three of said chapter is hereby amended, so far as it applies to such grounds, so as to read as follows, viz.: When any designation of shell-fish grounds which are wholly or partially within the exclusive jurisdiction of the State, contains therein a map thereof, or refers therein to such map lodged on file in the town clerk's office, and the owner or owners of the adjoining grounds, so far as they lie within the exclusive jurisdiction of the State, do not agree as to the location of the

line fixed by such map, or if the boundary between such owners is a town boundary and they disagree as to the same, one or more of such owners may apply to the Commissioners of Shell Fisheries who shall thereupon notify all parties in interest to file sworn statements of facts and copies of maps as claimed by them respectively, and said commissioners shall thereupon appoint a surveyor who shall take such maps and statements and lay out and survey the grounds in the various ways claimed, and if any town boundary comes into question he shall ascertain and report upon such boundary as it appears from the maps and records in the custody of the respective town clerks of such towns. Thereupon he shall report his doings, accompanied with the maps or copies of maps found by him touching the dispute to the dispute to the Commissioners of Fisheries, who shall thereupon summon all parties in interest before them at a time and place to be named in the summons, and after a full hearing of said parties, with their witnesses and counsel, the commissioners shall establish the line in dispute, and cause the same to be located and marked by ranges and buoys; and the line so established shall be the true dividing line between such grounds, unless an appeal is taken to the Superior Court, as provided for in section two of this act, and said decision shall be there reversed; and the costs and expenses of such proceedings shall be equally divided between the adjoining owners, who shall pay the same to the commissioners upon the filing of their decision, and the same shall be accounted for and paid to the State treasurer for the benefit of the State; and the cases provided for by this section shall not be deemed included under section one of this act.

SEC. 6. All expenses necessarily incurred in carrying out the provisions of this act shall be audited by the comptroller, and paid by the treasurer of the State.

SEC. 7. All acts and parts of acts inconsistent with the provisions of this act are hereby repealed.

SEC. 8. This act shall take effect from its passage.

Approved April 26th, 1882.

This act provides that all questions and disputes touching the ownership, titles, buoys, boundaries, ranges, extent or location of any shell fishery grounds within the exclusive jurisdiction of the State, may be referred to and settled by the commissioners upon the petition of any person interested therein, after due hearing of all persons interested, and their decision shall be final, unless an appeal be taken to the Superior Court of the county, within ten days after the decision has been filed with

the clerk, and said decision be reversed by the court. Practically the law has been very successful in its operations. Parties in dispute have generally agreed to submit their differences to the commissioners for adjustment, all persons interested have been summoned to appear, the facts have been investigated and patiently considered in all their aspects, and in every case thus far tried the parties concerned have submitted to the decision of the commissioners. A plan of taxation was also recommended in accordance with the requirements of the original law, and the result was the passage of an act providing for the taxation of oyster grounds, a copy of which is here inserted.

CHAPTER CXXV.

An Act providing for the Taxation of Oyster Grounds.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. All owners of shell-fish grounds lying within the exclusive jurisdiction of the State shall, on or before the first day of November, annually, deliver to the Commissioners of Shell Fisheries a statement under oath specifying the number of lots owned by them, the location and number of acres in each lot, the number of acres in each lot cultivated, and the value thereof per acre, the number of acres in each lot uncultivated, and the value thereof per acre; and printed blanks for such statements shall be prepared by the commissioners and furnished to such owners upon application to them or at their office; and upon the failure of any owner to deliver such sworn statement to said commissioners at their office within the time above specified, said commissioners shall make up such statement from the best information they may obtain, and shall add for such default ten per cent. to the valuation so made.

SEC. 2. All statements or delivered so made shall be alphabetically arranged, and said commissioners shall equalize, if necessary, and determine the value of all the property so returned and described in said statements, which property shall be liable to taxation at the valuation so determined, including the ten per cent. for defauft as aforesaid; and said commissioners are authorized and empowered to declare and lay a tax thereon, annually, at the rate of one per cent. upon such valuation, which shall be payable at the office of said commissioners on and after the first Monday in May, annually; and said tax shall be a lien upon the grounds so taxed from the time it is so laid by

said commissioners, until paid, and shall be in lieu of all other taxes on said grounds.

SEC. 3. If any tax so laid shall not be paid on or before the first Monday in July, the said commissioners shall make and issue their warrant for the collection thereof, with interest thereon, at one per cent. per month from the day such tax became due and payable until paid, together with the expenses of such collection, which warrant shall authorize any reputable person named therein, to seize such grounds and any oysters or other shell-fish thereon. or any other property of the owner or owners thereof not exempt from execution, and to sell the same, or so much thereof as he may find necessary, at such time and place, and in such manner, and by such person as said commissioners may direct, whereupon such sale shall be so made, and such warrant shall be immediately returned to said commissioners by such person with all his doings endorsed thereon, and he shall pay over to said commissioners the money received upon said sale, and they shall apply the same to the payment of such tax and all the expenses thereon, including the expenses of such sale, returning any balance that may remain to such owner or owners; and all moneys received by said commissioners in payment of taxes and interest thereon shall be accounted for and paid to the State treasurer for the benefit of the State, within thirty days from its receipt. Said commissioners shall each, in addition to the bond now required by law, give a bond with surety in the sum of one thousand dollars to the State, conditioned for the performance of the duties imposed upon them by this act.

SEC. 4. All other shell-fish grounds lying within the waters of this State shall be taxed in the same manner in all respects as real estate in the several towns within the meridian lines of which such shell-fish grounds are situated, and no other tax or rental shall be laid or collected on said grounds, or the franchise of any person therein.

SEC. 5. All expenses necessarily incurred in carrying out the provisions of this act shall be audited by the comptroller and paid by the treasurer of the State.

Approved, April 26, 1882.

It provides that all owners of shell-fish grounds shall on or before the first day of November, annually, deliver to the commissioners a sworn statement of their property, the number of acres cultivated, the number uncultivated, and their estimate of the value of each. In case of a failure to make a statement, the commissioners are empowered to make one from the best infor-

mation they can obtain, and add ten per cent. for the default. The commissioners are authorized to "equalize if necessary, and determine the value of all the property so returned and described," and to lay a tax of one per cent. thereon, and said tax is a lien upon the grounds so taxed from the time it is so laid by the commissioners until paid. If the tax is not paid by the first day of July, the commissioners are required to make and issue their warrant for the collection thereof, with interest at one per cent. per month from the time the tax became due until paid. The commissioners are further empowered to enforce such warrant by the seizure of any taxable property which the party in default may own.

Under this law the commissioners collected in 1883, $3,681.47, the entire tax laid. Of course there are difficulties in estimating the value of oyster grounds, and the commissioners were obliged in many cases to equalize and determine the value of the grounds returned. The general plan of valuation adopted was the following. The commissioners assumed that the very all best grounds should be assessed at a given figure, and then were graded with reference to their proportionate value compared with the best. This subject is one requiring careful consideration, and the system may doubtless be improved by further experience. As no appeal can be taken from the assessment of the commissioners, they have themselves acted as a board of relief for the present year. In other words, after the valuations of the grounds had been fixed according the best information obtainable by the commissioners, appointments were made of certain days on which they would be present with the lists at each of the principal towns along the shore, and listen to any parties who might wish to present reasons why the assessment of their grounds should be reduced. This proved to be a very popular move, and when the assessment was finally fixed, the only person seriously dissatisfied with the result was the one owning the largest acreage of oyster grounds in the State. The oystermen of this State are divided into two principal classes, namely, those who own and cultivate grounds of their own, and those who gain a subsistence by work upon the natural or public beds. The former are generally men of some means, and work with steam-

ers, the latter are poor men, who use sailing vessels. The public beds have been raked so constantly for a number of years that very few large oysters can be found upon them. Most of the "stuff" as it is called, taken from them is used for the planting of other beds more or less remote.

A few years ago a serious controversy arose as to the effect of steamer work upon the natural beds. The steamer owners claimed that their work tended to improve the bed by preparing the bottom for a better set of the spat in the breeding season. The owners of sailing vessels on the contrary claimed that the heavy dredges of the steamers plowed up the ground to such an extent as to ruin it. The result of the discussion of the subject was that in 1881, the legislature passed an act forbidding the use of steamers upon any of the natural beds of the State, and that law still remains in effect to-day. While most of the natural beds are in comparatively shallow water, the cultivators of oysters do not deem it safe to plant oysters in less than twenty-four feet of water, and many of their productive beds are in water from thirty to sixty feet deep. They claim that in less than twenty-four feet of water, the crop is liable to be destroyed by heavy storms, the oysters being either covered up and smothered with mud or sand, or washed ashore by the action of the waves.

The hydrographic work of the engineer of the commission is so accurate that confidence has been given to cultivators to take up claims in deep water, with a certainty that if they secure valuable ground and their stakes or buoys are removed or carried away by storms or steamboats, they can be replaced. The system adopted in this respect is the following: When an applicant has secured a grant of a plot of ground from the commissioners, on an appointed day, the engineer with an assistant proceeds to the locality with the applicant, and having fixed the precise situation with their instruments, the buoys are placed in position, and a record is made of the spot, which is transferred to the books of the office, each buoy being numbered. If at any future time, the buoys are misplaced, all that is needed to correct the error is to consult the number of buoys in the records, and they can be replaced without difficulty. The amount of

ground lying within the exclusive jurisdiction of the State returned to the commissioners for taxation, in 1883, was 74,930 acres, of which 13,008 acres were described as cultivated and 61,922 as uncultivated. In 1882 the returns were 9,007 acres cultivated, and 46,316 uncultivated. The gain therefore for 1883 over 1882, was 4,001 acres cultivated and 15,606 uncultivated. New applications are constantly being made, and more acres are annually put under cultivation.

The usual method of planting new ground is to strew about three hundred bushels of oyster shells, and thirty bushels of spawning oysters to each acre. In some cases where the new ground is in the vicinity of a natural bed or other ground on which are spawning oysters, a good set is obtained without the deposit of any mature oysters. The time of planting is from June 15th to September 1st, the deeper the water the later is the "set," and the cultivators govern themselves accordingly in their work, the great requisite being that the "cultch" shall be clean and fresh at the time of the floating spat. All kinds of business have their drawbacks, and the cultivation of oysters is no exception. In Connecticut the two principal enemies of the oyster cultivators are the star-fish (*Asterias rubens*), and oyster thieves of the human species. The oyster growers sometimes say that it is questionable which is the greater pest, the "five fingers" or the "ten fingers." The star-fish are much more destructive in some years than others, and during the same season inflict great injury upon the beds in one portion of the State, while in others they do not appear at all, or in such insignificant numbers as to do no appreciable harm. Until recently the only remedy has been to remove the oysters and star-fish together, the star-fish being destroyed, and the oysters either sold or removed to some locality where no star-fish were to be found. Mr. J. F Homan, of New Haven, in this State, has invented a dredge which, it is claimed, will remove the star-fish without taking the oysters. Its construction is based upon the fact that the star-fish is of lighter specific gravity than the oyster. The bag of the dredge is located about six inches behind the bar or rake, and a few inches higher.

The practical effect is that the oysters and star-fish being stir-

red up together, the oysters drop back to the ground, and the star-fish fall into the open mouth of the bag. When this pest makes its appearance upon the oyster grounds, great vigilence is needed to prevent the loss of the crop. The owners of private beds watch their grounds carefully, with a view to prompt action in case of necessity, but the public beds being open to every one, no one takes special pains to remove the star-fish, and it has been claimed that some of the oystermen have thrown them overboard after being taken. A stringent law to prevent this was passed at the last session of the legislature, and the owners of private grounds introduced an act to enable the commissioners to remove star-fish from the public beds at the expense of the State, but as some of the sections of the bill were deemed objectionable, the act was defeated.

Another effort will be made next year to accomplish the same end, and uncomplicated with other measures, will probably be successful. The whole area of ground in the exclusive jurisdiction of the State is about 300,000 acres. Of this about 45,000 acres were designated by the town committees before the appointment of the commission. The aggregate area designated by the commission during the last three years has been 38,548 acres, making in all 83,548 acres under their supervision. In addition to this, applications for 15,714 acres are now awaiting action, and this number will be increased as fast as parties discover what they consider to be advantageous locations. The oyster cultivators seem to be generally thriving, are eager to acquire larger areas of suitable grounds, and new steamers and sailing vessels are constantly being added to the fleet. New purchasers are coming into the field, more capital is being invested, and under the fostering care of the State the industry bids fair, at no distant day, to be one of the largest and most important in the entire commonwealth.

Lieut. WINSLOW: I would like to ask if, at the last session of the Connecticut State legislature, any act was passed which would facilitate the detection and punishment of theft from the oyster-beds. As I understand the law, as it existed a year or so

ago, a designation of a natural oyster-bed could not be made. Therefore, when the thief wanted an oyster he assumed all beds to be natural, and took what he wanted. He did not care whether it was a natural bed or not. The burden of the proof did not rest upon him, but upon the owner of the area. Any bed was assumed to be natural until the owner could prove to the contrary. Such a state of affairs surely militates very seriously against the owner. It has seemed to me that, after an area has once been designated, the owner should not be called upon to prove that it was not a natural bed. I would like to know if any measures have been adopted looking towards a remedy for that evil.

Dr. WILLIAM M. HUDSON: Such a bill was introduced in the legislature, but owing to the unfortunate fact that our oystermen in the western part of the State were in opposition to those in the eastern part, the bill fell to the ground. Earnest efforts have been made by our State Fish Commission to bring about that bill, and yet the only act passed in reference to the oyster interest, was one that simply prevented, under heavy penalties, any of the oyster dredges from throwing back into the water any star-fish they might catch. But the attempt to pass an effectual bill failed on account of this opposition between the east and west sections of the State. I think that possibly during the next twelve months a suitable bill will be passed.

Lieut. WINSLOW: Another question occurs to me. After having once adopted the system of proprietary ownership, the greatest difficulty was experienced in detecting a theft. You cannot prevent a man from traveling over the ground, and although you can readily see his appliances, dredge, etc., for taking the oyster, you have to prove that the man has actually taken the oyster: in other words, you must catch him in the very act, and prove that they are your oysters before you can really accomplish anything towards punishing him. Now, that is a very difficult thing to do, and it seem to me that there should be incorporated in the laws a provision for the punishment of a man found on a area with implements for taking oysters. His presence under such circumstances should be sufficient ground for his arrest, be-

cause evidently his intention is to take oysters. The excuse cannot be made that he mistook the ground, for each area is marked plainly. When you see the dredge-line going, it is pretty good proof that oysters are being taken. Public opinion is now very strong against the stealing of oysters, and it certainly seems to me that a provision should be made, which would assist the oyster grower in bringing an offender to justice.

Dr. HUDSON: I think that what Lieut. Winslow has said would be readily acknowledged by any who have looked into the matter. The Connecticut commissioners are anxious for favorable legislative action on this matter; but, as I have stated, there is unfortunately this controversial feeling which has arisen between the natural growers and the cultivators, which has thus far been the means of preventing the enactment of such laws as Lieut. Winslow has referred to. I have no doubt, however, that perhaps in the immediate future suitable laws will be passed.

Lieut. WINSLOW: I would like to say in addition that I do not know of any State that has made so great an advance in this matter as Connecticut. By examining the legislation on the subject for the last four or five years, it may easily be seen that it is of the most practical nature, and it is based on sound business principles. The people of Connecticut, proverbially shrewd, have certainly managed to get all the milk out of this particular cocoanut.

Prof. GOODE: I think that there can hardly be too much stress laid upon the importance of the work which Dr. Hudson and his colleagues are carrying on, the results of which have been described by him this morning. I have been looking into the history of the oyster industry of Europe lately, and am convinced that Connecticut is putting into practice the best system of oyster-culture in the world. The manner in which that State is dealing with the questions of fishery legislation, is certainly extremely interesting and worthy of commendation. The eyes of the world are upon Connecticut at the present time. I can appreciate this fact perhaps better than most of us here, having heard the eager questions and seen the intense interest of the fish-culturists and

oyster-raisers of Europe last summer in London, and having heard what was said concerning the action of Connecticut. Every country which has any oyster-fisheries is trying to solve the same problem, viz: how to protect the beds and give oyster-culturists right of property by the fruit of their labors. It really appears to me that this subject—the progress of the work in Connecticut—is one of the most interesting that could be brought before this society.

THE OYSTER INDUSTRY OF THE WORLD.

BY G. BROWN GOODE.

The oyster industry of the world is seated chiefly in the United States and France. Great Britain has still a few natural beds remaining, and a number of well conducted establishments for oyster culture. Canada, Holland, Italy, Germany, Belgium, Spain, Portugal, Denmark, Norway and Russia have also oyster industries, which are comparatively insignificant, and, in the case of the last two countries, hardly worthy of consideration in a statistical statement. Recent and accurate statistics, Mr. Goode said, were lacking except in two or three instances. A brief review by countries in the order of their importance was presented. The oyster industry of the United States was shown to employ 52,805 persons and to yield 22,195,370 bushels, worth $30,438,852, and that of France in 1881, employed 29,431 persons, producing oysters valued at $3,464,565. The industry of Great Britain yielded a product valued at from two to four million pounds sterling. Holland was shown to have a considerable industry in the Province of Zeeland, and to have produced native and cultivated oysters to the value of $200,000. Germany has an industry on the Schleswig coast valued at about $400,000; while the products of other European countries mentioned were too insignificant to deserve a place in this brief abstract. An

estimate of the total product of the world was presented as follows; the figures being given in the number of individual oysters produced.

COUNTRIES.	NUMBER OF OYSTERS.
United States	5,550,000,000.
Canada	22,000,000.
Total for North America	5,572,000,000.
France	680,400,000.
Great Britain	1,600,000,000.
Holland	21,800,000.
Italy	20,000,000.
Germany	4,000,000.
Belgium	2,500,000.
Spain	1,000,000.
Portugal	800,000.
Denmark	200,000.
Russia	250,000.
Norway	250,000.
Total for Europe	2,331,200,000.

The oyster industry is rapidly passing from the hands of the fishermen into those of oyster-culturists. The oyster being sedentary, except for a few days in the earliest stages of its existence, is easily exterminated in any given locality, since, although it may not be possible for the fisherman to rake up from the bottom every individual, wholesale methods of capture soon result in covering up or otherwise destroying the oyster banks or reefs, as the communities of oysters are technically termed. The main difference between the oyster industry of America and that of Europe, lies in the fact that in Europe the native beds have long since been practically destroyed, perhaps not more than six or seven per cent. of the oysters of Europe passing from the native beds directly into the hands of the consumer. It is probable that sixty to seventy-five per cent. are reared from the seed in artificial parks, the remainder having been laid down for a time to increase in size and flavor in the shoal waters along the coasts. In the United States, on the other hand, from thirty to forty per cent. are carried from the native beds directly to mar-

ket. The oyster fishery is everywhere carried on in the most reckless manner, and in all directions oyster grounds are becoming deteriorated, and in some cases have been entirely destroyed. It remains to be seen whether the governments of the States will regulate the oyster-fisheries before it is too late, or will permit the destruction of these vast reservoirs of food. At present the oyster is one of the cheapest articles of diet in the United States, while in England, as has been well said, an oyster is usually worth as much as or more than a new laid egg. It can hardly be expected that the price of American oysters will always remain so low; but, taking into consideration the great wealth of the natural beds along the entire Atlantic coast, it seems certain that a moderate amount of protection will keep the price of seed oysters far below the European rates, and that the immense stretches of submerged land, especially suited for oyster planting, may be utilized and made to produce an abundant harvest, at a much less cost than that which accompanies the complicated system of culture in France and Holland.

PRESENT CONDITION AND FUTURE PROSPECTS OF THE OYSTER INDUSTRY.

BY LIEUT. FRANCIS WINSLOW, U. S. N.

I beg that you will bear in mind that in a consideration of the oyster industry, present or future, there is opened to us so wide a field for investigation that it is hardly possible in a few minutes to treat the subjeet fully or thoroughly. I shall not attempt to go into minute details, but confine myself to the general principles which, in my opinion, govern successful oyster-culture.

At the last census, the oyster industry of the United States employed nearly 53,000 persons and over $10,500,000 of capital. Its production amounted to more than 22,000,000 bushels of oysters,

valued at about $13,000,000. While these figures are not of astonishing magnitude when compared with those of many of the industries of the country, they indicate, nevertheless, a gratifying volume of business, and when compared with the returns from the other fisheries they show the oyster industry to be of more importance than any.

I learn from Professor Goode's paper read at one of the conferences held in connection with the late London Exhibition, that the entire fishing interest of the country employs 131,426 persons and nearly $38,000,000 of capital, and produces $43,000,000 of products. Thus it is seen that the oyster industry employs nearly one-third of the persons, more than one-fourth of the capital, and produces over one-third of the income. Its product is about six times as great as that of the whale, seal, or menhaden fisheries, and considerably more than one-half of the product of all the other fisheries put together. Surely such an industry is well worth care and preservation. The question is, what degree of care does it receive; is its preservation in any way endangered?

The subject is of considerable moment, but that I need not impress upon you. Its full discussion would occupy more time than either you or I have just now to spare for it. I shall, therefore, only touch upon a few of the more important points, and salient features.

Oysters are found along the whole coast of the United States from Maine to the Rio Grande, and a species also exists on the north-west coast. But notwithstanding this wide distribution, pointing out the possibilities of the future, the greater part of the fishery and business is confined to the Chesapeake region; that is, to the States of Maryland and Virginia.

Of the 53,000 persons employed, nearly 40,000 belong to those States; and of the $10,500,000 of capital, over $7,000,000 is credited to them, while of the 22,000,000 bushels of oysters, more than 17,000,000 come from Chesapeake bay and its tributaries.

That is four-fifths of the laborers, seven-tenths of the capital, and considerably more than three-fourths of the product should properly be assigned to the Chesapeake region. Evidently, then, any consideration of the oyster industry must be to a great ex-

tent a consideration of the industry as it exists in the bay. Whatever other localities may produce; however valuable systems and methods in use in other States may be, whatever superiority of means or intelligence other fishermen may possess, they have not yet succeeded in wresting the trade from the Maryland and Virginia people. Superiority in intelligence, means, systems and crops, are but as so many drops in the bucket when compared with the natural advantages offered by the Chesapeake and enjoyed by those who fish in her waters.

The present condition of the Chesapeake fishery is, then, practically the condition of the whole industry, and the future prospects of the whole may be largely predicated upon the prospect in Maryland and Virginia. What is that condition? What are those prospects? Generally speaking, the condition is bad; the prospect worse. It is stated by many persons of good judgment and sufficient knowledge to enable them to speak with authority, that not only has the number of oysters on the great natural beds diminished very much of late, especially during the last five years, but it is stated by one of the most eminent and experienced observers and students of this question, Dr. William K. Brooks, of the Johns Hopkins University, chairman of the Maryland Oyster Commission and a member of the National Academy of Sciences, that the oyster property of the State is in imminent danger of complete destruction. From time to time during the last decade notes of warning have been sounded, but unfortunately, have not been heeded. Only within the last few years has the public awakened to the gravity of the situation and the necessity of taking steps to avert the threatened evil. The vague feeling of alarm which seized the oystermen as they discovered that the apparently exhaustless beds were no longer yielding their former returns, became sufficiently concentrated two years ago to cause the appointment, by the State of Maryland, of a commission to investigate the condition of the whole oyster industry. The rapid deterioration, both in size and quality of the oysters offered in the Baltimore markets, together with the frequent failure of the supply altogether, roused the packers of the city to set in motion under their own auspices, an entirely separate investigation. The expansion of the guerilla-

like depredations of the dredging vessels upon the beds reserved to the tongers, into first, a systematic onslaught of periodic occurrence; and second, into open, defiant and serious warfare with, not only the tongers, but also the civil, military and naval forces of Virginia and Maryland, lead to a more thorough and thoughtful discussion of the whole oyster subject, by both press and people. The results of the discussions and investigations are now before the public. It is not necessary that I should review them in detail. It will suffice if I mention but a few of the many indications of deterioration.

The report of the commission created by Maryland and Virginia in 1868, shows that the production of the Chesapeake was, in that year, 21,500,000 bushels. Possibly, says a writer in *Lippincott's Magazine*, it went as high as 25,000,000,000 bushels. If these figures are trustworthy, in spite of the improvements in implements, boats and general apparatus of the fishery, the production has fallen off rather than increased during the last fifteen years. Indeed, the testimony of all the oystermen is to the same effect. According to them, from three to seven times as many oysters could have been taken twenty years ago as at present, and a larger number actually were taken, some five years back. I am inclined to doubt the accuracy of the figures quoted for 1868. I am rather of the impression that the yield at that time was considerably less than it is now. Possibly not half so great. But there are very safe indications of a decrease within the last few years, even if the yield was an absolutely essential factor in determining the condition of the beds. But it is not essential by any means. An abnormally large production is quite as alarming, if not more so, than an abnormally small one, paradoxical as the statement may seem.

According to Mr. Edmunds, the gentleman who investigated the condition of the Chesapeake beds for the census, not only has the trade in raw oysters been greatly hampered, but, during the year of 1882, the packers were frequently compelled to quit steaming oysters on account of a deficiency in the supply. My own investigations in 1883 confirm this statement. One of the most prominent and well known Baltimore packers stated to me that he was compelled to take stock at 25 cents per bushel, which

three years back he could have purchased at 5 or 10 cents per bushel, and five years back would not have had at any price at at all.

I might continue quoting opinions indefinitely with the same result, but the decision of the matter is based upon sounder postulates than opinions.

In 1878-79 I made an examination of certain beds of the Chesapeake, and found them to be in a much impaired condition. Comparing my results with the results obtained by himself in 1883, Dr. Brooks states that the beds have decreased in value more than 39 per cent. This statement is based upon the following data: My examination in 1878-9, showed that in Tangier sound there was about one oyster to every 2.3 square yards. Dr. Brooks after examining the whole of the Maryland beds, states that in 1883, there was only one oyster to each 4.2 square yards. That is, the deterioration equalled nearly 40 per cent.

In 1876, Mr. Otto Lugger visited most of the Chesapeake beds and measured the quantity of shells and oysters obtained by dredging. He found 3.7 bushels of oysters for each bushel of shells.

In 1879, I made an examination of seventeen beds and found 1.9 bushels of oysters for each bushel of shells. A decrease of 1.8 bushels in three years.

In 1882, Dr. Brooks found 1.3 bushels to each bushel of shells, a decrease of 0.5 bushels in three years, showing that the deterioration was continuous. It is quite evident that an increase in the number of shells and a decrease in the number of oysters obtained at each haul of the dredge, is an indication of impairment, and combining that indication with the decrease in the number to the square yard, as shown by my own and Dr. Brooks' measurements, the impoverishment of the beds is apparent to the most superficial observer. But other evidence is not wanting. The principal test of the decrease of a commodity is the increase in its price; and it is well known among all oyster dealers of this region that oysters have been not only much more difficult to obtain, but much more expensive than they were a few years back. Fully twice and three times as much are now paid per bushel as was customary ten and fifteen years ago.

In 1861, oysters in the Chesapeake were worth, according to the writer in *Lippincott's* whom I have already quoted, 15 and 20 cents per bushel. In 1868, they had advanced to 25 and 30 cents. In 1879, the average price of the crop of 17,000,000 from Maryland and Virginia was over 40 cents per bushel; and at the present time it is nearer 50 cents than 40, and occasionally is much higher. And this increase in price is not wholly due to increase in demand. There has been an actual diminution in the number of oysters produced. The number of oysters passing through the Chesapeake and Delaware canal, the connecting link between Chesapeake and Delaware bays, is a pretty fair indication of the production of the Chesapeake beds. In 1879, in round numbers, 940,000 bushels passed through. In 1883, only 550,000. That is, the reduction was about forty per cent. of the amount in 1879. And it is worthy of notice how close this result agrees with Dr. Brooks' statement that the oyster beds had fallen off thirty-nine per cent. in value, since the examination made by myself in 1879.

The facts I have recited certainly should be sufficient to convince any one that the oyster industry in the Chesapeake is in a very bad way; and, as I have explained, the condition of the Chesapeake fishery is virtually the condition of the whole. In other words, the present offers but little encouragement. Does the future offer more?

A correct answer to the question necessitates the examination of the several causes which may have operated in bringing about the present state of things. We must decide upon the agency which has been at work and having discovered it, consider how it can be precluded from further operation. It may be confidently asserted that no natural cause has had any considerable deleterious influence.

The natural influences and conditions to which the oysters were exposed in the past and under which they increased and multiplied so greatly, have in no way changed. Temperature and density of the water have been no more various than in the past. Channels and bottoms have remained stable. Factories and mills with their polluting excrement have not been erected. Organic life of any kind has neither increased or diminished to

any noticeable extent. In fact, the environment has remained exactly as it has always been—with one exception. Continuous and exhaustive fishery has sprung up with all its attendant evils. To that and to that alone is the condition of the beds due. The prophecy so often made is at last coming true. The demand has outgrown the supply and in the effort towards equalization the beds, the source of wealth, are fast becoming a total sacrifice.

All the facts, all the opinions, all the evidence, was before the legislatures of the two States, and they did nothing beyond building a few more police boats. The influence of the oyster men was too strong to be overcome. They either would not or could not submit to any restriction of their privileges, and the influence so strong in the present is not likely to be diminished in the future, unless it is shown that it is for the best interest of the fishermen that a change of policy, radical and entire, is absolutely necessary for the preservation of the industry.

Look at the facts. The natural beds in the Chesapeake like the natural beds in the Northern States, are no longer capable of returning an adequate supply. What has been done to remedy the evil? An increase of the police force! In other words, a more perfect restriction of the fishery—a more extensive diminuition of the supply. Surely, that is not what we want! We do not care to have a valuable food product diminished. That is no real remedy. What should be done is to follow the course of the Northern States and endeavor, by artificial means, to cultivate the oyster and increase the productive area and supply.

I ask you but to look at the charts of the oyster beds exhibited in the fisheries, section and you will see a marked difference between the region north and south of the old Mason and Dixon line. In the northern portion the preponderance of the artificial over the natural beds is as marked as the reverse in the southern portion. Years ago the natural beds of Long Island Sound returned a sufficient supply to satisfy the demands of the consumers. Gradually those demands increased and with them the disposition towards the inordinate fishing of the beds. The natural consequence followed. The beds were over worked, became depleted, were exhausted. But the demand still existed and had to be satisfied. New beds were created; new methods intro-

duced; and to-day Rhode Island has some 10,000, and Connecticut some 100,000 acres of oyster ground over and above the allowance originally made by nature.

If the industry in the Chesapeake is to follow the same course as in the Northern States, then the establishment of artificial beds, and artificial extension of the oyster area with its consequent increase of the supply, will take place only upon the destruction of the present natural beds. Indeed a prominent and intelligent oyster planter testified before the Virginia legislature that he was half inclined to hope for just such a consumation, so little had he to expect from the present condition of things. But a careful study of the Northern fishery and the laws, statutory and natural, which govern it, will show quite plainly, the steps necessary to be taken in order to accomplish the desired end. And if history and experience are to have any influence in forming men's opinions and guiding their actions, the measures indicated by the study should surely be adopted. So far as I am able to see, the recuperation of an oyster industry is entirely dependent upon the recognition and adoption of one great principle as the foundation of the work. That principle is, the right of the State to cede and the individual to hold, tracts of bottom under a tenure similiar to that governing uplands. In other words the practice of holding the oyster area open to any and all as common property, necessarily prevents in practice the adoption of conservative measures, or a policy of comprehensive and systematic improvement. On the other hand, no sooner is an individual and proprietary right affected than that powerful lever—self-interest—is brought into play, and progress becomes assured.

Evidently cultivation of the common property will never be undertaken by the individual. Yet it must be undertaken by some one. It is impossible for the State to assume work. The Chesapeake oyster area equals some 400,000 acres. If the cost of cultivation did not exceed $10 per acre, and it is much nearer $30 than $10, the expense would be $4,000,000 every three years. If the State of Connecticut undertook to cultivate her artificial beds, it would cost her from one to three millions per annum. If Rhode Island entered the field it would be at an expense of

from $100,000 to $300,000 per annum. Evidently the expenditure of such sums for the benefit of a portion of the population is out of the question, even was it necessary. But it is not necessary. Oyster-cultivation can be carried on by individuals just as well as the cultivation of potatoes or rearing of live stock. That this is not understood is the principal difficulty met by those who desire the advancement of the fishery, and the first condition I would make with a fish-culturist in discussing this question, is that he should dismiss from his mind all impressions he may have which are based upon the supposed analogy between oyster and fish-culture. It is true that we can impregnate the eggs of an oyster in virtually the same way we impregnate the eggs of a fish. It is true we can keep the young oysters alive for some time in practically the same manner it is accomplished with a fish. But there the similarity ends.

Whoever may hatch the fish egg, the general public only can reap the benefit. Fish are migratory. Fisheries cannot be preserved. But the oyster is not migratory. It is an animal of domestic instincts and strong local attachments. Where it is placed it stays. Consequently, its cultivation is eminently a proper field for the employment of individual exertion. I would not be understood to mean by the term "cultivation" in this relation, the artificial impregnation of the eggs. That has not yet been made of practical importance. I refer, principally, to the cultivation of oyster ground rather than oysters. To the improvement of areas and beds rather than of stock. To increasing the facilities for natural expansion, rather than the exercise of natural function.

It is quite possible to take a totally barren tract of bottom and seed it with mature oysters, fertilize it with shells, and in a few years reap from it an abundant crop. But evidently no one will undertake this trouble or expense unless he is reasonably certain of gathering the harvest. Equally evident is it that the State cannot sow the ground for the fishermen. Naturally, but one conclusion can be reached. The harvest must be made sure to the individual, and it can only be made sure by the possession of indefeasible proprietary rights. How soon the industry revives under such conditions is proved by the history of every

Northern fishery, but I have not time to quote them in detail. Rhode Island offers perhaps the most instructive instance. In 1865 there was only some 60 or 70 acres of bottom under cultivation. The product was only some 71,000 bushels. The price was $1.75 per gallon.

In that year the law was passed which gave individual and proprietary rights to oyster ground, and an advance began which has never since been checked. In 1883, 11,000 acres were under cultivation; the product was in the neighborhood of 1,000,000 bushels, and the price per gallon had fallen to less than a dollar.

The fishery in Connecticut will be, I understand, the subject of a subsequent paper by a member of the Association, and I will not therefore do more than touch upon it. It will suffice for my purpose to state that since the operation of the law giving proprietary interest in defined tracts of bottom, an enormous area of what was entirely barren ground has been turned into productive oyster beds, and the crop of native oysters increased from insignificance to millions of bushels. Indeed, so great has been the success and so encouraging the prospect, that the most prominent planter in the State has said that the Connecticut people could easily afford a subsidy of $50,000 per annum to keep in existence the present Chesapeake policy.

These facts appear so overwhelmingly conclusive that it is a matter of astonishment that the course indicated by them has not been immediately adopted. Yet, though it has been urged with great persistency for several years, advocates and adherents have gathered but very slowly. The most important work to be done is, therefore, that of proselyting. But to accomplish this, methods differing from the usual ones must be adopted.

Experience shows that the class which it is desirable to convert cannot be reached by mere arguments, no matter how sound the postulates upon which they are based may be. It is useless to apply reason to prejudice. Only actual, tangible evidence can have any effect; and such evidence can only be given by what is practically a system of "object lessons." An excellent illustration of the value of such examples is given by the success of oyster-culture in France. There the individual oyster-culturist has been educated by the observation of the model govern-

ment *parcs*, until perceiving all the advantages which would accrue from systematic and intelligent effort in this field, he has engaged in the pursuit with wonderful success and credit. Some such system, it seems to me, must be adopted in the Chesapeake region, if we wish to secure sensible legislation and actual advance prior to the destruction of the great natural beds. The people must be educated—must be made to see the folly of their ways and the wisdom of those of others. And, though I am utterly opposed to the entrance of the State into the oyster business, yet if the establishment of a few model oyster farms can teach the people of Maryland and Virginia how to husband and increase the wealth nature has given them, I should regard the money expended in such establishment well spent.

But I have detained you far longer than I intended when I first thought of addressing you, and must bring this paper to a close. The range of my subject and the importance of the principle I have been most desirous of urging upon your consideration, have precluded discussion of many minor points of great interest to oyster-culturists, and possibly to the general public. It has also necessitated a more general and superficial treatment of the question, than I would desire. But if I have succeeded in impressing the need for some more efficacious measures than have yet been adopted my end has been accomplished. Certainly something should be done. Glance at the census tables and you will find that, with the exception of Virginia, Maryland employs ten times as many persons, and produces ten times as many oysters as any other State. The gross value of her product is two to four times as large, and her capital five times as great. She has at work two and three times as many vessels, and produces nine and ten times as many oysters. In every respect upon a superficial examination, Maryland's oyster trade appears head and shoulders above that of any other locality.

But when a comparison is made of the percentage of capital returned as income, instead of Maryland's heading the list as would be supposed, she actually brings up at the bottom, her industry returning a smaller income than any other State in the Union. Though the area of the oyster ground is about 400,000 acres, the yield per acre is only 40 bushels, while at the North

it is fully three times as much. Such a condition of affairs appears bad enough; but unless some such measures as I have suggested are undertaken matters will soon be worse. If the people are left to themselves, they will, in their ignorance, give us only another instance of exhausted beds and destroyed industry.

Unless they can be convinced of the folly of their present course we will have but a repetition in the Chesapeake of the experience in Long Island Sound.

The natural oyster of marketable size will disappear, and only a small "seed" oyster will be left. The goose will be killed; the golden eggs will be laid no more. And the vast fleet of pungies and canoes, and multitudes of men and women will have no employment beyond picking out the pin feathers of the inanimate carcass.

In the examination of one of the largest beds in Pocomoke Sound, I found that the shells represented 97 of the product; in other words, I had to get about fifty bushels of shells before I could get one bushel of oysters.

Prof. RYDER. I have listened to Dr. Hudson, Prof. Goode, and Lieut. Winslow with a great deal of interest, and it seems to me that all the data furnished in their papers point in the same direction, but I cannot but believe that artificial oyster-culture still holds out to us some little hope of success. I have lately read a recent paper by M. Bouchon-Brandely in which he makes the following remarkable statement: "It is to the French investigators that we are indebted for the first advances and experiments in artificial oyster-culture." That includes, I presume, the development of the methods of artificial oyster culture, or rather of artificial fertilization as applied to oyster-culture. And I take this occasion before the American Fish Cultural Association to make a reclamation in favor of American investigators, and especially Prof. Brooks, of Johns Hopkins University, in whose footsteps I and several others have trodden, and particularly in our work along the Chesapeake bay. We have succeeded in confining the spawn of the American oyster in arti-

ficial ponds, so as to develop the fry to that point in their life-history at which they can be transferred from the fertilizing pans or dishes to parks, and there placed under such conditions as will enable them to grow into adult oysters. I do not mean to insist that the American methods of confining the oyster spat are of paramount importance, but I do assert that we were the first to practically apply any methods, or to devise suitable apparatus for such experiments. In the pamphlet to which I have referred, there is described a machine in which the embryo are confined and in which the water is kept in continuous circulation. That machine was devised and operated by Colonel McDonald in 1882. I believe that Lieutenant Winslow, in association with Professor Brooks operated a similar machine about the same time. Both of these experiments were successful, I think, in getting the fry attached within about twenty-four hours after artificial fertilization. So much for the facts. Subsequently, or about a year later, I carried on some experiments at Stockton, Maryland, following out on a larger scale the methods which I had devised in 1880, in order to confine the artificially fertilized eggs with the result of getting spat from artificially fertilized eggs. The method of confining the fry is simple, and merely involves the use of a diaphragm of sand through which the tide may ebb and flow automatically, and thus renew the water in the inclosure. It is evident that such a diaphragm might be utilized to confine the larvæ which are thrown off from the beds, and which are confined to coves or areas with restricted months: in other words, that there are a great many places (as indicated on the maps in this hall, prepared by Lieut. Winslow) in which diaphragms might be constructed on a very simple plan, but upon a larger scale, and by means of which we could actually confine the spawn and prevent it from escaping from the areas, whilst we would provide in those same waters clean "cultch" to which the spat could adhere.

The history of the attachment of the spat has been worked out very carefully by Professor Huxley and myself, for both the American and European species. The papers in which these matters have been discussed may be found in the *English Illustrated Magazine* for 1883, and in the Bulletins and Reports of the

United States Fish Commission for 1881 and 1882. So that I think that purely artificial methods, as applied to the cultivation of oysters in this country, are not altogether without indications of success in the near future.

Lieut. WINSLOW: I did not mean that the artificial propagation of the oyster might not in the future be brought to some practical issue. I only stated that it had not yet been. But while the process of raising oysters by artificially fecundating the eggs of the female, will not, probably, soon be made a matter of economic importance, the study of the embryonic life of the oyster will certainly be of great value to oyster-culturists in the future. For instance, the usual method of the oyster farmer is to deposit in the spring or late winter months, a certain number of "spawners" or mature oysters. After those oysters have lain on the ground three or four months and the spawning season has approached, vast quantities of shells or other suitable "cultch" are scattered in the vicinity, for the young fry to fasten to. Now it is of the utmost importance that this "cultch" should be clean, and consequently the later it is thrown overboard the better, as the deposit of sediment is thus avoided. But care must be used not to wait too long, else the time when the fry attach will be passed. Now as every oyster-man knows where an oyster is spawning, if, through the study of the embryological life of the animal, we could tell him just how much time elapses between the spawning and the attachment, we would provide him with information of great practical value. For reasons such as I have just recited, I think embryological work in this direction desirable. Possibly we may also make oyster raising through the artificial impregnation of eggs a matter of practical importance, but so far as my experience goes, I am inclined to doubt any such consummation, desirable though it may be.

Prof. RYDER: The results of my own experiments and observations in this matter are I think of some value. I have found by more recent study of spat which I obtained in vast abundance at Buzzard's bay that after the fry-shell had grown to the dimensions of 1-90 inch or about four times the size of the fry-shell

when it first affixes itself, there was proof that the fry-shell had been attached to the surface of fixation for a considerable time before the spat-shell was formed, and that the fixation of the fry-shell was continuous with the fixation of the spat-shell, which may last until the diameter of the lower valve is nearly two inches. I take it that the fixation occurs in from 24 to 72 hours. There is, however, this fact opposed to it. I have found embryo oysters not larger than 1-250 inch, still free; that is about twice the size of the larvæ oysters ordinarily observed in our waters or obtained by artificial fertilization. These large free oyster larvæ were obtained from the stomach of adult oysters.

Prof. GOODE: It seems to me that, from what we have to-day heard from Dr. Hudson, Lieut. Winslow, and Professor Ryder, we cannot fail to see what no doubt we have all partially realized before, namely, that there is a great cause for alarm as to the future of the oyster fisheries. I have already stated that the natural oyster-beds of Europe have become almost extinct, except as a source of seed for private cultivation, and it seems as if our own beds were becoming similarly destroyed. I think that Professor Ryder has not in the least overstated the importance of the artificial culture of the oyster, as developed by himself and others. One of the most striking events connected with the participation of the United States in the fishery exhibition at London last summer, was the receipt of a telegram from Professor Baird, stating the results of Professor Ryder's work at Stockton, Maryland. The substance of the telegram was printed in one of the English papers, and in less than a week it had been reprinted in at least 5,000 papers. Letters began pouring in from Russia, Denmark, Holland and Scotland, asking for details, and the general enthusiasm over the matter was indeed astounding.

Some of the recommendations which Lieut. Winslow has made with reference to the encouragement on the part of the Government by the establishment of model farms, are of great importance, as also are many of the other suggestions which he made. It seems desirable that the United States should carry out that system, as has been done at St. Jerome, Maryland. I think that a

special obligation of this Association is to utter a word of warning to this country that unless something is done very soon, a portion, at least, of the oyster grounds in some of our States will be as worthless as some of those of the European countries have already become. And it appears to me that we ought to put forth some official utterance in the matter, which shall be quoted in legislative houses as the deliberate opinion of this body of men, which includes all who have given any attention to the subject of fish-culture. I therefore move that a committee be appointed by the president of the Association to report before the close of the session, some resolution which shall express the opinion of the Society as to the necessity of protecting our oyster-fisheries by legislation by artificial propagation, and by all other possible means.

Mr. Blackford: I second the motion, and believe this matter to be one of the most important that could come before this meeting. I am of the opinion that such a resolution, going out at this time from the Association, would have a great effect upon the action of the State legislatures, some of which are now considering the propriety of taking some measures for the protection of the oyster industry—especially New York.

The President: It is moved and seconded that a committee be appointed by the president, to report as soon as possible, as to what steps shall be taken by this Association to warn the different States in regard to the oyster depletion. I will appoint for that committee, Messrs. Goode, Winslow and Ryder.

NATURAL CAUSES INFLUENCING THE MOVEMENTS OF FISH IN RIVERS.

BY MARSHALL MC'DONALD.

If we will consider for a moment the varieties of conditions that concur in and modify agricultural production, we will be better prepared to appreciate the multiple influences that enter into the question of maintaining and increasing the production of our fisheries.

The farmer of to-day has a guide in the conduct of the practical operations of agriculture, the collective experience of all who have preceded him. The observations of many generations condensed in proverb and apothegm, and handed down from father to son, gives to the unlettered peasant the interpretation of natural signs, the forecast of seasons and the empirical rules by which he tills and sows and garners the unequal harvests, which the unequal seasons bring.

Less than a century ago, chemistry allying herself with agriculture, laid the foundation of rational methods, and since then chemists and botanists, physicists and physiologists, have been busy with their investigations, each contributing in some essential particular to the solution of the important problem of increasing and maintaining the fertility of the soil.

In those countries, like England for example, where the results of scientific investigations have been formulated into rules of practice, the average production of cereals per acre now exceeds two-fold, and often three-fold, the average production per acre two hundred years ago.

This result has been accomplished in the face of an intensive system of cropping, which long ago would have rendered the fertile fields of England unproductive moorlands, or barren wastes, but for the lessons taught by chemists in its application to agriculture, and appropriated and applied in practice.

Just in proportion as man has learned to dominate the conditions which influence agricultural production, he has been enabled to raise the average yield per acre ; but, unequalities of

production from year to year, resulting from the influence of natural conditions beyond his control, still persist.

Confronted with those adverse influences, all the toil of the husbandman, all his stores of experience, all the resources of science, are powerless to avert scanty harvests, or absolute failure of crops.

What is true of agriculture is equally true of aquiculture, and more particularly of pisciculture in rivers.

The restoration and maintenance of our river fisheries depends upon our ability to promote conditions favorable to production, and exclude those which are adverse.

First—The seed of the future harvest must be sown. Where, in consequence of the interference of man by excessive fishing, or by the destruction of spawning grounds, natural agencies are inadequate to produce the young fish in numbers sufficient to repair the inroads made by capture or by natural casualties, we must supply the deficiency by artificial propagation.

But the breeding and planting of shad or herring by the million or tens of millions, in an area like the Potomac or the James, or the Susquehannah rivers, cannot carry the annual product of the fisheries in these rivers beyond a certain maximum limit, which is defined, first by the extent of the breeding and feeding area acceptable to the fish, and second by the abundance of food for the fry which is to be found in this area.

Second—The extension of the breeding and feeding areas to their natural limits, by providing practical passes for our anadromous fishes over the artificial or natural obstructions which have contracted these areas, is a second essential condition to be fulfilled, and is one of equal or even greater importance than the artificial propagation and planting of the fry, because it is possible by this means to secure the permanent restoration of our river fisheries under natural conditions.

A third condition, exercising an important influence upon the permanence of our river fisheries, has only recently attracted attention, and offers an inviting and important field of investigation.

We may plant the young of shad or herring in our rivers in countless millions, we may extend the breeding and feeding

areas to their natural limits, but if the agency of man has so modified the natural conditions that the proper food of the young fish during their river life is no longer found, or occurs in much less than the necessary abundance, then the effort to increase the supply by artificial propagation and planting will prove a dismal failure.

How far the pollution of our rivers by sewerage, gas tar, refuse chemical products, etc., has changed the original conditions of our rivers, is a matter inviting exhaustive and critical investigation.

Fourth—A rational code of laws, relating to the fisheries, may exert an important conservative influence, by imposing such restrictions upon the time and methods of capture, as will permit some considerable portion of the shad and herring which enter our rivers, to reach their spawning grounds and deposit their eggs without molestation.

By the observance and enforcement of the conditions above indicated, we may reasonably expect to greatly increase the average annual production of our river fisheries, but we can never hope to eliminate great unequalities in the product of the fisheries in different seasons.

Natural conditions, apparently beyond the control of man, will determine disastrous and discouraging failures one season, and the next a teeming abundance in the same river.

The influence of water temperatures, in determining the presence or absence of certain species of fish in certain areas of water, has been observed both in regard to the ocean and the river species which are the object of commercial fisheries. Observation of water temperature and its relations to the migrations of fish, have not been continued long enough to justify us in formulating conclusions, but the drift of investigation and observations goes to show that there is for each species a normal temperature in which it prerers to be, and that its migrations are determined by the shifting of these areas of congenial temperature under the influence of the seasons.

Observations, now continued for several years, have led to the conclusion that, in the case of the shad, the normal temperature, toward which it is ever moving, is about 60 degrees, Fahr.

The data upon which this conclusion is based are as follows:

First—The shad make their appearance in the St. Johns river, Florida, as soon as the temperature of the river falls to 60 degrees, or thereabouts, which takes place from the middle of November to the 1st of December. At this time the river is colder than the ocean plateau outside, and the movements or migration is from warmer to cooler areas in the direction of the normal temperature of 60 degrees.

Second—The shad which are spawned in the Potomac in April, May and June, remain in the river all summer. Schools of them may be frequently seen in the river in front of Washington. They continue abundant until the latter part of October or 1st of November. When the temperature falls below 60 degrees, they begin to drop down the river in their migrations seaward. In this case they are moving from cooler to warmer waters and toward the normal temperature of 60 degrees.

Third—The beginning of the spring run of shad into the Potomac river is about coincident with the date when the river temperature rises above that of Chesapeake bay. In this case, too, the shad are moving from cooler to warmer waters, and in the direction of the normal temperature of 60 degrees, for the temperature of both bay and river is at the beginning of the season always below 60 degrees.

It will be seen, therefore, that wherever we have been able to intercept the shad in its migrations and place it under observation, it is always moving in the direction of the normal temperature of 60 degrees.

Assuming it to be true as a general fact that the shad in their ordinary migrations are ever traveling on temperature paths which lead to the normal temperature of 60 degrees, it becomes possible to determine the law, the rate, and the limit of their movements in a certain area, by tracing the shifting of the areas of congenial temperature under the influence of the seasons.

The data for the discussion are furnished by the records of observations of water temperatures, made at the lighthouses by the direction of the Lighthouse Board, and at Washington by an employee of the United States Fish Commission.

The three stations selected for comparison of ocean, bay and

river temperature are (1) Winter Quarter Shoals for the ocean plateau, (2) Wolf-trap Light for Chesapeake Bay, and (3) Washington, D. C., for the Potomac River.

The station at Winter Quarter Shoals is up the coast about forty miles north of Cape Charles, and is about eight miles from shore. It is close to the edge of that cold Arctic current which wedges itself down between the Gulf Stream and the shore, and bringing with it the temperature of Arctic latitudes, builds a wall of minimum temperature beyond which the shad probably never pass in their migrations.

The only records of bay temperature available for the season of 1881 were the signal service observations in Norfolk Harbor. These records, which give the temperature of Elizabeth river rather than the bay, indicate more rapid fluctuations than is possible in the general temperature of the bay, and give a daily range of temperature several degrees higher than that of the bay.

This correction I have approximately applied in the discussion of the temperature observations of 1881, in order to bring them into harmony with the observations of bay temperature for 1882 and 1883, which were made by observers at Wolf-trap Light.

This locality is on the west shore of the bay, half way between the Rappahannock and York rivers, and being well off from the shore, little influenced by local variations, the temperatures taken here may therefore be taken to represent the general temperature of the bay waters for corresponding dates.

The result of the study of the data above indicated are graphically presented in the three outline maps of the Chesapeake and Delaware basins, illustrating the movements of the areas of congenial temperatures under the influence of the seasons, and in the chart showing the relations between the temperatures of the Potomac river during the fishing seasons of 1881, 1882 and 1883, and the fluctuations in the shad fisheries of the rivers for the same period.

(The rest of Col. McDonald's remarks were oral and with reference to the maps and charts exhibited.)

The conclusions deducted by him from the discussion of the data presented were as follows:

The temperature records of 1881, '82 and '83 indicate that for the winter months the area of maximum temperature is not in the rivers or in the bay, but on that ocean plateau outside, extending from the capes of the Chesapeake to the Delaware breakwater. The presumption, therefore, is that the schools of shad belonging to both the Chesapeake and the Delaware, have their common winter quarters on this plateau. When under the influence of the advancing seasons the waters of the Chesapeake and the Delaware bays become warmer than on this plateau, the migrations into continental waters begin. The proportion of the entire run that will be directed to the Delaware or the Chesapeake, will be determined at this time. If the northern end of the area warms up more rapidly than the southern, then an unusual proportion of the shad will be thrown into the Delaware. On the other hand, cold waters coming down the Delaware, may effect a contrary movement, and throw the schools of shad almost entirely into the Chesapeake; thus leading to a partial or total failure of the the shad fisheries of the Delaware for the season.

When the schools of shad have entered the Chesapeake, their distribution to the rivers will be determined in the same way by temperature influences operating. If the season is backward, so as to keep down the temperature of the larger rivers which head back in the mountains, then the run of shad will be mainly into the shorter tributaries of the bay, which have their rise in the tide-water belt, and which, of course, are warmer at this season than the main rivers.

Again, warm rains at the beginning of the fishing season in our large rivers, and the absence of snow in the mountains, will determine the main movement of the shad into the larger rivers of the basin; and if, when the schools enter the estuaries of these rivers, they encounter a temperature considerably higher than that in the bay itself, the movement up the river will be tumultuous; the schools of shad and herring all entering and ascending at once, producing a glut in the fisheries such as we sometimes have recorded.

It follows, therefore, in the light of these facts, that we may have a successful fishing on the Delaware, accompanied by a total or partial failure in the Chesapeake area, and *vice versa;* and considering the Chesapeake area alone, we may have a very successful fishery in the aggregate, yet accompanied by partial or total failure in particular streams under the influence of temperature conditions, as above indicated. Statistics of the shad fishery, if they are to furnish a measure of increase or decrease, must include the aggregate catch of the Chesapeake and Delaware rivers and indeed of the rivers much further to the north. Statistics based upon a comparison of the catch in the same river in different seasons, are of no value as serving to give a measure of the results of artificial propagation.

THE AFTERNOON SESSION.

At the afternoon session the President asked if the Committee on Nominations was ready to report.

Professor GOODE: Your committee has nominated:

For President, Hon. THEODORE LYMAN, M. C., Massachusetts.
For Vice-President, Colonel MARSHALL MCDONALD, Virginia.
For Treasurer, Hon. E. G. BLACKFORD, New York.
For Corresponding Secretary, Mr. R. E. EARLL, Illinois.
For Recording Secretary, Mr. FRED MATHER, New York.

As members of the Executive Committee:

Mr. JAMES BENKARD, New York.
Mr. GEORGE SHEPARD PAGE, New Jersey.
Mr. BARNET PHILLIPS, New York.
Prof. G. BROWN GOODE, Connecticut.
Dr. WILLIAM M. HUDSON, Connecticut.
Mr. S. G. WORTH, North Carolina.

These nominations were formally carried.

The PRESIDENT: I would like to suggest to the gentlemen of the Executive Committee, and also to the officers for the ensuing year, that during the present meeting there be held a conference for consultation. We are sadly in need of rules and regulations, and have no order of business, and I think it desirable to move in this matter as our Association is rapidly growing in size and importance.

THE CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF OUR AMERICAN FOOD FISHES AND INVERTEBRATES.

BY W. O. ATWATER.

At the meetings of the American Fish-Cultural Association in 1880 and 1881, I had the pleasure of presenting some brief statements of the results of an investigation of the chemistry of fish and marine invertebrates, which has been going on for some years past in the chemical laboratory of Wesleyan University, under the auspices of the United States Fish Commission and the Smithsonian Institution.

Since the papers referred to were presented to the Association, the investigation has been continued so as to include chemical analyses of the flesh of some one hundred specimens of food-fishes, embracing fifty-one species, and sixty-four specimens of invertebrates, oysters, lobsters, etc., embracing eleven species, making in all one hundred and eighty-two specimens of sixty-two species.

Besides the analyses, the range of the investigation has been extended so as to include two other, but closely related, topics. One of these is the digestibility of the flesh of fish as compared with that of mammals used for food, *e. g.*, beef, mutton, etc. The other line of research is more purely chemical, and consists in the study of the constitution of the compounds of which the tissues of the fish are composed.

Along with the analyses of food-fishes and invertebrates, a parallel series of analyses of other food materials, animal and vegetable, has been undertaken at the instance of the United States National Museum, to furnish data for illustrating its food collection. The results are, of course, valuable in connection with our present subject, as we need to know not only the composition and nutritive value of fish, but, also, how they compare in these respects with other materials used for food.

The report of the United States Fish Commission for 1880, contained accounts of some of the earlier portions of the investigation. I hope a detailed account of the work up to the present may be printed soon. Meanwhile I desire to lay before the Fish-Cultural Association some of the more important results, in so far as they bear upon the nutritive values of the food-fishes and invertebrates that have been studied.

Inasmuch as these statements may come under the notice of some who are not entirely familiar with the later results of the investigation of the laws of nutritive values of food materials, and how they are most economically utilized, a few explanations may be in place. These will be the more appropriate, because late investigation is tending to decide some disputed questions regarding the ways in which food is used in the body, and because many of the statements which go the rounds of the papers and still linger even in current works on physiology and chemistry, are shown by the researches of a few years past to be misleading, and in too many cases, decidedly incorrect. I may, perhaps, be pardoned therefore if the statements which follow contain some slight repetition of those made in papers previously presented to the Association.

THE NUTRITIVE VALUES OF FOODS.

It is a striking fact that while the chief item of the living expenses of the majority of civilized men is the cost of their food, even the most intelligent know less of the actual value of their food than of any other of the important articles they buy. It makes but little difference to the man with $5,000 per annum, whether he pays fifteen cents or five dollars per pound for the

protein of his food, provided it pleases his palate. But to the humble housewife whose husband earns but $500 a year, it is a matter of great importance, and she is very apt, after hesitating at the dry-goods store between two pieces of calico for her daughter's dress, and taking one at ten cents a yard for economy's sake, though the one at eleven was prettier, to go to the grocer's, the butchers, or the fish-dealer's, and pay a dollar a pound for the nutrients of her children's food, when she might have obtained the same ingredients, in forms equally wholesome and nutritious, for fifty or even twenty cents. She will continue this bad economy until she obtains a general idea of the actual cheapness and dearness of foods, as distinguished from their price.

A pound of lean beef and a quart of milk both contain about the same quantity, say a quarter of a pound, of actually nutritive material. But the pound of beef costs more than the quart of milk and it is worth more as a part of a day's supply of food.

The nutritive materials or nutrients, as we call them, in the lean meat, though the same in quantity as in the milk, are different in quality, and of greater nutritive value. Among the numerous branches of biological research, one, and by no means the least interesting and important, is the study of foods and nutrition. Within the past fifteen years especially, a very large amount of scientific labor has been devoted to the investigation of the composition of foods and the function of their ingredients in the animal economy. Indeed, very few persons this side of the Atlantic have any just conception of the magnitude of this work and its results. And, though the most important problems are still unsolved, and must, because of their complexity, long remain so, yet enough has been done to give us a tolerably clear insight into the processes by which the food we eat supplies our bodily wants.

The bulk of our best definite knowledge of these matters comes from direct experiments, in which animals are supplied with food of various kinds, and the effects noted. The food, the excrement, solid and liquid, and in some cases the inhaled and exhaled air, are measured, weighed and analyzed. Many trials have been made with domestic animals—horses, oxen

cows, sheep, goats and swine—with dogs, rabbits, birds and the like, and a large number also with human beings of both sexes and different ages. In the philosophical planning of the researches, in the ingenuity manifested in devising apparatus, in accuracy, thoroughness, patience, and long continuance in the work, as well as in the distinguished genius of many of the workers, chemico-physiological science has assumed the highest rank among the sciences of our time ; with the rest it has brought us where we can estimate the nutritive values of foods from their chemical composition, with so near an approach to accuracy that in Germany, where the best research is done, tables, giving in figures, the composition and nutritive valuations of foods, have been prepared by eminent chemists and physiologists, and are coming into general use among the people.

We eat meat and fish, potatoes and bread, to build up our bodies, to repair their wastes, and to supply them with fuel for the production of heat and muscular force.

Of the meat my butcher sends me, the fish I find in the market, the bread and the other food upon my table, only a part serves to fulfill these purposes. The bone of our roast beef we do not use for food at all, and that of shad is worse than useless because of the bother it makes us to get rid of it ; it is only the edible portion that is of actual value to us as food, the rest being merely refuse. And when we come to consider the edible portion, the meat freed from bone and gristle, the flesh of the fish, or the flour as it is baked in bread, we find that these consist largely of water. And although water is indispensable, that in the meat or the potatoes on my table is of no more valuable for the support of my body, than the same amount in milk or in the glass of water by my plate.

Leaving out of account, then, the refuse and the water, we have remaining the nutritive material of our food. This consists of different materials which we may call nutrients. We may divide them into four classes: protein, fats, carbo-hydrates and mineral matter, or ash. Let me speak briefly of some of the characteristics of these classes of nutrients.

Protein.—The terms protein, proteids, and albuminoids, are applied somewhat indiscriminately, in ordinary usage, to several

or all of certain classes of compounds charcterized by containing carbon, oxygen, hydrogen, and with them, nitrogen. The most important are the proteids or albuminoids, of which albumen, the white of egg, fibrin of blood, casein of milk, myosin, the basis of muscle, and gluten of wheat, are examples. Allied to these, but occurring in smaller proportions in animal tissues and foods, are the nitrogenous compounds that make the basis of connective and other tissues. Gelatin is derived from some of these tissues, and may be taken as a type of the compound of this class. As these constituents are of similar constitution and have similar or nearly similar uses in nutrition, it is customary to group them together as protein.* What we should especially bear in mind, then, is that protein is a term applied to the nitrogenous constituents of our foods, and we shall see these are, in general, the most important, as they are most costly, of the nutrients.

Fats.—We have familiar examples of these in the fat of meat, (tallow, lard,) in the fat of milk which makes butter, and in olive, cotton seed, and other animal and vegetable oils. The fats consist of carbon oxygen and hydrogen and contain no nitrogen. In nutritive value, as in cost, they rank next to the protein compounds. For some of the nutritive functions, indeed, the fats equal or exceed protein in importance.

Carbo-hydrates—Starch, cellulose, (woody fiber) sugar, and inoosite, ("Muscle sugar") and other similar substances are called carbo-hydrates. Like the fats, they consist of carbon, oxygen and hydrogen, but they have less carbon and hydrogen, and more oxygen than the fats.

Mineral matters or Ash.—When vegetable or animal matters are burned, more or less incombustible material remains as ash. The ingredients which make the ash are called mineral matters, or sometimes, salts. They are for the most part compounds of the elements, potassium, sodium, calcium and iron with chlorine, sulphuric acid and phosperic acid. Sodium combined with chlor-

* The muscular tissues of animals, and hence the lean portions of meat, fish, etc., contain small qualities of so-called nitrogenous extractives—creatin, carnin, etc., contained in extract of meat, etc., which contribute materially to the flavor, and somewhat to the nutritive effect of the foods containing them. They are not usually deemed of sufficient importance, however, to be grouped as a distinct class in tabular statements of the composition of foods.

ine forms sodium chloride, common salt. Calcium with phosphoric acid forms calcium phosphate or phosphate of lime, the mineral basis of bones.

Our bodies contain scores of compounds, many of which can not be included in either of the above four classes. But the bulk of the compounds in the bodies of animals, as well as in the food by which they are nourished, are either water or some material which we may call protein, fats, carbo-hydrates, or mineral matters.

Animal foods, as meats, fish, etc., contain but little of carbo-hydrates, their chief nutrients being protein and fats. Milk, however, and some shell fish, as oysters, scallops, etc., contain more or less of carbo-hydrates. Vegetable foods, as wheat, potatoes, etc., contain less protein and consist largely of starch, sugar, cellulose, and other carbo-hydrates, though nearly all contain more or less of fats.

THE FUNCTIONS OF THE NUTRIENTS.

These different nutrients as we have seen, have different offices in nourishing the body, in building up its tissues, repairing its wastes, and serving as fuel to produce animal heat, and muscular and intellectual energy. Just what is done by each class, exactly how they are transformed and used in the body, is not yet fully known. Still we have to-day a tolerably fair idea of the principal parts played by each class of nutrients.

According to views formerly held and frequently met with, still, the protein compounds were regarded as the "flesh-formers" and the sources of muscular energy, while the carbo-hydrates and fat were looked upon as "fat-formers" and "heat-producers." A vast deal of painstaking research, however, has shown that these distinctions were not correctly drawn. The albuminoids are flesh-formers, it is true; indeed, according to the nearly unanimous testimony of the most trustworthy experiments, flesh, *i. e.*, muscular and other nitrogenous tissue, is made from the nitrogenous constituents of the food exclusively. But the balance of testimony is decidedly against the production of muscular energy exclusively or mainly, by nitrogenous com-

pounds. Each of the three groups of nutrients probably shares, directly or indirectly, in the production of muscular force. So, too, it appears that the combustion which produces animal heat is not confined to the carbo-hydrates and fats, but the protein compounds, or the products of their decomposition, are also used for this purpose. Again, the production of fat in the body was formerly ascribed to the fats and carbo-hydrates alone. On the other hand some physiologists maintain that the carbo-hydrates cannot be transformed into fats, and that a very large part of the fat of the body is formed from the disintegration of the albuminoids. The weight of evidence to-day is decidedly in favor of the assumption that all three of the great classes of nutrients in our foods—the albuminoids, the carbo-hydrates, and the fats—are transformed into fat, and that the fat thus formed is consumed, either before or after being stored as body-fat.

It appears, then, that protein is the most important constituent of our food, because, while it performs the functions of each of the other two chief nutrients in being transformed into fat and in being consumed for fuel, it has a most weighty office of its own in forming the basis of the blood and in building up the muscular and other nitrogenous tissues, an office which no other nutrient can perform at all. And, as we shall see further, in examining the pecuniary cost, protein is the dearest as well as the most important of the ingredients of foods.

Next in physiological importance to protein come the fats. They lack the nitrogen of the protein and cannot do the work of protein in forming nitrogenous tissue, making blood, muscle, etc. But they are very rich in carbon and hydrogen, more so than either protein or carbo-hydrates, and hence they have a very high value for fuel, to supply heat and probably muscular force. And in pecuniary cost as well as in physiological importance they rank between protein and carbo-hydrates.

The carbo-hydrates stand lowest in the scale of physiological importance and are pecuniarily the least expensive. Nevertheless it would be wrong to class the carbo-hydrates of food as on the whole of minor importance. They have a most important use in taking the place of protein and fats and protecting them from being consumed, just as the fats replace and thus save the

protein. The materials used for food by man contain, taken all together, more carbo-hydrates than fats or protein. The carbo-hydrates have their normal place in our food and we could not dispense with them. They are of inferior value to the protein and fats, in the sense that there is much of the work of food in the body which they cannot do as well as the protein and fats, and much more which they cannot do at all. But they do work which the scarcer and dearer protein and fats would otherwise have to do, and, furthermore, they occur in such large proportions, especially in vegetable materials which make the larger part of the food of man, that their actual importance is very great.

AMOUNTS OF NUTRIENTS REQUIRED FOR A DAY'S RATIONS.

Numerous attempts have been made to determine how much of each of the three principal classes of nutrients, protein, fats, and carbo-hydrates, is needed for a day's food for an individual, an adult or a child, at work or at rest. We know, in general, a man when hard at work requires more, because more is consumed in his body than the same man would when doing no work. But different men have different requirements, due to individual peculiarities, so that the best we can do is to take an average amount as expressing the need of an average man. By comparing the amounts of carbon, oxygen, hydrogen, and nitrogen, actually found by experiments to be consumed by different individuals, and also noting the amount and composition of the food consumed by different persons, estimates have been made of the quantities of the several nutrients by individuals of different classes under various conditions. Prof. von Voit, of the University of Munich, for instance, who has made more extensive researches upon this subject, perhaps, than any one else, computes that a fair daily ration for a laboring man of average weight, at moderate work, would need to supply: 4.2 ounces of protein; 2 ounces of fats; and 17.6 ounces of carbo-hydrates. Of course he may get on with less of either one, provided he has more of the others. But there is a minimum below which he cannot go without injury, and especially he must not have too little protein. He may have more protein and less carbo-hy-

drates or fats with no great harm, but with too little protein he will suffer, no matter how much carbo-hydrates his food may furnish.

If I have dwelt at some length upon this matter of the nutrients of foods and the ways they are used in our bodies, it is because it is extremely important to a proper understanding of our subject. And perhaps I can do no better than to recapitulate what I have said in the following tabular form.

NUTRIENTS OF FOODS.

1. *Protein Compounds:*—Contain Carbon, Oxygen, Hydrogen and Nitrogen.
2. *Fats:*—Consist of Carbon, Oxygen and Hydrogen.
3. *Carbo-hydrates:*—Consist of Carbon, Oxygen and Hydrogen.
4. *Mineral matters or Ash:*—e. g. Calcium, Potassium and Sodium, Phosphates and Chlorides.

Protein { A. *Albuminoids or Proteids:* e. g. Albumen of Egg, Myosin of muscle (Lean of Meat), Casein of Milk, Gluten of Wheat.
B. *Gelatinoids:* e. g. Collagen (which boiled, yields Gelatin).

Fats: e. g. Fats of Meat, Butter, Olive Oil, Oil of Maize and Wheat.
Carbo-hydrates: e. g. Starch, Sugar, Cellulose.

MEAN PERCENTAGE COMPOSITION.

	Protein Compounds.	*Fats.*	*Carbo-hydrates.*
Carbon	53.5 per cent.	76.5 per cent.	44.0 per cent.
Oxygen	22.5 " "	11.6 " "	49.6 " "
Hydrogen	7.0 " "	11.9 " "	6.4 " "
Nitrogen	16.0 " "		
Sulphur	1.0 " "		
	100.0	100.0	100.0

FUNCTIONS OF NUTRIENTS:

ie. Ways in which the nutrients are used in the body.

The Protein of food	forms the (nitrogenous) basis of blood, muscle, connective tissue, etc. is transformed into fats and carbo-hydrates. is consumed for fuel.
The Fats of food	are stored as fat. are consumed for fuel.
The Carbo-hydrates of food	are transformed into fat. are consumed for fuel.

AMOUNTS OF NUTRIENTS REQUIRED IN A DAY'S FOOD.

Minimum daily ration for laboring men at ordinary work.

Protein	*Fats*	*Carbo-hydrates*
118 grams (4,2 ounces).	56 grams (2 ounces).	500 grams (17,6 ounces).

The same experimental research which has revealed to us the ways in which our food supplies our bodily wants, has shown us how to estimate the relative nutritive values of different foods from their chemical composition. The estimates are only approximate, because the nutritive effects are influenced by various conditions, some of which research has not yet been definitely explained, while others vary with the nature of the food or the user, so that the value of a given food in a given case may vary from the standard set by the analysis. These sources of uncertainty are nevertheless so narrowed down by late investigation, and the errors confined within such limits, that by intelligent use of the facts at our disposal, we may judge very closely from the chemical composition of a food, what is its value as compared with others of the same class, at any rate, for our nourishment.

CHEMICAL ANALYSIS OF FOODS.

We are now ready to consider the amounts of the different ingredients, nutrients and non-nutrients, in fish and other foods. Perhaps I can illustrate this in no better way than by an actual example. A sample of beef, sirloin, of medium fatness, was found by analysis in our laboratory, to consist of about one-fourth bone and three-fourths flesh, edible substance. The flesh was analyzed and found to contain, nearly: water, 60 per cent.; protein, 19 per cent.; fats, 20 per cent.; mineral matter, 1 per cent. Calculating upon the whole sample of meat, which one-fourth, or twenty-five per cent., was bone and other refuse, and 75 per cent. flesh, the analysis would stand as in the following table, in which the composition of the flesh by itself and that of the meat, bone, and all, are both given:—

	In flesh, edible portion.	In meat as bought including refuse.
	Per cent.	Per cent.
Refuse, bone, etc.	None.	25
Water	60	45
Protein	19	14¼
Fat	20	15
Mineral matters	1	¾
Total	100	100

This very imperfect analysis may be stated in the following form, as is done in the tables beyond:

The tables beyond contain also columns for carbohydrates, etc., which occur in milk and in some shell-fish, but are not found in ordinary meats in sufficient amount to warrant their insertion in such tables as these.

CONSTITUENTS OF SAMPLE OF BEEF—SIRLOIN.

FOOD-MATERIAL.	In Edible Portion— i.e., flesh freed from bone and other refuse					In Meats as purchased— including both edible portion and refuse.					
							Edible portion.				
			Nutrients.						Nutrients.		
	Water.	Nutrients.	Protein.	Fats.	Mineral matters	Refuse: Bones, etc.	Water.	Nutrients.	Protein.	Fats.	Mineral matters
	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct	Per ct
Beef, sirloin, medium fatness	60	40	19	20	1	25	45	30	14.3	15	0.7

I think that with the above illustrations the following tables, illustrating the composition of fish and other animal and vegetable foods will be plain.

Table I gives the composition of a number of specimens of the flesh of fish and invertebrates, *i. e.*, the edible portion freed from bone, skin and other refuse.

Table II gives the composition of the specimens as actually found in the markets including both refuse and edible portion.

Table I is the more interesting from the chemical and physiological standpoint, but Table II is more useful, practically, since it shows how much of the several nutrients we actually get in the materials as we buy them.

Table III gives the composition of a number of our more common vegetable food materials.

Table IV includes a smaller number of the analyses of fish, but gives other animal foods, meats, dairy products, etc., for comparison. The composition of edible portions and of the materials as found in the markets are both given together.

I ought to say with regard to all the figures in the tables, that they are based upon too few analysis to allow them to be entirely satisfactory. It is only a short time since analysis of American meats, fish, etc., have been undertaken in any considerable number, and those as yet accomplished are far from

sufficient for a complete survey of the subject. Indeed, the work already done can be regarded only as a beginning. Still, the figures will give a tolerably fair idea of the composition of the articles named.

The analysis of animal food, the tables with the exception of a few from European sources and indicated by italics, are selected from the results of the investigation of which I have spoken as conducted under the auspices of the Smithsonian Institution and the United States Fish Commission, and are almost the only ones as yet attempted in this country. Those of vegetable foods are in part from the investigation, and in part from other sources.

TABLE I.

Percentages of Water and Nutritive Ingredients in Flesh, Edible Portion.

(Freed from Bone, Shells and other Refuse Matters)

OF FOOD FISHES AND INVERTEBRATES.

Specimens of flesh of Fish and of edible portion, (flesh and liquids) of Oysters, etc., were found to contain water and nutritive substances, as below. The figures represent parts in 100 by weight. Protein x Fats x Carbo-hydrates, etc. x Mineral Matters = Nutrients. Nutrients x Water =100.

KINDS OF FOOD FISHES AND INVERTEBRATES.		WATER.	NUTRIENTS.	NUTRIENTS. PROTEIN.	FATS.	CARBO-HYDRATES, ETC.	MINERAL MATTERS.
FRESH FISH.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Alewife		73.0	27.0	19.5	6.0	.....	1.5
Black Bass		76.7	23.3	20.4	1.7	.....	1.2
Bluefish		78.5	21.5	19.0	1.2	.....	1.3
Cod		82.6	17.4	15.8	0 4	.....	1.2
Eel		71.6	28.4	18.3	9.1	.....	1.0
Lamprey Eel		71.1	28.9	14.9	13 3	.....	0.7
Flounder		84.2	15.8	13.8	0.7	.....	1.3
Haddock		81.7	18.3	16.8	0.3	.....	1.2
Halibut		75.4	24.6	18.3	5.2	.....	1.1
Herring		69.0	31.0	18.5	11.0	.....	1.5
Mackerel, rather lean		78.7	21.3	18.1	2.2	.....	1.0
" fat		64.0	36.0	18.2	16.3	.....	1.5
" average		73.4	26.6	18.2	7.1	.....	1.3
Yellow Perch		79.2	20.8	18.7	0.8	.....	1.3
Pike Perch		79.7	20.3	18.4	0.5	.....	1.4
Pickerel. (Pike)		79.7	20.3	18.6	0.5	.....	1.2
Salmon. In season, fat		61.4	38.6	24.2	13.0	.....	1 4
" "Spent" lean		79.2	20.8	17.6	2.0	.....	1 2
Shad		70.6	29.4	18.5	9.5	.....	1.4
Smelt		79.2	20.8	17.3	1.8	.....	1.7
Brook Trout		77.7	22.3	19.0	2.1	.....	1.2
Salmon Trout		69.1	30.9	18.3	11.3	.....	1.3
Whitefish		69.8	30.2	22.1	6.5	.....	1.6
PREPARED FISH.	Salt per cent						
Dried Cod. Boned and dried artificially	2.9	15.2	81.9	74.6	1.9	.....	5.4
Salt Cod. Salted and Dried	20.6	53.6	25.8	21.4	0.3	.....	4.1
Salt Mackerel. "No. 1 Mackerel" Salted	10.6	42.2	47.2	22.6	22.9	.....	2.6
Smoked Haddock. Salted, Smoked and Dried	2.1	72.6	25.3	23.6	0.2	.....	1.5
Smoked Herring. Salted. Smoked and Dried	11.7	34 5	53.8	36.4	15.8	.....	1.6
Canned Salmon. California (Oregon)	1.3	59.9	38.8	19.4	18.0	.....	1.4
Canned Fresh Mackerel	1.9	68.2	29.9	19.9	8.7	.....	1.3
Canned Salt Mackerel. "No. 2 Mackerel" Salted	10.3	43.4	46.3	17.3	26.4	.....	2.6
INVERTEBRATES. SHELL FISH, Etc.							
Oysters. Shell contents. Best (1)		83.4	16.6	6.4	1.7	6.5	2.0
" " " Inferior (1)		91.4	8.6	4.5	0.6	1.8	1.7
" " " Average (1). 34 samples		87.3	12.7	6.0	1.2	3.5	2.0
Oysters. Solids (2) Edible portion. Av'ge		87.2	12.8	6.3	1.6	4.0	0 9
Long Clams. Shell contents		85.9	14.1	8.2	1.0	2.3	2.6
Round Clams. " "		86.2	13.8	6.6	0.4	4.2	2.6
Mussels. " "		84.2	15.8	8.7	1.1	4.1	1.9
Scallops. Edible portion (Muscle)		80.3	19.7	14.7	0.2	3.4	1.4
Lobsters. " "		81.8	18.2	14.5	1.8	0.2	1.7
Crabs. " "		77.1	22.9	16.6	2.0	1.2	3.1
Cray Fish " "		81.2	18.8	16.0	0.5	1.0	1.3
Canned Oysters		85.2	14.8	7.4	2.1	4.0	1.3
Canned Lobsters		77.7	22.4	18.1	1.1	0.6	2.5

(1) In respect to quantity of nutrients.

(2) Shell contents as commonly sold, including whole of "solid" and most of liquid portion.

TABLE II.

Percentages of Refuse, Water and Nutritive Ingredients in specimens of Food Fishes and Invertebrates as found in the markets.

Samples of Fish—whole or dressed—and of Oysters, etc., including or freed from the shell, as ordiarily sold in the New York or Middletown, Conn. markets, were found to contain

1. Refuse—Bone. Shells, and other Inedible Matters.
2. Edible Portion—Water and Nutritive Substances.
3. Ingredients of Nutritive Substance, Nutr ents—Protein, Fats, Carbohydrates, etc. ("Non-nitrogeneous Extractive Matters") and Mineral Matters in parts in 100 by weight, as below. (Nutrients x Water x Refuse = 100.)

Kinds of food fishes and invertebrates, and portions taken for analysis.	Refuse. Bone, skin, shells, etc.	Edible portion. Water	Edible portion. Nutrients.	Nutrients. Protein.	Nutrients. Fats.	Nutrients. Carbohydrates, etc.	Nutrients. Mineral matters.
FRESH FISH.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Alewife. Whole	49.4	36.9	13.7	9.9	3.0	.....	0.8
Black Bass. Whole	54.8	34.6	10.6	9.2	0.8	.....	0.6
Bluefish. Entrails removed	48.6	40.3	11.1	9.8	0.6	.....	0.7
Cod. Head and entrails removed	29.9	57.9	12.2	11.0	0.3	.....	0.9
Eel. Skin, head and entrails removed	20.2	57.1	22.7	14.6	7.3	.....	0.8
Lamprey Eel. Whole	45.8	38.5	15.7	8.1	7.2	.....	0.4
Flounder	66.8	27.2	6.0	5.2	0.3	.....	0.5
Haddock. Entrails removed	51.0	40.0	9.0	8.3	0.1	.....	0.6
Halibut. Sections of body	17.7	62.1	20.2	15.1	4.2	.....	0.9
Herring. Whole	46.0	37.3	16.7	10.0	5.9	.....	0.8
Mackerel. Rather lean. Whole	38.3	48.5	13.2	11.2	1.4	.....	0.6
Mackerel. Fat	33.8	42.4	23.8	12.1	10.7	.....	1.0
Mackerel. Average	44.6	40.7	14.7	10.1	3.9	.....	0.7
Yellow Perch. Whole	62.7	30.0	7.3	6.7	0.2	.....	0.4
Pike Perch. Whole	57.2	34.1	8.7	7.8	0.2	.....	0.6
Pickerel (Pike). Whole	47.0	42.2	10.8	9.9	0.2	.....	0.7
Salmon. In season, fat. Whole	38.5	37.6	23.9	15.0	8.0	.....	0.9
" "Spent" lean. Whole	46.2	42.6	11.2	9.5	1.0	.....	0.7
Shad. Whole	50.1	35.2	14.7	9.3	4.7	.....	0.7
Smelt. Whole	41.9	46.1	12.0	10.0	1.0	.....	1.0
Brook Trout. Whole	48.1	40.3	11.6	9.9	1.1	.....	0.6
Salmon Trout. Entrails removed	35.2	45.0	19.8	12.4	6.6	.....	0.8
Whitefish	53.5	32.5	14.0	10.3	3.0	.....	0.7
PREPARED FISH.	Salt per cent						
Dried Cod. Boned and dried	2.9	.....	15.2	81.9	74.6	1.9	.....	5.4
Salt Cod. Salted and dried	15.4	24.9	40.3	19.4	16.0	0.4	.....	3.0
Salt Mackerel. "No. 1 Mackerel" salted	8.2	22.9	32.5	36.4	17.0	17.4	.....	2.0
Smoked Haddock. Salted, smoked and dried	1.4	32.2	49.2	17.2	16.1	0.1	.....	1.0
Smoked Herring. Salted, smoked and dried	6.5	44.4	19.2	29.9	20.2	8.8	.....	0.9
Canned Salmon. California (Oregon)	1.3	.....	59.9	38.8	19.4	18.8	.....	1.3
Canned Fresh Mackerel	1.9	.....	68.2	29.9	19.9	8.7	.....	1.3
Canned Salt Mackerel. "No. 2 Mackerel" salted	8.3	19.7	34.8	37.2	13.8	21.3	.....	2.1
INVERTEBRATES, SHELL FISH, Etc.							
Oysters. In shell. Inferior (1)	88.8	10.2	1.0	0.5	0.1	0.2	0.2
" " Best (1)	81.4	15.2	3.4	1.5	0.2	1.3	0.4
" " Average	82.3	15.4	2.3	1.0	0.2	0.6	0.5
" Solids. In shell. (2) Edible portion. Average	.....	87.2	12.8	6.2	1.5	4.1	1.0
Long Clams. In shell	43.8	48.3	7.9	4.3	0.5	1.3	1.8
Round Clams. "	68.3	27.3	4.4	2.1	0.1	1.3	0.9
Mussels. In shell	49.3	42.7	8.0	3.9	0.5	2.1	1.5
Scallops. Edible portion. (Muscle)	.....	80.3	19.7	14.7	0.2	3.4	1.4
Lobsters. In shell	60.2	33.0	6.8	5.4	0.5	0.2	0.7
Crabs. "	55.8	34.1	10.1	7.3	0.9	0.5	1.4
Crayfish. "	87.7	10.0	2.3	1.9	0.1	0.1	0.2
Canned Oysters	.....	85.4	14.6	6.4	1.6	5.1	1.5
Canned Lobsters	.....	77.7	22.3	18.1	1.1	0.6	2.5

(1) In respect to quantity of nutrients.

(2) Including solid and most of liquid shell contents as commonly sold.

TABLE III.

Constituents of Vegetable Foods and Beverages.

Kinds of Foods and Beverages.	Water.	Nutrients. Protein (Albuminoids).	Fats.	Carbo-hydrates etc.	Woody Fiber.	Mineral Matters.
FOODS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Wheat-flour, average*	11.6	11.1	1.1	75.4	0.2	0.6
Wheat-flour, maximum*	13.5	13.6	2.0	78.5	1.2	1.5
Wheat-flour, minimum*	8.3	8.6	0.6	68.3	0.1	0.3
Graham-flour (wheat)	13.0	11.7	1.7	69.9	1.9	1.8
Cracked wheat	10.4	11.9	1.7	74.6		1.4
Rye-flour	13.1	6.7	0.8	78.3	0.4	0.7
Pearled barley	11.8	8.4	0.7	77.8	0.3	1.0
Buckwheat-flour	13.5	6.5	1.3	77.3	0.3	1.1
Buckwheat "farina"	11.2	3.3	0.3	84.7	0.1	0.4
Buckwheat "groats"	10.6	4 8	0.6	83.1	0.3	0.6
Oatmeal	7.7	15.1	7.1	67.2	0.9	2.0
Cornmeal	14.3	8.4	3.5	70.9	1.6	1.3
Hominy	13.5	8.3	0.4	77.1	0.3	0.4
Rice	12.4	7.4	0.4	79.2	0.2	0.4
Beans	13.7	23.2	2.1	53.7	3.7	3.6
Peas	15.0	22.9	1.8	52.4	5.4	2.5
Potatoes	75.5	2.0	0.2	20.7	0.8	1.0
Sweet Potatoes	75.8	1.5	0.4	20.0	1.1	1.2
Turnips	91.2	1.0	0.2	6.0	0.9	0.7
Carrots	87.9	1.0	0.2	8.9	1.2	0.8
Cabbage	90.0	1.9	0.2	4.9	1.8	1.2
Cauliflower	90.4	2.5	0.4	5.0	0.9	0.8
Melons	95.2	1.1	0.6	1.4	1.1	0.6
Pumpkins	90.0	0.7	0.1	7.3	1.3	0.6
Apples	84.8	0.4	.....	12.8	1.5	0.5
Pears	83.0	0.4	.....	12.0	4.3	0.3
Starch	15.1	1.2	.....	83.3	. .	0.4
Cane Sugar	2.2	0.3	.....	96.7	...	0.8
Wheat Bread†	32.7	8.9	1.9	55.5		1.0
Graham Bread	34.2	9.5	1.4	53.3		1.6
Rye Bread	30.0	8.4	0.5	59.7		1.4
Soda Crackers	8.0	10.3	9.4	70.5		1.8
"Boston" Crackers	8.3	10.7	9.9	68.7		2.4
"Oyster" Crackers	3.9	12.3	4.8	76.5		2.5
Oatmeal Crackers	4.9	10.4	13.7	69.6		1.4
Pilot (bread) Crackers	7.9	12.4	4.4	74.2		1.1
Macaroni	13.1	9.0	0.3	76.8		0.8
BEVERAGES.			Alcohol.		Free acid.	
Lager Beer	90.3	0.5	4.0	6.6	.....	0.2
Porter and Ale	88.5	0.7	5.2	7.2	.....	0.3
Rhenish Wine, white	86.3	.....	10.5	2.6	0.4	0.2
Rhenish Wine, red	86.9	.....	8.9	3.4	0.5	0.3
French Wine, Claret	88.4	.....	8.1	3.7	0.6	0.2

* Of forty-nine analysis.

† From flour of about average composition.

The analysis of foods in Roman letters are American, those of food and beverages in italics, are European.

TABLE IV.

CONSTITUENTS OF ANIMAL FOODS.

KINDS OF FOOD MATERIALS (Italics indicate European Analysis, the rest denote American.)	IN EDIBLE PORTIONS, i.e., Flesh, etc., freed from Bone, Shells and other Refuse — Water	Nutrients	Protein (Albuminoids)	Fats	Carbohydrates, etc.	Mineral Matters	IN SPECIMENS AS PURCHASED IN THE MARKETS, Including both Edible Portions and Refuse — Refuse — Bones, Skins, Shells, etc.	EDIBLE PORTION — Water	Nutrients	Protein (Albuminoids)	Fats	Carbohydrates, etc.	Mineral Matters
			Nutrients							Nutrients			
	Per cent.	Per cent.	Per cent	Per cent	Per cent.	Per cent.	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent.
MEATS—Fresh.													
Beef, side, well fattened	54 6	45 4	17 9	23 5		1 0	10 7	43 8	36 5	14 4	21 3		0 8
Beef, lean, nearly freed from fat	76 0	24 0	21 8	0 9		1 3		76 0	24 0	21 8	0 9		1 3
Beef, round, rather lean (1)	66 7	33 3	23 0	9 0		1 3	10 0	60 0	30 0	20 7	8 1		1 2
Beef, sirloin, rather fat (1)	60 0	40 0	10 0	26 0		1 0	25 0	45 0	30 0	14 3	15 0		0 7
Beef, flank, very fat (1)	27 3	72 7	12 4	59 6		0 7	12 5	23 9	63 6	10 8	52 2		0 6
Beef, liver	69 5	30 5	20 1	5 4	3 5	1 5		69 5	30 5	20 1	5 4	3 5	1 5
Beef, tongue	63 8	36 2	17 1	18 1		1 0	15 3	54 0	30 7	14 5	15 3		0 9
Beef, heart	56 8	43 2	15 8	26 3		1 1	6 0	53 4	40 6	14 9	24 8	..	0 9
Veal, loin	79 8	21 2	19 9	0 8		(0 5)	?						
Veal, rather fat	72 3	27 7	18 9	7 5		(1 3)	?						
Mutton, side, well fattened	53 6	46 4	16 5	29 0		0 9	20 0	42 9	37 1	13 2	23 2		0 7
Mutton, leg (1)	61 9	38 1	18 2	19 0		0 9	18 4	46 2	41 4	12 2	28 6		0 6
Mutton, shoulder (1)	58 6	41 4	18 0	22 4		1 0	16 9	48 7	34 4	15 0	18 6		0 8
Mutton, loin (chops)	49 3	50 7	11 9	35 1		0 7	16 3	41 3	42 4	12 5	29 8		0 6
MEATS PREPARED													
Dried beef	59 5	40 5	29 2	4 5		6 8	6 5	55 5	38 0	27 4	4 9		6 4
Corned beef, rather lean	58 1	41 9	21 4	17 4		3 1	6 2	54 5	39 3	20 1	16 3		2 9
Smoked ham	41 5	58 5	24 0	30 6		3 9	12 4	36 4	51 2	21 0	26 8		3 4
Pork, bacon, salted	10 0	90 0	3 0	80 5		6 5	5 0	9 5	85 5	2 8	76 5		6 2
FOWL													
Chicken, rather lean	71 5	28 5	25 1	2 0		1 4	41 6	41 8	16 6	14 6	1 2		0 8
Turkey, medium fatness	65 6	34 4	24 7	8 5		1 2	35 4	42 4	22 2	16 0	5 5		0 7
Goose, fat	38 0	62 0	15 9	45 6		0 5	?						
DAIRY PRODUCTS, EGGS, Etc.													
Cows' milk	87 4	12 6	3 4	3 8	4 8	0 7		87 4	12 6	3 4	3 7	4 8	0 7
Cows' milk, skimmed	90 7	9 3	3 1	0 7	4 8	0 7		90 7	9 3	3 1	0 7	4 8	0 7
Cows' milk, buttermilk	90 3	9 7	4 1	0 9	4 0	0 7		90 3	9 7	4 1	0 9	4 0	0 7
Cows' milk, whey	93 2	6 8	0 9	0 2	5 0	0 7		93 2	6 8	0 9	0 2	5 0	0 7
Cheese, whole milk (2)	31 2	68 8	27 1	35 4	2 4	3 9		31 2	68 8	27 1	35 4	2 4	3 9
Cheese, skimmed milk	41 3	58 7	38 3	6 8	9 0	4 6		41 3	58 7	38 3	6 8	9 0	4 6
Butter	7 0	93 0	1 0	89 0		3 0		7 0	93 0	1 0	89 0		3 0
Butter	4 5	85 5	0 7	83 3	0 6	0 9		14 5	85 5	0 7	83 3	0 6	0 9
Hens' Eggs	73 7	26 3	12 5	12 1	0 6	1 1	11 0	65 6	23 4	11 1	10 8	0 5	1 0
FISH, Etc.													
Flounder, whole	84 2	15 8	13 8	0 7		1 3	66 8	27 2	6 0	5 2	0 3		0 5
Haddock, dressed	81 7	18 3	16 8	0 1		1 2	51 0	40 0	9 0	8 3	0 1		0 6
Halibut, dressed	78 5	21 5	19 0	1 2		1 3	48 6	40 3	11 1	9 8	0 6		0 7
Cod, dressed	82 6	17 4	15 8	0 4		1 2	29 9	57 9	12 2	11 0	0 3		0 9
Whitefish, whole	69 8	30 2	22 1	6 5		1 6	53 5	32 5	14 0	10 3	3 0		0 7
Shad, whole	70 6	29 4	18 5	9 5		1 4	50 1	35 2	14 7	9 3	4 7		0 7
Mackerel, average, whole	73 4	26 6	18 2	7 1		1 3	44 6	40 7	14 7	10 1	3 9		0 7
Salt Cod	53 6	25 8	21 4	0 3		4 1 (Salt) 21 6	24 9 (Salt) 15 4	40 3	19 4	16 0	0 4		3 0
Smoked Herring	31 5	53 8	36 1	15 8		1 6 11 7	44 4 6 5	19 2	29 9	20 2	8 8		0 9
Salt Mackerel	42 2	47 2	22 0	22 6		2 6 10 6	22 9 8 9	32 5	36 4	17 0	17 4		2 0
Oysters, average (3)	87 3	12 7	6 0	1 2	3 6	2 0	82 3	15 4	2 3	1 0	0 2	0 6	0 5
Scallops, edible portion	80 3	19 7	14 7	0 2	3 4	1 4		80 3	19 7	14 7	0 2	3 4	1 4

(1) Portions of the side of which analysis is given above. (2) New York Factory Cheese. (3) i.e. The edible portion as ordinarily purchased in the markets, including the "meats" and most of the liquid portion of the shell contents.

I have said so much by way of introduction to the tables, that it may be hardly advisable to discuss their contents at much length. Nor will this be necessary for the figures themselves tell their own stories and very plainly. Only a glance is needed to show that fish as found in the markets generally contain more refuse bone, skin, etc., than meats, as is illustrated in Tables I, II and III. With the larger proportions of both refuse and water, the proportions of nutrients, though variable, are usually much less than meats. Thus a sample of flounder contained 67 per cent. of refuse, 28 of water, and only 5 per cent. of nutritive substance, while the salmon averaged 23, the salt cod 22, and the salt mackerel 36 per cent. of nutrients. The nutrients in meats ranged from 30 per cent. in beef to 46 in mutton, and 87½ in very fat pork (bacon). The canned fish compare very favorably with the meats. It is worth noting, that the nutrients in fresh codfish, dressed, in oysters, edible portion, and in milk, all were nearly the same in amount—about 12½ per cent., though differing in kind and proportions.

Vegetable foods have generally less water and more nutrients than animal foods. Ordinary flour, meal, etc., contain from 85 to 90 per cent. or more of nutritive material. But the nutritive value is not proportional to the quantity of nutrients, because the vegetable foods consist mostly of carbo-hydrates, starch, sugar, cellulose, etc., of inferior nutritive effect, and because their protein is less digestible than that of animal foods. Potatoes contain a large amount of water, and extremely little protein or fats.

There are two things concerning the composition of fish to be particularly noticed:

1st. The chief difference between the flesh of fish and ordinary meats is, that the fish generally contains less fat and more water. The fat of meats is in the fish, to a considerable extent, replaced by water. On this account the flesh of fish has, generally, a lower nutritive value, pound for pound, than ordinary meats. Fish, as we buy them, have the further disadvantage in comparison with meats, that they contain larger percentages of refuse bone, skin, entrails, etc., than meats.

2nd. On the other hand, the flesh of most fish, the nutritive

material is nearly all protein. That is to say, fish supply the nutrient that is at once the most important and the most costly of all.

DIGESTIBILITY OF FISH.

Regarding the ease and rapidity of the digestion of fish, the experimental evidence is as yet insufficient for exact conclusions. The investigations thus far made upon the constitution of the ingredients of the flesh, as well as those upon artificial digestion, indicate no great difference between the fish and the leaner meats, as lean beef, and imply that both would be very readily digested. The actual amounts of nutritive ingredients digested from fish can be only told by actual experiment. The only attempts to test this question, of which I am aware, were made in connection with the investigation the results of which I am alluding to, and are very few in number. It was my fortune sometime since to spend some months in Munich, Germany, where through the kindness of Prof. Voit, I was enabled to make some experiments in the physiological laboratory of the university in that city. The proportions of the nutrients digested were tested in a series of experiments with a healthy man and with a dog. The man digested some 95–97 per cent. of the protein of the fish, and nearly the same proportion from meat (lean beef). That is to say, the digestion of the protein of both meat and fish was nearly complete. The experiments with the dog also gave essentially the same results with both kinds of food. In brief, the experimental facts at hand do not indicate any decided difference in digestibility between fish and the leaner meats. Both belong to the more readily and completely digestible foods.

To get a fully satisfactory knowledge of the digestibility and nutritive values of fish compared with other foods, it will be necessary to make detailed studies of the nature of the chemical compounds contained in them. During a late residence in Heidelberg, I was enabled through the courtesy of Prof. Kuhne, who kindly gave me all needed opportunities in his laboratory, to commence some studies in this direction. Though far from complete, they indicate a very great similarity in the constituents of the flesh of fish and mammals used for food.

In brief, while fish contain somewhat less percentages of nutrients than ordinary meats, they have more waste, more water, and less fat. The nutrients they do contain seem to be very similar in constitution, and in nutritive value to those of other animal foods.

COMPARATIVE EXPENSIVENESS OF ACTUAL NUTRIENTS IN FISH AND OTHER FOODS.

The relative physiological values of the nutrients in different foods depends upon (1) their digestibility and (2) their functions and the proportions in which they can replace each other in nutrition. An accurate physiological valuation is, in the present state of our knowledge, at least, impracticable. The pecuniary costs of the nutrients are, however, more nearly capable of approximation.

From extended comparisons of the composition and market prices of the more important animal and vegetable food-materials, such as meats, fish, flour, etc., those which serve for nourishment and not as luxuries, and form the bulk of the food of the people, it has been estimated that a pound of protein costs, on the average, five times as much, and a pound of fats, three times as much as a pound of carbo-hydrates; that in other words, these three classes of nutrients stand related to each other in respect to cost, in the proportion:

Assumed ratios of costs in staple foods:	Protein . . .	5
	Fats . . .	3
	Carbo-hydrates	1

Suppose a pound of beef of average fatness to cost 25 cents, and to contain 25 per cent of inedible matters, bone, etc., 45 per cent. of water, and 30 per cent of nutritive substance, upon which latter—the bone and water being assumed to be without nutritive value—the whole cost comes. The 30 per cent. or $\frac{30}{100}$ pounds of nutritive substance thus costs 25 cents, or at the rate of $83\frac{1}{3}$ cents per pound. If now we leave out of account the minute quantities of carbo-hydrates and the mineral matters, the whole cost will fall upon the protein and fats. Assuming these to cost in the ratio of 5:3 and the amounts in the meats to be: protein $14\frac{1}{4}$ per cent., and the fats 15 per cent., an easy computation

will show the protein to cost 107,7 cents and the fats 64,6 cents per pound.—Proof: $14\frac{1}{4}{}_{100}$ pound of protein at 107,7 cents=15,3 cents. $\frac{15}{100}$ pounds of fats at 64,6 cents=9,7 cents. 15,3 cents × 9,7 cents=25 cents; the cost of the pound of meat which contained the given amounts of protein and fats. The above ratios, protein: fats: carbo-hydrates=5: 3: 1 represent at best only general averages, and may in given cases be more or less incorrect. A method free from these objections consists in simply comput-

COMPARATIVE COSTS OF PROTEIN IN FISH AND OTHER ANIMAL AND VEGETABLE FOODS.

FOODS.	Ordinary prices per pound.	Cost of protein per pound
	Cents.	Cents.
Beef: Sirloin, medium fatness	25	108
" Same, at lower price	20	86
" Round, rather lean	18	70
" Round, rather lean, lower price	16	62
" Corned, lean	18	56
" Flank,* very fat	15	36
Mutton: Leg	22	107
" Side, medium fatness	20	59
Pork,* very fat	16	30
Smoked ham	18	48
Milk, 8 cents per quart	4	61
Cheese: Whole milk	18	38
" Skimmed milk	8	19
Salmon: Early in season	100	572
" When plenty	30	172
Shad	12	98
" When abundant	8	65
Bluefish	10	98
Haddock	7	94
Halibut	15	87
Mackerel	10	80
" When abundant	5	40
Cod	8	67
" When plenty	6	50
Alewife	3	19
Canned salmon	20	70
Salt mackerel	12.5	46
Salt cod	7	38
" Lower	6	33
Oysters;† 25 cents per quart	12½	156
" 35 cents per quart	17.5	220
" 50 cents per quart, choice	25	312
Lobsters	12	209
Wheat flour, best	5	19
Indian corn (maize) meal	3	12
Oatmeal	5	15
Beans	5	14
Potatoes:* 50 cents per bushel	0.8	14
" 100 cents per bushel	1.7	28

* Contains very little protein. † Shell contents.

ing the amounts of nutrients that may be bought for the same price in different food materials. At the same time the method above detailed is doubtless accurate enough for a general comparison of the relative cheapness and dearness of ordinary foods, and is used in calculating the costs of protein below.

Of the different nutrients, protein is physiologically the most important as it is pecuniarily the most expensive. In fish, furthermore, as in the leaner kinds of meat, it is the predominant nutritive ingredient. For these reasons the cost of protein in fish and other foods may be used as a means of comparing their relative cheapness or dearness, as is done in the preceding table. The figures represent the ordinary prices per pound and the corresponding costs of protein, in specimens of food-materials obtained in New York and Middletown, Conn., markets. Though the number of specimens is too small for reliable averages, the figures, taken together, doubtless give a tolerably fair idea of the relative costliness of the nutrients in the different classes of food.

Thus the nutrients of vegetable foods are, in general, much less costly than in animal feeds. The animal foods have, however, the advantage of containing a larger proportion of protein and fats, and the protein, at least, in more digestible forms. And further, the so-called "nitrogenous extractives" of kreatin, carnin, etc., of meats, which contribute so much to their agreable flavor, exert a nutritive effect which, though not yet explained, is nevertheless important. It is these which give to "extract of meat" its peculiar flavor and stimulating effect.

Among the animal foods, those which rank as delicacies are the costliest. By the above calculations, the protein in oysters costs from two to three dollars, and in salmon rises to nearly six dollars per pound. In beef, mutton and pork, it varies from 108 to 48 cents; in shad, bluefish, haddock, and halibut, the range is about the same; while in cod and mackerel, fresh and salted, it ranges from 67 to as low as 33 cents per pound. Salt cod and salt mackerel are nearly always—fresh cod and mackerel oftener, and even the choicer fish, as bluefish and shad, when abundant, furnish cheaper sources of protein than any but the inferior kinds of meat.

In short, we pay for many of our foods according to their agreeableness to our palates rather than their values for nourishing our bodies. At the same time it is interesting to note that the prices of the materials that make up the bulk of the food of the people seem to run more or less parallel with their actual nutritive values. Here, as elsewhere, the resultant of the general experience of mankind has led slowly and blindly, but none the less surely, to the same general result to which accurate research more understandingly and quickly guides us.

USE OF FISH AS FOOD. ITS PLACE IN DIETARIES.

The chief uses of fish as food are (1) as an economical source of nutriment, and (2) to supply the demand for variety in diet, which increases with the advance of civilization and culture.

As nutriment, its place is that of a supplement to vegetable foods, the most of which, as wheat, rye, maize, rice, potatoes, etc., are deficient in protein, the chief nutrient of fish.

The so-called "nitrogenous extractives," contained in small quantities in fish as in other animal foods, are doubtless useful in nutrition. The theory that fish is especially valuable for brain-food on account of an assumed richness in phosphorus is not sustained by the facts of either chemistry or physiology.

It is an interesting fact, that the poorer classes of people and communities almost universally select those foods which chemical analysis shows to supply the actual nutrients at the lowest cost. But, unfortunately the proportions of the nutrients in their dietaries are often very defective.

Thus, in portions of India and China, rice; in Northern Italy, maize meal ; in certain districts of Germany, and in some regions and seasons in Ireland, potatoes ; and among the poor whites of the Southern United States, maize meal and bacon, make a large part, and in some cases almost the sole food of the people. These foods supply the nutrients in the cheapest forms but are all deficient in protein. The people who live upon them, are ill nourished, and suffer physically, intellectually and morally thereby.

On the other hand the Scotchman, shrewd in his diet as his

dealings, finds a most economical supply of protein in oatmeal, haddock and herring, and the rural inhabitants of New England supplement the fat of their pork with protein of beans and the carbo-hydrates of potatoes; maize and wheat flour with the protein of codfish and mackerel, and while subsisting largely upon such frugal but rational diets, are well nourished, physically strong, and distinguished for their intellectual and moral force.

In conclusion I have two more things to speak of:

The first is to repeat, but more emphatically, what I have already said, that the work of which I have been speaking is only the tentative beginning of an investigation which, if rightly prosecuted, may, I believe, develop into one of great importance.

The second, a very pleasant subject to refer to, is the assistance which has been given to the investigation thus far. Besides pecuniary and other aid which has been granted by the United States Fish Commission through Prof. Baird, one of the most efficient promoters of the Fish Cultural Association, Mr. E. G. Blackford, Fish Commissioner of New York, has donated $100 in money, and a large number of specimens of fish. Mr. A. R. Crittenden of Middletown, has also contributed $100 toward the expenses of the investigation of the chemistry of fish. Thanks are likewise due to Mr. G. H. Shaffer of the well-known firm of Dorlon & Shaffer, of New York, for a considerable number of specimen of invertebrates. As I have stated, the investigation of fish has been supplemented by one of other food materials

A considerable portion of the expense of these, also, has been met by private generosity. Mr. F. B. Thurber, of the firm of H. K. & F. B. Thurber of New York, having donated $500 for this purpose, while Hon. J. W. Alsop, M. D., of Middletown, has contributed a considerable sum in aid of researches carried on in the chemical laboratory of Wesleyan University, in which, with more abstract investigation, the studies of fish and other foods have been included. These gifts of gentlemen interested in science, have covered a not inconsiderable part of the total expenses of the investigations whose results I have thus briefly detailed. Without such aid they would have been, in their present form at least, impracticable.

The PRESIDENT: Although this paper has been quite exhaustive, I have no doubt that some members would like to ask questions.

Mr. WILLCOX: We have, I am sure, been greatly interested in Professor Atwater's paper, and I would like to ask whether one animal by eating the flesh of another can transform that food into fats.

Prof. ATWATER: A great deal of experimental study has been devoted to the precise question to which you refer, during the past thirty years, and it may be thirty years more before it is fully answered. We have, however, a great deal of information already; enough to prove that the protein of one animal may be transformed into fat in the body of another. Dogs fed on lean meat have been proven to grow fat upon it in the limited sense that some of the protein of which the lean meat was composed was changed into fat and stored as fat in the bodies of the dogs. It is quite possible that a portion of the protein of the beef steak which you and I may have eaten for breakfast this morning, is during the course of the day, being changed into fat and carbo-hydrates. But how much of the protein of our food is transformed into fats, or how much of the fats in our bodies comes from the protein we eat, are matters which cannot, in the present state of our knowledge, be answered exactly.

The members of the Association then visited the Central Hatching Station of the United States Fish Commission in the armory building, east of the Smithsonian grounds, where they saw a model of the McDonald fishway in operation, and the hatching of shad in the McDonald hatching jars.

ON THE FORCES WHICH DETERMINE THE SURVIVAL OF FISH EMBRYOS.

BY JOHN A. RYDER.

Mr. PRESIDENT: Unfortunately the programme announces the title of my communication in a form somewhat different from the one actually chosen for my paper, although in reality there is no great difference between the two. I propose to-day to discuss some of the causes which limit the survival of fish embryos. It is well known to fish-culturists and naturalists that there is a great amount of variation in the number of ova produced by different species of fishes. This great variation is significant and can be accounted for on no other ground than this: that it must be supposed that there is a great over-production of eggs in order to make up for the losses in the struggle for existence, as indicated in the first place by Malthus and afterwards elaborately worked out by Mr. Darwin. This disparity in the number of germs produced by different species is so great as to astound us at first. There are species, for instance, in which the number of germs produced by the female fish would not exceed twenty. There are some, indeed, that only produce five or six. Again, there are species which produce as many as 10,000,000. Now, how is this difference to be explained? It is a singular fact that the greatest number of eggs appear to be produced by those fishes that take the least care of their progeny, viz., those species which discharge their eggs into the open sea and commit them to the mercy of the winds and waves, such as the codfish and flounders and many of the *Clupeoids*. Whereas the reverse seems to be true, in the case of those fish which studiously take care of their eggs, or incubate them inside of their ovaries —as for instance the *Embiotocoid* fishes of the west coast—or as in another case (*Gamcusia*) within the ovarian follicle, modified into a quasi-placental structure; or, as in the case of the catfish, where the male hovers over the adherent mass of ova and forces the water through them, or yet again where the eggs are retained in a pouch underneath the abdomen, as in the pipe-fishes, or are

kept in a similar pouch under the tail, as in the male sea-horse (*Hippocampus*). It seems as if the number of eggs was diminished just in proportion to the amount of care taken—usually by the male—of the embryos. This, of course, indicates that in the case of eggs which are not protected in the way mentioned, millions of surplus ova are destroyed in the struggle for existence, whereas with the species which protect their ova, the struggle for existence at the commencement of development must be much less severe.

There are other points to be noticed. Some species have very small ova. Such are usually hatched in a condition in which the little fish is much feebler than in those cases in which the ova are large, and in which the young fish leave the egg in a much more vigorous conditon—in a condition, in short, in which they are able to contend with the environment more effectually. That is an important fact to be considered. Again, there are some species which leave the egg with the throat perforated, and other forms which do not. In the case of the shad, for instance, the young fish cannot swallow at the time of hatching, but in other forms the young can swallow as soon as they leave the egg membrane. There are still other causes which would affect the percentage of survivals, such as changes in their habitat produced by man, or the pollution of a river by substances which sink into its ooze, and so vitiate the water and thus render incubation on the bottom impossible.

There are also forms in which there are protective contrivances developed on the eggs themselves. We are all familiar with gelatinous strings that we find in stagnant ponds and which enclose the eggs of the toad, for example. Most of the various kinds of frogs have a different kind of spawn, adhering together in masses instead of in strings. Certain fish-ova, again, have long thread-like appendages, by which they are suspended on weeds and grass, so that the currents of sea-water can pass backward and forward among them, ærating them and preventing them from being smothered. This is the case with a number of marine, and some few fresh-water forms of fishes. There are cases where mimicry doubtless plays a part in preventing the capture of young fish, as in the case of the young of the stickle-

back, where the young fish seem to undergo a sudden change of coloration, rendering them much more difficult of detection in the water. A certain writer, speaking of sticklebacks, asserts that the male will acutally catch and return the young fish to the nest during the first day or two after hatching. This change of coloration may possibly be dependent upon the action of light. Regarding the survival of fish embyos, the specific gravity of the eggs of different species, is another point to be considered. Thus, the eggs of the cod, mackerel and crab-eater, are buoyant and tend to come to the surface of the water. Others as persistently sink. In other fish ova the oil drops are so arranged as to persistently turn the germinal disc to the top, as is the case with the salmonoids; this relation is reversed in the case of floating eggs, in which the vitellus is on the top and the germinal disc underneath.

Judging from the attempts made to rear and multiply certain feral mammalia, we know that confinement tends to produce sterility. I believe that under such conditions certain changes are effected in the ovaries of fishes in their efforts to free themselves from the bondage imposed by man, and that the physiological organization of the eggs is destroyed.

The distribution of food—especially articulate food—is also an element to be considered with respect to the survival of young embryos. In various regions of the globe certain living aquatic food seems to swarm at particular times and in fixed localities. I know this to be so from my own observations in the vicinity of Philadelphia, and especially in the swamps and low grounds of New Jersey. It is impossible to predicate from outward appearances what particular forms of articulates will be encountered until you are on the ground and make a careful examination, and there is no doubt in my mind that the absence from streams of certain small forms of articulates, such as Daphnids and *Copepoda*, have a great deal to do with the survival of the young fish. As this kind of food is absent or abundantly present, so will the young fishes perish or survive.

There is another cause to which may be attributed the destruction of the fish embryos, and that may be embraced under the head of "shocks" which pervert development. We know, for

instance, that shocks given to fish eggs during the time that they are in process of incubation, will often produce monstrosities, and if very violent will produce death. Shocks may be exerted as the result of natural causes, or may be brought about in the course of the application of artificial methods in the incubation of fish ova. The ordinary mode of formation of any fish embryos is around a globular vitellus. There is a dome-shaped cap of plastic material formed over the yelk in which nuclear matter is imbedded immediately after fertilization. Segmentation proceeds step by step, and in the course of this process shocks may produce aberration of development. The germinal matter at first covers, or is partially scattered through the vitellus and connected with the surface, migrating toward that surface and to one point so as to form a discoidal germinal mass at one side of the egg. That, of course, is not the first step in development. Now it is easy to understand that the shocks would impair the delicate processes of development going on within, especially when we remember that during this time the nuclear matter is arranged in a certain peculiar way, and that as cleavage proceeds, this nuclear body elongates and throws out rays through the enveloping protoplasmic matter. If at this stage of development I should shake the eggs violently, a second embryonic axis may be formed which soon fuses with the axis of the originally formed embryo, and the result would be a double-headed fish. Thus you can readily see that certain forces tend to diminish the number of normally developed embryos, malforming them and producing irregularities which cannot become adult or perfect fishes like the parents.

I have only mentioned some of the forces which are operative in diminishing the chances of survival of young fishes, but I trust that enough has been said to indicate to some extent, the nature of the ploblem still to be solved by those who are interested in the breeding, protection and multiplication of food fishes.

The first and most important principle which I would especially commend to the thoughtful attention of the Association is the general law already hinted at, namely: that just in proportion as the individuals of a species are prolific in respect to the

number of their germs, just in that proportion do the chances of survival of the individual germs seem to be diminished, and *vice versa*, and that this natural fecundity, or the want of it, is dependent upon the amount of protection received by the eggs in the course of development.

Prof. GILL: The observations of Mr. Ryder are very interesting, and it is one of those strange cases that we so often meet in nature—the accommodation and correlation of different things. In this case we have the number of eggs in a certain ratio to the capability of the young fish to take care of themselves. We have it now established on a large basis that there is generally a close correlation between the two, and that the number of eggs is in inverse ratio to the capability of the young to protect themselves. Besides the cases alluded to by Mr. Ryder, we have an interesting instance of the female of one type of catfish found in South America, *Aspredinidæ*, in which there occur periodically swellings of the skin of the abdomen in which the eggs are received, and therein they are nourished for some time. Again in the same group, or order of catfishes, but in another family, we have the *Arii*, in which the male parent takes care of the eggs by holding them in his mouth, and so preserving them from danger very skillfully. Care is taken of the young by other species of the family. It was with great interest, that some months ago Mr. Ryder and myself observed the habits of our common catfish. The male hovered over the young, and when feeding frequently took the young into his mouth, but always ejected them again, thus discriminating accurately between the objects taken as food and the young fish incidentally transferred to his mouth. This same habit of taking care of the young in the mouth is exhibited by certain *Cichlids*, forms somewhat like, and perhaps akin to, our common sunfishes. One of these is a fish found in the Holy Land, a species of *Chromis*. And the same peculiar habit is likewise manifested by species of the same family living in South America, the *Geophagi*. The belief was also long current, and found expression in most of the old books, that fishes not only did not take care of their young, but were invariably

oviparous. We all know how false such a statement is. In one class, the *Selachians*, the larger proportion of forms are viviparous. For example, of the sharks proper, three-fourths, or more, are viviparous, and the same statement holds good with respect to the rays or skates. Thus, out of 150 species of rays, over 100 are viviparous, and another noteworthy fact is that the oviparous rays are nearly all included in one family—the common skates or rays brought to our markets. This feature of viviparity was known to the ancient naturalist, Aristotle, who even went so far as to say that the *Selachians* were viviparous, while all scaly fishes were oviparous. There, however, he erred, for there is no such limitation. Many of the *Selachians* are oviparous, and, on the other hand, many of the scaly fishes are viviparous. For instance, all the *Embiotocoids* are viviparous; and of these the common perch of the Pacific is an example; also viviparous are the eelpout of our markets, and species of the *Cyprinodont* family among others. Viviparity is, indeed, largely manifested among fishes. The only reason why reverse statements are found in the old books is that in Europe these cases were almost unknown.

I agree with the statement of Mr. Ryder that confinement frequently affects the power of procreation, either directly or indirectly, and this does not apply to fishes alone, as is evident from the experience of those in charge of menageries and zoological gardens. It is known that many animals and birds which are confined seem to live with perfect freedom in zoological collections, but they do not bring forth young, or their eggs are sterile. There are many exceptions to this rule, but many cases of sterility for which we can assign no other cause. Somewhat anologous is the peculiar pathological condition of animals living in confinement, in which the bones become softened or rickety.

THURSDAY, MAY 15TH.

The President called the meeting to order at 10 o'clock A. M., and declared the reading of papers to be in order.

NOTES ON THE DECREASE OF LOBSTERS.

BY RICHARD RATHBUN.

One of the most important of our seacoast fisheries is that afforded by the American lobster, the *Homarus americanus* of naturalists. This interesting crustacean, the largest of its kind in North American waters, ranges from Labrador in the North to Delaware in the South; but is most abundant and most sought for along New England and the southernmost of the British coast provinces.

Its great abundance and rare flavor are not unfrequently mentioned in the early annals of New England, and it probably formed an important element in the food supply of the seacoast inhabitants of colonial times. As a separate and distinct industry, however, the lobster fishery does not date back much, if any, beyond the beginning of the present century, and it appears to have been first developed on the Massachusetts coast, in the region of Cape Cod and Boston, although some fishing was done as early as 1810 among the Elizabeth Islands and on the coast of Connecticut. Strangely enough, this industry was not extended to the coast of Maine, where it subsequently attained its greatest proportions, until about 1840. Concerning the history of this unique fishery, but few authentic records of any kind exist, nor was any attempt ever made to estimate its

extent and value prior to the census investigations of 1880. We are, therefore, left without much reliable data for comparing its past and present conditions, and for solving the many problems which now, in the minds of many, seem to threaten its continued prosperity.

The great question at issue, and one which demands the earnest attention of every lobster fisherman and dealer, is whether lobsters are decreasing in abundance, and will eventually become rare and difficult to obtain, or whether they are still as plentiful as ever and show no indications of approaching extinction. While we hope for the latter, we are forced to acknowledge that a carefuf study of all the materials at our command inclines us to the belief that the abundance, of lobsters has very perceptibly diminished within comparatively recent times, and that, unless some active measures are instituted to prevent continued decrease in the future, a great and irreparable injury to the fishery will ensue.

Although, as we have just said, the lobster fishery is without a carefully recorded history, we have been enabled, through the assistance of many intelligent fishermen and dealers, some of whom have shown themselves to be very capable observers, to trace back the conditions of the fishery through a number of years. The results so obtained have been embodied in a report prepared for publication by the United States Fish Commission. It has been suggested that a short statement of some of the facts bearing upon the supposed decrease might be of interest to the members of this Association, and it is for that purpose that the following brief notes have been prepared:

Concerning the distribution of lobsters it may be stated that a few stray individuals have been occasionally recorded from the extreme northeastern corner of Virginia, but the Delaware Breakwater may more properly be regarded as the southern limit of their range. On the New Jersey coast they are somewhat more abundant, and give rise to a limited fishery in the neighborhood of Atlantic City and Long Branch. Though formerly quite plentiful and extensively fished for in New York bay and Hell Gate, they are now nearty exterminated from that region, due to overfishing combined with the pollution of the

waters by the refuse from large factories. Along the Connecticut shores they are moderately common, while at the eastern end of Long Island and in the region of Block Island, the outer Elizabeth Islands and Marthas Vineyard they afford a very profitable industry.

The entire coast line of Massachusetts abounds in lobsters, wherever the character of the bottom is suited to them; but overfishing has nearly depleted some of the shallow-water areas which were once prolific, as at Provincetown. The sandy shores of New Hampshire furnish only a moderate supply, but on the Maine coast they are much more abundant than anywhere to the southward, and the yearly fishery greatly exceeds in quantity and value those of all the other States combined. This State is in fact the main source of supply for all the principal markets of the United States. Contrary to the belief of many persons the lobster is not a migratory animal in the common acceptation of that term as applied to fishes. On the approach of cold weather it leaves the shallow areas near shore, and retreats into somewhat deeper water, where the temperature remains milder and more uniform during the winter. As the spring advances it returns to its summer haunts. These spring and fall migrations vary as to time and extent on different portions of the coast, occurring earlier in the spring and later in the fall at the South than at the North. During the summer they often approach very close to the beaches, and in some favorable localities, especially on the coast of Maine, the traps set for their capture become partially uncovered at low water. The more usual depths for the summer fishery are, however, those of a few fathoms. The winter grounds are in depths of twenty to fifty or sixty fathoms, and generally not far from those of the summer, especially in regions where the water deepens rapidly.

In so far as it has been possible to make the observations, it is supposed that the different schools of lobsters, if we can so define them, return to about the same shallow places every spring, and do not journey northward or southward along the coast to any very great extent, although there may be a gradual interchange of ground in the course of time.* If this supposition be correct, as appears most natural, and there are many

facts to substantiate it, each geographical region is more or less independent of all others, and not influenced by large and frequent migrations from them. This division into distinct schools, and defined geographical regions, while an arbitrary one, not strictly existing in nature, serves to simplify the argument which we desire to make, and which is to this effect: That continued overfishing in any one region will tend to eventually reduce the stock of lobsters in that region, without the hope of its being replenished by early accessions from neighboring regions, and that the almost total depletion of that region is, therefore, quite within the bounds of possibility. This is not the case with such truly migratory fishes as the mackerel, menhaden and herring, and the laws which govern the movements of the latter cannot be applied to the lobster. In support of this proposition there are several well-authenticated instances of the almost entire extinction of lobsters in what were formerly regarded as exceedingly rich regions, and since lobster-fishing has been more or less abandoned in those regions, the abundance of lobsters has never perceptibly increased.

Another strong proof of the continued decrease in abundance of lobsters has been the gradual decrease in the average size of those brought to market. It is not rational to suppose that lobsters grow less rapidly now than in former years, or have in any way become dwarfed in size. On the contrary, it has been overfishing, restricted by legislation which protects the young, and influenced by the higher prices paid for the larger individuals in the fish markets which has caused the greater diminution in the supply of large lobsters. A strict observance of existing laws may prevent the total extinction of the species, but it cannot maintain the average size of those taken for market much, if any above the limit prescribed by those laws. This limit in nearly every instance is, moreover, about the size of the young female just beginning to spawn, and, therefore, with absolutely no protection for the spawning female, excepting in the close season, during which there is but little spawning, it is doubtful whether existing legislation is of much avail. A careful consideration of all the facts available certainly indicates

that a marked decrease in the size of lobsters is proof of an equally great, if not a greater diminution in the supply.

It is not possible within the scope of this short paper to strengthen our conclusions with a long array of facts, but the brief statement of some of our evidence must here suffice.

One of the best illustrations of the great decrease in the abundance of lobsters is furnished by the once famous fishing-grounds of Cape Cod. The lobster fishery was first started in this region about the year 1800, by Connecticut lobstermen, who carried nearly their entire catch to New York city. As early as 1812, the citizens of Provincetown began to entertain fears that unless some restrictions were placed upon the fishery, the extermination of the species would be speedily effected. Protective laws were at once passed by the legislature of Massachusetts, and from that time to the present they have been continued in one form or another, but all without avail unless it may have been to somewhat prolong the fishery which might otherwise have been much earlier destroyed. The fishermen of Provincetown did not themselves engage in lobstering until about 1845, but between then and 1850 the fishery was greatly expanded and a large trade started with New York city. In fact about this time the latter market received nearly its entire supplies from the vicinity of Provincetown. A great many men engaged in the fishery, using the old style of hoop-net pots, and catching from 100 to 200 lobsters each every night. These were prosperous times, and yielded the inhabitants of the town a profitable income. The carrying smacks obtained large fares and were kept busy. No marked diminution in the supply was noticed until about 1865, since which date there has been a rapid decrease in abundance from year to year, obliging the lobstermen to resort to other occupations for a living. In 1880 there were only eight men engaged in lobstering, and although they used the most improved appliances, their annual gross earnings were only about $60 each.

On the cost of Maine, although the fishery is of much more recent date, it has already exhibited many unfortunate changes, and in numerous places there has been a marked decrease in the average size of individuals caught. The shore fisheries have

also, in some cases, been well nigh exhausted, and the fishermen forced to resort to more distant grounds. When the fishery first began hoop-net traps were in general use; but soon after the introduction of lath-traps competition caused them to be universally employed. From year to year the fishermen increased the number of traps they used, and the custom of setting them, trawl fashion, rapidly came into vogue. These changes were due to the competitions of trade, the desire to obtain larger catches and for one man to perform the work of two. The fishing grounds were strained to their utmost, and there was no fear of an overstock, as the canneries were ready to buy all that were not taken by the market smacks. More recently the fishermen have begun to return to the old method of setting their traps singly, and why? Because they say the lobsters are more scattered over the bottom, and that by altering the position of the traps every time they are set, they fish better. But why should they be more scattered now than formerly unless they are more rare? In 1864 lobsters were so abundant at Muscle Ridges that three men tending forty to fifty traps each, caught all the count lobsters which one smack could carry to market, making a trip once in eight days. In 1879 the same smack was obliged to buy the entire catch of fifteen men in order to obtain full fares, and at times required to visit other localities to complete the load.

Regarding the Booth bay region, very nearly the same may be said. As late as 1856, lobsters were very abundant about the islands of Booth bay harbor, and the fishery was carried on close to the shore in slight depths of water. The season lasted about six months, and each man setting fifty traps could make about $500 during the season. By 1869, the number of fishermen having increased, however, the season's stock was reduced to about $175 per man, and the average size of lobsters had greatly diminished. This caused the fishermen to try further out from shore, and the fishery is mainly carried on in depths of twenty-five to thirty-five fathoms. The facts of these changes were furnished from many places in this section, between Cape Small Point and Pemaquid Point.

The canneries have undoubtedly largely influenced this result on the coast of Maine, as all sizes of lobsters large enough to

pay for the handling are consumed, and the ready market thus afforded has tempted the fishermen to save every specimen that enters their traps. It is unquestionably this extensive destruction of the young that has hastened the decrease; but that the decrease is not solely due to the presence of canneries is evidenced by the statements we have already made regarding other sections of the coast.

In the Saco district, although there are no canneries located nearer than Portland, a smack trade between the fishing grounds and the canneries to the eastward has recently been started, and several witnesses have testified to a marked falling off in the proportionate catch since it began. The average catch per man is now about one-third what it was twenty years ago, and while, in 1876, a barrel of lobsters averaged 65 by count, an average of 80 lobsters is now required to fill a barrel.

On the New Hampshire coast the decrease for twenty years is stated to have been from 50 to 75 per cent.

From Rhode Island and Connecticut we have complaints regarding a decrease in abundance and size of lobsters, similar to those already noted from the more northern States; but the statements we have given constitute but a small proportion of the evidence that we have obtained.

That this evidence is unimpeachable as to a general and lasting decrease, we would not now affirm, but to our minds it has been conclusive. To press a definite and unfavorable opinion, however, regarding so extensive and valuable a fishery, after the meager returns of a single investigation extending through only one or two years, would scarcely be justifiable, but it has seemed to us that public attention should be now attracted to the subject, as it appears in the light of the tenth census.

The fishery has had such a rapid growth, and the demands upon it have so exceeded its capacity, that the problem of weighing evidence has been somewhat difficult. The total catch of lobsters has increased from year to year, but so has the number of fishermen, and the number of traps used, even in greater proportion; and the grounds have been enlarged until they now cover an exceedingly broad area, and extend into deeper water than was ever dreamed of formerly in connection with this fish-

ery. The decrease in the average catch per trap and man, in the yearly earnings, and in the average size of lobsters has kept pace with the increase of the fishery; the inshore grounds in many places have been nearly depleted, and in some of the deeper areas the lobsters are so much scattered that it is no longer profitable to set the traps in trawls. If a continuous and rapid decrease should be proved, what can be done to stop it and insure the future prosperity of the fishery? The task of remedying the evil will be much more difficult than the proof of its existence, and the question is one regarding which we have as yet no definite ideas.

Past legislation has certainly not been very effective, nor can any laws avail much until the true character and extent of the evil has been determined. Neither are laws beneficial unless they can be enforced—an exceedingly difficult task in the case of any fishery.

The question of artificial propagation has been raised, and a few unsuccessful attempts have already been made to carry it on. But the failures have not been without cause, as we do not yet even know the rate of growth of lobsters, or whether they require six or a dozen years to attain the adult size, which is about ten or twelve inches. Immediately after hatching they swim freely about at the surface of the water, and continue their erratic ways of life during most of the first season, after which they settle down upon the bottom and assume their future habits.

The first task, therefore, which we suggest for the would-be benefactor of the lobster fishery, is a most thorough investigation of all points bearing upon the natural history of the species, upon the changes which have occurred in the fishery grounds, and upon the relations of the total catch for each section to the number of fishermen and traps set, and the average size of the lobsters taken.

With the census returns, soon to be published, as a starting point, a plan of the work can easily be sketched out, and the figures there given may serve as a basis for future calculations.

THE PROPAGATION OF THE STRIPED BASS.

BY S. G. WORTH.

The propagation of the striped bass, by artificial methods, appears to be as easy of accomplishment as that of the shad, and there are greater opportunities probably of doing a large work with less money than is necessary in the propagation of shad.

It is much to say that the striped bass can be as economically hatched as the white shad, for the expense of shad hatching is very small. From the observations upon the shipment of rock fry, it would seem that there is no difficulty whatever in successfully depositing the fry in rivers at points distant from the hatcheries.

It is not known at what points ripe fish of this species can be found in greatest abundance, but in our present state of knowledge, Weldon, North Carolina, presents the greatest number. This town is at the head of navigation on Roanoke river near the North Carolina and Virginia line, and is more than one hundred miles above the head of the tide. The Roanoke river, at this point, is a large stream, which would be navigable many miles further up except on account of the abrupt falls existing above a distance of a few miles.

It is a muddy stream a great portion of the year, having its source about two hundred miles in the tributaries of the Dan and Staunton.

However muddy its waters may be at times, a great portion of the volume is from pure mountain springs.

Although large quantities of striped bass are taken during the several months by the large seines and pound nets seaward, there appears to be no one point where the eggs in a condition proper for fecundation can be found so abundantly. At the particular point named, the fall is so great that ordinarily, owing to a lack of a great volume of water to smooth over the falls, the fish are unable to pass directly over, and in consequence are detained at the foot of the falls.

Here more than a hundred canoes are used each spring in the capture of the striped bass.

Bow nets are used in water ten or more feet deep, two men occupying the boat, one using the paddle, the other holding the net.

At times great numbers of fish collect here, and within fifteen years past as many as three hundred of these fish, weighing upward of thirty pounds, some reaching seventy, have been taken on a slide or trap (another minor fishing contrivance used there), in a single day.

The quantity, however, has greatly fallen off of late years, owing to the greatly increased fishing operations below.

It is stated on good authority that on many occasions, when these fish were very numerous at this point, that in their spawning movements they have been so abundant that great quantities of blood were extracted, owing to the contact with each other, conveying the idea that the water was literally overcrowded with them, causing them to come into abnormal conflict with their sharp spines, owing to the lack of space.

The bloody appearance of the water has been popularly considered the bleeding consequent upon an actual fight between those fishes, but was probably only the result of overcrowding where dorsal fins were frequent.

Some few thousand of striped bass are still taken at this place.

The place has appeared favorable for the work of collecting eggs for artificial propagation, and after investigation of its capabilities the following results may be enumerated:

In the year 1882, in the month of May, I sent an expert among the fishermen by way of investigation, and had reported back from him the sale during his stay of something less than a dozen spawning fish.

He was there but a few days, and made no attempt to fecundate or hatch the ova. Previous experience in the propagation of the striped bass at Avoca, in 188–, led to the inference that the discovery of this many fish in a ripe condition at Weldon, would ordinarily afford material for a limited hatchery.

Consequently, I established at Weldon, quite late in the season of 1883, an exceedingly crude establishment, containing sixty-five McDonald jars, equipped as if for very rude shad or whitefish hatching.

The station was provided with five experts, a force rather too small, though efficient. During a period of ten days from May 14th to 24th, nine rock-fish in spawning condition were secured.

Four of these were sold on the market before the hatchery was ready, and the eggs were lost. They were observed, however, to contain ripe eggs. Five others were captured and handled by my force subsequent to the establishment of the hatchery.

One of these weighed thirty-four pounds twelve ounces, but being dead and stiff before it was found, the eggs were not available for impregnation, so I used it for the purpose of determining as near as possible the relative number of eggs contained in this species. A fraction of an ounce was carefully weighed out on apothecary's scales by a young druggist who chanced to be in my corps, and a computation was made of the number of eggs, and 3,194,000 were found. The two ovaries were packed in ice and sent to Prof. Baird for more careful calculation. They are in his possession and are preserved in alcohol. The total weight of these ovaries at the time the calculation was made was seven pounds nine ounces.

However many the exact number may be, it is evident that the average rockfish produces upward of 1,000,000 of eggs.

Four other fishes in spawning condition were taken, one on the 17th, weighing 12 pounds, two-thirds spent, yielded 250,000 eggs, another taken on the 18th, weighing 8 pounds, two-thirds spent, contained 280,000 eggs. The eggs from the last named fish, when impregnated, measured 14 U. S. standard liquid quarts, and in the ovaries which I dissected afterward, were remaining 4 ounces unimpregnated eggs. These latter I considered about 100,000 in number, showing that this fish of 8 pounds weight, contained upward of 1,200,000 eggs.

The result of the crude operations at Weldon, produced something like 1,000,000 of eggs from the four fish stripped (these being mostly spent), from which a very moderate number of fish —50,000—were hatched and turned into Roanoke river; specimens being sent to Prof. Baird in glycerine.

The only difficulties encountered were two, the one consisting

in the great delicacy of the egg shells in the latter stages, which caused the fish to hatch prematurely by concussion, and the other consisting of the difficulty of securing fine enough screens to hold the fish when hatched.

Now since I found that the eggs would stand a great while in water without a change, even twelve hours, it is apparent that they may be hatched without motion, and thus prevent premature hatching, and as to the difficulty of confining the young fish by proper screens, all that seems necessary, is the substitution of clear water for that muddy water which I used. Not only do the rock spawn at Weldon, but incidentally at several points below, and with the system of impounding, there seems scarcely a doubt of securing a great supply of eggs, thus opening a means of propagating the choice, valuable striped bass.

RESULT OF THE INTRODUCTION OF GILL-NETS INTO THE AMERICAN COD-FISHERIES.

BY CAPT. J. W. COLLINS.

The United States Fish Commission, though it has in so many ways done a useful and important work in the artificial propagation of food-fishes, has not confined itself solely to fish-culture as a means for improving the American fisheries. It has accomplished quite as important objects by disseminating among our fishermen knowledge of methods of fishing, etc., to which they were previously strangers, and which has been of the utmost advantage to them for the successful prosecution of their work. The introduction of the use of gill-nets in the cod fisheries may be mentioned as an instance in point, and viewed in the light of results already attained (though we may yet consider this method of fishing only fairly begun), it seems not too much to claim that the bringing about of such an innovation in the

ocean fisheries, is entitled to rank among the most important works of the Commission. The change that has been made in the method of taking cod and other species of the *Gadidæ*, has proved of such immense advantage to the New England fishermen that an entire revolution has been created in the winter shore cod fishery, and it is difficult to predict to how great an extent the gill-net fishery for cod may be prosecuted in the future. It is not possible now to say with any degree of certainty whether or not gill-nets may be successfully employed in the cod fisheries of the outer banks, since a thorough and careful trial needs to be made to settle that question. A few unsatisfactory attempts have already been made by the fishermen to use gill-nets on the outer banks, but in no case have these trials been so extensive and thorough as to fully demonstrate what might or might not be done. In consideration of the results which have already been attained, it seems desirable that a brief historical sketch should be given here of the introduction of gill-nets into the cod fisheries of the United States, and also of the varying success which has attended their use since they were first adopted by American fishermen.

Though gill-nets have been long used in Northern Europe, more especially in Norway, as an apparatus for the capture of cod, and are considered by the Norwegians as quite indispensable, they have not, until recently, been employed by American fishermen. In 1878, Professor Spencer F. Baird, United States Commissioner of Fish and Fisheries, knowing how profitably these nets were employed by the Norwegian fishermen, decided to make experiments with them at Cape Ann, with a view to their introduction among the fishermen of this country. He accordingly secured a number of the Norwegian nets, which were forwarded to Gloucester, and there tested by the employees of the Commission.

Experiments were made when the winter school of cod were on the shore grounds in Massachusetts bay, but the results obtained were not satisfactory, owing chiefly to the fact that the nets were found far too frail for the large cod which frequent our coast in winter. This was apparent from the numerous holes in the nets, which indicated plainly that large fish had torn their

way through, none being retained excepting those that had become completely rolled up in the twine. The current also swept the nets afoul of the rocky bottom, which injured them still more, so that they were soon rendered nearly unfit for use. They were invariably in bad order when hauled from the water, but even under such unfavorable circumstances nearly a thousand pounds of fish were caught on one occasion. This seemed to indicate that nets of sufficient strength might be used to good advantage, at least on some of the smoother fishing grounds along the coast.

These preliminary trials, therefore, having demonstrated that nets could be employed advantageously in the American cod fisheries, Professor Baird availed himself of the first chance that offered, for obtaining definite knowledge of the methods of netting cod in Norway, with the intention of disseminating this information among the American cod fishermen.

The opening of the International Fishery Exhibition at Berlin, Germany, in the spring of 1880, presented a favorable opportunity for accomplishing this purpose. Professor Baird having appointed me as one of the commission to attend the exhibition on the staff of Professor G. Brown Goode, desired that I should make a careful study of the foreign methods of deep-sea fishery as represented at the exhibition. The method of capturing cod with gill-nets, as practiced by the Norwegian fishermen, was mentioned as a subject which should receive especial consideration.

In the meantime, Professor Baird offered to lend the nets to any responsible fisherman who would give them a fair and thorough test. But the fishermen were conservative and hesitated to adopt any "new-fangled notions" for catching fish. This disinclination to try the new method was due chiefly to the fact that fishermen cannot usually afford to spend any time in making experiments, especially when they feel fairly confident of good returns by continuing in their old ways of fishing.

Mention has been made of the introduction and trial of cod gill-nets by the United States Fish Commission in 1878, but no attempt was made by the fishermen to use them until the fall of

1880, when Captain George H. Martin, of Gloucester, Mass., master of the schooner "Northern Eagle," fitted out with them for the winter cod fisheries off Cape Ann and in Ipswich bay The immediate cause which led to this trial was the difficulty of getting a supply of bait, the procuring of which is a source of considerable trouble to our shore-fishermen, and its cost, even when obtainable, is such a heavy tax on this branch of the fishing industry, that often the fishermen hesitate to engage in it, fearing that the result may be a loss rather than a gain. It was to obviate this difficulty about bait, and to render our cod fisheries more valuable in consequence, that led Professor Baird to bring the cod gill-nets to the notice of the American fishermen. The bait principally depended upon by the shore fishermen in the vicinity of Cape Ann, during the fall and early winter, is young herring (*Clupea harengus*), known as the "spirling." The appearance of these fish about the cape is somewhat uncertain; sometimes large schools remain for several weeks, and at other times but a few can be taken. There was so little prospect of getting a supply of bait in the season of 1880, that Captain Martin hesitated about fitting out for trawling, fearing that the cost and difficulty of securing a supply of this article, which is indispensable to the trawl-line fishery, would render the undertaking unprofitable. While the matter of fitting out in the old way was under consideration, gill-nets were suggested by the father of Captain Martin, an employee of the Fish Commission, as a means of solving the perplexities of the bait question. He thought the idea a good one, and, together with several of his crew, visited the station of the Commission at Gloucester, looked at the Norwegian nets that were there, and consulted with the agent in charge as to the probabilities of success. The result of this interview was that Captain Martin decided to fit out and give the new method a thorough trial, and nets were therefore obtained for this purpose, part of them being supplied by the Fish Commission.

Before the trial trip was made Captain Martin had an interview with me at Gloucester, to get some additional information as to the management of the nets. I briefly explained to him the methods adopted by the Norwegians. He thought, however

that the nets might be "underrun," as trawls sometimes are, which would enable one man to handle a gang of nets for which an entire boat's crew, six to eight men, is required in Norway. I could see no reason, myself, why the nets could not be underrun, providing the current was not too strong and the water not to deep. It may be explained here that the Norwegians set their nets late in the day and take them up on the following morning, the apparatus being carried to the land, the fish removed from the meshes, and the gear prepared for setting again. This involves a large amount of labor and much loss of time, as compared with the method of underrunning, which may be considered "another yankee invention."

When the nets are set for underrunning, the anchor is first thrown over, and 25 fathoms of line paid out, when the buoy-line is bent to it. The buoy and line are then thrown over, and the remainder of the anchor line, the end of the latter being made fast to the nets, which are the next to follow. A middle buoy is attached to the center of the gang. When the nets are all out, the other anchor line, with the buoy-line attached, is veered out, and last of all the anchor is thrown over, which finishes the work. The nets are usually set in the afternoon, and allowed to remain in the water for several days, unless for some reason the vessel leaves the fishing ground. Even then, when the vessels have been forced to seek the shelter of a harbor during a storm, the nets have frequently been left out. Fish are caught only at night, and, consequently, the nets are underrun only in the morning, unless the men are detained by unfavorable weather until later in the day. In underrunning, the fisherman goes to one of the buoys on the end of his gang of nets, takes it in the dory, and hauls away on the buoy-line, the buoy being thrown out on the other side and the line allowed to run out on one side as fast as it is hauled in on the other. When the anchor-line (or underrunning line, as it is sometimes called) is up, it is taken across the dory, and the fisherman hauls along towards the nets. The gear is underrun by pulling the nets in on one side of the dory, and, as fast as the fish are removed, allowing the apparatus to pass over the other side into the water, the anchors which remain firmly fixed in the bottom, holding

the nets in position until the work is accomplished. When the end of the gang is reached, it is thrown off the dory, and the nets remain setting as before, needing no further attention until the next day.

As will be readily understood, this method of fishing can be carried on with the minimum of labor, and it has also this additional advantage, namely: while the gear is still out, the vessel may take her morning's catch to the market, or, if the weather is threatening, she may quietly remain at anchor over night in the nearest harbor, though, in the meantime, her nets are fishing.

Ipswich bay, where the nets have been chiefly used, more particularly in the winters of 1880-'81 and 1881-'82, lies north of the prominent headland of Cape Ann, which divides it from the waters of Massachusetts bay on the south. A sandy beach extends along the northern and western sides of the bay, and the bottom sinks gradually from this, only reaching a depth of 25 to 30 fathoms at a distance of several miles from the land. The bottom of the bay is a sloping and sandy plateau, with only here and there small patches of rocks or clay, supporting but a small amount of animal life that may serve as food for the cod. It is, therefore, a spawning rather than a feeding ground for these fish, and large schools visit the bay during the winter for the purpose of reproduction, and generally remain until late in the spring. The nets are usually set along the northern portion of the bay, only a few miles from the shore, in about fifteen fathoms of water, where there is less current than at many other points along the coast.

In this connection may be mentioned a curious fact which has been observed concerning the fish that have been taken in Ipswich bay during the past two or three winters. It is stated that a large portion of the fish caught in this bay have been netted on a small area not exceeding three-fourths of a mile in diameter. This piece of ground, I have been told by the fishermen, for a considerable portion of the season seems to be swarming with cod, while the adjacent bottom appears to be quite barren of fish. According to Captain S. J. Martin, the center of this area bears south by west from Whales-back light, Portsmouth,

and southwest by west from the light-house on the Isle of Shoals. It is somewhat irregular in outline, the fishermen say, judging from where the fish are taken, but so far as anything can be told of its physical conformation, it does not differ at all from the rest of the sandy slope immediately surrounding it. It is said that there is no "feed" on the bottom. The fishermen have a curious theory that there are fresh water springs in this particular locality, around which the cod love to gather; nor, indeed, can they assign any other reason, since there appears to be no special feature in the character of the bottom to attract the fish. So persistent are the cod in clinging to this locality, that it almost invariably follows, that nets placed within its limits come up well filled with fish, while gear that is set a dozen or twenty fathoms outside, get very few, if any, cod. The fishermen confess that it is a mystery to them, and they are exceedingly puzzled to know how the fish get there and escape the walls of netting which surround this spot in all directions. They do not believe it possible that enough cod could be there at once to fill the nets night after night for months, and they arrive at the conclusion that the fish must reach the place during the day, at which time they are supposed to rise above and swim over the nets that bar their progress near the bottom, and which of course can be seen by daylight.*

The results that were obtained from the use of nets by the "Northern Eagle" during the winter of 1880'-81 were considered very remarkable. The amount of codfish taken in the first three trials (which were made in Massachusetts bay) in unfavorable weather and with inferior nets, was 4,000, 6,000 and 7,000 pounds, respectively. On a trip ending January 11th, 35,000 pounds of cod were taken by the "Northern Eagle," 8,000 pounds of which were caught in a single morning. Two other vessels, which were absent the same length of time, fishing at the same place

* Captain S. J. Martin, writing from Gloucester to Professor Baird under date of January 7th, 1884, says: "In Ipswich bay the fish are in one place. Four hundred nets are set in a place one-half mile wide by one-half mile long. The nets are across one another. The vessels have set their nets all over the bay, but find only a few scattering fish except in that one spot. There they get good hauls every morning when there is a chance to haul the nets. * * * The fishermen think strangely of the fish being in one place. They can find nothing (there) to keep them alive.

with trawls, got only 4,000 and 8,000 pounds respectively. After that time she made another trip, taking the same amount 35,000 pounds, in four days' fishing, 18,000 pounds of which were caught in one day. On this day the schooner "Christie Campbell," of Portsmouth, set ten trawls (each trawl having 1,000 hooks) close to the nets. The 10,000 hooks caught 2,000 pounds of fish to the 10,000 taken in the nets.

The "Northern Eagle" began fishing with nets on November 27th, 1880, and as early as January 20th, 1881, she had taken 111,000 pounds of cod. None of the trawlers during that time caught more than one-third of that amount, though they were fishing at the same place. The netted fish were much larger than those taken on the trawls, averaging during the first six weeks' fishing twenty-three pounds each. Among these were individuals which weighed seventy-five and eighty pounds a piece, but there were no small fish, such as are frequently taken on trawls, and which can be sold only at reduced prices. This, it may be stated, has invariably been the case when gill-nets have been used. No immature fish or what is termed as "trash" by the fishermen, have been taken. At first the nets met with the same opposition from the trawl line fishermen that trawls did—when first introduced—from the hand-liners some thirty years ago. Notwithstanding, however, that many of the fishermen were inclined at the start to inveigh against "building a fence" to prevent the fish from moving about on the bottom, it was not long before they all began to realize the advantages of using gill-nets. It is said that whenever in port, the deck of the "Northern Eagle" was crowded with fishermen, anxious to learn about the method of capture which she had adopted. Before the close of the first winter several vessels, both from Gloucester and other ports, fitted out, to a greater or less extent, with nets. As a rule these schooners commenced their operations so late in the season that they could not make a fair test of the gill-nets, for the schools of spawning fish that had been in Ipswich bay began to leave the shore-grounds soon after the vessels began operations.

Gill-net fishing for cod and pollock opened favorably in the winter of 1882, but the shore codfish were much less abundant

during the greater part of that winter than in the previous year; and consequently the success of this branch of the fisheries was not so pronounced as has generally been the case.

Writing under date of November 15th, 1881, Captain Martin says: "I find that pollock will mesh as well as codfish. The first night the schooner "Maud Gertrude" set her nets, twelve in number, they caught 3,000 pounds of pollock and 2,000 pounds of cod. The nets were set on "Brown's" [This is a small rocky shoal lying off to the southward of Eastern point, at the entrance to Gloucester harbor]. * * * Captain Gill told me that if the nets had eight-inch meshes, they could get them full of pollock. The ten-inch mesh catches large pollock, some of them weighing 20, 21 and 21½ pounds." The nets are often very badly torn by the pollock, which is well known to be a remarkably strong and active fish.

It does not seem necessary that I should go into detailed statements of statistics of the amount taken each season, since the following instances that are given of catches made on various occasions will, I think, serve to convey a fair idea of the results obtained.

Although the winter of 1881-'82 was unquestionably the least productive of any season since the introduction of gill-nets into the shore cod fishery, we find that the catches were often of considerable magnitude. For instance, Captain Martin mentions the following facts: Early in November twelve nets set in Ipswich bay caught 12,000 pounds of cod in two nights' fishing. A little later the "Northern Eagle" landed 33,000 pounds of large cod from an eight days' trip, stocking $800, and each of her crew sharing $63. Captain Martin, writing under date of December 6th, said that during the previous week there were 145,000 pounds of codfish caught in gill-nets, and he makes this remark: "If it were not for the gill-nets we could not get fish enough to eat." He also says: "All the vessels that were fishing with trawls are getting nets."

Again on December 22nd, he states: "There were 165,000 pounds of codfish caught in gill-nets last week." This, too, was when codfish were remarkably scarce upon the shore grounds,

and when there was only a small fleet of about 25 or 30 vessels engaged in the net fishery.

The importance of the introduction of the method of catching codfish with gill-nets was more fully demonstrated than ever before in the winter of 1882-'83, and the operations carried on during that season in the inshore fisheries may be considered as having first fairly established this method of fishing in New England; since, previous to that time, there had been many persons rather skeptical as to the benefits that might be derived from the use of nets for catching cod.

Owing to the almost total failure of the bait supply in the latter part of 1882 and the beginning of 1883, it was found impracticable to carry on the shore cod fishery by the old method of hook-and-line fishing. Such a scarcity of bait had never been previously known, and if the fishermen had been ignorant of the use of gill-nets for the capture of cod, a valuable and important industry must have been almost abandoned, for that season at least, while it may be considered probable that the scarcity of fresh cod, which would have resulted, must have increased the price in our markets very materially, possibly, in some cases, to such an extent as practically to place this desirable article of food beyond the reach of the masses. But during the two previous years the New England fishermen had learned a great deal about catching codfish in nets, not only by practical experience but also from an illustrated pamphlet, containing descriptions of all the methods, which had been freely circulated by Professor Baird. The fishermen were, therefore, prepared to meet this unforseen emergency—an almost entire absence of bait. Instead of being compelled to give up the shore cod fishery, as they otherwise must have done, they met with a success which had seldom or never before been equalled. Such results were obtained by the use of gill-nets, that the local papers in the fishing ports contained frequent notices of successful catches. As an instance may be mentioned the following from the *Cape Ann Advertiser*, December 8th, entitled "The Good Results of Net Cod Fishing. On Tuesday, December 4th, boat "Equal," with two men, took 5,000 pounds of large codfish in seven nets off shore, sharing $40 each. The "Rising Star" has stocked

$1,200 the past fortnight fishing in Ipswich bay. The "Morrill Boy" has shared $101 to a man net fishing off this shore the past three weeks.

The "Morrill Boy" met with unexampled success, her crew of five men having shared $320 apiece, clear of all expenses, by the last of December, the time employed being less than six weeks.

From the port of Gloucester alone, according to Capt. Martin, there were employed in the gill-net cod fishery during December, 1882, twenty vessels, carrying 124 men and 176 nets. In the period between November 19th and the last of December, 600,000 pounds of large shore cod were landed in Gloucester, while 150,000 pounds were marketed at Rockport and Portsmouth, making a grand total of 750,000 pounds. When to this is added the amount which was probably taken by the vessels from other ports, it is perhaps safe to say that no less than 2,000,000 pounds of this highly valued and most excellent food-fish were caught in nets during the month of December and the latter part of November.

In the early part of the winter of 1882-'3 codfish were taken in nets in great abundance on the rocky shoals of Massachusetts bay. After the beginning of January, however, the fish were found to be most abundant in Ipswich bay; and, in consequence of this, the fleet of shore cod fishermen resorted to that locality, where they met with the most remarkable success, the catch during the first month of 1883 being, it is said, much larger than at any previous time. According to Captain Martin's report for January, 1883, 121,000 pounds of netted cod were landed in Gloucester during the month. Writing to Professor Baird under date of February 6th, he made the statement that "ten sail of small vessels which had been fishing in Ipswich bay, had landed at Rockport, Mass., and Portsmouth, N. H., during the previous twenty days, 230,000 pounds of large codfish." Calculating on this basis, the total catch of the whole fleet during the month of January, 1883, must have been very large.

It was not, however, until the winter of 1883-'4, that the real value and importance of the introduction of gill-nets into our cod fisheries could be fully and fairly estimated. The results

obtained during the winter of 1882-'3 had inspired the fishermen with more confidence to engage in the net fishing in the succeeding fall. Consequently, we find that the shore fishermen were prosecuting this method of fishing earlier in the season than ever before, even employing it for the capture of pollock before the winter school of cod had reached the shore grounds. This method of fishing was found especially well adapted for taking the large pollock, which generally visit, in the fall, the inshore fishing grounds in Massachusetts bay. The singular fact was also discovered that many of the finest pollock, like the cod, may be taken with nets when they utterly refuse to bite a hook, and consequently cannot be captured by the old methods.

Writing under date of October 28th, 1883, Captain Martin says: "Pollock and cod have been scarce this fall. Forty sail of small craft, which were out two days on the pollock grounds, came in with 2,000 pounds. Captain Gill, of the boat 'Gracie,' had four cod nets given him that were worn out in catching codfish last winter. He set them, together with two new ones, and the first night he caught 5,500 pounds of pollock and 400 pounds of codfish. The pollock averaged 21½ pounds apiece, while those caught on hand-lines averaged 13 pounds a piece. * * * * There are three boats which have nets set. They catch three times as much pollock and three times as much codfish as they do on hand-lines. There will be more cod gill-nets used this winter than there have been since they began to use them. * * * There are no sperling this fall, so that the most of the boats will use nets." Under date of October 31st, 1883, he gives the following statement, which shows in a most striking manner the advantages that are sometimes derived from the use of gill-nets, and, at the same time, affords us an insight into the way in which the fishermen are often induced to adopt this method of fishing. "The schooner 'S. W. Craig,' of Portland, one of the high-line pollock catchers," says Captain Martin, "was in here last Wednesday. I went aboard to see the skipper and to gain what information I could concerning the pollock fishery. The conversation ran thus: 'How do you find the pollock, Captain?' 'Pollock! there ain't none. I have been out two days with twelve men and got 2,000 pounds—that is bad enough.' I said:

'They are catching a good many pollock in nets. Do you see that small boat coming? That is Horace Wiley's; he caught 3,000 pounds the night before last, and caught as many last night. He has got nets.' 'Where does he catch them?' 'Off on a spot of rocks called Brown's.' The Captain said: 'I will get some new sperling to-night, and go off where they have got their nets set. We will give them fits, if we can get some new sperling.' I answered: 'Cap., it is no use to go where they have got their nets set. If you do, you will get no fish.' He replied: 'That be hanged for a yarn. I think you can catch fish with sperling as well as you can with nets.' I said: 'No sir, you can't do it.'

The next day he went out with some new sperling to where Wiley was hauling his nets. (The latter had picked out a dory full of cod and pollock, about 2,000 pounds). He let go his anchor close to the nets and gave the order, "all hands over lines." He lay there two hours, but did not catch a fish.

"I was aboard again yesterday and said: 'Captain, how did they bite where the nets were?' 'That beats all,' he replied; 'we never felt a bite. I am going to Boston to order twenty-five nets.'"

The boat "Gracie," which began fishing with nets the middle of October, did remarkably well; her crew made $145 a piece up to November 11th. According to Captain Martin she had landed 15,000 pounds of large cod and 30,000 pounds of large pollock, and he writes: "Some of the line fishermen have not caught as much as 10,000 pounds in the same time. * * * All the shore fishing will be done with nets this winter, as the sperling are scarce." This success had the effect to induce others to engage in this fishery, and at the date just given (November 11th) there were ten boats using nets. Each one was provided with fifteen nets, each fifty fathoms long, 2½ fathoms deep, with a 9½ inch mesh.

The first vessel to go to Ipswich bay began fishing there early in November, and on her first trip, with only five nets, she caught 6,000 pounds. By November 18th, there were 26 boats setting 390 nets in Massachusetts bay. This would make 39,000 yards of netting. Besides this there were two or three ves-

sels in Ipswich bay, and the schooner "Onward," which left Gloucester that day to go round the cape, had a gang of thirty-five nets. The little schooner "Morrill Boy," previously alluded to, set her nets for the first time on the Sunday preceding November 18th, and at the last mentioned date she had landed 43,000 pounds of cod and pollock, stocking $1,066.75. There were seven men in the crew, who shared $124 for their week's work, and this, too, when two days of the time were lost on account of high winds. On one day (Wednesday) they made $50 to a man. At the same time bait was so scarce and difficult to obtain that the hook and line fishermen could do almost nothing. Sperling, when obtainable at all, brought the high price of fifty cents a bucket-full, which was a very heavy tax on the cod fishermen. On the six days ending November 25th, 487,000 pounds of cod and pollock were taken in gill-nets set in Massachusetts bay, and during the same time four small gill-netting vessels caught 55,000 pounds of fish in Ipswich bay. Writing under the last mentioned date, Capt. Martin says that "about all the fish caught in-shore is by nets," and he also remarks that "if they could be knit fast enough the whole fleet would have nets." So urgent was the demand for cod nets at that time that many of the women at Gloucester were employed in making them. Capt. Martin tells us that "every body is at work," and he continues: "A great winter's work is anticipated." By the latter part of November the fleet of netters had increased to 35 vessels, and it is probable that a larger number might have been engaged in this fishery at that date if they could have obtained gear. The fishermen were often bothered to get nets, and on one occasion several boats had to wait four days to get a supply of glass floats which are so essential in this fishery. By the last of January the fleet numbered fifty-two vessels, which appears to be the maximum; for about the middle of March only forty-two schooners were engaged in netting, a few of the boats having probably worn out their nets, and not caring to refit so late in the season, left shore fishing to go to the outer banks, or else, perhaps, to fit out for the spring mackerel fishery. In addition to the vessels a few open boats engaged in the gill-net cod fishery last winter, and as early as December, according to Captain

Martin, five dories were thus employed from Salisbury, each having three nets.

The gill-net fishery has not been exempt from loss of gear, though, perhaps, this loss is much less than it would be if trawls only were used. In a gale that occurred January 4th, 1884, considerable property was destroyed or injured. Captain Martin reports that thirty-five nets were lost and many others badly damaged. "No fish," he says, "were caught for four days after the storm." Curiously enough, the fishermen say that they never get many fish just previous to a heavy storm, and the netters have learned by experience that a sudden falling off in the catch is generally an indication of the near approach of bad weather. Another feature of the net fishing is that, in addition to various species of the *Gadidæ* which have been taken, porpoises (locally called "puffers"), monk-fish or fishing frogs, and dogfish (*Squalus*) have been caught, though, fortunately, the latter, which are considered especially obnoxious by net fishermen, are not on the coast during the coldest weather.

In addition to the instances already given of catches made last winter, the following have been recorded. For the week ending December 9th, 1883 there were landed at Gloucester 590.000 pounds of netted fish, while 84,000 pounds were marketed at the two ports of Rockport and Portsmouth, the week's catch amounting to the total of 674,000 pounds. The following week Gloucester received 430,000 pounds, Rockport and Portsmouth a total of 81,000, and Swampscott 48,000, making a total of 559,000 pounds. This large amount was taken, too, when the weather was so unfavorable that nothing could be done for three nights and days of the week. For the week ending March 23rd, 1884, 530,000 pounds of cod that had been caught in gill-nets were landed. For the week ending March 30th, 1884, 18 vessels landed 483,000 pounds. The following statement of the total amount of fish captured by the use of gill-nets during the past winter, has been compiled for me by Mr. C. W. Smiley from the notes of Captain Martin, who has made it a special object to collect all possible statistics and information, relative to this important branch of the fisheries.

TOTAL AMOUNT OF FISH LANDED FROM GILL-NETS DURING THE MONTHS OCTOBER, NOVEMBER, AND DECEMBER, 1883, AND JANUARY, FEBRUARY, MARCH, AND APRIL, 1884, FROM THE NOTE BOOKS OF CAPT. S. J. MARTIN, GLOUCESTER, MASS.

MONTH.	COD. No. of lbs.	POLLOCK. No. of lbs.	HADDOCK No. of lbs.	HAKE. No. of lbs.	CUSK. No. of lbs.	GRAND TOTAL.
OCTOBER, 1883,	35,500	573,000	45,000	36,000	30,000	719,500
NOVEMBER, "	1,275,500	185,000	249,000	20,300	9,000	1,738,800
DECEMBER, "	1,373,000	3,000	264,000		15,000	1,655,000
JANUARY, 1884,	932,000		40,000			972,000
FEBRUARY, "	923,000		75,000			998,000
MARCH, "	1,248,000					1,248,000
APRIL, "	705,000					705,000
TOTAL,	6,492,000	761,000	673,000	56,300	54,000	8,036,300

An important matter for consideration in connection with the cod gill-net fishery, is that not only can fishing be successfully carried on even when bait is not obtainable (for of course no bait is required when nets are used), but there is a very great saving of money and time that must be expended in procuring the bait and baiting the lines when hook and line fishing is followed. As an instance of the expense involved, it may be stated that the average bait bill of a shore trawler is not, under ordinary circumstances, less than from $150 to $250 per month, when herring are as high as they usually are in winter. It is therefore, safe to estimate that when as many vessels are employed in gill-netting as there has been during the past two winters, the money saved to the fishermen, which otherwise must have been paid for bait, could not be less than from $30,000 to $70,000 each season. Besides this, a very large percentage of the time is saved, as has been stated, that otherwise must have been lost in seeking for bait.

In pursuing the cod gill-net fishery, fishermen have been to some extent, handicapped by the rotting of their nets, and in some cases—more especially in the fall when the waters are filled with animal life—the nets have decayed very rapidly so that they have been found quite unfitted for use after being in the water for five or six weeks. While at Gloucester, last fall, I had this matter brought to my attention by fishermen, who were anxious to obtain some preservative which would prevent their nets from rotting. I addressed a letter to Professor Baird on the subject, and the result was that the matter having been

brought to the notice of Messrs. Horner and Hyde, of Baltimore, by Major T. B. Ferguson, Deputy United States Fish Commissioner, those gentlemen forwarded to Gloucester a barrel of their net preservative for the purpose of having its merits tested on the cod gill nets. It was applied to a portion of the nets of several small vessels in January last, and after the apparatus had been in use from that time to the middle of April, sections of the net so prepared were forwarded to me at Washington, together with a statement by Captain Martin as to what the fishermen said regarding its use. Previous to this, however, I had talked with some of the fishermen concerning the nets treated with Horner and Hyde's preservative, and they asserted very positively that not only did it prevent the nets from rotting, but that they were fully impressed with the idea that a great many more fish were caught in nets so treated than in others prepared in the ordinary way. The sample of netting sent me by Captain Martin shows little sign of deterioration, notwithstanding the fact that the net from which it was taken had been in constant use for upwards of three months.

Whether future trials of this material will sustain the statements made by the fishermen who have already experimented with it, I am unable to say; but, if such should be the case, there can be no question but that a very important step has been attained through the efforts of the Commission in perfecting the work of cod gill-netting, which it commenced in American waters five years ago.*

* It is, perhaps, proper to state here that some of the North Carolina fishermen who have tried Horner and Hyde's treatment on their nets, have complained most bitterly that their gear was much injured if not almost ruined by it. I have seen copies of two letters from fishermen of the South containing such complaints. This being the case, it will, perhaps, require a longer test to settle definitely whether or not this treatment has all the merit that the Gloucester fishermen say it has, though it is altogether possible—the conditions being so very different—that what might give excellent satisfaction when properly applied and used in the ocean fisheries might prove a failure under other conditions.

In this connection it may be well to say that last winter nets cost $14.25 a piece, and that glass floats could not be obtained cheaper than 22 cents each. It will therefore be seen that a "set of gear" for a vessel carrying thirty to thirty-five nets costs a considerable sum, and if these had to be renewed every few weeks it was a material drawback to the prosperity of the fishery.

The SECRETARY then read the following letter:

WASHINGTON OFFICE
WORLD'S INDUSTRIAL COTTON CENTENNIAL EXPOSITION,
515 Fourteenth Street.

WASHINGTON, D. C., *May 13th*, 1884.

Mr. MARSHALL MCDONALD,
Chairman Local Executive Committee:

DEAR SIR:—Permit me through you to extend to the American Fish Cultural Association, an invitation to hold its next annual meeting on the grounds and in one of the buildings of the World's Industrial Cotton Centennial Exposition, to be held at New Orleans, beginning December 1st, 1884, and continuing for six months. Any time that your Association may designate for said meeting will be acceptable to the Directory, which I have the honor to represent. As there will undoubtedly be large displays of fish-culture made by both the United States Fish Commission, and by the several States interested in this great food industry, I think your Association will derive both pleasure and profit by accepting this invitation. Be assured that the Executive Managers of the Exposition will do all that in them lies to make your annual meeting next year—if held at the Exposition—a great success.

Very respectfully yours,

E. A. BURKE, *Director General.*

Mr. WORTH offered a resolution as follows:

Resolved, That if the United States Fish Commissioner makes a fishery display at the World's Exposition, that the fishermen of the country be requested to meet in convention the American Fish- Cultural Association there at its next annual meeting.

Dr. HUDSON then offered:

Resolved, That the thanks of the visiting members of the American Fish-Cultural Association are hereby tendered to the various local committees for their cordial reception, and take this opportunity to express their appreciation of the efforts which have been made to render this fourteenth annual reunion the most successful since the organization of the Association.

The PRESIDENT announced that after adjournment the Association would call upon the President of the United States, as had been arranged.

On motion the Association adjourned to meet at the call of the Executive Committee.

At 11 o'clock A.M. the members were introduced to President Arthur by Professor Baird.

At noon Professor Baird convened a meeting of the State Fish Commissioners in the office of the Assistant-director of the Museum.

THE RIVER EXCURSION.

At 1 o'clock P.M. the members of the Fish-Cultural Association proceeded in carriages to the Lower Cedar Point wharf, where they embarked on board the "Fish Hawk," one of the Fish Commission steamers, which had been tendered for the occasion by Professor Baird.

In the course of the afternoon the committee, appointed on Tuesday by the President of the Association to draw up a resolution looking to the interests of oyster cultivators, prepared their report, and shortly afterwards a meeting of the Association was called to order in the saloon of the vessel by the President.

The PRESIDENT: This meeting is called for the purpose of considering the desirability of changing the name of the Association. The present name is not considered comprehensive enough by a number of its members. After this point has been settled, we will consider any other business that may be brought forward.

Prof. GOODE: I beg to propose that the name of the "American Fish-Cultural Association" be changed to the "American Fisheries Association." I have conferred with several of the members present in order to get an idea as to what the general feeling might be in the matter. I should not have brought up this question on the present occasion but for the fact that every one with whom I have spoken, seems to be in favor of the change. I think it hardly necessary, therefore, to present all the reasons

for the proposed change. I will, in brief, say that in most of the European countries,—Norway, England, Holland, Germany and Spain,—there are "fisheries associations," "fisheries societies," and "fischerei vereins," which in scope correspond precisely to this one, and I believe that by changing its name, we shall be brought into a more appropriate relation with those sister societies, and that thereby the limitations of the Society will be more exactly represented. Of course the greater includes the less, and the change of the words "Fish-Cultural" to "Fisheries" will in no way diminish the importance of fish-culture, or of the work of those members of the Association who are more particularly interested in that special branch of the fisheries.

The PRESIDENT submitted a general request for the opinions of the members.

Mr. ROOSEVELT: I confess that the proposition to change the name of this Association has surprised me somewhat. I am not quite satisfied that the proposed name conveys to our English-speaking and American-thinking men precisely the purpose of the organization. Our Association is in reality a Fish-Cultural Association. The name "Fisheries Association" is open to various interpretations. At this moment I am hardly prepared to define distinctly what would be precisely conveyed by that expression. We certainly do not meet for the purpose of catching fish but for the purpose of creating fish. I do not think that to the English mind the word "fishery" or "fischerei" conveys the purpose of this Association at all, and it seems to me that "Fish-Cultural" is the better term. The name of this Association originally was "Fish-Culturists' Association," but that was not broad enough. Fish-culturists confine themselves exclusively to raising fish, involving practical and not scientific research. It has been suggested that many of the papers that have been read before the Association have been only indirectly connected with fish-cultural matters; but it seems to me that all of them have had a direct bearing on fish-culture. The food of fish is necessary to their cultivation and a knowledge of their uses, character and nature is also essential. I cannot see how anything that is connected with the study of fish would not come within the

limits of a Fish-Cultural Association; and when I heard of the name proposed, it occurred to me that the term "Fisheries Association" would not definitely interpret the aims of this society.

Dr. HUDSON: I have been reflecting upon this matter and would say that my thoughts in the main coincide with those of Mr. Roosevelt, although my conclusions are somewhat different. I am inclined to the opinion that the word "Fisheries Association" is rather broader than "Fish-Cultural Association," and would be more acceptable. Many men when asked to join our Association, say "I am not a fish-culturist. I do not feel as if I had any special interest in the subject," although, if they attended its meetings, they would soon discover that all kinds of fish, lobsters and oysters are described; their anatomy and physiology discussed; their food investigated; their flesh analyzed, and their organizations compared with others. It seems really as though in the term "Fish-Cultural" all the matters just alluded to cannot be strictly included, and for that reason I believe that "Fisheries Association" would be more suitable. It is the term most generally employed in Europe, and I think it is the best for us to adopt.

Mr. PIKE: I think the proposed change of name is one which should commend itself to this Association. According to my view, the Association has outgrown its original purposes. Its primary object was to bring into closer relations those who were immediately engaged in the artificial breeding of fish; and when the fish commissioners of the several States were invited to join, some, I know, declined, because they were not fish-culturists or fish growers for gain. But all this is changed now; the aims of this Association have gradually become more expanded and elevated—embracing everything that pertains to food fishes in all their manifold relations. This is seen in the great variety of topics which were presented for discussion during the session of the Association. Strictly speaking, Professor Atwater's excellent paper would not have been an appropriate one before an association of persons devoted simply to the best method of cultivating and increasing food fishes. And yet it was one of the most acceptable papers presented; and it was acceptable because

the members of the Association have learned to take broader and more comprehensive views of the subject of fisheries. In a word, this Association has outgrown its name—and it needs to adopt a name that will more truly, more significantly, indicate its present commendable objects and studies. I think the term "Fisheries Association" would accomplish this. It may be adopted with or without the definite article "the;" but I would prefer to call it "The American Fisheries Association."

Mr. WORTH: Mr. Chairman and gentlemen: I have felt in my work that I needed the hearty co-operation of the fishermen, and I have endeavored to bring about a more intimate relationship between them and fish-culturists. I have found in North Carolina that the fishermen were fighting the work, and at the Exposition which we propose to hold there this fall, I have already organized in the State a movement which will bring about a "fisherman's convention," which will hold its sessions in October, at which time I hope to display the fishery industries of North Carolina. With regard to the change of name, I think that the term at present in use is rather narrow. Several special subjects have been taken up at our recent sessions which are not fish-cultural, and yet if we call it "The American Fisheries Association" we drop rather beyond the line where we want to go. As Colonel McDonald said to me, we are a kind of protective association of the fisheries. We not only want to propagate fish, but to perfect the system of fishing, and the methods of preparing and marketing them; all of which considerations have direct bearing upon the name by which our Association should be known. While it is desirable that these various questions should have their place with us, it seems to me that the proposed name is rather a broad departure from its present anchorage. I think the name should be broader and more comprehensive than at present, but I am rather opposed to calling it "The American Fisheries Association." I can suggest nothing better, I admit, but it seems as if there must be some intermediate and appropriate name. The term "Society" strikes me as more suitable than "Association." If manufacturers and fishermen be allowed to come in, I am somewhat afraid that they will overbalance en-

tirely the fish-cultural element. I am opposed to changing the name to "The American Fisheries Association," but there is an intermediate name if we could just hit on it.

Col. McDonald: I have no opinion to express beyond what has already been expressed by Mr. Pike. I agree with him fully.

Mr. Evarts: I somewhat disagree with my friend Mr. Roosevelt. I would suggest something covering the same idea, but how it will sound I cannot say—"The Fish Interests Association"—I don't know whether that would be intelligible or not.

Mr. Willcox: I feel as if it were desirable to change the name, judging by what my feelings were when I was asked to become a member. I said: "I am not a fish-culturist, although I am interested in its scientific relations." I thought I would be "out of my latitude" in the territory of this Association. But judging from what I have seen and heard since I have been a member, I now believe that the Association has outgrown the purpose of its original organization. I think the time has come when the name should be changed; but I am not prepared to suggest a substitute, as I have not considered the matter sufficiently.

Mr. Stone: I do not know that I have much to say. I think the considerations on both sides are of about equal weight. When Professor Goode asked me if I objected to the change being made, I said I had no objection, but since Mr. Roosevelt has spoken on the other side, I can say that the change of name would I believe, radically change the purpose of the Association. I think it would be rather a pity to do that. Perhaps I am more sensitive on the subject than some of the others, because I happen to be the one who drew up the constitution under the old name. If, however, the change is thought to be for the interests of the Society, I don't think I should offer any objection, but I think it would be a good plan to let the matter lie over for a year, until we have given it more thought.

Mr. Mather: I feel like saying a few words. I think with

Mr. Stone that if we could offer a name that would embrace the whole purpose of the Association—perhaps "The American Fish, Fisheries, Oyster, Lobster, and Fish-Cultural Association"—it would be well, but it would take a great deal of ink. I should prefer to call it a "society," because there are fewer letters in it than in "association," and the Secretary has less writing to do. As a fish-culturist, I do not like to see the idea of fish-culture lost sight of or made to take a second place. That was the main purpose of the Association at its birth, and I believe that Mr. Stone and I are the only two original members left. I agree with Mr. Stone's suggestion that the matter lie over for a year. I object to any change whatever, because we are well known by our old name and under it, have taken in all questions which we can under the proposed new one. If at a future meeting there should be a majority of net-makers, they might wish to again change the name to include their business. I have grown up with the Association under its old names, and it seems to me suicidal to make a change. It is like exchanging a tattered flag that we have fought under for one just out of the shop. I can readily see how new members may desire a change, but I cannot approve it.

Prof. GILL: Although I may not be a member of this Association, I have no objection to speak, as I am requested. I am rather inclined to disagree with that old proverb that a rose under any other name smells equally sweet. I think Mr. Roosevelt has given a good argument for changing rather than keeping the name. He has well remarked that the Association has developed from a fish-culturists' association into a fish-cultural association, and that it is still in progress of further development; and it seems as though it would be merely following a natural sequence to enlarge it still further and call it "The American Fisheries Association." As regards the preference of the word "association" or "society," I should be disposed to retain the old name, because we are apt to recognize a "society" as a local organization, while this is rather a peripatetic body. It would then be on a footing with the "American Association for the Advancement of Science," and others which are also peripatetic

in their habits. I should, therefore, be in favor simply of changing the name to "American Fisheries Association."

Dr. H. H. CARY: It occurs to me that the name might be made a little more comprehensive, and it seems to me that a change is desirable. In that view, I venture to throw out a suggestion, and ask how it would do to call it "The American Fish-Cultural and Protective Association." We need protection as much as anything else. There are as many poachers of fish as of game.

Mr. ENDICOTT: I have listened to the interesting papers that have been read at many annual meetings of this Association, and have as yet seen nothing to prevent a member from introducing any matter that pertains even in the remotest degree to fish or fisheries. Nor do I suppose we shall ever have any difficulty in that particular. Consequently I see no reason for changing the name. I do not think that we have grown so large that we should be ashamed of the old colors. I am in favor of retaining the old name.

Mr. ROOSEVELT: I propose to let the matter lie over for a year. If you change the name to "Association of Fisheries," people would regard it as composed of fishermen. It would narrow our aims instead of broadening them. If we could agree on an accurate and satisfactory substitution, I would not object. I move that the subject lie over for a year, or until the next meeting of the Association.

Prof. GOODE: Mr. President: I have no personal feeling in the matter, but it seems to me that there has been a little misapprehension of the significance of the term "fisheries" as used in the literature of the present time. We have had last year in London the International Fisheries Exhibition, the classification of which corresponded to some extent with the scope of this society, and was much broader than this institution at the present promises to be. The word "fisheries" is used in the broadest sense by a great many writers upon fishing topics. "Fishery" is a very different word. The word "fisheries," as in Germany and France, takes in the whole subject of economy in fishing, and

includes protection, propagation, proper methods of carrying on the fisheries, and embraces all the subjects that have been discussed by this Association during the past two or three years of its history, in which interval the scope of the Association has been much wider than in previous years. I have not the slightest objection to voting for a deferment of the consideration of the subject, but fail to see what can be gained. I think such action will retard the Association in its march of progress just twelve months.

Prof. GILL: I would suggest that the furtherance of the fisheries is the object of this Association, as I understand it, and fish-culture is simply a means by which this objective can be obtained. Now I think that the work of this Association naturally includes a very wide field of investigation, and therefore am of the opinion that the term "fish-culture" is decidedly too narrow in its meaning. If fish-culture is its limit, then to be logical we would have to eliminate a good deal that has been done by this Association; in other words, we should have to call a halt, put down the brakes, and put back the work of the Association a good deal behind that point which it has already reached. This organization began in a small way—as a fish-culturists' association;—it became naturally developed in the course of time into an association that took cognizance of all that related to fish-culture, and it has now developed beyond that point, embracing in its aim all that is useful for the fisheries. It seems to me consequently that, if it be desired to have a name which is expressive of its present aims such a change as is proposed, namely, to call it the "American Fisheries Association," is decidedly preferable.

The PRESIDENT: Gentlemen: Are you ready for the question? The first vote will be on Mr. Roosevelt's amendment.

This was taken and lost.

Mr. ROOSEVELT: I recommend the word "society" instead of "association."

Prof. GOODE: I accept this amendment, and am willing that it should be called "The American Fisheries Society."

Mr. MATHER: I would really like to ask whether it is parliamentary, after this Association has adjourned, and some of its members have gone home, to hold this meeting here. I object to all the proceedings of this meeting as being irregular.

The PRESIDENT: I shall rule it in order, as the Association has no order of business. Besides, Mr. Mather has taken part in the discussion, and therefore has no right to object to the meeting as an irregular one.

Col. McDONALD: It is the largest attendance we have had throughout the whole meeting.

Mr. MATHER: But the regular meeting adjourned this morning.

The PRESIDENT: The last amendment has been accepted that the name shall be changed to "The American Fisheries Society."

Prof. GOODE: I would like to ask one question. Supposing the wish of the majority be to retain the old name, "Association?'

The PRESIDENT: The amendment has already been accepted. We will now vote upon it.

This was taken and carried.

The PRESIDENT: The future name of this Association is "The American Fisheries Society."

Mr. MATHER: It has been suggested that, in order to put ourselves on an equality with similar bodies in other countries, and carry on an exchange of publications, this Society should have, in addition to its regular members and honorary members, one or two of the leading men connected with the fisheries and fish-culture in each foreign land as corresponding members, to whom our reports shall be sent. It was complained to Professor Goode, while in Europe last summer, that our publications were not to be had. Several people wanted to know what we were doing, and we want to know what they are doing. Therefore, at the suggestion of Professor Goode, I make a motion that this Society add to its list of members and honorary members, certain

corresponding members to be elected from among men who are prominent abroad in connection with fisheries and fish-culture.

The PRESIDENT: Is that motion seconded?

Mr. ROOSEVELT: I second it, but would put it in a different form—That the Executive Committee be empowered to select correspondents abroad in connection with foreign societies.

Mr. MATHER: I withdraw my motion.

Col. McDONALD: Before the motion is put I beg to say, that the object to be attained in the election of corresponding members is that the Association may be promptly informed of the progress of fish-culture abroad, and be kept in close relations and correspondence with societies whose aims are similar to ours.

An election as corresponding member is, moreover, a compliment to the distinguished gentleman who may be selected, inasmuch as it is a recognition of eminent services rendered to fish-culture, or important investigations germane to it.

The compliment of election will in my opinion be more distinguishing if made by a vote of the Society, rather than by designation of the Executive Committee, and I propose therefore, to amend this resolution of the honorable commissioner from New York by requiring the election of corresponding members to be by vote in open meeting.

Neither resolution or amendment, however, are in order until we by resolution provide for a class of corresponding members.

Under our present organization, only two classes of members are specified, viz.: honorary members and ordinary members.

I beg therefore to submit the following resolution, viz.:

Resolved, That persons in foreign countries who have made themselves conspicuous by services to fish-culture or by investigation of questions relating to fish-culture and the fisheries, may, upon nomination duly made, be elected corresponding members of the American Fisheries Society, with all the privileges of members, but without liability for initiation fee or annual dues.

Prof. GOODE: I second the proposition.

The PRESIDENT: If there is no objection to Colonel McDonald's motion we will proceed to vote on it.

This was taken and carried.

Mr. MATHER: The following names have been suggested, on consultation, as persons who should be elected as corresponding members of this Society.

Capt. N. Juel, Norwegian Royal Navy, President of the Society for the Development of Norwegian Fisheries, Bergen.

S. Landmark, Inspector of Norwegian Fresh-water Fisheries, Bergen.

Dr. S. A. Buch, Christiana, Norway, Government Inspector of Fisheries.

Prof. G. O. Sars, Christiana, Norway, Government Inspector of Fisheries.

Dr. Oscar Lundberg, Stockholm, Sweden, Inspector of Fisheries.

Baron N. de Solsky, Director of the Imperial Agricultural Museum, St. Petersburg, Russia.

Prof. B. Beneke, Commissioner of Fisheries, Konigsberg, Pomerania.

Prof. T. H. Huxley, H. M. Inspector of Fisheries for Great Britain.

Edward Birbeck, Esq., M. P., President National Fisheries Association of Great Britain.

Sir James Gibson, Maitland, Bart., Sterling, Scotland.

R. B. Marston, Esq., Editor of the *Fishing Gazette*, London.

Dr. Francis Day, F. L. S., late Inspector General of Fisheries for India.

Thomas Brady, Esq., Dublin Castle, Inspector of Fisheries for Ireland.

Archibald Young, Esq., Edinburgh, H. M. Inspector of Salmon Fisheries for Scotland.

Arthur Fedderson, Viborg, Denmark.

Prof. A. A. W. Hubretcht, Member of the Dutch Fisheries Commission and Director of the Netherlands Zoological Station.

M. Raveret Wattel, Secretary of the Societe d'Acclimatation, Paris.

Don Francisco Garcia Sola, Secretary of the Spanish Fisheries Society, Madrid.

Prof. E. H. Giglioli, Florence, Italy.

M. A. Apostolides, Athens, Greece.

William Maclean, Sydney, President of the Fisheries Commission of New South Wales.

The PRESIDENT: You have heard the names which have just been read. We will now vote on them.

This was taken and carried.

The PRESIDENT: The Committee on the Oyster Resolution will please report.

The COMMITTEE has the honor to report:

WHEREAS; The oyster industry of the United States exceeds all other fisheries in the number of its employees, capital invested, and value of its products, which are not articles of luxury but a veritable food supply; and it having been shown that this important industry is in danger of extinction; and it being the opinion of this Association and of all competent persons, that the preservation of the industry and the increase of the supply of oysters is dependent upon artificial extension of the present oyster-area, which extension can only be achieved through private ownership and cultivation of oyster ground, therefore be it

Resolved, That this Association most earnestly recommends the adoption of the principle of individual ownership of oyster grounds, that the oyster culturist may possess the surety of gathering the results of his labors. And it is likewise the opinion of this Association that an investigation of all the conditions affecting the life of the oyster is eminently desirable and should be immediately undertaken. And furthermore be it

Resolved, That a copy of this preamble and the resolution be forwarded to the Governors and legislative assemblies of the oyster producing States, and that copies also be transmitted to the President and Senate and the House of Representatives of the United States.

Lieut. WINSLOW added: I am also instructed to move the immediate adoption of the preamble and resolution.

Mr. ROOSEVELT: I question the propriety of the resolution that has just been read. I beg that it may be read again.

WHEREAS, The oyster industry of the United States exceeds all other fisheries in the number of its employees, capital invested, and value of its products, which are not articles of luxury but a veritable food supply, and it having been shown that this important industry is in danger of extinction; and it being the opinion of this Association and of all competent persons, that the preservation of the industry

and the increase of the supply of oysters is dependent upon artificial extension of the present oyster-area, which extension can only be achieved through private ownership and cultivation of oyster ground, therefore be it resolved, etc.

Lieut. WINSLOW reads preamble, and adds: The demand for oysters has far outgrown the supply. No remedy is likely to be of any practical value which does not have in view an increase of the supply, and upon that principle the preamble is drawn. It sets forth that an extension of the oyster area is necessary, and it has been proved by the experience of every oyster community and country in the world, that an extension of the area and increase of the industry has resulted only when private individuals have taken it into their hands. The only government that ever attempted it was the French government, and if you look at the translations on this subject by the Fish Commission, you will see that one of the most eminent of authorities says that the failure of Coste's efforts was due to the fact that the government attempted to go into the oyster business, and that oyster culture was made a success only when private individuals undertook it. A private oyster area is certain of a most conservative treatment, for it can be handed down to the descendants of the owner. Ownership begets that most powerful influence, self-interest, upon which success depends. If money is needed for its cultivation, money can be raised on it by mortgage. I am not alone in this opinion. It is supported by the experience of all other fisheries, and by gentlemen who have had greater experience in the elaboration of details than I. That being, then, the essential principle upon which depends the extension of the oyster areas, the committee thought it more advisable to deal with that alone, and leave the details to be decided by the legislatures of the different States. I do not think that this Society wishes to commit itself in this matter, other than to advise the adoption of a principle, as I have already explained.

Mr. WILLCOX: I favor the resolution; but, if I were participating in the legislation concerning the subject, I should provide that the owners should only have the exclusive use of the areas for the cultivation of oysters; and only as long as they use them for that purpose. I shall vote for the resolution.

Mr. EARLL: It is not my purpose, in calling out a discussion of this resolution, to oppose any legislation that may prove beneficial to our oyster interests as a whole. It should, however, be remembered that this Society is national in its scope, and that any resolutions tending to affect legislation without limit as to locality, should not receive its sanction until it is clearly proven that such resolutions are for the best interests of the industry when taken as a whole. Several gentlemen familiar with the oyster interests of the New England and Middle States are present, and, as I understand, heartily approve of the adoption of the resolution for these regions.

But the oyster interests vary greatly with the locality, and laws of unquestionable benefit for one portion of the coast might work disastrously in another.

As one who has given considerable attention to the oyster interests of our South Atlantic and Gulf States, I cannot believe that the adoption of the resolutions proposed would be a benefit to that region. On the contrary, I am strongly of the opinion that they would have an injurious effect.

Our entire coast between Cape Henry and Mexico, including the thousands of miles of coast line along the numerous sounds, bays, and tide creeks, are literally alive with oysters, and yet, in all this region, the oyster interests are absolutely undeveloped. There are not half a dozen places along this entire coast that have a shipping trade in oysters of any importance, and yet the oysters are so abundant that men can wade about in the shoal waters, and pick up boat loads of them in a few hours, often finding them in bunches larger than they can lift. In North Carolina, for example, oysters are so abundant that some of the fishermen find profitable employment in securing vessel loads of them, and carrying them to the river landings in the agricultural regions and selling them for fertilizing at three to four cents a bushel. I feel safe in the statement that there is not one city between North Carolina and Mexico, where, with proper attention, the oyster interests could not be increased fifty-fold without endangering the natural supply.

What we most need in this region is more encouragement of

the oyster interests, rather than legislation having a contrary effect.

Lieut. WINSLOW: Please explain how a resolution which is an incentive to individual cultivation of oyster area or propagation of oysters, and to an increase of the oyster supply of the market, is likely to result disastrously.

Mr. EARLL: The resolution urges the principle of private ownership of oyster beds, and does not exclude the natural beds from such control. The natural beds in the South are capable of furnishing many more oysters than are now taken. If the principle of private ownership were adopted here, the best beds would naturally come under the control of individuals, who could neither utilize them, nor allow their less fortunate neighbors to do so without charge. Many of the poorer fishermen would be thus shut out from the best localities, and would be put to inconvenience in being obliged to go further from home to obtain a supply. In addition, many of the farmers living five to twenty miles from the shore, who now make occasional visits to the coast to gather a supply of oysters for distribution among their neighbors, would meet with opposition from the oyster monopolists, and a large quantity of food would thus be lost to the country.

I believe that, as a rule, it is not best to introduce the principle of private ownership until the national supply of oysters is endangered; and even then it would seem unwise to give a man control over more ground than he is willing to keep up to its full limit of production, and work regularly.

Mr. PIKE: I heartily concur in both the preamble and the resolution. I do this not alone theoretically, but from practical experience.

As I understand the resolution, it is not designed to exclude those who get their living from the natural beds; but simply to encourage private enterprise and systematic effort to develop the growth of oysters where they are obviously disappearing. This can be done without interfering with the natural beds to any serious extent. There is room enough for both classes of oystermen to work, and work profitably. The States of Mary-

land, Delaware and Virginia are suffering from a rapid depletion of their oyster beds. Something must be done to stay the waste, and this Society believes that this resolution embodies a method which will meet the difficulty. The poor man will continue his wasteful ways of gathering oysters from the natural beds; while those who wish to pursue the better ways of private cultivation will have an opportunity to do so, and will be protected by the law in the product of their labor. We have adopted this plan in Connecticut, and we find that both classes of oystermen get along together harmoniously and prosperously. Indeed the poor oysterman finds his best customers in the cultivators. The result is that the oyster industry of Connecticut has grown beyond all anticipation, and we have ten-fold more oyster cultivators to-day than we had ten years ago. This is the direct result of the system set forth in the resolution. Why; our Connecticut growers are now shipping thousands of bushels of oysters every week to Baltimore. This may be exceptional. We do not expect to compete with the Southern growers, but we can see that our system is greatly improving our industry, and giving us unusual advantages in the market. This Society can safely recommend such a system to the States named. I advocate this on theoretical and on practical grounds. I hope the resolution will be adopted. The poor men are not to be driven off the natural beds. They can gather the products of the natural beds as heretofore. The resolution simply proposes to encourage another class of oystermen who will cultivate private tracts. They will occupy but a very small part of the oyster grounds of these States—so small a part, indeed, that there can be no interference with the poor men, and there is not the slightest danger that they will be excluded from the natural beds.

Mr. Roosevelt: A year ago I sailed from Charleston, S. C., through the inland waters to Florida, and was astonished at the oyster resources of that part of the country. For a thousand miles I sailed between masses of natural oyster beds that at low tide were six feet high. In our localities at the North we have to bear in mind that in establishing oyster beds it is necessary to supply them with seed, which can only be obtained from pub-

lic beds, or by importation. Shut up the public beds or make them private, and you shut them out of competition. So I suggest these words as an amendment to the resolution: "That in approving private ownership in oyster lots, we do not recommend that the natural beds should be so appropriated."

Lieut. WINSLOW: I object to the amendment. I think it would be unwise to embarass the enunciation of the general principle with any particular applications of it. That is a province which perhaps we have no right to enter. I should, therefore, speaking for the committee, prefer to see the resolution adopted as it stands, thinking it would better accomplish our end—that is an extension of the oyster area and an increase of the supply of oysters.

Mr. EARLL: I second Mr. Roosevelt's amendment.

Lieut. WINSLOW: I move to strike out the amendment made by Mr. Roosevelt. This preamble and resolution have been very carefully drawn, and are simply the enunciation of a general principle. As I explained, we want the supply of oysters increased, and that can be done only by an extension of the area. The extension can only be accomplished through the efforts of private individuals, which efforts will be exerted only when those individuals have a proprietary interest in the beds. We should not in the same resolution enunciate a principle and recommend only its partial application. Let others decide that.

The motion to strike out Mr. Roosevelt's amendment was put, resulting in a tie.

The PRESIDENT: I move to strike it out.

The amendment was therefore cancelled.

Mr. PIKE: I beg to offer this amendment.

[This amendment was never delivered to me, and a letter to Mr. Pike asking for a copy of it has never been replied to.]

RECORDING SECRETARY.

Lieut. WINSLOW: I object to this amendment on the general principle already stated.

Mr. EARLL: I think that the resolution will tend towards the monopolizing of individual beds.

Prof. GILL: I think it is unnecessary to add anything whatever to, or make any change in the resolution.

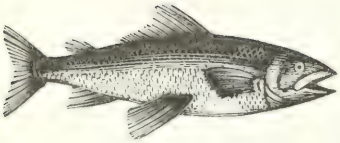
The PRESIDENT: We will now vote on Mr. Pike's amendment.

This was taken and lost.

The PRESIDENT: We will now vote on the original motion.

This was taken and carried.

The meeting then adjourned.



TREASURER'S REPORT.

DR. AMERICAN FISH CULTURAL ASSOCIATION in acct. with E. G. BLACKFORD, Treas. CR.

1884.			
To balance due Treasurer as per last report, - - - -	$89 55	By amount received for dues since last report	$393 00
Jan. 11th, To cash paid for stamped wrappers,	4 20	Balance in Treasury. - - - -	205 75
22nd, " " J. M. Davis, for printing reports, etc. - - -	91 80		
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