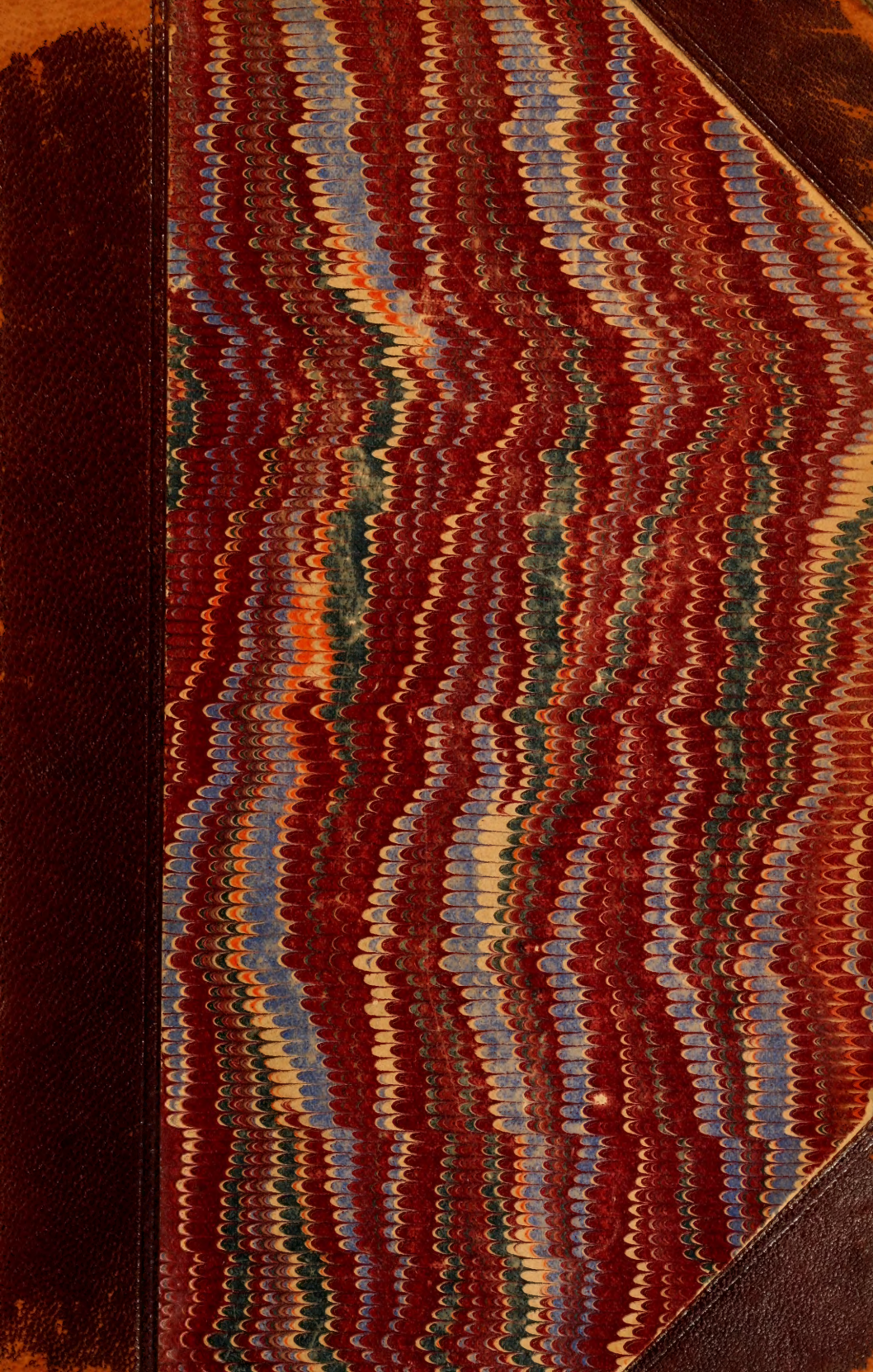

American Fisheries Society.

1889.

TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY.

EIGHTEENTH ANNUAL MEETING.

HELD AT THE ROOMS OF THE

ANGLERS' ASSOCIATION OF EASTERN PENN'A,

PHILADELPHIA,

MAY 15TH AND 16TH, 1889.

SPANGLER & DAVIS, 529 COMMERCE ST., PHILA.

Officers for 1889-90.

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V.-Pres't,	HERSCHEL WHITAKER,	*Detroit, Mich.*
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Rec. Sec'y,	FREDERICK W. BROWN,	"
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EIGHTEENTH

ANNUAL MEETING

—OF THE—

American Fisheries Society.

FIRST DAY.

The Eighteenth Annual Meeting of the Society was held in the rooms of the Anglers' Association, of Eastern Pennsylvania, No. 1020 Arch Street, Philadelphia, Pa., on Wednesday and Thursday, May 15 and 16. There was also an evening session, on Wednesday, at which various subjects were discussed in an informal manner.

The meeting was called to order at 11 A. M. Both the President, J. H. Bissel, and the Vice-President, S. G. Worth, being absent, Dr. W. M. Hudson, of the Connecticut Fish Commission, was unanimously called to the chair. He accepted the position with appropriate remarks and was followed by Mr. A. M. Spangler, President of the Anglers Association, of Eastern Penna., who extended the hospitalities of the Anglers Association in a brief address of welcome as follows:

Gentlemen of the American Fisheries Society:

In the name and on behalf of the Angler's Association of Eastern Pennsylvania, it affords me great pleasure to extend to you a most cordial welcome to the city of Philadelphia

and to these, the headquarters of our Association. At the same time, permit me to tender to you the unrestricted use of these rooms during the sessions of your society, requesting also, that if the services of the members of our Association can, in any way, be made to contribute to your comfort or convenience, you will unhesitatingly command them.

These tenders gentlemen, are the more appropriate on the part of the Anglers' Association, from the fact, that notwithstand our name, the primary objects of our organization, are identical with those of the American Fisheries Society, namely, the promotion of the great fishery interests of the country. While your body deals mainly with the ichthyological, we have assumed a more practical position ; supplementing to the fullest extent of our abilities, the good work in which you are engaged, by securing the enactment and enforcement of rigidly protective fishery laws.

While in our membership there are many keen and skillful anglers—gentlemen possessing and exercising all the instincts of true sportsmen—they have ever been mindful of the important fact, that in order to have fish for catching, there must be fish propagation and protection. True, our labors have been confined to the eastern portion of our own State only, but we know that they have not been in vain. The success of the past incites to renewed efforts; your presence here, gentlemen, giving additional stimulus to them.

In view of these facts which so clearly demonstrate the unity of our purposes, we feel that we can extend the right hand of good fellowship, and again bid you cordial welcome ; trusting and believing that your deliberations will be profitable to the great fishery interests of the country, and your sojourn in Philadelphia pleasant to you all.

Allow me in conclusion to direct your attention to the fact, that a day or two since, a fine Kennebec or Atlantic Salmon was taken in the Delaware river, a few miles below the city, and can be seen in an adjoining room. We will be pleased to

have you examine it and if possible, determine whether it is an estray, or a result of the salmon planting made in the river several years since, To-morrow you will have an opportunity of discussing its table qualities at the planked shad dinner at Gloucester. Once more, gentlemen, a cordial welcome.

Dr. Hudson replied on behalf of the Society. It was further announced that, through the courtesy of Hon. Marshall McDonald, Commissioner of Fisheries of the United States, the U. S. Steamer "Fish-hawk" had been placed at the disposal of the "Anglers' Association," for the purpose of affording the Fisheries Society an opportunity of observing the process of hatching shad, and they were invited to participate in a trip on the Delaware River, for that purpose, to proceed to Gloucester, N. J., where they would witness the hauling of the large shad seine, and partake of a Planked Shad Dinner, as guests of the "Anglers Association"—which invitation was duly accepted.

Mr. Mather then suggested that a Recording Secretary should be appointed or elected, before further business was transacted, in order that he could begin to take notes for his report. He said, "I did not expect to be with you at this meeting, and had mailed my resignation to Mr. Ford which is as follows:

COLD SPRING HARBOR, SUFFOLK CO., N. Y., May 14, 1889.

HENRY C. FORD, ESQ.

Corresponding Secretary American Fisheries Society,

MY DEAR SIR:

I herewith transmit my resignation as Recording Secretary of the American Fisheries Society.

My manifold duties to both the New York and the United States Fish Commissions deprive me of the pleasure of much other congenial work in the line of fish culture which I might desire to do.

Elected to the office of Recording Secretary in 1883, I feel that I have served the society faithfully and ask to be relieved from further work, The office which I have held, involves more labor than any other in the society, requiring the special knowledge of a journalist in the preparation of papers and reports, and if I can be of any assistance to my successor he has only to name the manner of it.

Very truly yours,

FRED MATHER.

After some discussion, Mr. Mather consented to act as Recording Secretary until the election of officers.

PRESIDENT BISSELL'S ADDRESS.

The following address by President Bissell was then read by Dr. Hudson :—

Gentlemen of the American Fisheries Society :—

It may not be inappropriate, on opening this Annual Meeting of the Society, for the President to comment briefly upon affairs of the Society, or other subjects which he may deem suitable for the Society's consideration.

OF MEETINGS.

As we all believe that some good may accrue to the cause of fish-culture in this country from the proceedings of this Society, it is important to make the meetings of the Society as interesting and practical as we may; and to secure each year as large an attendance as possible of the persons within reach who are to some extent interested in the topics discussed. To that end I advise that, in future, at least two members of the Executive Committee should be selected from the locality where the meeting of the year following is to be held, and that those members, with the President and Corresponding Secretary, should be constituted a sub-committee having special charge of the Annual Meeting. We cannot always meet in Philadelphia, nor always have the dis-

interested and valuable services of the present Corresponding Secretary. Even if these conditions were permanent, it is hardly fair to throw an undue proportion of the work in arranging for the meeting upon a single officer, however efficient and willing.

STATE FISHERY COMMISSIONS.

You are probably all familiar with the organizations employed by the different states in carrying on the business of fish-culture. Nearly all the states, where there is much being done in this art, have commissions composed of from three to seven commissioners. These gentlemen are not always selected on account of their special aptitude for discharging the duties required of them, although generally they are persons having some interest in the general subject. My purpose is to suggest that a little interest taken in the appointment of new members to the various State Commissions, by persons really interested in fish-culture, as the members of this Society are, would often result in the appointment of really capable men. Any of us who have had the opportunity to see what energetic and intelligent men can accomplish, when appointed to such a place—having, of course, a thorough interest in fish-culture and believing in its immense ultimate importance to the states—need not think twice to appreciate the need of urging upon the appointing power the selection of the most capable men who can be persuaded to accept the duty. The office of a Fish Commissioner is as much a "public trust" as any other, and is one where the service rendered by a man whom the office seeks is many-fold more fruitful, than of the man who has sought the office for the pleasure to be got of it or the slight patronage which its possession may yield. Here almost every member of the Society can exercise some influence which will be of value to the art of fish-culture as well as a service to his own state. It is worth the trial of each one of us; and if the members of this Society rendered no other service to the cause of fish-culture than seeking to influence appointments of competent

and thoroughly interested men upon State Fish Commissions, its existence would be amply warranted, and it would deserve well of the country. In the main, the gentlemen at present comprising the several State Commissions are men of character and capacity; but some of them do not give of their time and talent all the attention their work seems to require of them.

ORGANIZATION OF STATE COMMISSIONS.

Thorough organization of the work of a Fish Commission is as essential to its greatest influence as it is in business enterprises carried on by private individuals or corporations.

(1). There must be regularity of meetings for consultation and the general planning of work. All advancement cannot be expected from the employes, no matter how capable and intelligent. When Commissioners know what is going on, and assume direction of the general plan of work, are watchful of, and check unnecessary expense, and by their own work secure suitable appropriations for improvement and enlargement of the work, they get better service from their employes, the general tone of the work done improves and the results are vastly greater to the public.

Then also, regular and frequent meetings lead to frequent consultation about the discharge of official duty, the effect of which is to give a steadier and more even impulse to improvement in plans and methods. It secures more general interest in every member of the board and neutralizes the tendency to concentration of direction in the hands of one or of a limited number. It equalizes the responsibility. It brings home to each member of the Board the oft needed reminder that he has an actual duty to perform, requiring his thought and personal attention.

(2). There must be a fair division of labor among the Commissioners. Where this is done systematically, it will result in securing the best results in many ways. It gives equal means of knowledge of the needs of the various departments

of the work carried on. It brings each Commissioner into personal contact with the men employed; and gives to the several departments of work the advantage of different kinds of influences all bent upon improvement and advance.

(3). There should be persistent, systematic, thorough work done with the State Legislatures, The greater part of this kind of work must necessarily be performed by the Commissioners. The Secretaries and Superintendents can be of more or less service, but the legislative committees, if they are in earnest, wish to have information and advice from the men who are responsible by virtue of their office, and they have a right to be resolved of their doubts by the men who do, or should, know the requirements of this department of the State's business. This is a particular in which many State Commissions have not accomplished what seems to me their whole duty. Legislatures are not in the habit of increasing appropriations unless good reasons are advanced for it, and a good account given of the expenditure of past appropriations. The advances made in our art require of all who are to keep pace with them, increased and better facilities, better equipments, ever increasing operations. What State Commission is doing all that can be done for the culture of its waters? and doing it so well, there is no room for improvement. Until that point is fairly reached and maintained, there seems to be no stopping-place in continual improvement and extension. To keep pace, then, with the growing requirements in the conditions of successful fish-culture, appropriations must grow. And to that end all legitimate influences must be brought to bear on State Legislatures. This is no one's business if it be not of the State Fishery officers. And, in my judgment, it cannot be as thoroughly and successfully done by others as by the Commissioners of the respective states.

WHITE FISH IN THE GREAT LAKES.

Another notable success in fish-culture has been attained in the re-establishment of white fish in Lake Erie, and the

definite proof of success which we have from a few other points on the Great Lakes. In the face of the most persistent and destructive methods of fishing, the ever increasing demands of a growing and insatiable market, improved methods of preservation and transportation, the stock of white fish in Lake Erie has steadily increased for the past four or five years under the influence of artificial propagation and planting. The season's fishing in Lake Erie last year was the most productive for the past fifteen years. From 1885 the increase has been gradual and marked. The improvement had been closely watched by the fishermen, and in the season of 1888 many of them transferred their operations from the less productive, bscause over-fished grounds of the Upper Lakes to Lake Erie. The demonstration came first in Lake Erie, because there the largest quantities of fish had been planted. All the product of the Ohio hatcheries, generous allowances from the United States Fish Commission's stations in Michigan, regular plants by the Michigan Fish Commission in Lake St. Clair, Detroit River and the Western end of the Lake, and the entire product of the Canadian station on Detroit River, have here concentrated, making the actual number of fish planted for the area far in excess of the amounts deposited in any other waters of the Great Lakes. Future fishing seasons in Lake Erie will be affected by the product of the Pennsylvania hatching station at Erie. The fishermen are to a man finally convinced, that the success of artificial methods has been proved beyond any doubt. They have ceased to attribute the increase of white fish in Lake Erie to the small-mesh gill-nets, and strange to relate, they no longer attribute it to the use of the beneficent pound-net.

State regulation of fishing methods has done something, and in time may accomplish much more, but artificial propagation is the prime factor, and this fact is fully acknowledged by every intelligent observer. The re-stocking of Lake Erie shows what can be accomplished in the other Great Lakes, when the states interested can be induced to provide the means for it.

THE ANNUAL REPORT OF PROCEEDINGS.

The thanks of the Society are due to the committee appointed last year to attend to the publication of the Annual Report of its proceedings, for the prompt attention given to the business committed to them, as well as for the creditable manner in which it was performed. The Society's appreciation cannot be shown more emphatically than by the re-appointment of the same committee.

HONORARY MEMBERSHIP.

The Society last year made a graceful acknowledgement of the courtesy extended to it by the Lake St. Clair Shooting and Fishing Club, in electing the latter to Honorary Membership. The chair hopes to have the pleasure of entertaining a motion to elect the Anglers' Association, of Eastern Pennsylvania to Honorary Membership in the American Fisheries Society, in acknowledgment of its hospitality on this occasion, and also of its generous efforts to promote the success and pleasure of the annual meeting.

JOHN M. BISSELL.

On motion of Mr. W. L. May, of Nebraska, the Society then adjourned to meet at 2 P. M.

On again being called to order in the afternoon, the Chairman appointed the following gentlemen as a Committee to nominate officers for the ensuing year: W. L. May, of Nebraska; W. A. Butler, Jr., of Michigan, and Dr. T. H. Bean, of Washington.

A paper on hybrids in Salmonidae, by Dr. T. H. Bean, was then announced. Dr. Bean prefaced his paper by saying that information on the subject was difficult to get. The reports of the New York Fish Commission are the best on the subject. Dr. Day, in England, has written something on the subject, and there is also something in the Pennsylvania Reports but it is much like that of New York. Dr. Day goes back to Willoughby, but the individuals he considered to be

hybrids were merely the variation of individuals, accordi · to Day, who has seen the specimens preserved in the British Museum.

I want to make it clear that ichthyologists do not believe that trout and salmon hybridize, in a state of nature. No museum has any wild trout or salmon which are hybrids. On the other hand they have been produced by fish-culturists. Hybrids between trout and charr are sterile, they have been crossed by Coste in France and by Hansen in Norway.

HYBRIDS IN SALMONIDÆ.

BY DR. TARLETON H. BEAN.

A great many experiments have been made in crossing species of the salmon family and with more or less satisfactory results. It is not yet demonstrated that any valuable economic progress has been achieved by these efforts, except in the case of very closely related species. No attempt is here made to present a history of what has been accomplished by hybridization, but I have described several hybrids whose history, except in a single instance, is well known. These are the result of artificially uniting brook trout and rainbow trout, lake trout and brook trout and brown trout and saibling. In all of these hybrids the coloration differs remarkably from that of both parents, the shape is modified, the variable characters of the parents continue to be variable in their progeny and in certain important features, the impression is stronger from one parent than the other.

The union of a large-scaled species with a small-scaled one produces a large-scaled cross in all the specimens which I have examined.

As a rule, hybrids between members of distinct genera are sterile.

Supposed Cross Between Brook and Rainbow Trout.

"About the middle of April, 1887, the Commissioner of Fish and Fisheries called my attention to some curious living trout

in aquaria at the central station. These beautiful fish had just arrived from the United States ponds at Wytheville, Virginia, where their origin and relations were unknown. We do not know to this day how the cross was produced and in what establishment, but it is believed the fertilized eggs were obtained from Northville, Michigan, and that the fish, of which a few still remain alive at Wytheville, are the progeny of the female rainbow and the male brook trout. I have previously intimated in *The Angler* of November 10 my inability to prove the assumption as to the nature of the hybrid which I am about to describe, but there is no doubt in my mind that the theory here adopted is justified by what we know of hybrids in general. In form and to some extent in coloration the fish represented in the following illustration resembles the brook trout. In the character of the teeth and the size of the scales the resemblance to the rainbow trout is very striking. Two noteworthy features are, the absence of red spots and the presence of whitish vermiculations on the sides. None of the fins are mottled except the large fin on the back. It will be remembered that the brook trout has dark bands and irregular blotches, or mottlings, on the tail. The rainbow has black spots on the body, the tail and the back fins, and many adults have a broad band of crimson along the middle line.

The hybrid is ten and a half inches long, or about two and a half times the length of the illustration. The line shown under the tail represents one inch of the length of the fish; the same system of indicating length is applied in the plates of the "Fisheries and Fishery Industries of the United States." The scales are as large as in the rainbow, numbering 135 rows from the head to the tail. The row of teeth in the middle of the roof of the mouth is double in the first half of its length and single posteriorly; it is longer than in the brook trout and shorter than in the rainbow. There are four pairs of teeth on the tongue; the root of the tongue (hyoid bone) is toothless. The large back fin has ten split rays and

the fin behind the vent nine rays ; in this respect the resemblance is to the brook trout, but the difference from the rainbow is slight. The height of the body is about one-fifth of the length excluding the tail, and the length of the head about two-ninths. The large back fin and the fin behind the vent are higher than in the brook trout and more nearly like the fins of the rainbow.

The cœca at the pyloric end of the stomach are fewer in number than in both of the reputed parent species. The reproductive organs are short and thin, the sex not discernible, which is the usual condition in hybrids of this kind. The air-bladder is very large, nearly as long as the abdominal cavity.

This is a graceful and active fish and one that is worthy of the attention of fish culturists. Our examples were so full of life that some of them jumped out of the aquarium. Under favorable circumstances, if the cross continues to exhibit sterility, it should grow rapidly and reach a great size.

If any of the readers of *The American Angler* can furnish information about the fish here described or about experiments in hybridizing species of the salmon family, it will be received with much interest."

Cross Between Lake Trout and Brook Trout.

The Pennsylvania Fish Commission has been experimenting for some years, at the Corry station, with hybrids between the lake trout, *salvelinus namaycust*, and the brook trout *salvelinus fontinalis*. A very brief account of the experiments is to be found in the report of that commission for 1886. Some fine specimens of these artificially produced hybrids have been received by the United States Fish Commission. A large one measuring about twenty inches in length is apparently a male as the lower jaw has a small cartilaginous tip. The end of the maxilla extends behind the eye a distance nearly equal to the length of the snout. The scales are larger than in the brook trout and about equal in size to those of the lake trout. The caudel is deeply forked, about as deeply as

that of the lake trout. In shape the hybrid is similar to the lake trout, as also, in the general pattern of coloration; but the very numerous spots on the sides are somewhat smaller and a pale lemon in color, instead of whitish. The spots below the middle line of the body have a center of orange. The pectorals, ventrals, anal, and the lower lobe of the caudal have a broad white edge. The ventrals and anal are a pale vermilion orange. The outer half of the upper surface of the pectoral is dusky. There is a narrow black line limiting the white of the ventrals and a similar trace bounds the white of the anal. The ground color of the sides is greenish, olive. The sides of the head have numerous spots of lemon-yellow, some of them larger than the largest of those on the sides. The lips are yellowish, flesh colored; the eye is golden, with a dusky border; the top of the head and back have some scattered vermiculations like those of the brook trout, but much less developed and not so plentiful. The caudal and dorsals are spotted with lemon-yellow, like the sides.

A smaller one, supposed to be a male, has the back slightly elevated as in old male brook trout, but its caudal is forked and it has the large scales and peculiar coloration of the bybrid.

The vomerine teeth are as in the lake trout and the hybrid teeth are in a well developed band. The stomach is very large, siphon-shaped, and the cœca number about 60, being more numerous than in the brook trout, which has 44 ; but not nearly so abundant as in the lake trout. In all characters of great importance, as in the shape of the tail, size of the scales, and the dentition, the cross has received its impression from the lake trout, while in coloration, general form, and number of cœcal appendages the impression came from the brook trout. In other words, in characters most subject to variation, *fontinalis* has left its impress, but in characters of greater permanence *namaycush* has left its unmistakable mark. The specimen was an undeveloped male about 20 inches long.

Cross Between Salmo fario and Salvelinus alpinus.

The finest and largest series of hybrid trout which we have seen is in the United States National Museum. It is the result of crosses between the saibling and brook trout of Norway, artificially produced at one of the Norwegian fish cultural stations, some years prior to the International Exposition at Philadelphia in 1876. These hybrids were exhibited in the Norwegian section at the Centennial Exhibition, and at the close of the Exhibition, were presented to the United States National Museum. The collection contains individuals ranging in age from one year to six years, and includes the results of crossing both ways between the two species.

In no instance does the hybrid resemble either parent in general appearance. In shape there is a compromise between the two parent forms. The saibling (*Salvelinus alpinus*) has a forked tail, while the *Salmo fario* has the tail nearly truncate when expanded. In the hybrid, until five years old at least, individuals all have the tail more forked than in the brook trout (*fario*) and less so than in the saibling. One of the largest six-year-olds has the tail-fin truncate, about as it is in *salmo fario.*

The proportions of the hybrid have already been hinted at above. The height of the body equals more than the height of the head, and is contained four and two-thirds times in the length of the fish measured to the end of the scales. The head is one-fourth of this same length and contains the diameter of the eye about six times. The snout is half again as long as the eye and one-half as long as the upper jaw. The maxilla extends far behind the eye, the length of the upper jaw being somewhat more than one-half the length of the head.

The teeth in the vomer are invariably similar to those of the *Salmo fario.* In all but six individuals of this large series, teeth are present and well developed on the base of the

tongue, their absence occurring in both crosses and in specimens five and six years old, although it is more common in yearlings.

The peduncle of the tail is one-third of the length of the head. The first dorsal fin is somewhat in advance of the middle of the total length, its anterior two-thirds being in front of the belly fins. The base of the first dorsal is nearly as long as its longest ray. The anal fin is very long; its longest ray is much longer than the length of its base and somewhat larger than the longest ray of the dorsal fin. The short and stout adipose dorsal fin is placed over the end of the anal. The belly fin reaches almost or quite to the vent, when laid backward. Its appendage is one-third to two-fifths as long as the fin. The breast fin is about three-fourths as long as the head. A six year old hybrid, produced by fertilizing saibling eggs with milt of *Salmo fario*, has the breast fin of the right side produced into a long tip, three fifths of an inch longer than its fellow of the opposite side. There are 142 scales in the lateral line, of which 122 are tube-bearing. There are 14 rows of scales from the end of the anal fin obliquely upward and backward to the lateral line; 16 rows from the end of the adipose fin obliquely downward and backward to the lateral line; 23 rows from the end of the dorsal obliquely downward and backward to the lateral line.

The branchiostegal membrane is supported by 12 rays. The dorsal fin has 10 divided rays; the anal 8; the breast fin 12, and the belly fin 8. The number of gill-rakers is 21, of which 13 are below the angle; the longest raker is nearly one-half as long as the eye. There are 58 pyloric cœca in one individual, and 60 in another example crossed the opposite way, that is, by fertilizing saibling eggs with milt of the *Salmo fario*. The latter trout has 42 cœca and the saibling has 42 to 45 in specimens examined.

The general color is vandyke brown, the lower parts lighter. The sides are profusely vermiculated with narrow, pale markings and with small blotches of the same color, the vermicula-

tions or blotches, and sometimes both, extending on the head. The fins are usually pale; occasionally the dorsal and anal have several faint, band-like, brown markings, and the tail fin is inconspicuously banded.

Hybrids one year old, between female saibling and male *Salmo fario*, are four inches long; between female *fario* and male saibling they are 3 7–10 to 4½ inches. Two-year-olds vary from 6¾ inches to 8 2–5 inches. Three-year-olds, produced by fertilizing saibling eggs with the milt of *Salmo fario*, measure 9¼ inches; the opposite cross of the same age varies from 10 inches to 10¾ inches. Four-year-olds, crossed between female saibling and male *fario* vary from 11¼ to 11¾ inches; those crossed the other way are 11 inches long. Five-year-old hybrids between male saibling and female *Salmo fario*, range from 13 inches to 14 inches in length- Six-year-olds, between male saibling and female *fario*, measure from 17 inches to 19½ inches; those between male *fario* and female saibling are from 17 to 18 inches long.

None of the specimens examined by me show any development of the reproductive organs, and it is probable that this hybrid, although a large and beautiful animal, is uniformly sterile.

Dr. Kingsbury.—I would ask if the flesh of hybrids is better than that of either parent?

Dr. Bean replied that the specimens with which he was familiar are alcoholic, but, Mr. Hansen, of Norway, recommends a cross between a saibling and the brown trout as an excellent fish for the table.

Mr. Ford could answer the question. He had eaten a fish which was a cross between a lake and a brook trout, and, while it was not quite as good as a brook trout, it was a good table fish.

Mr Powell thought that such hybrids would revert to brook trout, if placed in trout streams.

Dr. Hudson considered that the cross between lake and brook trout is the one most able to resist adverse influences,

like the mule, and they resemble the patient and much-abused mule in being sterile. The cross between the buffalo and the domestic cow is fertile but is hardy.

Mr. Mather did not approve of bastardizing fish further than to see what could be done as a scientific curiosity. He had used the milt of the alewife on shad eggs, when no male shad were at hand, hoping that a fish of some kind might result from eggs that would otherwise be wasted, but that was as far as he would plead guilty to bringing any living thing into the world with the bar sinister on its escutcheon. Nature has placed a barrier between the crossing of the brook and lake trout of Eastern America by fixing the spawning time of the former in the day and the latter at night. There is throughout all nature, an abhorrence of miscegenation, and a law that if it is practiced, its fruits shall not perpetuate the crime. If this were not so, there would be no such thing as species, or even genera, for the late Seth Green claimed to have crossed a shad with a striped bass. I do not believe such a cross to be possible, any more than you can cross a dog and a cat, two animals nearer alike in structure than the fishes named.

Dr. Bean had examined specimens which were said to be a cross between the California or Chinook, salmon, and the brook trout, sent to the Smithsonian Institution by Mr. Green, but could find no difference between them and other fish sent by Mr. Green, which he claimed were the progeny of the rainbow and brook trouts. Possibly Mr. Green made a mistake.

Mr. Mather called attention to the fact that Mr. Green claimed his hybrids to be fertile, and that specimens had been exhibited at Mr. Blackford's on the opening of the trout season in New York, labelled from ¾ to ⅞ blood of brook and lake trout. Just which species was alleged to predominate in these crosses was not remembered, perhaps Mr. Blackford might furnish the information from the newspaper chips concerning his annual displays, of which he has a full line. Dr. Bean has declared hybrids between the trouts and the sal-

mons to be sterile, and also those between the trouts and charrs. If this is so, and I hope it is, then the violation of Nature's laws by man in his efforts to perpetuate monstrosities will be a failure. If man could cross the elephant with the butterfly there would be no limit to his ambition to produce curiosities for dime museums.

Dr. Kingsbury asked if the food of fish did not color the flesh, and if it was not possible that the rich, red-fleshed trout had not fed upon food of that color.

Dr. Bean replied that once he had believed that the red flesh of salmon came from crustacean food, but the mackerel and other white-fleshed fish feed on the same food, and at present he thinks that the color of the food does not affect the color of the flesh of the fish which eats it.

Prof. John A. Ryder, of the University of Pennsylvania, Philadelphia, spoke on the embryology and histology of the shad.

THE LATERAL LINE ORGANS AND THE HYALINE TISSUES OF THE HEAD OF THE SHAD.

BY PROF. JOHN A. RYDER.

The common shad of our markets is in many respects one of the most strikingly characteristic fishes amongst the variety of native species exposed for sale in the spring months. The lateral line system of these fishes is interesting from a number of points of view. First, from the consideration of its possible relation to the annual migration of that species into fresh water for the purpose of spawning, and secondly, on account of the very singular histological structure of the skin over a considerable portion of the extent of the system and over the head.

Whether or not this part of the nervous system of the shad enables that fish to appreciate very slight differences of temperature at two points in the water separated only by the

distance between the anterior and posterior ends of that system, and to thus enable the fish to appreciate and determine the direction of its migration according to the temperature differences, is an open question. While such a suggestion may seem far-fetched and improbable, there is enough of the barest possibility of the lateral line system having such a function to warrant serious consideration.

The other point in relation to the lateral line system, which seems to me to be of sufficient interest to be worth noting, is the following: Every one, upon carefully examining the sides of the head and opercles of the shad for the first time, will have the attention arrested by the large amount of clear tissues in front of and behind the eyes and over the gill-covers, forming a quite considerable layer over the latter, which is traversed in its deeper parts by five canals, which open to the surface. Similar canals traverse tissues covering the space between the eyes over the front of the head. In these canals, many of which are exceedingly narrow and repeatedly branched before reaching the surface, the cephatic portion of the lateral line system is lodged. The terminations of the nerves are at the bases of little clusters of cells, adherent to the walls of the canals, surmounted by five hair-like protoplasmic processes. These fine processes of the cells are probably the terminal elements of an exceedingly delicate special sensory apparatus. The fine processes project into the fluid in the canals, and when the fluid is set in motion by even the slightest vibration, sensory impressions are conveyed to the brain of the fish. In the present state of our knowledge it is probably useless to speculate as to the uses of this delicate mechanism, which is many times more complex than the system of labyrinths found in the human ear. Some idea of the complexity of the system of canals may be obtained by carefully inspecting the manifold branchings of this system on the opercles, where they may be readily made out with a pocket magnifier, embedded in the considerable layer of clear substance already mentioned.

An examination of this clear substance with the aid of sec-

tions and the microscope shows that it is made up of a clear matrix, in which elongate or spindle-shaped cells are embedded at pretty wide intervals apart. Its remarkably cartilage-like, clear aspect is due to the large amount of clear substance between the cells already mentioned. This peculiar structure undoubtedly belongs to the skin, yet it is a most singular type of dermal tissues, probably not found in any type of vertebrates except fishes. It is most largely developed over the opercles or gill-covers and over the region in front of and behind the eye in the shad. In fact the eye-ball seems to be partly embedded in it. Its great transparency, although covering in the eye in large part and even encroaching at times upon the pupil, would not interfere with the lines of vision either backward or forward. This transparent tissue thus forms a sort of imperfect anterior and posterior immovable transparent eye-lid, thus also affording a not inconsiderable amount of protection to the eye-ball without obstructing vision. Such an arrangement of a transparent anterior and posterior eye-lid is met with in a good many other types of fishes in which the microscopical structure is probably very similar. At any rate, whatever its function, its histological structure would afford an interesting field for more exact histological observation.

The lateral line system of the front of the head of the sea-bass is also exceedingly complex and also seems to be embedded in a peculiar kind of tissue. These types, the shad and sea-bass, therefore present complications of the lateral line system over the head and the investing tissues, which would well repay further and more elaborate biological and microscopical investigation than has been bestowed upon them in this brief note.

Mr. May brought up the subject of a place for the next meeting of the Society and moved that the place be now decided on.

Mr. Blackford seconded the motion and named Wash-

ington as the place where the most successful meetings had been held, and where there was the greatest collection of fish cultural apparatus and the greatest collection of material of interest to fish culturists.

Dr. Kingsbury approved of Washington as the best place for the meeting.

Mr. Mather favored Washington as a permanent place for annual meetings, and thought that the largest attendance could be had there, or in New York.

Mr. Osborne moved to amend Mr. Blackford's motion by substituting Put-in Bay, on Lake Erie, as the place of meeting. The United States Fish Commission will put up a large hatchery there and it will be in operation.

Mr. Blackford—A ballot on this question will be the best way to settle it, and I move that the question be so decided.

This motion was carried, tellers were appointed and the result was seven votes for Washington and eight for Put-in Bay. The Chairman announced that the meeting wuuld be held at the latter place, the time of meeting to be decided upon adjournment.

A long discussion then took place on the advisability of holding an evening session. Mr. May argued against as not only uncustomary but unnecessary, and coming so far (Nebraska) to attend the meeting he regretted to lose a word of the discussions, but if an evening session was held he, for one, would be unable to attend. Not anticipating an evening meeting he had made other engagements; that if a meeting was held in the evening he could not be present. He, therefore, was opposed to an evening meeting.

Dr. Hudson said that it was now a question of courtesy to the members of the Angler's Association, whose guests we are, to hold an evening session. Several of them wished to meet with us and they had been given to understand that there would be such a session.

The question was called for and it was decided to hold an evening meeting.

Mr. Spangler called attention to a 12 pound salmon which was caught in the Delaware river the day before, which he had bought purposely to have served at the dinner the following day, and which had just been brought into the room for exhibition to the members present.

Mr. Mather said that at the last moment he had decided to attend the meeting and had written a letter to that effect to Mr. Ford. It contained a bit of history which might be of interest, and was as follows:

Cold Spring Harbor, Suffolk Co., N. Y., May 14, 1889.

Henry C. Ford, Esq., Cor. Sec'y Am. Fisheries Society.

Dear Sir:—I regret that I cannot be with you at the only meeting at which I have not been present since the first one held in New York City, December 20, 1870, in response to a call, as the first report says, of "W. Clift, A. S. Collins, J. H. Slack, F. Mather and L. Stone."

We were then all breeding trout and selling eggs and fry, and as the prices of those days may be of interest to compare with those of to-day, I copy the following from my circular of 1871-72. now in my scrap-book:

BROOK TROUT!

Trout Ponds and Hatching House

Of FRED MATHER.

Honeoze Falls, Monroe Co., N. Y.

The prices of spawn and fish for the season of 1871-72 *are as follows:*

Trout spawn, per single thousand	$10 00
" " " five "	40 00
" " " ten "	70 00
Young trout (meaning fry ready to take food) single thousand	30 00
Young trout, each additional thousand	25 00

If the prices seem enormous now, it must be remembered that a hatchery that had 100,000 eggs ranked among the largest.

Mr. Collins had the most spawning fish and had shown a disposition to cut the prices. I proposed to Dr. Slack to form a "trades union" to keep up prices, and this was our only object in forming the American Fish-culturists' Association, which is now the society which meets to-day. At the first meeting, our ideas broadened and ran away with us, and the "trades union" never was formed.

Fortunately, I have every report of this society, from the first to the last, bound in accessible volumes, and doubt if outside the Smithsonian Institution there are two other full setts. At any time that the Association should need reference to these volumes, I will be glad to be of service in quoting from them.

Very truly yours,
FRED MATHER.

NOTES ON TROUT WORK IN MICHIGAN.

WM. A. BUTLER, JR., DETROIT, MICH.

In the earlier days of the Michigan Fish Commission—which was organized in 1873—no very careful attention was given to the raising of Brook-Trout, and this fish occupied only a small share of the time of the Commissioners, who devoted themselves principally to the propagation of white fish, and a few other varieties of fish that were by nature entirely foreign to the waters of our state.

The fish hatchery was erected at Crystal Springs, about two miles from Pokagon Station, on the Michigan Central Railroad, in Cass County, on the grounds of The Methodist Camp Meeting Association, and here the Commissioners began work with a vigor and devotion that were worthy of better results than they obtained. Here all the work was

done for a number of years, with some assistance from two or three private hatcheries, which for their work were under the supervision of the Commissioners.

It took the Commissioners several years to thoroughly satisfy themselves that they had made a mistake in the location of this hatchery, and that all fish could not be successfully raised in any water. It was here supposed the temperature of the water could be changed in a sufficient degree to fit any case by the use of ice and the widening or deepening of the ponds through which the supply stream flowed. All these methods were tried and eventually failed of success. Here was time wasted on Atlantic salmon, California salmon, Land-Locked salmon, Shad, Eels, White-Fish and other varieties of the finny tribes;—thousands of eggs were hatched and the fry deposited in numerous streams and lakes throughout the state, only to grow for a short time and then disappear entirely.

In 1874, a dozen speckled trout from six to ten inches in length, caught in one of the streams of the northern part of the state, were put into the ponds, for "observation and comparison with those hatched from eggs received from New York and some of the New England states." The White-fish work was taken to Detroit in 1876, and with it was removed a great strain upon the limited resources of the Pokagon hatchery.

In 1865 the Legislature had passed a law protecting Brook-Trout from capture by nets or seines in any inland lake, river or stream, but specifying no time when they might not be taken with hook and line, and a close season was not made for them until 1873, when they were protected from Oct. 1st to April 1st next succeeding, and the Legislature following, extended the time from Sept. 1st to May 1st.

A number of these fish, in excellent condition, were in the ponds according to the report of 1874—5, but no mention is made of planting any fry: the fish seem to have been kept—not as curiosities exactly, but as specimens of what some of

our northern streams contained, and do not seem to have received any special attention from the commission.

The beauties of climate and scenery of the upper portion of the lower peninsula of Michigan, and the extended reputation of its rivers and brooks for fine fishing, had called to their banks sportsmen, from all over our own state and from neighboring states, in such numbers as to rapidly diminish the supply of trout, and the Fish Commission, ere they had been but a few years at work, were earnestly importuned to replenish the fished-out streams that had been but a short time before the glory and pride of the man with rod and reel.

The laws for the preservation of Brook-Trout were not very carefully observed, the state had no fish-wardens to look after its interests, and numberless anglers carried from their native streams or killed upon its waters thousands of fish that were too small for table use and only served to add volumes to the marvelous fish-stories they told when at home.

In 1878—9, there were upon the trays of Pokagon about 300,000 Brook-Trout eggs; of these 250,000 had been purchased, as demands for trout fry had been coming in from various parts of the state. The Commission had now become convinced that this delicate fish could be raised to advantage. and had resolved to give it a greater share of their attention,

For some reason, which they themselves did not then understand, but 15,000 of this large number of eggs were hatched. Again in 1879—80, the Commissioners made another purchase of eggs, and 170,000 had the close and careful attention of the superintendent during the winter; but with the same disastrous results, "the eggs died rapidly, and after hatching, the little fish died by thousands before the food vescicle was absorbed." Here was a poser for the fish-breeders. This stream which they had looked upon but a few years before as one of the most desirable in the state for fish-propagation had not met their expectations. The clear, limpid waters which had given every hope of success to the commissioners, contained some hidden poison that was almost certain death

to eggs and fry alike. Reasons for this rapid destruction existed without question, and the commissioners set themselves to work to find out the cause of their repeated failures. A noticeable diminution in the volume of water. towards the latter part of the season, had been observed for some time back, and the temperature had gone up to 52°. A microscopical examination of the fry revealed "little blisters on the gill covers, distended and inflamed eyes and a fungoid condition of the gills," and an analysis of the waters of the creek found it "contaminated to a high degree, with decomposing vegetable matter, sewage from some slaughter house or glue factory courses into it"—said the examiner. Thus were they convinced that any more work in this line at Pokagon would would be worse than useless: from the thousands and thousands of eggs over which they had labored, less than 450,000 fry had been planted in eight years, and it is more than probable that the greater part of these were so infected with dis ease as to live but a short time after being put into the stream were it was hoped they would thrive.

In July 1881, Cheney Creek, near Paris, in Mecosta County, was selected as a desirable place to which to remove the hatchery.

As grayling were found in the stream and had been known to exist there for some time previous, it was deemed almost certain that the waters contained the necessary food and all other properties and accessories so essential to the success of trout work: the magnificent results obtained by the Commission at this point since have fully shown the wisdom of its selection.

About 39 acres of ground and a strip of land 15 rods wide, the creek meandering across 120 acres more, were purchased. A hatching house, dwelling, barn, etc., were erected at a cost of $5000 which included apparatus, and the Michigan Commission after eight years of hard labor, over which no one felt very much elated, virtually began afresh in the work of hatching brook trout. It might be well to add a few facts in re-

gard to the change of location from Pokagon to Paris, which were developed sometime after the transfer was made, the absence of which seemed to render the abandonment of the old hatchery so necessary. In the first place the superintendent at that time was not an educated fish-culturist, and to his want of knowledge of the work he had undertaken, was undoubtedly attributable, in a great degree, his lack of success. He had been a Baptist minister, and had waged a continual and unceasing war with the managers of the Methodist Camp Meeting Association from his earliest connection with the work there, which state of things probably made the location distasteful to him.

The water, the analysis of which showed such destructive properties to all fish-life, it has been ascertained was not taken from the spring, but from a pond some distance below the hatching house, which had not been cleaned in months, was filled with a rank growth of weeds and received the refuse from the house and ponds, and it has always been supposed that he took this means of relieving himself from neighbors that were disagreeable to him, and also of the odium of failure in his work. The truth of this seems more than probable, when we look at the present situation at Pokagon, as a private hatching house on a moderate scale has since been successfully operated on the same grounds. But in the light of more recent events, the State of Michigan has never had cause to regret the desire that superintendent had to shift the responsibility for Pokagon disasters from his own shoulders, and success never crowned the efforts of the Commission until his name was placed in the list of those that *had* been connected with its work.

In the removal of stock-trout from Pokagon a large portion were lost, and of the amount saved, over one-half were given to the Superintendent in a settlement with him when relieved from charge of the work some time after, leaving in 1883 but 900 breeding trout in the four ponds at Paris.

These with devoted care and attention from our present

experienced Superintendent have increased to such an extent that now there are but few less than 14,000 on hand.

From 250,000 fry planted in 1882, a large portion of which were from purchased eggs, the work has so far developed that almost 3,000,000 fry have just been put into streams in various parts of the state as the result of the past winter's work: the eggs from which they were hatched being entirely obtained from stock fish in the ponds.

New blood and strength has been infused into this fish by adding from time to time trout caught in neighbrring streams, by exchanges of eggs with the New York and Wisconsin Commission, and with the United States Commission at its Northville station, from which place some yearlings have also been received.

From the four breeding-ponds with which the work started at Paris, it has been found necessary to add others, until at present there are 21 breeding and four wild ponds in which the fish are kept, and the supply of water is still sufficient to add a number more as they may be required.

During last year a new hatching-house, at a cost of a little over $4000, was built, which was fitted with every convenience that the experience of the Commissioners and Superintendent could suggest. This house is 82½ feet long by 40 feet in width. Water is brought through a 12 inch pump-log from the creek above and carried into the house by two iron pipes which discharge into two large tanks; from these it passes into the feed troughs and thence into the hatching troughs through brass faucets. The water is wasted through open drains, paved and cemented, into the creek below the largest wild pond. The hatching-troughs are 14 feet in length by 1 foot in width and placed in groups of three.

The capacity of the house is about 3,500,000, and with the old one which is still available about 5,000,000 fry can be safely and conveniently handled. Thus the Commissioners hope to meet the rapidly increasing demand for trout and to furnish good sport for the angler in every part of the state

where suitable streams exist; as they have added about 80 acres to the original purchase of ground, which gives them the control of the wooded land about the sources of Cheney Creek, thereby making more permanent the water supply. it looks as if their object might be accomplished from the Paris station alone.

Fishing is prohibited by law in any stream into which trout has been put by the Commission under three years from the date when first planted, and under these regulations, about two hundred streams have been opened for sport in the last two years, and the number will be largely increased in 1890.

Trout in lower Michigan were discovered about forty years ago, and were then confined to an extent of country embraced by six or seven counties in its extreme northern portion, none being found south of the Boardman River which empties into Grand Traverse Bay after coursing through the counties of Kalkaska and Grand Traverse, and as at the present time this fish is found in about forty counties of the lower Penninsula, one can readily see that the efforts of the Fish Commission have not been devoid of gratifying results in this line of work at least.

On motion the meeting adjourned to 8 P. M.

EVENING SESSION.

There were no papers read in the evening, but several subjects were discussed in an informal manner.

Mr. Blackford had been looking over the Delaware river salmon which Mr. Spangler had bought. Some had raised a question about the possibility of this fish being one of the Quinnat, or Chinook salmon which were planted in the river years ago. There was no possible doubt about it; it was an Atlantic salmon, *salmo salar*, and from its small size and trim shape was not an old fish.

Dr. Hudson.—From our experience in the Connecticut river it is well established that for years after planting has

been discontinued, there were straggling salmon caught. After the salmon had been restored to the Connecticut river they were freely taken by the fishermen. For a number of years there was a marked falling off in the numbers of fish caught after the plantings had been discontinued for four or five years, and then followed straggling fish in more or less numbers every year.

MR. SPANGLER.—Early in the seventies, salmon were planted in the Delaware. In 1878 about 40 fish were taken, but since that time only one or two each year.

MR. MATHER.—As I have before stated, I made a plant of 100,000 salmon, on account of the U. S. Fish Commission, in some tributaries of the Delaware river in 1885, and it is possible that the fish purchased by Mr. Spangler may be one of that planting. The fry were put in in two New Jersey streams, the Pequest river and the Paulin's Kill, in May of that year, and would now be four years old. An account of this planting will be found in the report of U. S. Commission of Fish and Fisheries for 1885, page 115.

DR. KINGSBURY.—I would ask Mr. Mather if the salmon of which he speaks were the Atlantic or the Pacific species?

MR. MATHER.—They were the Atlantic salmon. The Pacific salmon plantings have been abandoned on this coast for over six years, and possibly more. I can't say just how long, at this distance from my books.

DR. KINGSBURY.—Is there any known reason why the millions of California salmon which were planted in our Atlantic streams some years ago never returned?

MR. MATHER.—Nothing is positively known of the quinnat salmon in Eastern waters after the fish went to sea. They seemed to thrive in our rivers and many "parr" were caught, or seen, but the adult fish never returned. I have a theory to account for this, and it may be briefly stated thus: Mr. Stone recommended this salmon as one that could, or would, pass through warmer waters than our Eastern fish and consequently might thrive below the limit in which the At-

lantic salmon is found. A glance at the map shows that salmon streams of the Pacific coast are very short, and we know that they are snow-fed. My theory is that those streams are colder at the bottom than ours and that when this Western salmon matured, if it ever did, it could find no suitable stream to enter on our coast. Temperature is the thing which influences the migration of fish more than even food, and if there is a strata of cold water in the Sacramento river, coming down from the perpetual snows that feed tributaries a short distance above, as I think very probable, then the reason why the fish did not enter our warm rivers in May and June is plain. It is possible that there may be a difference of thirty degrees, Fahrenheit, between the bottom and the surface of the Sacramento river in June. I know nothing of these temperatures and this statement is mere theory, but it is the only theory which I can frame to fit the facts.

Dr. Hudson.—The planting of the California salmon in the rivers of the Atlantic coast was an experiment that many of us watched with great interest. We believed that it was adapted to warmer waters than our own salmon, and the young swarmed in our rivers and went to sea in good condition and in fair size, giving hope of their return, which was never fulfilled. Why they did not come back has been a puzzle to us and this theory, which has just been stated by Mr. Mather, seems to be the only solution of the question.

Dr. Cary.—We planted thousands of them in the rivers of Georgia, but none returned. My theory accords with that of Mr. Mather, the rivers are too warm.

Prof. Goode.—The Germans have kept this California salmon in ponds and report that they thrive under pond culture ; their success seems to be better than ours. It is certain that if this species was at all adapted to live on our Eastern coast it would have lived in some of the streams between Maine and Georgia, for no fish that has been introduced has had a greater chance to find suitable conditions to live in than this one. Every condition of food and temperature that

our Atlantic streams possess was offered it, but none of them were favorable and the fish was unable to accommodate itself to any of the rivers.

Mr. Mather.—The aquatic fauna of our Western coast more clearly resembles that of the west coast of Europe than that of our Eastern coast, and this fact may be a bar to the acclimatization of some species of fish, here or in Europe Our Eastern charr, which we call the brook-trout, does not thrive in England, while the rainbow trout does. The latter fish lived with us, in the East, but its eggs do not impregnate well, and I do not believe that it would perpetuate itself in our streams if left to itself. Attempts have been made to introduce the sole from Europe, but I doubt if the rocky coast of Massachusetts will ever prove a home for them. In my opinion this fish will never thrive north of New Jersey, and if I were asked where to plant them I should say South Carolina, and I would not insure their success there, because of this difference between the Eastern and Western shore of the Atlantic.

Dr. Bean.—Our brook trout, when introduced into English Waters, seems inclined to migrate, much as the rainbow trout does with us. There is a movement among the trout before the spawning season, usually in September. With us the *fontinalis* starts up stream for the spawning beds, but in England the movement seems to be down stream. Just what this different habit of this fish means we do not know, but there seems to be a great difference in the habit of *fontinalis* when transplanted from Eastern America to Western Europe, as there are in other fishes which Mr. Mather has cited. The European carp, when transplanted to America, has thrived, and, in places, exceeded its rate of growth in Germany.

Mr. May.—In our new country, where almost every stream has a saw-mill on it, the effect of sawdust is a question for the fish culturist to consider. On many streams the fish have been destroyed, or driven away by sawdust.

Dr. Kingsbury.—The evil effect of sawdust in our streams

is well known to every angler, and the erection of a saw-mill on a stream means the destruction of the trout, and perhaps other fish, within a few years.

Mr. Mather.—A man should have no legal right to make a sewer of a stream in which he can flow refuse of any kind that is detrimental to the fish in it. The public have rights in the fish, and if the saw-mill man cannot afford to take care of his refuse then he should not run his mill. Saw-mills may be a necessity, but fish are also needful, and the fish were there before the mill. If a man can't run his business without ruining the streams he should be compelled to shut up shop. He should not be allowed to maintain a nuisance in order that he may make money. It is not a public necessity that he should make money, but it is of general benefit that the streams are filled with fish. I have said that sawdust does not kill the adult fish but does ruin the spawning beds.

Mr. Spangler.—The theory that sawdust kills adult fish is not a true one, but that it kills the eggs and the young fry is indisputable. The great injury from sawdust comes from the smothering of the spawn and from the decay of the finely comminuted wood, which rots in the water and injuriously affects the fry. The pollution of our streams should be stopped.

Mr. Osborn.—We have had some experience with poison in our Ohio streams, but the paper mills are not turning in as much chloride of lime as formerly, they now use this material over and over. The straw-board mills send quantities of fine pulp into the streams, and this kills suckers by adhering to their gills. The crayfish march up when fermentation takes place from this pulp, and perhaps sawdust also ferments and has the same effect.

Dr. Hudson.—As the sawdust question seems to have been exhausted I would like to say a word on a matter that is troubling us in Connecticut. This is the decrease of shad in our rivers. Some years ago we increased the shad by hatching, so that the fishermen begged us to desist because

the prices were too low. Now shad are scarce in our rivers, but seem to be plenty in other waters. This is not merely this year, but has been the case for several years past.

MR. FORD.—The catch of shad in the Delaware this year has been one of the largest known. The fish have been cheap, have wholesaled for $12 per hundred, and at times the local market has been glutted.

MR. MATHER.—This may be the question of temperature. For some years the Connecticut streams may have been too low for the spawning fish to enter and they may have gone elsewhere. In a paper which I will read to-morrow I will show that shad have strayed from California to Oregon, and perhaps they were after the temperature that they required.

DR. KINGSBURY.—The temperature of the water may have more or less effect upon the migrations of fish, just how much I am not prepared to say, but it is possible that there are other conditions which also affect their movements, such as food, turbid waters and floods. It is a difficult matter to define the causes of the migrations of fishes because we cannot follow them.

The meeting then adjourned until 9 A. M. the next day.

SECOND DAY.

The meeting was called to order at 10 A. M. The Nominating Committee was called upon for their report which was as follows:

PHILADELPHIA, May 16th, 1889.

To the American Fisheries' Society:

Your committee appointed to nominate officers for the ensuing year beg leave to report the following:

President... EUGENE G. BLACKFORD, New York City.
Vice-President, HERSCHEL WHITAKER, Detroit, Mich.
Treasurer, ... HENRY C. FORD, Philadelphia, Pa.
Recording Secretary, FRED'K W. BROWN, Philadelphia, Pa.
Corresponding Secretary,.... C. V. OSBORN, Dayton, Ohio.

EXECUTIVE COMMITTEE.

DR. W. M. HUDSON, Chairman,..... Hartford, Conn.
HOYT POST,..... Detroit, Mich.
PHILO DUNNING,..... Madison, Miss
DR. H. H. CARY,..... Atlanta, Ga.
JAMES V. LONG, ... Pittsburgh, Pa.
S. P. BARTLETT,..... Quincy, Ills.
HENRY BURDEN,..... Troy, N. Y.

All of which is respectfully submitted.

W. L. MAY,
A. BURLEIGH,
T. H. BEAN,
Committee.

These officers were duly elected.

NEW MEMBERS.

At different times during the sessions, the following new members were proposed and elected:

Frederick W. Brown, N. W. cor. Broad and Cherry Streets, Philadelphia.

William S. Hergesheimer, 1119 N. 4th St., Philadelphia.

H. O. Wilbur, 237 N. 3rd St., Philadelphia.

R. M. Hartley, 627 Walnut St., Philadelphia.

J. Penrose Collins, 850 Drexel Building, Philadelphia,

Collins W. Walton, 1713 Spring Garden St., Philadelphia.

Dr. Bushrod W. James, 1719 Green St., Philadelphia.

E. H. Frishmuth, Jr., 151 N. 3d St., Philadelphia.

John Gay, U. S. Fish Commission, Washington, D. C.

Richard Rathbun, U. S. Fish Commission, Washington, D. C.

Capt. J. W. Collins, U. S. Fish Commission, Washington, D. C.

Edwin Hagert, 32 N. 6th St., Philadelphia.

Robert M. Mackay, 1517 N. 13th St., Philadelphia.

Thos. B. Harper, 709 Market St., Philadelphia.

Jacob F. Miles, 1820 Arch St., Philadelphia.

A. M. Spangler, 529 Commerce St., Philadelphia.

Amos R. Little, Aldine Hotel, Philadelphia.

H. C. Miner, New York City.

Henry Burden, Troy, N. Y.

Hoyt Post, Detroit, Mich.

The following gentlemen were elected to be corresponding members:

Mr. O. T. Olsen, Grimsby, England.

Prof. F. A. Smitt, Stockholm, Sweden.

Dr. Filip Frybom, " "

Prof. A. J. Malmgren, Helsingfors, Finland.

SALMON IN THE HUDSON RIVER.

BY FRED MATHER.

Mr. President and Gentlemen:

I would preface my report on the stocking of the Hudson river with salmon by saying that it has not, at present writing, been published.

When we hatch and plant any species of fish in a stream that already contains them, it is impossible to prove to what extent the work has been beneficial, and we can point to but few instances, such as the planting of shad in the streams of the Pacific coast, the introduction of carp and brown trout, where the whole credit of all fishes taken, can be claimed for fish culture. The stocking of the Hudson with salmon can now be pointed to as the result of hatching and planting, for there were no salmon in the river until 1886, four years after the first planting, barring a stray fish caught at intervals of years. These stray fish would have stocked the river centuries ago if they could have reached the breeding grounds, for it is the stragglers, the roving, restless fellows among fishes as among men, which spy out new and attractive places to settle in and "grow up with the country." A notable proof of this fact is that the U. S. Fish Commission planted shad in the Sacramento river, where they now abound, and stragglers from the main army have been taken as high up the Pacific coast as Puget Sound.

With these facts in view I regard the successful planting of the Hudson river with salmon as of especial importance to fish culturists, as one of the cases in which the entire credit can be clamed for artificial propagation.

To the Commissioners of Fisheries of the State of New York.

Gentlemen:—After investigating the catch of salmon in the Hudson river, and before making my report to Colonel Marshall McDonald, Commissioner of Fisheries for the

United States, under whose direction the stocking of the river with fish is done, I asked his permission to furnish your board with a copy of it, which was granted in the following letter :—

UNITED STATES COMMISSION OF FISH AND FISHERIES,
MARSHALL MCDONALD, Commissioner,
WASHINGTON, D. C., Nov. 30, 1888.

Fred Mather, Esq., Cold Spring Harbor, N. Y.

Dear Mr. Mather :—I think it desirable that information of general interest, prepared under the auspices of the United States Fish Commission, should have as wide circulation as practicable. The matter of your report should interest very much the people of New York, and by being published early would tend to awaken and increase interest in regard to the protection and improvement of the salmon fisheries of the Hudson.

You are authorized therefore, to furnish a copy of the same to the State Fishery Commission for their information, and for printing if they so desire.

Very truly yours, M. MCDONALD, Com'r.

Col. M. McDonald, Commiss'r of Fisheries, Washington, D. C.

Dear Sir :—In compliance with your order of July 11th, 1888, I have made an examination of the Hudson river from its mouth to the tributary trout streams of Warren County, N. Y., with a view to learning the number of adult fish captured during the last season ; the possibilities of taking salmon eggs in sufficient numbers to warrant the establishment of a temporary station for this purpose ; to also learn the character of the small streams, and determine which give promise of the best conditions for developing the young fish during their river life ; and to ascertain the height and character of the natural and artificial obstruction to the ascent of salmon, and herewith forward my report on this work.

PLANTING OF SALMON.

With the exception of some quinnat, or chinook, salmon planted in the Hudson ten or a dozen years ago by the New York Fishery Commission. which have never been heard from, I believe that all the plantings of *S. salar* in the river have been done under my immediate supervision.

In 1880, I suggested to the late Professor Spencer F. Baird, then Commissioner of Fisheries, that the streams of the upper Hudson had all the requisites for growing young salmon, and he agreed with me that it might be possible that the river had never been a salmon river because of the natural obstructions to the ascent of the parent fish. On January 16th, 1882, I was ordered to try to obtain a hatchery near New York City, for the purpose of hatching salmon for the Hudson, and secured one from Mr. Thomas Clapham, at Roslyn, on the north side of Long Island, about twenty-three miles from the city, and in the spring planted 225,000 fry in the streams of Warren County, as well as some in other waters (see Report United States Fish Commission, 1882, page 876). In January 1883, I was appointed superintendent of the new hatching station of the New York Fishery Commission at Cold Spring Harbor, Long Island, and transferred the work of salmon hatching there, where it has since been conducted.

The following plants have been made in the tributaries of the river :—

	FRY.
1882	225,000
1883	244,900
1884	424,700
1885*	319,100
1886	297,573
1887	140,450
1888	440,000
*Total	2,091,733

* And 150 yearlings

Where the odd figures occur, I would explain that there was no pretense to actual count, but from the measured number of eggs there was an actual count of the losses of eggs and fry, my men being instructed to keep such a record, and the loss being deducted, left odd numbers which were always added in the last shipment; except in cases of loss in transportation, when they are deducted from that particular shipment.

The streams in which the fry were placed are good trout streams, but there exists great confusion as to their names. For instance, while on this investigation I asked Nate Bennett, a well known Adirondack guide, where "Roaring brook" was, and he said that it was only another name for "Thirteenth brook." This happened at the North River Hotel, and the latter brook empties into the Hudson about one hundred yards above, but others said that "Roaring brook" was a tributary of North creek. As it will be found that a brook by this name was stocked in four different years, I cannot say which one received the two plantings of 1883, made by O. B. Hewitt; nor in 1884, by F. A. Walters, because the men are no longer in my employ and I do not know their addresses. The plantings in "Roaring brook," made in 1886, by C. H. Walters, and in 1888, by O. V. Rogers, were in the stream emptying into North creek. Depending as we must, on the natives for the nomenclature of these little mountain streams, we find the names are much mixed, and the maps do not name these little brooks. My foreman, C. H. Walters, tells me that Eldridge brook, stocked by him in 1886, is the stream also known as "Balm of Gilead," and that it had two plantings in that year in consequence of its double name. I have now a better knowledge of the smaller brooks, and will try to avoid confusion of this kind in the future. The following is a list of the brooks, with the number of salmon placed in them :—

Carr's brook, also called "Deleby brook," comes into the Hudson from the east, a mile or two above North Creek,

the northern terminus of the Adirondack railroad, is a good trout stream and is one of the best for planting salmon, as it contains insect larvæ and crustaceans in apparent plenty. It received the following plants :—

1882	35,000
1883	49,800
1884	29,200
1885	69,800
1886	49,800
1887	49,000
1888	50,000
Total	342,600

Glen brook comes in from the west at the station of the Adirondack railroad called the Glen, and is some twenty or thirty miles below North Creek. It received 50,000 in 1882 and 39,000 in 1884. It is said to be a good trout brook.

Balm of Gilead brook, also known as "Eldridge brook," is a fine stream which comes into the river from the west, half a mile below the village of North River, received the following plants :—

1882	40,000
1883	49,700
1884	39,000
1885	*58,973
1886	*59,800
1887	49,700
1888	50,000
Total	347,173

Raymond brook.—This is a good stream which comes in from the west two or three miles above North Creek and

* These two plants were made in the same brook owing to the confusion of names by the residents in recommending it.

below Balm of Gilead. It appears in the earlier reports as "Raymont." It had:—

1882	45,000
1883	39,000
1884	38,000
1885	49,800
1886	49,500
1888	50,000
Total	271,300

Roblee brook.—This is not a good stream, because the lower portion is dry in summer. It runs through the village of North Creek and is a strong stream most of the year, In 1888 it had 50,000 fry, but I would not recommend it for future stocking. There is another brook by this name which empties into North creek.

North creek.—This is a good stream. It has a dam and a tannery at its mouth, in the village of that name. It directly received:—

1884	38,900
1887	41,750
1888	55,000
Total	135,650

Besides this it had plants in one of its tributaries, known as roaring brook, given below.

Roaring brook.—This stream is referred to in the sixth paragraph above, and I have reason to believe that all the plants made were in the tributary of North creek, and not in the Thirteenth brook. Those of 1886 and 1888 certainly were, The stream received:—

1883 (two plants)	67,400
1884	38,800
1886	59,800
1888	50,000
Total	216,000

Thirteenth brook.—A rapid stream which comes from the west and empties at the village of North River. It is sometimes dammed for logging purposes, but was avoided on the years when it was so used. It received :—

1885*	79,900
1888	50,000
Total	129,000

Beaver Meadow brook is a tributary of Indian river, which enters the Hudson in Essex county. The brook crosses the stage road from North river to Blue Mountain lake about eight miles from the former place, and if the roads were better in the spring this would be a good point of deposit. In 1883 there were 39,000 salmon planted in this stream.

Indian river received 36,200 in 1884.

Minerva brook was stocked in 1888, with 35,000 salmon at Olmsteadville, Essex county. It is a tributary of the Schroon river which enters the Hudson at Warrensburgh, some twenty miles, as the crow flies, below, but by the course of the river is nearly double that distance. This stream is a celebrated trout brook, and I strongly recommend it for salmon.

Loon lake empties into the Schroon at Starbuckville, Warren county. It received 38,600 salmon in 1884. I am not certain that lake plantings are good for these fish. I prefer mountain brooks.

Gulf brook and Hokum pond received 55,000 fry in 1882, Hokum pond is in the town of Johnsburgh, Warren county, southwest of the village of North Creek. Its outlet is Mill brook (not Mill creek, in the same county). which is tributary to North creek. Gulf brook empties into Mill brook near the outlet of Hokum pond.

Kelso brook was stocked with 37,000 in 1884. It empties into Minerva brook a mile above Olmsteadville, in Essex

* In the reports this plant was credited to North River.

county, and is therefore tributary to the Schroon river. Another stream, with the same name, empties into Carr's brook, in the town of Chester, Warren county.

Cedar river comes from the southwest and joins the Hudson in Essex county, about three miles above the point where Indian river comes in. It rises in the Cedar lakes, near the middle of Hamilton county, and flows northeast. Within a mile or two of its source the West Canada creek rises and flows off southwest to the Mohawk, and the south branch of Moose river, another tributary of the Mohawk, via Black river, rises within a mile and a half of the Cedar. In 1885 I made a plant of 59,900 salmon in the Cedar, where the stage road from North river to Blue Mountain lake crossed it, just beyond the village of Indian Lake. There was no logging on the stream that year, and the fish could have a run of a dozen or more miles up the river.

Clendon brook flows into the Hudson about five miles above Glens Falls, and is an excellent stream for salmon. I have already recommended this stream, and, at the meeting of the American Fisheries Society, in Washington, have shown young salmon from it, which were caught and sent by Mr. A. N. Cheney, who, I think, also sent some to Mr. E. G. Blackford. It is a good trout stream, and is protected by its owners against public fishing. On the 23d of August, 1888, in company with Mr. Cheney, I visited the brook and we fished in it for about half a mile. In an open spot we took a few chubs and a few little trout, which we returned to the water. Following down the stream through a dense growth of alders, we found a pool in which was a school of perhaps twenty fish, which Mr. Cheney said were salmon, and on casting his fly in it he took one which proved to be a salmon of seven inches in length. In another pool he took a second one, and by letting my fly drift down under the brush, leaving the rod back on the ground and holding the line in my hand, I brought one up where I could identify it before it broke loose. Mr. Cheney's fish were both returned to the

stream. We then stopped. I had seen enough to assure me that the fish were there in numbers.

Clendon brook has received the following plants :

1884	41,000
1885*	59,700
1886	19,700
1888	50,000
Total	170,400

I can strongly recommend this brook for future plantings. It not only is a good stream for rearing the fry in, but is below several of the falls, especially the great one at Jessups Landing, which is a formidable one for fish to go over but which is dry in summer, owing to the water being used in the great paper mill at that place. (See account of Palmer Falls, under the head of "Dams and Obstructions.")

When I began the work Professor Baird left the selection of streams to me, as I had a slight knowledge of the Adirondack region, but some of the brooks I did not know and depended on the opinions of the natives, judging that if they were good trout brooks they would do for salmon. I am, however, more indebted to Mr. Cheney than to any other man, for this information as well as for the dams and obstructions lower down, as he has fished that country very extensively and is one of our best informed anglers. Stoddard's excellent map of the Adirondacks was also of use, but its scale does not permit the naming of the smaller brooks.

RECAPITULATION OF PLANTINGS SINCE 1882.

Carr's brook	342,600
Balm of Gilead brook	347,175
The Glen brook	89,000
North Creek	135,650
Raymond brook	271,300

* And 150 yearlings.

RECAPITULATION OF PLANTINGS SINCE 1882.—CONTINUED.

Gulf brook	55,000
Roblee brook	50,000
Minerva (including Kelso)	72,000
Beaver Meadow brook	39,000
Roaring brook	216,000
Clendon brook	170,400
Thirteenth brook	129,900
Indian river	36,200
Cedar river	59,900
Loon lake	38,600
Total	2,091,723

SALMON CAUGHT.

Up to 1888, when these investigations were made, it may be fair to consider only the three first plantings which comprise 894,600 fry.

In 1886 several salmon were taken, one by John B. Denyse, in Gravesend bay, and three at Troy dam, the weights ranging from ten pounds to fourteen and a half pounds. (See Report U. S. Fish Commission for 1885, foot note to p. 110.) It has been estimated that a dozen or more were taken in that year by the fishermen. Mr. Blackford bought the salmon caught by Denyse and displayed it on his stand, where it attracted great attention as a Hudson river salmon.

In 1887 many "North river salmon" were sold in New York, and were reported to have been taken up the river, although I know that some were taken in Gravesend bay. On November first of that year a spent male salmon was taken at Port Monmouth, New Jersey, and sent to Mr. Blackford. It was very poor and, while it measured two and a half feet in length, it weighed but seven pounds. The hook on the jaw was slight and the sides were blotched with red, as is usual with a ripe, or spent, male.

This year, 1888, I have met with some difficulty in interviewing the shad fishermen, who are the ones who catch them, because of a law of New York which forbids their capture except with hook and line, and on interviewing a fisherman his first thought was that I was one of the State fish and game protectors or their agent, and he became suspicious. The conversation would run somewhat this way. After the usual references to the weather and other topical subjects, I would ask:—

"Did you catch any salmon this season?"

"No-o; I did'nt get one. That $100 fine for catching them is still good, ain't it?"

"Yes; that is the law, but (in a conciliatory tone) no man has been fined for it yet and it has not been enforced. I am the man who hatches and plants these fish in the river, and I want to get evidence of the result of our work for the United States Fish Commission, in order to judge whether it will be advisable to continue it or not, and any information you give me will not be used to your detriment. If I publish any captures, as I may in my report, it will be so long in appearing that your grandchildren will be glad to know that you caught one of the first salmon placed in the river, and the game protectors will be too old and infirm to interest themselves in your case. Besides this, I will decline to testify against you and fail to recognize you in court, if you will only tell me what you know of catching salmon in the Hudson."

"Well, you talk square enough, but a man don't like to give his neighbors away, for while I didn't get a salmon some other fishermen did. Now if you won't give me away to them I'll tell you that———of———cotched two," etc. and in this way I have dug out a few catches. When I interviewed ———of———he went over the same story, only he told me that the man I first talked with "got a big one."

The following is the full text of the law of the State on salmon, which of course does not affect the New Jersey fisher-

men, or those who fish from Bergen Point to below Piermont:—

Chapter 530, Laws of New York.—An act for the protection and preservation of salmon in the waters of this State. Passed June 6th, 1887; three-fifth being present.

The people of the State of New York, represented in Senate and Assembly, do enact as follows:—

SECTION 1. No person shall at any time kill or catch, or attempt to kill or catch, salmon in the waters of this State with any device or in any manner, save that of angling with line or rod, held in hand.

§ 2. No person shall catch, or attempt to catch or kill, any salmon in said waters save only from the first of March until the fifteenth day of August in each year.

§ 3. Any person using nets in that part of the Hudson river within the jurisdiction of this State, in fishing for other fish allowed to be taken therein by nets, shall upon catching any salmon immediately return and restore the same to the water without injury. The foregoing provisions are not to apply to the operations of State or public hatcheries or to the artificial propagation of said fish by State or public authority.

§ 4. Any person violating any of the foregoing provisions of this act shall be deemed guilty of a misdemeanor, and, in addition, shall be liable to a penalty of one hundred dollars or one day's imprisonment for each dollar of fine; any informer to receive one-half of said fine. Actions for any violation of this act may be brought before any justice of the peace in any county which borders on the river or water opposite where the offence was committed, without regard to channel boundaries.

§ 5. All acts inconsistant with this act are hereby repealed.

§ 6. This act shall take effect immediately.

Gravesend bay.—The largest number of salmon taken by one man, that has come to my knowledge, was taken by John B. Denyse, of Unionville, Kings county, N. Y., who fishes in

Gravesend bay, which is a portion of lower New York bay. He caught ten fish, averaging from nine to twelve pounds each, the largest weighing nineteen pounds. The fish were taken in fyke nets, set for shad, and were caught between May 9th and 29th. Eighteen more were taken in this bay, making twenty-eight in all. Mr. Donnelly took four; S. Voorhees, seven; Denyse and Cozine, three; while A. Voorhees, J. B. Vorhees, S. Morris and D. Snedicor took one each. Mr. John B. Denyse showed me a drawing of a young salmon, made by his son, of a fish caught by him on June 14th, 1887, which was eight inches in length. The drawing was well done, and I had no doubt of its being a salmon.

New York bay.—There were twenty fish taken in the bay, weights not given. The following men took them: L. Kells, Greenville, N. J., three; H. Meserole, Greenville, N. J., four; J. Gelshion, Greenville, N. J., four; J. M. Minugh, Communipaw, N. J., two; J. Woods, Communipaw, N. J., one; J. McLaughlin, Jersey City, N. J., one; George Griffin, Pamrapo, N. J., two; Van Buskirk and Titus, Pamrapo, N. J., two; Richard Cadmus, Bayonne, N. J., one; total, twenty.

Prince's bay.—Three fish are recorded from this water. D. Finnegan, Morris & Brown, and W. M. Morris, all of Port Monmouth, N. J., each took one.

New Jersey Shore of the Hudson.—Five salmon were taken just above Weehawken by as many men, or fishing partners. J. & J. Ludlow, S. & J. Ludlow, and R. DuBois, all of Weehawken, each took one salmon, as did also Henry Scott, of Pleasant Valley, N. J., and Barber and Wilson of Alpine, N. J.

From New York to Troy.—By favor of Mr. E. G. Blackford I obtained the addresses of the men who fish for shad in Hudson, and was thereby enabled to go directly to the fishermen, which greatly simplified the work in the different cities and villages by saving the time in making inquiries for them. Mr. Henry Burden, also one of the New York Fishery Commissioners, helped me to many facts concerning the catch about Troy and above. Mr. Burden has taken much interest

in this matter, and was instrumental in getting a McDonald fishway put in the Troy dam by the state, mainly for the passage of salmon, which had been seen jumping at the dam and bad been netted below it in former years. Mr. Matthew Kennedy, of the city of Hudson, and one of the fish and game protectors of the State, as well as a shad fisherman owning several nets and employing a number of men in the season, gave me valuable assistance, in reporting such salmon captures as had come to his knowledge.

Mathew Kennedy says that eight salmon were taken at Hudson by two parties, and the fish were returned to the water alive. He saw the fish, and his men caught some of them. His nets were old and tender, and the salmon made holes in them; but if the nets had been stronger a great many more would have been taken. If the striped bass were as plenty about Hudson as they were a dozen years ago, that fish would have been credited with making the holes, but the bass are scarce now, and he believes that salmon made them, for they were too small to have been made by sturgeon. Four of these fish were taken on one day in rough weather, and Mr. Kennedy thinks it worthy of note that all the others were taken when the water was rough. They were caught between the 1st and 14th of June. The water in the river was very high up to the middle of May, and but little shad fishing was done until after that date.

Stockport.—John W. Best took four fish—weights not given; and at New Baltimore, H. Van Hoesen caught three which weighed forty pounds, or an average of over thirteen pounds each. At this point the channel is shallow, and the nets are short, and salmon can escape them better than in most places.

At the following places I learned of fish being taken. The towns are given as found on my note-book, without regard to their geographical sequence. In all cases it was not possible to learn the names of the captors, nor the weights of the fish; but where these items were learned they are given: Highland

Falls, Mike McKiel, one; Mulls Fishery, Anthony Putnam, seine, two—eleven, eleven and one-half pounds; Catskill Point, seine, John Pindar, one—fifteen pounds; Cornwall, one—nine pounds; Barrytown, drift net, two—ten and three-quarters and thirteen pounds (several persons intimated that more were taken at this place, but were cautious about giving information for fear of being called on as witnesses); Kingston Point, drift net, two, ten, eight pounds; North Staatsburg, Millard Archer, two—ten, twelve pounds; Hyde Park, drift net, one; Elmore's Dock, drift net, two—ten and eighteen pounds; Newburgh, one; Verplanck's (Stony Point), three—twelve and three quarters, eleven and one-half, and fifteen and one-half.

Troy.—As before stated, Mr. Henry Burden kindly volunteered to get the needed information at this place, and his knowledge of men and locality enabled him to work the field better than a stranger could. I went out with him to a fisherman's floating house one day, and found that the man in charge was very suspicious, and if he or his friends had caught any salmon, they were not going to expose themselves to a fine by telling it. Mr. Burden writes me as follows:—

224 Third St., Troy, July 30th, 1888.

Mr. Fred Mather:—

Dear Sir.—The catch of salmon in the vicinity of the Troy dam for the season of 1888 was twenty-six, varying in weight from five to twenty-six pounds. This number was known to have been taken, but the person who obtained the information thinks that more were caught.

Very truly, Henry Burden.

Of the salmon in the lower river, Forest and Stream of May 17th, 1888, said: "Up to Saturday last, fourteen salmon have been taken in the Hudson river between Communipaw and Yonkers. The largest one weighed 10½ pounds and the smallest eight pounds. They were taken

by the shad fishermen in gill nets, and were, therefore, too badly injured to be returned to the water, as the law requires. The fisherman who took the fish at Yonkers did not know what it was, and on cutting it open found that it was red inside, and threw it away as uneatable. The stocking of the river, begun by Professor Baird, is being continued by Colonel McDonald, and about 440,000 will be planted this spring from the Cold Spring Harbor Hatchery. Over half of the fry have already been planted in the trout streams of Warren county, and the end of this week will find them all in the tributaries of the upper river. The experiment seems to be proving successful in spite of the doubters."

The Troy Times of May 26th, said: "This morning W. E. Hagan, of the Fish and Game Protective Association, reported to District Attorney Griffith that a salmon had been caught at the State dam in a net. The catch of salmon in this way is a violation of chapter 530, laws of 1887. The penalty is $100 fine or 30 days imprisonment, at the option of the magistrate. A fine of $25 is also to be imposed on any person having in his possession a salmon caught in a net. The salmon was in the possession of McGrath & Laflam, fish dealers at the Fulton Market, Troy. They said they purchased the fish from William Askins, who caught it. The fish had been sold to a citizen, but when the latter was told that it would be a violation of law to receive it, he declined to accept the salmon. District Attorney Griffith sent officer Forrest after Askins, who said he did not know that he had violated any law. He was admonished to refrain from fishing for salmon with a net hereafter, and as this was the first case reported, it is not probable that Askins will be prosecuted. The same law prohibits fishing in the Hudson River on Sunday, and the agents of the Fish and Game Protective Association called on Superintendent Willard and requested that the law be enforced within the city limits. The Superintendent said he would direct the police to enforce the law. The salmon caught at the dam weighs twenty pounds."

Mechanicville.—Some fish went over the Troy dam in the June rise, and got up as far as Mechanicville where the dam is high and impassable at the greatest floods known. Concerning this I have received the following letters:—

GLEN'S FALLS, N. Y., July 24th.

Mr. Fred Mather:—

Dear Sir.—Mr. A. C. Johnson of Mechanicville, N. Y., writes me that the salmon are below the dam at that place. He saw five at one time yesterday, and one was found dead last week, which weighed twelve and a half pounds. He says that the boys want to shoot or spear them, but he does not mean that they shall. The water is low, and the fish cannot pass the dam. He says they are all big fish. There is a necessity for fish-ways in order to let the fish get to the breeding grounds, and the dams should be watched in order to keep the fish from being destroyed. The people should be instructed to let the breeding fish alone in order that they may be benefitted hereafter. A. N. CHENEY.

There was a rumor that reveral salmon had been dynamited at Mechanicville, and the following letters relate to this:—

TROY CLUB, August 18th.

Mr. Fred Mather.

Dear Sir.—On my return home from Rochester I found a letter from Mr. A. N. Cheney, giving an account of the dynamite outrage at Mechanicville, and stating that he had written the Lake Shore game constable to go over there and investigate. I visited Mechanicville a few days ago with the builder of the Troy fishway to look at the dam at that place. I saw Mr. A. C. Johnson, the person who reported about the dynamite to Mr. Cheney, and he said that no game constable had been there, and that it was now too late to fasten the crime on any one, from the evidence on hand, although suspicion

pointed strongly to two prominent citizens of the village. He said that three salmon, weighing from eight and one-half to twelve and one-half pounds, were found dead floating about the day after the dynamite was used.

Mr. Johnson also reported that a salmon was taken there recently on a trolling spoon. I never heard of such a case, and can hardly believe it. Will investigate further, and try and find out about it. HENRY BURDEN.

TROY, N. Y., November 12th.

Mr. Fred Mather.

The name of the man who took a salmon with a trolling spoon is John Conners. He is employed in the Fitchburg car-shops at Mechanicville. HENRY BURDEN.

Newburg bay.—A newspaper slip, sent me by a correspondent, said that Mr. Eugene B. O'Sullivan, who lives at Fishkill Landing, caught a salmon, weighing nine and one-half pounds with a fly, and sold it to Thomas Talbot, a fish dealer at the latter place. This was important, if true, and in conversation with State Game Protector Willett Kidd, I told him of it. Mr. Kidd kindly looked the matter up, and found that the fish was taken in a shad net.

RECAPITULATION OF CAPTURES.

Gravesend bay	28
New York bay	20
Prince's bay	3
New Jersey shore	5
Hudson city	8
Stockport	4
New Baltimore	3
Highland Falls	1
Mulls	2
Catskill Point	1
Cornwall	1

RECAPITULATION OF CAPTURES.—CONTINUED.

Barrytown	2
Kingston Point	2
North Staatsburg	2
Hyde Park	1
Elmore's Dock	2
Newburgh	1
Newburgh bay	1
Verplancks	3
Communipaw to Yonkers	14
Troy, below the dam	26
Mechanicville	4
Total known	134

I have no doubt, that four times this number were taken by the shad fishermen who as before stated, are very cautious about giving information.

PROSPECTS FOR SPAWN GATHERING.

There are but two places where the fish have been taken in sufficient numbers to enable us to get some spawning fish. These are Troy and Gravesend bay. At Troy a number could be caught, or bought from the shad fishermen. At Gravesend bay they might be kept alive by the fishermen until the season was over, and than be purchased. The fishermen at this place did not know of any law on the subject, and openly sold their fish in the New York markets, receiving from twenty-five cents to one dollar per pound, the last figure being for the first two or three fish taken.

I do not think the water in the Hudson is cool enough to pen salmon in below Troy. Between Troy and Mechanicville there are deep, cool spots which I think would answer. Mr. Burden thinks that the trout ponds of Cold Spring Harbor would be the best place to keep those captured in the lower river until the spawning season, and in this I agree with him. At Mechanicville the fish would require watching night and

day; but this might be done by watchmen at the mills, or an inclosure might be made in the tail-races of the mills where it would be difficult of access. I believe that some eggs might be taken next season, but experiment only would determine the number and cost of obtaining them. If the operations were confined to the upper river a few might be obtained at Hudson, through Matthew Kennedy, and taken up in a fish car, to add to the Troy catch. If the lower river was to be worked for fish to store at Cold Spring Harbor, a small sail-boat, with a well in it, would be needed.

POLLUTIONS OF THE RIVER.

In my opinion, ordinary house, or water-closet, sewage does no harm to fish in a river. In proof of this, I would call attention to the fact that shad have increased in the Hudson, through artificial culture, in spite of the growth of cities along its banks. Chemical works pollute the water to some extent, but the injury depends entirely on the relative amounts of chemicals and water. A poisonous stream entering one side of a river does not mix at once with the whole stream, but continues down one shore, and is finally precipitated, and becomes harmless. The poisoned water would kill a fish entering it, but the instinct of the fish teaches it to avoid it. At times the muddy water of the Missouri river can be seen for many miles below its junction with the Mississippi, and this will serve to illustrate this point.

The paper mills formerly poured great quantities of chloride of lime in the river, and this substance was claimed, rightly or otherwise, to be the cause of the decrease of shad in the Connecticut river, some years ago, because of the paper mills at South Hadley Falls, Mass. There are paper mills on the Hudson from Troy up to Jessup's Landing, both numerous and large, but in all of them that I visited I was told that the use of chloride of lime had decreased to a mere fraction of what was formerly used. In these mills wood-pulp is the basis of paper, and it does not require the bleaching

that other materials do, and, as one manufacturer said: "We do not use as much chloride of lime in a month as we did in a day before we began using wood-pulp, and you will find that this is the rule with all the paper mills." In conversation with other paper manufacturers they confirmed this statement, and therefore there is less than four per cent. of poison from the paper mills than there was before wood-pulp was used to make paper.

DAMS AND OBSTRUCTIONS.

The first obstruction that a salmon meets in the Hudson is the State dam at Troy, which barred their ascent until in June last when a rise in the river gave two feet of water on the crest of the dam, and some salmon went over it. These are the fish referred to above, seen at Mechanicville. The State Legislature made an appropriation for a fishway in this dam, and one was built last summer, after the salmon run was over, by the McDonald Fishway Company. After the completion of this fishway I was in Troy, but the water was too high to see the structure, which I am informed is substantially built and is complete in all respects. This form of fishway differs in principle from all others, and from a study of fishways in Europe and America I believe it to be the best in use. I have drawings of all different fish passes in the world, some of which have never been published, and some of them are very odd. When in charge of the department of American Fish culture at the International Fisheries Exhibition, held at Berlin in 1880, I gathered a mass of material which was never published, because the Government did not issue a report of that exhibition, and among my sketches are some odd fishways in the English department. Allowing me to judge, I will say they were, some of them, of a most primitive sort, and of little use to most fishes. I merely cite this to show that I have paid attention to the construction of fishways and have a knowledge of the principles of all the different fishways, without professing to know anything about the

practical building of one. From study of working models I am satisfied that the McDonald fishway is the easiest of ascent of any. I have seen a model of a catamaran actually go up one by the force of the side currents, while the water in the middle of the fishway was a turbulent rapid, gradually working down, but checked at every foot into a semblance of a mountain torrent.

I think, and so said in print, a dozen years ago, that fish will find the entrance to a fishway with greater certainty if it is at the foot of the dam, instead of below it, and would, therefore, advocate the building of fishways above dams, if possible to do so.

Mechanicville.—The dam at this place is nine miles above the Troy dam, and the water between them is a splendid series of salmon pools and rapids. It was at the foot of this dam that several salmon were seen jumping, by a Mr. Greene, residing there, and where a twelve pound salmon (not elsewhere reported) was found dead by George Baxter. The bed of the river here, as well as above and below, is a slate formation. The dam is 15 feet high, built of stone laid in cement. I looked the dam over, in company with Commissioner Henry Burden, and settled on a place where the fishway could be placed. Later, Mr. Burden, in company with Mr. Blaisdell, President of the McDonald Fishway Company, visited the dam, and wrote me as follows :—

TROY, N. Y., August 18th, 1888.

Mr. Fred Mather :—

We found a new place to locate a fishway in the Mechanicville dam, and that is alongside of the stone wall forming the canal from which the mill wheels take water. The gates at the head of this canal are always open, so that fish could get through to the river above. If there is no pollution in this canal I think a fishway could be built as cheap, if not cheaper than the one at Troy. It would be out of the way of ice, and would not cut into the main dam.

Sincerely yours, HENRY BURDEN.

Stillwater.—This place, whose name awakens memories of the revolutionary war, has a dam made of logs, with an eight foot perpendicular face, and it is three miles above Mechanicville, and fifteen miles below the Fort Miller dam. Although the dam is eight feet high on the west side of the river, it is not a foot high on the east side, and, before the dam at Mechanicville was built, suckers and river herring (alewives) went over it in the spring. No fishway is needed here, because in ordinary seasons while fish are running they can pass this dam. Surely a salmon will have no trouble with an obstruction which a sucker can pass. A fishway at Mechanicville would give the salmon a clear run from Troy to the next dam, a distance of 27 miles.

Thompson's Mill (P. O.)—At this place is the Saratoga State dam, two miles below the Fort Miller dam, and it is of stone, 824 feet long, 9½ feet high, with an apron of ten feet. There are no falls here, only swift water, "rifts" below. In stages of high water there is moderately deep water below, which would serve as a resting place for salmon.

Fort Miller.—The dam here is a wing-dam, ten feet high at one end, but only eighteen inches at the other. It is of wood, with a square face, and would not obstruct the passage of salmon. It is two miles above Thompson's Mill.

Fort Edward.—There is an old wooden dam here, made of log cribs, which will soon require to be rebuilt as it is much decayed. The dam is sixteen feet high. There are good pools just below it which have fourteen feet of water in them at low water. There is a spill-way in the dam through which all the water goes when the river is low. This is for the passage of logs in the summer. Below the dam is a great bed of sawdust, on the east bank.

Baker's Falls and Dam.—These falls are at Sandy Hill, a few miles below Glens Falls. It is said that before there were any dams on the river the shad came up as far as this, but could go no further. I heard this tradition from several persons, but can not say more. The falls are slate rock, and fall

fifty-eight and a half feet in about 500 to 600 feet, the exact height being obtained from Allen Bros., paper manufacturers. The pool below, where the shad formerly stopped, is said to be seventy feet deep. Half-way up the falls is a pool about 125 by 75 feet, and apparently fifteen feet deep. The dam on the top of the fall varies from three to eight feet in height.

Sandy Hill Dam.—This dam is about a half-mile above the former and is of logs, eleven feet six inches high, with a spill-way in the middle, from which an incline runs down to low water, for the purpose of running logs.

Glens Falls and Dam.—The falls are hard, stratified rock, and at low water the descent from the crest of the dam is forty feet, in a distance of 150 feet. There are several steps and pools, in some of them the vertical distance is not over thirty feet. In the center it is higher, and consequently the great body of water is divided to flow on either side. I saw it on August 23d, and the river was then exeptionally low. It looked, at that time, to be practicable to make a passage for fish, part of the way in the rock.

State Dam (at Feeder Dam).—This is one and three-quarter miles above Glens Falls. It feeds the Champlain canal and runs two saw-mills. Its height is thirteen feet and eleven inches, and is built of wood with an eighteen feet apron. Water goes over this dam until July, when the brackets are put on and the water is all used by the canal and the mills. From this dam to Clendon brook, above, is five miles by river.

Palmer's Falls and Dam.—These are at Jessup's Landing. The dam on the crest is 25 feet high, then rapids for a distance of 100 feet, more or less, and a sloping fall of about 50 or 60 feet. It is 85 feet from the pool below to the foot of the dam. In dry times the enormous paper mill takes all the water in the river, but when I saw this fall, Nov. 22d, it was a terrible place to think of going over, either for a salmon or a man. While building the dam in this wild mountain gorge,

two men went over the falls. One was killed, and the other was so badly injured that he has never fully recovered. If the salmon planted above this fall go down safely they can go the rest of the way without injury. I confess to being doubtful about it, and begin to think that possibly Clendon brook may have supplied a good share of the fish that have grown to maturity, for this fall surprised me with its violent rush through a narrow pass and its lack of a deep pool to receive the falling waters. I do not see how a living thing could escape being battered to death on the many exposed rocks, and especially at the foot of the dam, where is a sheer fall of 25 feet and a shallow pool.

Rockwell's Falls.—These are at Luzerne, or Hadley. The village is on both sides of the river, in different counties, and has two names. This is the last obstruction on the river. The dam is 15 feet high on the west bank, and runs to nothing on the east bank. A salmon could go over it with ease, if it could get here. The Sacandaga River enters the Hudson about 200 yards below these falls.

Conclusion.

While I have expressed surprise that anything could live after passing Palmer Falls, I do not wish to be understood as saying that it is impossible for it to do so. The varying current, which would dash a man to pieces on the rocks, may be safely run by a salmon going down tail first and keeping steerage way all the time by a vigorous up-stream motion, but if one simply looks at these formidable falls with the idea that a salmon would go down them as he or any other mammal would, he would shudder at the thought. The fact that all fishes go down stream in rapid water tail first, when not hooked or frightened, must save them many a contusion which a cow would get. I have seen a trout go over a small dam, when, of course, it did not know what might be below, and it would back down until its fear would cause it to resist the rapid current, and so would feel of it, always heading up

stream, until at last it let the water have its way, in part only, and with head up stream and caudal fin in active motion, it was prepared to meet the wild rush of water with such muscular energy as it could muster. Taking this view of the case, it is possible that young salmon may safely go down any impediment in the Hudson, but, if they go down at a low stage of water, when the whole river is turned into the wheels of the mills, "aye, there's the rub," for in that rush of turbines what grinding comes when salmon have "jumped this bank and shoal" is more than we can say.

While holding fast to that which is good, and this means stocking the streams which have reared fish and sent them to sea in sufficient numbers to return again, I would suggest that the Sacandaga River be stocked. I know that its lower waters, especially below Mill Creek, where the new hatchery of the New York Fish Commission is located, contain pickerel, *Esox lucius*, but so does the Hudson, from Albany up to above North Creek. If the Sacandaga is to be stocked, I would say that the nearest way to reach its headwaters is via North River, six miles above North Creek, where the Adirondack railroad ends, and thence by wagon to the "Drake Place," three miles east of Oregon, and make the plant in Diamond Mountain brook and in Siamese brook, and also in Buck Meadow brook and Botheration pond. The latter is the head of the Sacandaga River. There is no need for me to write an essay on the benefits of planting salmon in the headwaters of streams where they get insect and crustacean food and escape their larger enemies.

I think that the tributaries of the Hoosick River, which enters the Hudson as low down as Stillwater, and other streams in Washington County, N. Y., might prove to be good rearing streams for salmon, but I have no personal knowledge of them. The same might be said of streams in the Catskills, of which I also know little beyond the fact that there are good trout streams there. If it is desirable to extend the number of streams to be stocked, or to substitute

others for those which, in my opinion, are not as good as they should be, then some competent person should make an examination of other brooks.

I do not know what time of the year the young salmon go down past the obstructions named. If they go at low water, when at several places the great body of water goes through mill-wheels, many of them may be killed; hence my suggestion of stocking some streams lower down. If, however, the fish make the descent of the upper river at times of high water, they have the choice of going over dams or through wheels. However this may be, some have escaped, and the stocking of the Hudson with salmon is one of the successes of fish culture with which I feel proud to have been connected.

Cold Spring Harbor, N. Y.

Mr. Burden.—The salmon in the river promise a larger run than that of last year, to which Mr. Mather's paper refers, although it is early yet. I am told by Mr. Blackford that ten salmon were taken yesterday within ten miles of the battery, which is, as you all know, the southern extremity of New York city.

THE COLOR OF FISHES.

BY G. BROWN GOODE.

The skin of a fish, upon the structure of which its color depends, consists of two layers, the outer or *epidermis*, delicate, transparent and not supplied with blood-vessels; the inner, the corium or *dermis*, laminated and elastic, varying in thickness in different species, and in different parts of the body, and permeated by blood-vessels and nerves. Between the skin and the underlying muscles is a layer of loose connective tissue, often loaded with fat, especially in the mackerels

and salmonoids, and in the herring tribe: in the menhaden this layer is thick, hard and blubber-like.

The scales are modifications of the dermis, and are, ordinarily, thin, transparent, horny plates, with rounded quadrangular outlines, which are partially imbedded in folds or pockets in the dermis, and covered by the epidermis, through which, however, their tips protrude. The scales are usually

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SECTION OF THE SKIN OF A FISH.
a. Epidermis. b. Scales. c. Dermis.

imbricated, overlapping each other like the shingles on a roof, but are sometimes separate and imbedded and partly hidden in the skin, as in the eel.

In fishes which live near the bottom and among the rocks, such as the sea bass, red snapper, sheephead and perch, the scales are usually thick, hard, closely imbricated and deeply set in their sheaths, forming a strong coat of mail.

In fishes which live in the mud, such as the tautog, the burbot and the carp, the scales are usually covered by thick layers of epidermis and mucus.

In fishes which swim free and far from shore, such as the herrings and the lake white-fishes, the scales are attached merely by a small area of their rims, and being but slightly covered by the epidermis, are easily rubbed off. Scales thus removed are in many fishes easily renewed.

The smooth polished surface of the closely set scales offers little resistance to the motion of the fish as it glides smoothly through the water.

The exposed surface of the ordinary fish scale is usually covered with a thin silvery coating, which derives its brilliant

metallic lustre from the presence of numerous crystals of a combination of guanin and lime. This coating may readily be loosened and rubbed off, and in one European fish, the bleak or ablette, a member of the carp family, the crystals are sufficiently abundant to become the source of the metallic pigment known in the arts as *Essence d'Orient* or argentine, which is used to impart a nacreous lustre to the glass globules sold under the name of "Roman pearls." When the silvery coating is absent, scales are lustreless and transparent, as in the smelt, the abdominal cavity of which, however, has a brilliant silvery lining composed of the same substance.

Crystals from the silvery coating of a fish-scale. Magnified 600 times.

The colors of fishes are very varied and often exceedingly brilliant and beautiful. "Aucune classe d' animaux n'a été aussi favorisée à cet égard," says Lacépède, "aucune n'a reçu une parure plus élégante, plus variée, plus riche : et que ceux qui ont vu, par exemple, des zées, des chétodons, des spares, nager pres de la surface d'une eau tranquille et réfléchir les rayons d'un soleil brillant, disent, si jamais l'éclat des plumes du pœon et du colibri, la vivacité du diamant, la splendeur de l'or, le reflet des pierres precieux, ont été mélés à plus de feu, et ont renvoyé a l'œil de l'observateur des images plus parfaites de cet arc merveilleusement colorie dont l'astre du jour fait souvent le plus bel ornament des cieux."

The colors are often due to a simple arrangement of pigment cells, placed at different depths in the skin, but those changeable and brilliant hues, which constitute the greatest beauty of fishes, are dependent, as Pouchet and others have shown, upon two very dissimilar causes.

One of these, which may be well observed in the scales of the herring, shad or mackerel, is a true iridescence, similar to that seen in the pearl or in antique glass, and due to the refraction of the rays of light as they glance off the surfaces

of thin plates or ridges in the scales; this is called "lamellar coloring." There are certain bodies called *iridocytes* (rainbow plates) imbedded in the epidermis which have an important function, it is said, in this iridescent play of colors.

The coloration is, however, chiefly dependent on the arrangement of the pigment cells or *chromatophores*, which lie in the lower strata of the epidermis. These are black, yellow and red; the latter, according to Pouchet, being capable of dimorphic changes into blue and green. The combinations of the various hued *chromatophores* with the metallic crystals of silver, the white of the bony scale plates showing through the epidermis, and the *iridocytes* already referred to, produce the coloration of every kind of fish.

An embryonic fish is colorless, but the pigment cells of black, yellow and red soon begin to appear, as is shown in Alexander Agassiz's beautiful plates of the early stages of flounders and other species, published in the *Bulletin of the Museum of Comparative Zoölogy.* When the black pigment predominates, the color is sombre, as in the adult tautog, *Tautoga onitis.* A slight admixture of yellow gives the bronze-like hue of the eel, and a little more of the same results in the brighter green of the black-bass, the blue-fish and the cunner. In all of these there is a sprinkling also of red, giving the warmer brownish greens so often seen in these species. Red pigments intermixed with black give the dingy browns of the carp, the sculpins and some of the cat-fishes. When the yellow and red outnumber the black cells, there result the tawny colors of the sand-dabs, the sun-fishes, the cusks and the ling, and of some varieties of the cod. Red chromatophores alone cause the brilliant scarlet of the red snapper and the rose-fish, and when these are interspersed with black, the deeper colors of the mangrove snapper and the ruddy variety of the sea-raven. When the chromatophores begin to segregate into separate groups according to color, the result is the formaticy of bands, stripes, spots and shadings infinite in their possibilities of muta-

tion and combination and quite beyond the power of words to describe.

The entire absence of chromatophores results in albinism. I have already called attention to the curious albino haddocks occasionally taken on our coast. Sometimes these are of a light golden color, and are in what Günther calls a state of *incipient albinism*, the dark pigments having changed into yellow. This has been observed also in flounders, carps and eels, and in the gold-fish, which in its native haunts in China is a dull green; the golden orfe and the golden ide have become permanent in a state of domestication. The silver-fish, a form of gold-fish, is an example of still more complete albinism, and a combination of the two conditions is very common in the breeding ponds of the United States Fish Commission.

The blind fish of Mammoth cave, *Amblyopsis spelæus*, is an illustration of permanent adaptive albinism, and in the abysses of the sea, where the light is very scanty, many fishes appear to remain permanently in this condition.

Adaptive coloration seems to be possible in quite another way, through the secretion of pigment cells, which permanently change the color of the fish to make it harmonize with that of the bottom upon which it lives. On certain ledges along the New England coast the rocks are covered with dense growths of scarlet and crimson sea weeds. The cod-fish, the cunner, the sea raven, the rock-eel and the wry-mouth, which inhabit these brilliant groves, are all colored to match their surroundings, the cod, which is naturally lightest in color, being most brilliant in its scarlet hues, while the others, whose skins have a larger original supply of black, have deeper tints of dark red and ruddy brown. These changes must be due to the secretion of a special supply of red chromatophores. It has occurred to me that the material for the pigmentary secretion is probably derived indirectly from the algæ, for, though the species referred to do not feed upon these plants, they devour in immense quantities the invertebrate animals inhabiting the same region, many of which

are likewise deeply tinged with red. Possibly the blacks and greens which prevail among the inhabitants of other colored bottoms are likewise dependent upon coloring matter which is absorbed with the food. Günther believes that the pink color in the flesh of the salmon is due to the absorption of the coloring matter of the crustaceans they feed upon.

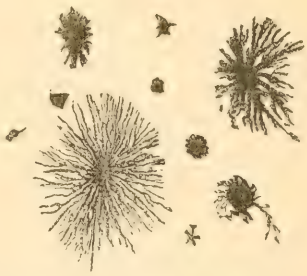
The brilliant coloration of many kinds of fishes during the breeding season may possibly have a relation to sexual selection; indeed, this can scarcely be doubted by any one who has observed the peacocking moments of male fishes. It has also a physiological significance which it is not difficult to comprehend. The increased brilliancy is usually most manifest in those parts of the body which lie close to the reproductive organs, which is often flushed and vivid in color, in the ventral fins, and in less degree in the sides of the body and the posterior and lower parts of the head. The entire vascular system is in a condition of extreme activity at this time, as is evident from the manner in which outgrowths of the head and teguments are so rapidly developed. Every pigment cell is receiving an unusual supply of blood, and its more abundant nutrition is in part at least the cause of its brilliancy.

If an abundant supply of blood results in an increase in brilliancy, its withdrawal from the teguments, on the other hand, causes an immediate decrease. I have often watched the large brightly striped groupers, (*Epinephelus striatus*) confined in the crystal fish pools in Bermuda. When one of these had swallowed a large morsel of food its color became almost instantly lighter and duller. This was evidently the result of the rush of blood to the stomach, to take part in the work of digestion: in like manner a man's face sometimes becomes paler after he has eaten a hearty dinner.

The dullness and pallor in the color of fishes after death is due to the absence of living blood from the chromatophores. If, however, a fish not long dead is placed in the sun, its color

will soon become almost as deep and bright as in life. In a few seconds it fades again, and cannot again be brightened.

This phenomenon leads to the consideration of another peculiarity in the arrangement of the pigment cellswhich renders rapid changes possible in hue in certain species. In these the pigments are associated with oily matter, and are arranged areclæ, which favor their approach toward or retreat from the surface of the skin. The accompanying diagram, drawn by Prof. Benecke, shows how they may sometimes show as small, irregular spots upon the skin, and soon after become conspicuous star-shaped markings with far-reaching arms. Such changes may be effected by stimulation of various kinds; and even by the reflex action of the nerves under the influence of impressions of color received by the eye of the fish.



Chromatophores variously expanded.

Every angler knows that trout inhabiting stagnant pools or dark bottoms are deep colored, while those from deep, sunny waters are brighter. The same is true of many other fishes. I have often seen the common flat-fish change its color to that of the gravel and sand in which it was trying to hide, the hue varying as rapidly as that of the landscape when the sunlight is suddenly cut off by a passing cloud.

These changes of color are directly connected with the impressions of color received by the eye, and brought about by the reflex action of the nervous system. In no other way can changes such as these already referred to in flounders be accounted for. I have seen the tropical squid in Bermuda change color rapidly, and at will, while being pursued. This was evidently through the influence of emotion or fear, since it can hardly be supposed that there was definite purpose in the act, which, however, seemed at first sight to be intended to baffle its pursuers.

Pouchet experimented with young turbots, and found that if their eyes were blinded they did not change, thus proving that the color cells were under the control of the nervous system. Day records that young hybrid salmon raised at Howietoun, in which vision was more or less deficient, were observed to be generally lighter in color than their fellows.

The fishes of the sea are, as a rule, more brilliant than those of the river or the lake. Warmth and light are favorable to brightness and variety of hue. The fishes of circumpolar regions, and those living at considerable depths, are, therefore, usually sombre, though occasionally they have iridescent scales or plates of great brilliancy.

In temperate regions, as along the coasts of the United States, sombre ones are most common, but in summer many sunny-hued strangers come up from the South.

In the tropical seas, however, the greatest beauty is to be found, and in some groups, such as the parrot fishes and the wrasses, the most bizarre and astounding combinations of masses of brilliant color. Harsh and inharmonious as they seem, however, when imitated by the brush, they are never unpleasing in the living creature. The West Indian fauna has many wonderful fishes, such as the angel fish, *Holacanthus ciliaris*, and the Spanish lady, *Bodianus rufus*, but the utmost possibilities of beauty are to be found only in the Southern Pacific and the Indian Ocean.

As Count Lacépède has so eloquently shown, in the passage already quoted, no class of animals has been so richly endowed with color as the fishes, except it may be the insects, and the effect of brilliancy in a fish is much greater on account of its larger size. Birds appear at a disadvantage in comparison, because—except in the metallic patches on the throats of the humming bird, and a few similar instances—the surfaces of their feathers are not so well adapted to display as the broad burnished sides of fishes, kept constantly moist and lustrous by contact with water.

The beauty of fishes can only be known to those who have

had the good fortune to see them swimming at ease, bathed in the limpidest of water and the brightest of sunshine. Aquaria are always dark and gloomy, and their glass walls seem more prison-like than the bars of a menagerie cage. Museum preparations do not tell of the vanished beauty even so well as the lifeless bodies of the fishes themselves, and every angler knows how suddenly the dead fish loses its attractions of texture and color. This change has been well described by Dr. Badham:

"While blazing breast of humming bird and Io's stiffen'd wing
Are bright as when they first came forth new-painted in the spring.
While speckled snake and spotted pard their markings still display,
Though he who once embalm'd them both himself be turned to clay,
On fish a different fate attends, nor reach they long the shore
Ere fade their hues like rainbow tints, and soon their beauty's o'er.
The eye that late in ocean's flood was large and round and full,
Becomes on land a sunken orb, glaucomatous and dull;
The gills, like mushrooms, soon begin to turn from pink to black,
The blood congeals in stasis thick, the scales upturn and crack;
And those fair forms, a Veronese, in art's meridian power,
With every varied tint at hand, and in his happiest hour,
Could ne'er in equal beauty deck and bid the canvas live,
Are now so colourless and cold, a Rembrandt's touch might give."

Mr. Mather.—We have an occasional blind trout in our ponds, and can at once pick them out by their velvety-black color. I have even seen a trout that was black upon one side, when the eye on that side was gone, and there was a distinct line where the colors met on the back. They did not shade off into each other. I have also seen trout which were black, or nearly black, from the nose to the dorsal fin, and lighter from there down; and also those which were black on one side of the forward half, presenting the appearance of having one anterior quarter colored. These fish, it is proper to say, were all tame or pond kept. I never saw any such instances among wild trout. The enemies of wild trout are too numerous and alert to allow a fish to live when its sight is injured, much less when entirely destroyed.

PROF. GOODE.—The remarks just made are exactly what we want, observations of men who have live fish under their eyes all the year round. That blind trout turned black is a new thing to me.

MR. MATHER.—This is a thing that is so familiar that I would not think of mentioning it; but for what Prof. Goode said in his paper I supposed that everybody knew it. I would as soon have thought to tell this Association that fishes live in the water.

COL. MCDONALD.—I must differ with Mr. Mather on the subject of blind trout always turning black. At Wytheville, Virginia, we placed some rainbow trout fry in a trough that had been recently coated with asphalt, and the coating was not dry. The fry went blind, but instead of turning black they changed to white.

MR. MATHER.—Did they live?

COL. MCDONALD.—There were originally some six or eight hundred of them, and they lived for several years. I believe that some of them are alive yet, but they were white.

DR. KINGSBURY.—In my salmon fishing excursions I have frequently seen salmon which were blind, and these were invariably black or very dark.

MR. MATHER.—The trout that Col. McDonald speaks of as turning white, when blind, were the *iridens* or rainbow trout. I do not remember to have seen a blind fish of this species. When I said "trout," I meant our Eastern brook trout, *S. pontinalis*, therefore it is possible that neither of us have erred in our observations, as we have been talking about two different species.

MR. POWELL.—In parts of Pennsylvania it might be possible to profitably breed the fresh-water terrapin. Many of them are caught and sold, therefore they have a market value, and as the demand exceeds the supply, an increase of terrapins would mean an increased revenue.

MR. MATHER.—While the particular species of fresh-water terrapin, mentioned by Mr. Powell, is not designated, it may

be well to say that all terrapin are exceedingly destructive to fish life, and the fresh-water ones are not much esteemed as food. As a fish culturist I would not advise stocking any waters with them, if the waters contained any fish that had value as food. The terrapins, or tortoises, float up under a fish, take a bite out of it, and it dies. Often they cannot eat the whole of the fish. I have watched them in aquaria.

A MEMBER.—The Juniata terrapins sell from two to six dollars per dozen, to mix with the diamond-back terrapin, and those are considered good prices.

On motion the meeting then adjourned, to meet on the boat at 1 P. M.

THE TRIP ON THE "FISH-HAWK."

Immediately upon adjournment the Society, in accordance with the invitation extended by the Anglers' Association of Eastern Pennsylvania, repaired to the U. S. Steamer "Fish-Hawk," where they were met by a large delegation of the Anglers' Association and other guests, and cordially welcomed by Lieut. Commander Platt, of the "Fish-Hawk," and an hour or more was spent in an examination of the interesting process of shad hatching, then in progress on the vessel. The hatching, which was done with Col. McDonald's efficient apparatus, was fully explained by those in charge, and greatly interested all present. Capt. Platt stated that there were at the time 2,795,000 shad eggs in the eighty-five McDonald hatching jars, then in process of hatching. The eggs were obtained from the several fisheries in the vicinity of Gloucester, N. J., the boats attending the nets as they were hauled. The process of hatching them was thus described: On tables located on the main deck were placed the jars, and rubber tubes with glass connections to a two-inch pipe under the spar deck. This pipe connected with a large wooden tank on the spar deck. The water for this tank was supplied by a steam pump situated on the main deck. The water from this tank passes through the two-inch pipe, thence through the

rubber tubes and glass connections into the jars, and out of jars by an over-flow glass tube. The eggs are kept in constant motion by the flow of water, and thus prevented from matting together, and dead eggs are carried off by the over-flow.

As soon as the eggs show signs of hatching, a large glass aquarium is placed on the table, and the over-flow pipe led into it, so that as the fry come out they are taken out of the hatching jars through the over-flow into the aquarium and placed in a tank having a constant stream of fresh water running through it. The fry are retained in this box until called for for shipment or put overboard.

Capt. Platt stated that the process was quite simple, the principal thing being attention to the supply of fresh water, and cleanliness of the eggs, the McDonald jars being so well and carefully constructed that this end was readily attained.

The "Fish-Hawk," on starting, steamed up the river, enabling the visitors to get an idea of the extent of the water-front of Philadelphia, and then proceeded on its way to Gloucester, where a "planked shad" dinner was served in the large banqueting pavilion of Thompson's hotel. Mr. A. M. Spangler, President of the Anglers' Association, presided.

After partaking bountifully of that luxury of world wide reputation, "Glo'ster planked shad," and of the salmon which had been caught a day or two before in the Delaware River, which was pronounced by all who partook of it fully equal to the best "Kennebec," the company listened to brief speeches by Dr. Hudson, Mr. Eugene Blackford, Prof. Leidy, Fred Mather and Dr. Levick, but the speech making was cut short by the announcement that the great shad seine, a mile and a quarter in length, was being drawn, and that those who desired to witness the haul would have to leave. Nearly the entire company hurried to the shore, and with great interest watched the proceeding. In order to gratify the visitors a second haul was immediately made, after which the party re-embarked on the steamer and returned to the city. The

unanimous sentiment of the members of the Fisheries Society, as well as that of the many other invited guests, being that the excursion had been a marked success, full of interest and enjoyment to all; a hearty and unanimous "vote of thanks" being awarded to Lieut. Commander Platt and his officers for their kind and courteous attention during the trip, before the well-pleased company separated on their arrival at the wharf.

During the trip the Society was called together in the cabin of the boat, and the following business transacted: The Treasurer's report was read and accepted.

The following gentlemen were elected to be corresponding members: O. T. Olsen, Grimsby, England; Prof. F. A. Smitt, Stockholm, Sweden; Dr. Filip Frybom, Stockholm, Sweden; Prof. A. J. Malmgren, Helsingfors, Finland.

Death of Frederick III.

Mr. Mather gave notice of the death of Emperor Frederick III., of Germany, an honorary member of the Society, and a great friend to and patron of fish culture. While in charge of the fish cultural display of the United States at the International Fisheries Exhibition at Berlin, in 1880, Mr. Mather many times met the late Emperor, at that time the Crown Prince, and found him greatly interested in fish culture, as well as in other arts of peace. His questions concerning such details as the practical working of different forms of apparatus showed that he had not been a superficial student of the subject. The following resolution was presented, and unanimously adopted:

Resolved, That in the death of Emperor Frederick III., of Germany, fish culture has lost an earnest friend and most powerful supporter, and that the fish culturists of America hereby express their sympathy with their German brethren in their great loss.

The Death of Seth Green

Was also referred to, and the following resolution in regard to the same was presented:

Resolved, That the American members of the Fisheries Society take this opportunity to express publicly their sense of appreciation of the service to fish culture of the late Seth Green, one of the superintendents of the New York State Fish Commission, and of regret at his death.

A man of ability and enthusiasm, great practical experience, thoroughly familiar with every department of his work, his value to the commission with which he was associated was very great, and his services to practical fish culture of the utmost possible importance. Carried.

Mr. Long moved to return thanks to the Anglers' Association of Eastern Pennsylvania for the very generous manner in which they had entertained the Society. Carried.

Mr. Blackford moved that the Anglers' Association of Eastern Pennsylvania be made an honorary member of the American Fisheries Society. Carried.

TREASURER'S REPORT.

NEW YORK, May 10th, 1889.

The American Fisheries Society in Account with Eugene G. Blackford, Treas.

CR.

April 6th, 1888, By balance on hand,		$ 61 65
May 10th, 1889, By total receipts from membership dues,		111 00
May 10th, 1889, By balance due Treasurer,		5 29
		$177 94

DR.

July 2d, 1888, To expenses of Detroit meeting,	$ 2 45	
Aug. 28th, 1888, To expressage on box from Cold Springs Harbor,	60	
Sept. 1st, 1888, To stamped wrappers,	6 54	
Sept. 22d, 1888, To bill, F. Mather, postage, etc.,	1 60	
Sept. 22d, 1888, To Morton C. Brown, printing report,	166 75	$177 94

MEMBERS

OF THE

AMERICAN FISHERIES SOCIETY.

Honorary Members.

Behr, E. von, Schmoldow, Germany; President of the Deutschen Fischerei Verein, Berlin, Germany.

Borne, Max von dem, Berneuchen, Germany.

Huxley, Prof. Thomas H., London; President of the Royal Society.

Jones, John D., 51 Wall Street, New York.

St. Clair Flats Shooting and Fishing Club, Detroit, Mich.

Anglers' Association of Eastern Penn'a.

Corresponding Members.

Apostolides, Prof. Nicoly Chr., Athens, Greece.

Buch, Dr. S. A., Christiana, Norway; Government Inspector of Fisheries.

Birkbeck, Edward, Esq., M. P., London, England.

Benecke, Prof. B., Konigsberg, Germany; Commissioner of Fisheries.

Brady, Thomas F., Esq., Dublin Castle, Dublin, Ireland; Inspector of Fisheries for Ireland.

Chambers, Oldham W., Esq., Secretary of the National Fish-Culture Association, South Kensington, London.

Day, Dr. Francis, F. L. S., Kenilworth House, Cheltenham, England; late Inspector-General of Fisheries for India.

Feddersen, Arthur, Viborg, Denmark.

Giglioli, Prof. H. H., Florence, Italy.

Hubrecht, Prof. A. A. W., Utrecht, Holland; Member of the Dutch Fisheries Commission, and Director of the Netherlands Zoölogical Station.

K. Ito, Esq., Hokkaido, Cho., Sapporo, Japan; Member of the Fisheries Department of Hokkaido, and President of the Fisheries Society of Northern Japan.

Juel, Capt. N., R. N., Bergen, Norway; President of the Society for the Development of Norwegian Fisheries.

Lanmark, S., Bergen, Norway; Inspector of Norwegian Freshwater Fisheries.

Lundberg, Dr. Rudolf, Stockholm, Sweden; Inspector of Fisheries.

Maitland, Sir J. Ramsay Gibson, Bart., Howietown, Stirling, Scotland.

Malmgren, A. J., Prof., Helringfors, Finland.

Marston, R. B., Esq., London, England; Editor of the *Fishing Gazette.*

Macleay, William, Sydney, N. S. W.; President of the Fisheries Commission of New South Wales.

Olsen, O. T., Grimsby, England.

Sars, Prof. G. O., Christiana, Norway; Government Inspector of Fisheries.

Smith, Prof. F. A., Stockholm, Sweden.

Solsky, Baron N. de, St. Petersburg, Russia; Director of the Imperial Agricultural Museum.

Sola, Don Francisco, Garcia, Madrid, Spain; Secretary of the Spanish Fisheries Society.

Trybom, Filip, Dr., Stockholm, Sweden.

Wattel, M. Raveret, Paris, France; Secretary of the Société d'Acclimation.

Walpole, Hon. Spencer, Governor of the Isle of Man.

Young, Archibald, Esq., Edinburgh, Scotland; H. M. Inspector of Salmon Fisheries.

Deceased Members.

Baird, Hon. Spencer F.
Carman, G.
Chappel, George.
Develin, John E.
Emperor Frederic III.
Garlick, Dr. Theodatus.
Habershaw, Frederick.
Lawrence, Alfred N.
McGovern, H. D.
Parker, W. R.
Redding, B. B.
Redding, George H.
Rice, Prof. H. J.
Ryer, F. R.
Smith, Greene.
Shultz, Theodore.

Members.

Persons elected at last meeting, and who did not pay their dues, do not appear in this list.

Adams, Dr. S. C., Peoria, Ill.
Agnew, John T., 284 Front Street, New York.
Anderson, A. A., Bloomsbury, N. J.
Annin, James, Jr., Caledonia, N. Y.
Atkins, Charles G., Bucksport, Me.
Atwater, Prof. W. O., Middletown, Conn.

Barrett, Charles, Grafton, Vt.
Bartlett, S. P., Quincy, Ill.
Bean, Dr. Tarleton H., National Museum, Washington, D. C.
Belmont, Perry, 19 Nassau Street, New York.
Benjamin, Pulaski, Fulton Market, New York.
Benkard, James, Union Club, New York.
Bickmore, Prof. A. S., American Museum, New York.
Bissell, J. H., Detroit, Mich.
Blackford, E. G., Fulton Market, New York.
Booth, A., Chicago, Ill.
Bottemane, C. J., Bergen-op-Zoom, Holland.
Brown, F. W., N. W. Cor. Broad and Cherry Sts.
Brown, J. E., U. S. Fish Commission, Washington, D. C.
Brown, S. C., National Museum, Washington, D. C.
Bryan, Edward H., Smithsonian Institute.
Bryson, Col. M. A., 903 Sixth Avenue, New York.

Burden, Henry, Troy, N. Y.
Butler, W. A., Jr., Detroit, Mich.
Butler, Frank A., 291 Broadway, New York.
Butler, W. H., 291 Broadway, New York.

Carey, Dr. H. H., Atlanta, Ga.
Cheney, A. Nelson, Glens Falls, N. Y.
Clapp, A. T., Sunbury, Pa.
Clark, Frank N., U. S. Fish Commission, Northville, Mich.
Clark, A. Howard, National Museum, Washington, D. C.
Collins, J. Penrose, 850 Drexel Building, Philadelphia.
Collins, Capt. J. W., U. S. Fish Commission, Washington, D. C.
Comstock, Oscar, Fulton Market, New York.
Conklin, William A., Central Park, New York.
Cox, W. V., National Museum, Washington, D. C.
Crook, Abel, 99 Nassau Street, New York.
Crosby, Henry F., P. O. Box 3714, New York City.

Dewey, J. N., Toledo, O.
Dieckerman, George H., New Hampton, N. H.
Donaldson, Hon. Thomas, Philadelphia, Pa.
Doyle, Hon. E. P., Secretary New York Fish Commission, New York.
Dunning, Philo, Madison, Wis.

Earll, R. E., National Museum, Washington, D. C.
Ellis, J. F., U. S. Fish Commission, Washington, D. C.
Endicott, Francis, Tompkinsville, N. Y.
Evarts, Charles B., Windsor, Vt.

Fairbank, N. K., Chicago, Ill.
Ferguson, T. B., Washington, D. C.
Fitzhugh, Daniel H., Bay City, Mich.
Foord, John, Brooklyn, N. Y., Editor *Harper's Weekly*.
Ford, Henry C., Philadelphia, Pa.

French, Asa B., South Baintree, Mass.
Frishmuth, E. H., Jr., 151 N. Third Street, Philadelphia.

Garrett, W. E., P. O. Box 3006, New York.
Gay, John, U. S. Fish Commission, Washington, D. C.
Gilbert, W. L., Plymouth, Mass.
Goode, G. Brown, National Museum, Washington, D. C.

Haley, Albert, Fulton Market, New York.
Haley, Caleb, Fulton Market, New York.
Hagert, Edwin, 32 N. Sixth Street, Philadelphia.
Harper, Thos. B., 709 Market Street, Philadelphia.
Harris, Gwynn, Washington, D. C.
Harris, W. C., Editor *American Angler*, 10 Warren Street, New York.
Hartley, R. M., 627 Walnut Street, Philadelphia.
Hayes, A. A., Washington, D. C.
Henshall, Dr. J. A., 362 Court Street, Cincinnati, O.
Hergesheimer, Wm. S., 1119 N. Eighth Street, Philadelphia.
Hessel, Rudolf, U. S. Fish Commission, Washington, D. C.
Hicks, John D., Roslyn, Long Island, N. Y.
Hill, M. B., Clayton, N. Y.
Hinchman, C. C., Detroit, Mich.
Hofer, J. C., Bellaire, O.
Hudson, Dr. William M., Hartford, Conn.
Humphries, Dr. E. W., Salisbury, Md.
Hutchinson, E. S., Washington, D. C.

Isaacs, Montefiore, 42 Broad Street, New York.

James, Dr. Bushrod W., N. E. corner Eighteenth and Green Streets, Philadelphia.
Jessup, F. J., 88 Cortlandt Street, New York.
Johnston, S. M., Battery Wharf, Boston, Mass.

Kauffman, S. H., *Evening Star* Office, Washington, D. C.
Kelly, P., 346 Sixth Avenue, New York.
Kellogg, A. J., Detroit, Mich.
Kingsbury, Dr. C. A., 1119 Walnut Street, Philadelphia, Pa.

Lawrence, G. N., 45 E. Twenty-first Street, New York.
Lawrence, F. C., Union Club, New York.
Lee, Thomas, U. S. Fish Commission.
Little, Amos R., Philadelphia.
Long, James Vernor, Pittsburgh, Pa.
Loring, John A., 3 Pemberton Square (Room 8), Boston, Mass.
Lowrey, J. A., Union Club, New York.
Lydecker, Major G. I., U. S. Engineers.

Mallory, Charles, foot Burling Slip, New York.
Mansfield, Lieut. H. B., U. S. Navy, Washington, D. C.
Mather, Fred, Cold Spring Harbor, Suffolk Co., N. Y.
Marks, Walter D., Paris, Mich.
May, W. L., Fremont, Neb.
McDonald, Col. M., Fish Commissioner of the United States, Washington, D. C.
McGown, Hon. H. P., 76 Nassau Street, New York.
MacKay, Robert M., 1517 N. Thirteenth Street, Philadelphia.
Middleton, W., Fulton Market, New York.
Milbank, S. W., Union Club, New York.
Miles, Jacob F., 1820 Arch Street, Philadelphia.
Miller, S. B., Fulton Market, New York.
Miller, Ernest, Fulton Market, New York.
Miner, C. Harry, New York.
Moore, George H. H., U. S. Fish Commission.

Nevin, James, Madison, Wis.

O'Brien, Martin E., South Bend, Neb.
O'Connor, J. J., U. S. Fish Commission, Washington, D. C.
Osborn, Hon. C. V., Dayton, O.

Page, George S., 49 Wall Street, New York.
Page, W. F., U. S. Fish Commission, Washington, D. C.
Parker, Dr. J. C., Grand Rapids, Mich.
Parker, Peter, Jr., U. S. Fish Commission.
Pease, Charles, East Rockport, Cuyahoga Co., O.
Pike, Hon. R. G., Middletown, Conn.
Post, Hoyt, Detroit, Mich.
Post, W., Knickerbocker Club, New York.
Powell, W. L., Harrisburg, Pa.

Rathbun, Richard, U. S. Fish Commission, Washington, D. C.
Ray, Hon. Ossian, M. C., New Hampshire.
Redmond, R., 113 Franklin Street, New York.
Reinecke, Theodore, Box 1651, New York.
Reynal, J., 84 White Street, New York.
Reynolds, Charles B., 318 Broadway, New York.
Ricardo, George, Hackensack, N. J.
Robeson, Hon. George M., Camden, N. J.

Schaffer, George H., foot Perry Street, New York.
Schieffelin, W. H., 170 William Street, New York.
Schuyler, H. P., Troy, N. Y.
Sherman, Gen. R. U., New Hartford, Oneida Co., N. Y.
Simmons, Newton, U. S. Fish Commission, Washington, D. C.
Smiley, C. W., Smithsonian Institute, Washington, D. C.
Spangler, A. M., 529 Commerce Street, Philadelphia.
Spensley, Calvert, Mineral Point, Wis.
Spofford, Henry W., Smithsonian Institution.
Steers, Henry, 10 E. Thirty-eighth Street, New York.
Stone, Livingston, Charlestown, N. H., U. S. Fish Commission.
Stone, Summer R., 58 Pine Street, New York.
Swan, B. L., Jr., 5 W. Twentieth Street, New York,
Sweeny, Dr. R. O., Duluth, Minn.
Streuber, L., Erie, Pa.

Thompson, H. H., Bedford Bank, Brooklyn, N. Y.
Tomlin, David W., Duluth, Minn.

Walton, Collins W., 1713 Spring Garden Street, Philadelphia.
Ward, George E., 43 South Street, New York.
Weeks, Seth, Corry, Erie Co., Pa.
West, Benjamin, Fulton Market, New York.
Whitaker, Herschel, Detroit, Mich.
Whitney, Samuel, Katonah, N. Y.
Wilbur, H. O., Third Street below Race, Philadelphia.
Wilbur, E. R., *Forest and Stream*, New York.
Wilcox, Joseph, Media, Pa.
Wilcox, W. A., 176 Atlantic Avenue, Boston, Mass.
Willets, J. C., Skaneateles, N. Y.
Williams, A. C., Chagrin Falls, O.
Wilmot, Samuel, Newcastle, Ontario.
Wilson, J. P., U. S. Fish Commission.
Wood, Benjamin, 25 Park Row, New York.
Woodruff, G. D., Sherman, Conn.
Woods, Israel, Fulton Market, New York.
Worth, S. G., U. S. Fish Commission, Washington, D. C.

American Fisheries Society.

1890.

TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY.

NINETEENTH ANNUAL MEETING.

HELD IN THE PARLOR OF THE

BEEBE HOUSE, PUT-IN-BAY,

OHIO,

WEDNESDAY, MAY 14TH, 1890.

J. M. DAVIS, TYPOGRAPHER, 40 FULTON STREET, N. Y.

Officers for 1890-91.

President, EUGENE G. BLACKFORD.....*New York City.*
Vice-Pres't, Dr. JAMES A. HENSHALL.....*Cincinnati, O.*
Treasurer, HENRY C. FORD.....*Philadelphia, Pa.*
Recording Sec'y, EDWARD P. DOYLE.....*New York City.*
Cor. Sec'y, Dr. TARLETON H. BEAN.....*Washington, D. C.*

Executive Committee.

W. L. MAY, Chairman - - - - *Fremont, Neb.*
HERSHEL WHITTAKER - - - *Detroit, Mich.*
CALVERT SPENSLEY - - - *Mineral Point, Wis.*
Dr. H. H. CARY - - - - - *Atlanta, Ga.*
Dr. M. M. HUDSON - - - - *Hartford, Conn.*
JAMES VERNON LONG - - - *Pittsburg, Pa.*
Dr. R. ORMSBY SWEENY - - - *Duluth, Minn.*

NINETEENTH ANNUAL MEETING

—OF THE—

AMERICAN FISHERIES SOCIETY.

PART FIRST.

MINUTES OF MEETINGS.

THE Nineteenth Annual Meeting of the Society was held on Wednesday, May 14, 1890, at 2 o'clock P.M., in the parlor of the Beebe House, Put-in-Bay, Ohio.

Eugene G. Blackford, the President of the Association, promptly called the meeting to order, and, in the absence of the Recording Secretary, Fred. W. Brown, of Pennsylvania, Edward P. Doyle, of New York, was elected Secretary pro tem.

Before proceeding with the regular business of the Association, the President requested Mr. C. V. Osborne, of Ohio, to explain to the members the programme provided for their entertainment during the meeting.

After Mr. Osborne's explanation, the President, by unanimous consent, appointed C. V. Osborne and Dr. J. A. Henshall, of Ohio, a committee on local entertainment.

Mr. Hasbrouck, of the Castalia Trout Club, extended an

invitation to the Association to visit the ponds of the Club and partake of a trout dinner.

On motion of Dr. H. H. Cary, of Georgia, the thanks of the Society were given the members of the Castalia Trout Club for their kind invitation.

The President read a letter from Mr. Frank Clark, of the United States Fish Commission, regretting his absence from the meeting.

The President then addressed the meeting at length.

PRESIDENT'S ADDRESS.

Gentlemen of the American Fisheries Society :

I congratulate you upon so large an attendance at so remote a place as Put-in-Bay, Ohio. For many of our members to come here involves a journey of some hardship and considerable expense; that we have here to-day gentlemen from Georgia, Pennsylvania, Michigan, Minnesota, and Wisconsin is proof that interest in the Society and its work has by no means lessened.

I hope that when we shall meet at some more central place, although none perhaps can equal this as to beauty of surroundings, a still larger number of our members may be present. All things considered, however, this promises to be one of the most successful of our meetings, and I have no doubt that the object of our Society will be gratifyingly promoted.

It may not be amiss at this point to say something about the original design of this Association, and to give some idea of the work it has accomplished. Eighteen years ago the Society was organized under the name of the American Fish Culturists Association by a few practical fish culturists, who hoped to make it an aid to the financial part of their business, and to secure, if possible, a better and more uniform price for the product of their skill. The aims and

scope of the Society's work were enlarged from year to year, until we now have a Society embracing within its list of members the most distinguished fish culturists of the world.

It has broadened out with its growth in membership until its original object has been forgotten, and the question of how to best advance purely scientific interests of fish culture and fish distribution and fish protection have become of paramount importance.

It is unnecessary for me, perhaps, to remind you of how much we have accomplished in the past, for you have all shared in the labors and are acquainted with the facts. There can be no doubt but that the present United States Fish Commission, with its value and importance and its great success, owes its origin and development, in a great measure, to this Society. Papers read at our several annual meetings have done more than anything else to stimulate the growth of the interests in fish culture and fish protection throughout the United States, and I think we can say, without boasting, that the present advanced condition of this science in this country is due, in a large measure, to the work of the American Fisheries Society.

As illustrative of the practical advance of fish culture and the great results now obtained by it, it may not be out of place for me to give you at this point a brief account of the work of the Commission of which I am the President. This Commission has been remarkably successful, and the past year was one of the best in its history. Its work has been divided into three heads—first, fish propagation; second, fish and game preservation; third, granting franchises for oyster cultivation and protecting natural-growth oyster-beds.

The first and principal work of the Commission is, of course, the artificial propagation of fish. By the terms of the act creating the Commission, they are to examine the streams and lakes of the State, with a view to stocking

them with fish. In this department the Commission is doing a great work. Last year they operated five hatcheries, and the coming year two more will be added. This will give the Commission seven hatcheries, all capable of producing excellent results. These hatcheries are at Caledonia, Cold Spring Harbor, Adirondack, Sacandaga, Fulton Chain, Clayton, and Chautauqua, and their importance is in the order I have given them.

The total output last year of the five then in operation was 31,489,638 fry. Of this number there were 3,099,900 brook trout, 927,500 brown trout, 5,329,000 lake trout, 863,000 California trout, 1,350 quinnat salmon, 78,000 land-locked salmon, 687,188 salmon, 4,600,000 smelts, 30,000 shrimps, 4,100,000 tomcod, 1,900,000 white-fish, 6,053,200 shad, 3,780,000 frost-fish, and 2,625 adult fish of various kinds.

This year's distribution will be much larger than ever before, and an increase of at least 30 or 40 per cent. is looked for.

The entire distribution for the past ten years was, in round numbers, 203,363,600 fry, of which the principal distribution was of lake trout, brook trout, and shad; 39,055,000 of lake trout were distributed, 18,140,000 brook trout, and 81,138,000 of shad.

The correspondence of the Commission from various parts of the State shows conclusively that artificial propagation and stocking have been wonderfully successful. In spite of continuous fishing, consequent to the rapid increase of population, the Adirondack streams, stocked yearly by the Commission, are full of trout, the large lakes in the central part of the State afford excellent lake trout fishing, and shad and salmon are increasing in numbers in the Hudson every year. The Commissioners recently succeeded in obtaining appropriations for the necessary fish-ways in the last-named river, and as soon as they can be built the work of the Commission in this stream will show

more abundant results. The last Legislature has made an appropriation of $3,500 for a fish-car for fish hatching and fish distribution, and this, it is also believed, will materially aid our work in this department.

The prospects for the future work of the Commission in fish propagation and in stocking streams are excellent, and great results will certainly be obtained.

In the department of fish protection the Commission has been most successful. The Legislature of 1888 provided for the appointment of a corps of fish and game protectors for the State, and created an executive head, to be known as the Chief Game and Fish Protector, all of whom are appointed by and subject to the Fish Commission. This is what the State most needed, and the enforcement of the fish and game laws has been much more thorough and satisfactory.

During the year ending September 30, 1889, 180 suits for penalties were successfully prosecuted, the receipts from fines amounting to $4,104 51.

The work this year has been even more successful, and the results have been most gratifying. At the last session of the Legislature the Commission succeeded in having passed an act for a commission to revise and codify the game-laws of the State. This commission will consist of one member from the Fish Commission, one from the Society for the Preservation of Game, and one Deputy Attorney-General of the State. The work of this Commission will be most important, and the presentation by them to the Legislature and the subsequent adoption of a concise and consistent code of game-laws will do a great deal towards securing the successful and vigorous protection of game and fish.

In the department of oyster culture great progress has been made, although the first surveys are not yet finished; 261 franchises have been issued and $4,520 in fees have been paid into the State Treasury.

A large number of applications for oyster territory are now ready for favorable consideration, and the receipts by the State this year will be correspondingly large.

In addition, the benefit derived by this important industry from this law cannot be overestimated, and is thoroughly appreciated by the oystermen. We think that the Commission, in its various departments, can claim, without boasting, that valuable results have been obtained for the State, and that no investment made by it shows more gratifying returns.

You will pardon me for the time I have taken in speaking of my own State, but the work done by the Commission there is simply indicative of the progress of fish culture, and shows the great value of the work this Society may do and has done in stimulating the interests of the country in the artificial propagation of fish.

Many other States have vigorous and successful commissions, perhaps, of greater efficiency than that in which I am possibly more particularly interested, and that all the State Commissions have been helped by our Society is beyond question. These meetings cannot fail to produce excellent results. Aside from the pleasures of social reunion and intercourse, the mutual expression of practical experiences in fish work is of great value to all of us.

I thank you for the attention you have given me, and congratulate you upon the present standing and membership of the Society, and await your further pleasure.

The Treasurer, Henry C. Ford, presented the financial report of the Society for the year ending May 14, 1890, which report was received, and, on motion, accepted.

TREASURER'S REPORT.

The American Fisheries Society in account with Henry C. Ford, Treasurer.

CR.

May 12, 1890, By cash received from membership dues		$207 00

DR.

May 15, 1889, To cash paid E. G. Blackford, Treasurer, balance due	$5 29	
May 15, 1889, To cash paid A. M. Spangler for printing circulars and postal notices for May, 1889, meeting	4 00	
May 15, 1889, To cash paid for 150 postage stamps	3 00	
May 15, 1889, To cash paid for envelopes	1 00	
June 12, 1889, To cash paid for printing notices of yearly dues	1 00	
June 12, 1889, To cash paid for postage stamps for yearly dues	3 00	
June 12, 1889, To cash paid for stationery and envelopes	1 20	
June 12, 1889, To cash paid for postage stamps for returning receipts, &c	3 00	
May 12, 1890, To cash paid F. W. Brown, wrappers, stamps, envelopes, &c., for sending annual report, &c	7 66	
May 12, 1890, To cash paid Spangler & Davis for printing annual report	101 00	
May 12, 1890, To cash balance on hand	76 85	
	$207 00	$207 00
May 12, 1890, By balance on hand		$76 85

H. C. FORD, Treasurer.

On motion of W. L. May, of Nebraska, the President was authorized to appoint a committee of three to present to the Association nominations for officers for the ensuing year.

The President appointed W. L. May, of Nebraska, J. Vernon Long, of Pennsylvania, and Fred Mather, of New York, as such committee.

Dr. R. O. Sweeny, of Minnesota, moved that the accounts of the Treasurer be audited and allowed.

The motion was unanimously adopted.

Hershel Whittaker, of Michigan, moved that a recess of ten minutes be taken to enable the Committee on Entertainment to prepare a list of papers to be read before the Association.

On re-assembling, Dr. Henshall, from the Committee on Entertainment, reported as follows:

That papers by the gentlemen whose names are given below would be read: Fred Mather, Hoyt Post, Dr. R. O. Sweeny, Hershel Whittaker, Emory D. Potter, Dr. J. A. Henshall, John M. Bissell, John Gay, and William P. Seal.

On motion of Hershel Whittaker, of Michigan, the President was authorized to appoint a committee of three to draft resolutions expressing the sentiments of the Society as to the bill of Senator Paddock relating to the United States Fish Commission now before the Congress of the United States. The President appointed Hershel Whittaker, of Michigan, C. V. Osborne, of Ohio, and W. L. Powell, of Pennsylvania, as such committee.

The following persons were proposed for membership in the Society, and by unanimous consent were duly elected: Charles F. Imbry and George T. Moon, of New York (proposed by E. G. Blackford); Hon. Seymour Brown, of Deerfield, Mich. (proposed by Hershel Whittaker); William P. Seal, Washington, D. C., and A. H. Miller, 1020 Spring Garden Street, Philadelphia (proposed by Henry C. Ford); Hon. J. J. Stranahan, Chagrin Falls,

Ohio (proposed by J. A. Henshall), and Hon. Emory D. Potter, Sandusky, Ohio (proposed by Fred Mather).

On motion of Dr. R. O. Sweeny, Washington, D. C., was chosen as the place for holding the next meeting of the Association.

On motion of Hershel Whittaker, of Michigan, the question as to the time for holding the next meeting was made a special order for the evening session.

On motion of C. V. Osborne, of Ohio, the Secretary was directed to write the members of the Fishing Club at Middle Bass Island to attend the evening session of the Society.

Dr. Sweeny, of Minnesota, moved that Mr. Hasbrouck, of the Castalia Trout Club, be invited to sit with the Society during its sessions.

The motion was unanimously adopted.

The President read letters, regretting their inability to be present at the meeting, from Col. Marshall McDonald, W. T. Dennis, N. D. Tomlin, Charles G. Atkins, and W. P. Seal.

The reading of papers then began and continued for some time. These papers will be found in full in Part Second of the proceedings.

Dr. R. O. Sweeny moved that the question as to the advisability of printing an edition of the reports of the Society from its organization be referred to the Executive Committee.

The motion was unanimously adopted.

Henry C. Ford, President of the Fish Commission of Pennsylvania, addressed the meeting on the work of the Pennsylvania Fish Commission, and gave testimony as to the value of fish-ways. He said that large numbers of shad have been seen ascending the fish-ways at Lackawaxen.

On motion, Dr. R. O. Sweeny was permitted to read two papers by title, which papers the Secretary was directed to print in the annual report.

A number of interesting papers were read, after which, on motion, a recess was taken until 8 P.M.

Minutes of an adjourned meeting of the American Fisheries Society, held Wednesday, May 14, at 8 P.M., in the parlor of the Beebe House, Put-in-Bay, Ohio.

Reading of the minutes of the afternoon session was on motion dispensed with.

Henry C. Ford, of Pennsylvania, proposed for membership C. T. Hasbrouck, of Cleveland, Ohio; Dr. J. A. Henshall, of Ohio, proposed Mr. J. E. Gunkell, of Toledo, Ohio.

By unanimous consent the by-laws were set aside, and the gentlemen elected to membership by acclamation.

Hershel Whittaker, of Michigan, from the committee appointed for the purpose, reported the following preamble and resolution, which, upon motion, were unanimously adopted:

Whereas there is now pending before Congress a proposition to change the organization of the United States Fish Commission, attach it and make its chief and employés of every grade and position subject to the appointment and removal by the Secretary of Agriculture, which legislation we feel to be directly inimical and prejudicial to the progress and proper consummation of the original intent and present practical and efficient work of the Commission;

Resolved, That the American Fisheries Society, which for the past twenty years has been actively interested both in the science and practical development of fish culture, does most earnestly and emphatically protest against such legislation, and therefore would respectfully urge our Senators and Representatives, by every proper means, to oppose and defeat such obnoxious enactment.

On motion, the Secretary was instructed to have these resolutions printed and sent to every Senator and Representative in Congress.

Mr. Mather, from the committee appointed to make nom-

inations for officers for the Society for the ensuing year, presented the following report:

To the American Fisheries Society :

Your Committee on Nominations for officers would respectfully report the following:

President, EUGENE G. BLACKFORD....New York City.
Vice-President, DR. JAMES A. HENSHALL, Cincinnati, O.
Treasurer, HENRY C. FORD.....Philadelphia, Pa.
Recording Secretary, EDWARD P. DOYLE, New York City.
Cor. Sec'y, DR. TARLETON H. BEAN, Washington, D. C.

EXECUTIVE COMMITTEE.

W. L. MAY, Chairman.....Fremont, Neb.
HERSHEL WHITTAKER.....Detroit, Mich.
CALVERT SPENSLEY.....Mineral Point, Wis.
DR. H. H. CARY.....Atlanta, Ga.
DR. W. M. HUDSON.....Hartford, Conn.
JAMES VERNON LONG.....Pittsburg, Pa.
DR. R. ORMSBY SWEENY.....Duluth, Minn.

On motion, the report of the committee was received and accepted.

Upon motion, the Secretary was then directed to cast one ballot for the officers recommended by the Committee on Nominations, which was done, and the President declared the officers named duly elected.

The special order for the evening session then came up, and it was moved and seconded that the next annual meeting of the Society be held at Washington, D. C., the second Wednesday in February, 1891.

The motion was put and carried.

At this point Mr. Osborne, from the Committee on Entertainment, explained the character of the excursions to be made on the following day, and gave the necessary information to the members as to the time of leaving.

A paper was then read by Hon. E. D. Potter, of Ohio (see Part Second), on Origin of Artificial Propagation of Fishes in the United States.

On motion of Dr. Cary, thanks of the Society were voted Mr. Potter at the conclusion of his paper.

Mr. Broman, of Put-in-Bay, one of the oldest fishermen of that place, gave the Society some interesting information as to the habits of white-fish.

A paper was read by Dr. J. A. Henshall, as to fish protection. (See Part Second.)

A paper by John A. Bissell, of Michigan, entitled "The Grayling," and one by the same gentleman entitled "Michigan White-fish Hatchery," were ordered printed. (See Part Second.)

Mr. Ford, of Pennsylvania, read a paper prepared by John Gay and William P. Seal, of the U. S. White-fish Commission, entitled "Past and Present Aspect of Fish-culture," with an inquiry of what may be done further to promote and develop the science. (See Part Second.)

Mr. Fred Mather moved to reconsider the vote by which the date of the next annual meeting was fixed.

The motion was carried.

The question then recurred on the original motion.

Mr. Whittaker moved to amend so that the meeting should be held the last Wednesday in May.

The amendment was adopted.

The original motion was then carried.

W. L. May, of Nebraska, offered the following resolution, which, upon motion, was adopted:

Resolved, That this Society urge upon the different State Fish Commissioners the necessity of sending to future annual meetings the Superintendents of their respective

State Hatcheries at the expense of proper funds under their control.

On motion the meeting then adjourned.

EDWARD P. DOYLE,
Recording Secretary.

PART SECOND.

EGGS OF PIKE-PERCH—*S. Vitreum.*

By Fred Mather.

On April 25 of the current year I had some eggs of this fish in hand. They were not in good order on receipt, but there were hopes of some. On looking up the literature of the hatching of pike-perch, but little was to be found beyond statistics, and that little was in the reports of this Society, in an article by Mr. James Nevin. On measuring the eggs, my estimate of the number in a quart greatly exceeds that of Mr. Nevin, who gives it as 100,000.

From my notes, taken at the time of receiving the eggs (in water), I find the following: the eggs measure thirteen to the linear inch, 169 to the square inch, and 2,197 to the cubic inch. As there are 57,775 cubic inches in a quart, there would seem to be 126,931 eggs in it; but the above calculation is made on the supposition that the eggs would be piled up in such a way that their diameters are in line, thereby wasting the greatest space in the interstices. As this is not the case, I have, after careful counting and estimating, added 350 eggs to each thousand for this filling of chinks, and in this case the addition would be 44,450, making the total number of pike-perch eggs in a quart to be, in round numbers, 171,000, which I believe to be nearly

correct if the eggs measure thirteen to the linear inch, as mine did.

In the last report of the New York Fishery Commission I gave an estimate of the number of eggs in a common sun-fish, but did not add for the filling of interstices. Afterwards I gave the facts to a newspaper man at more length, and he printed the following:

"Last summer Mr. Fred Mather, Superintendent of the New York Fishery Commission, computed the eggs in one of our common pond sun-fishes. The extreme length of the fish, including the caudal fin, was 6½ inches, and its weight was 5½ ounces. The fish was captured on June 16, and was nearly ready to spawn; the weight of the ovaries was 1¼ ounces. The eggs measured twenty-eight to the inch, making 21,962 to the cubic inch. The displacement of the ovaries in water was a trifle over two cubic inches, and the number was estimated, in round numbers, to be 44,000—a most enormous number for so small a fish. This fish makes a nest in the sand or gravel near the edge of ponds or on shallow spots, and, according to Mr. Mather, it is the male fish which guards off intruders after the eggs are laid—a fact not known to ichthyologists, who study fishes after they have been kept in alcohol."

Adding 350 eggs to each thousand, for closest packing, and the total in this small fish would reach 58,000, a figure that I believe to be a more correct one.

Cold Spring Harbor, N. Y., April 30, 1890.

THE DETROIT WHITE-FISH STATION.

By J. H. Bissell, of Michigan.

Among the notable fish-cultural establishments of the United States, there is one of which very little has been said in the public press outside of the State. It is the White-fish Hatching-house of the Michigan Fish Commission, located at Detroit.

The commercial value of the white-fish very early attracted attention to its artificial culture, after it began to be inquired about and discussed whether any fishes could be advantageously cultivated by artificial methods. Even in the early sixties attempts were made at it—of course, crude and, in the main, unsuccessful—but still they were steps ahead and in the right direction.

It was not, however, until a Fishery Commission had been reluctantly granted by the Legislature in 1873 that efforts were made in the systematic way necessary to insure success. After two years of hatching by contract with a private individual, Orren M. Chase came from Caledonia, N. Y., and erected a humble building near the river front, in Detroit, on a rented lot. The house was about 20x50 feet, one story, and battoned. It was equipped with Holton boxes, which, in their day, were the best known apparatus for that work. A few years of observation on the working of the Holton box showed to the clear mind of Orren Chase a better way, one which has held its place for twelve years, and has not been improved upon yet—that is, the glass jar. There is not space here to go into the history of the evolution of Mr. Chase's idea; it was, like most inventions, a series of experiments which, step by step, led the seeker after truth, who steadfastly follows true principles, to a correct conclusion.

The glass jar furnished the eggs a regulated flow of water upward, which gives constant motion, keeping the eggs clean and preventing the dead or imperfectly fecundated ones from injuring the sound ones. Besides enabling the handling of a very much greater number of eggs with a given water supply and a given room space, by using the same water over and over; it allows two persons to take better care of 40,000,000 eggs than eight or ten persons could of 10,000,000. This house contained 212 jars, with a capacity each of about 140,000, making the aggregate of the house, if all were filled, of nearly 30,000,000. In 1883 the Legislature

furnished the means for erecting and equipping the present house. It is located at the corner of Champlain Street and Campau Avenue, in a nice residence neighborhood, and has often been mistaken for a plain church. Its dimensions are 40 x 80 feet, with a wing 38 x 55 feet. The main building is a single room full length and width, excepting a small office and bedroom partitioned off from one corner. The floor is of solid concrete. The water supply is from the city water-supply pipes in the adjoining streets, the connections being equal to five one-inch pipes.

The equipment was 312 glass jars of larger size than used in the old house, as they showed, by actual measurement and count for three seasons, an average of 156,000 to the jar, making a total for the house of 48,672,000 white-fish eggs.

This house was very carefully constructed with a view to maintaining an equable temperature. Outside of the studding it is sheathed with common boards, over which very heavy building-paper is placed, and the clapboards outside of that.

The space above the ceiling being quite large, is opened at both ends and covered with sloping boards; three apertures were left from this space connecting with the main room of the house, which are controlled by hatches.

The windows are all rather high, and on the inside are supplied with wooden slat-shades, which allow of regulating the light as desired. It is generally understood that no more light should be admitted than is necessary for the proper handling of the eggs.

Over the wing are large storage-rooms for the cans and other apparatus necessary about such an establishment.

The jars stand on frames about twelve feet high, placed the long way of the house, each frame carrying on its outsides rows of the jars one above the other. Within the frame are alternate feed-troughs for water supply to the jars and the wasteways into which the water flows from the

lips of the jars, there being a feed-trough and waste for each row of jars. The jar-frames were about twenty-three feet apart at one end, and they were connected by cross-tanks or troughs, by which the waste water from one side was carried across the house to the feed-trough on the other frame. The large cross-tank on the floor into which the water finally flowed, and in which the young fish were gathered in hatching-time, was connected with a long tank extending between the jar-frames, 48 feet in length, 4 feet wide, and 2½ feet deep.

In 1888 a hatching-house on the Little Traverse Bay was given up, and its complement of jars were accommodated in the Detroit house, making its number of jars 520 and the house capacity over seventy millions. In 1889 the house was remodelled within by the erection of two additional frames, taking out the central tanks, and making each frame carry four tiers of jars on each side. The number of jars was increased to 1,025, giving the house now a capacity of carrying 150,000,000 white-fish ova. By the new arrangement the storage-tanks for the young fish, four in number, are placed in the wing, or tank-house, the storage-tanks there being connected by siphons to the collecting-tanks in the main or jar-house, for transferring the young fish.

This house is supplied with a steam-boiler and pump. The boiler answers the double purpose of heating in extremely cold weather, and furnishes power for the pump in case of accident to the water supply occasioning a stoppage of water from the city mains; the pump will lift the water from the tanks on the floor to the upper trough, and use the same water over and over as long as needed. The house is furnished with a stove, and that most necessary adjunct for ventilation—an open fire. Every hatching-house ought to be provided with a good, large, open fireplace to keep it dry by proper ventilation. There is no provision that can be made for the comfort of the men equal to that.

The present season there are about 900 jars filled in this house, the take of eggs in Detroit River in November last not being sufficient to fill the jars. However, with the average hatch, the house will turn out about 121,566,000 white-fish fry, to be planted in April and May, 1890, in Michigan waters.

The Detroit hatching-house, as constructed and equipped in 1883, cost about $6,500; its subsequent improvement and alteration, with increased apparatus, about $4,000 more. How such an establishment is stocked with eggs, as it requires nearly one hundred solid bushels, and how its millions of product are planted, it will take another article to tell.

ON THE DESIRABILITY OF THE ESTABLISHMENT, OF GREAT PUBLIC AQUARIA IN THE UNITED STATES.

By William P. Seal.

The beginning of the development of great public aquaria in the United States will undoubtedly be hailed by anglers, fish-culturists, biologists, and as well by the general public, as a "consummation devoutly to be wished." Some past experiences in this direction offer but little encouragement if not positive discouragement, in this direction. But, as in all advances in human knowledge, there is an experimental stage of development by which, through repeated failure, there comes finally a general knowledge of the conditions required for success. In the case of fishes, living in another element, the difficulties in providing them with suitable conditions are apparently greater than with land animals. There is the necessity of providing for fishes in an artificial condition an abundance of oxygen, or air, the amount of which, in suspension in water, from various causes, is exceedingly variable, therefore requiring an artificial system of aeration.

There is, no doubt, a more rapid accumulation of carbonic acid gas and other deleterious gases in the water. There is the difficulty of providing suitable food. There is also the delicate nature of fishes to contend against; the fungus growths which infect them wherever scratched or bruised, or in weak or diseased condition, and the numbers of parasites infesting them, some of which are very destructive.

And yet, upon a fair examination, it may be said that, in the present state of our knowledge, the handling of fish, or the keeping of them in captivity, is probably attended with but little, if any, greater mortality than is usual in the keeping of any but domestic animals. And even among domestic animals the ravages of epidemics are frequent, and the unaccountable deaths occur at times in quite as great a proportion as ever occur among wild animals in captivity.

The fact that some species of animals are more amenable to the conditions of captivity than others, and that the same is true of the individuals of a species, is, of course, generally understood; but it is not usually recognized in such a way as to make the knowledge of practical value by providing for each the conditions necessary for their comfort and happiness. We recognize this necessity in providing for our pet animals or our stock, because this is a matter that comes home to the individual; but in our aggregations of animals for purposes of exhibition or observation, through a false economy generally, or, perhaps, often through ignorance of the real necessities (for such work is often taken up by inexperienced persons), we provide what may be called comfortable prisons for the confinement of animals whose natures chafe at all restraint, and whose natural instincts are thus wholly checked and thwarted; the sexual instinct, that of migration, hibernation, the variation of food and temperature, and, in the case of certain fishes, perhaps, a necessity for a change of character of water—fresh, salt, or brackish, as required—and the activity possible in greater space, etc.

When we consider that we may confine the smaller species of fishes, such as the gold-fish, minnows, shiners, sticklebacks, darters, and others, in ordinary aquaria, which, owing to the small size of the fish, give them considerable room, and have them to live contentedly, spawn naturally, and live in every respect, apparently as happily as in their native waters, it becomes apparent that when we provide conditions proportionately adequate, we may expect the same results with any of our fishes. The desirability of the accomplishment of such results needs no argument to the mind of the fish culturist. It is, in fact, the only way in which we may obtain a knowledge of the habits of many of our fishes, hidden as they are from our view in the depths of the waters. To the biologist the opportunities afforded for investigation by such means are very great and of increasing necessity. To the general public, as a means of recreation and education in a branch of knowledge in which the ignorance is very great, but in which the popular interest is equally great, the value of great public aquaria would be well worthy a general popular support.

It is quite apparent that in most of the attempts heretofore made to establish aquaria in the United States, the conditions established were such as from our present knowledge we can say were inimical to any permanent success.

Of course, it should be understood that we are at present but on the threshold of our knowledge in this direction; but we may claim that there are certain great principles underlying success in the keeping of living things in healthy and happy condition, and that a violation of these plain requirements invites certain failure.

From a standpoint of practical experience established by years of observation, in accordance with these principles, and in view of minor results actually achieved, we may now confidently proceed to the successful establishment of great aquaria.

A brief explanation of these fundamental principles may be necessary for a proper understanding of the subject from the writer's standpoint. It is well known that many animals, when held in restraint, exhibit all the symptoms of fear, grief, rage, etc., and frequently refuse all food, and pine and die. Many birds will beat themselves to death on the wires of their cages. All such restraint, evidently involving great suffering, is necessarily cruel and objectionable from that standpoint alone. From a financial standpoint it is altogether objectionable, because the great mortality resulting from keeping animals in an unhealthy or unhappy condition makes the expense of maintenance of great collections of animals of any kind too great for financial return for private enterprise, or for popular support for educational purposes.

The attempts heretofore made in this direction in the United States, as well as the known financial aspects of the establishment of aquaria abroad, and of zoological gardens as well abroad and at home, justify the statements herein made. There is nothing to be gained by ignoring them. Whatever advance is made in the future must come from a recognition of the general principles herein sought to be explained. The establishment of the National Zoological Garden at Washington, under the direct management of a naturalist who has studied animals in their natural homes and haunts, instead of in books, promises to make a departure in such work in many respects, in a closer approximation of natural conditions, as far, at least, as the limited extent of space provided will allow. A much greater park, such as the entire Rock Creek Valley would make, affording all the room and variability of surroundings necessary to the contentment of animals of widely divergent natures, would only be worthy of so great a country.

In the establishment of great aquaria, when the subject assumes an importance deserving consideration, it will be

found that to follow in the methods of the past will, as heretofore, be to invite failure. The question of, in a measure at least, imitating natural conditions underlies all success. There can be no further question of its necessity, whether with aquatic or terrestrial animals. In regard to the mere question of space, it has been found with fishes that those which it is impossible to keep in an aquarium of a certain size, will live comfortably in one considerably larger. This has been tested in the cases of a number of species very difficult to keep, and it may be emphatically stated as a principle that as the area or space allotted to animals in captivity increases, the symptoms of depression will decrease and the difficulties in keeping them diminish in a like ratio.

In the question of fishes, the question of the purity of the aquarium is one of the greatest importance. The oxidation of metals, the decomposition of paints, and the galvanic action resulting from the use of more than one metal in salt water, are all inimical to success. The further injurious effects of the decomposition of organic matter, the food or excreta of fishes, etc., in combination with the first-mentioned elements of injury, still further increase the difficulty. Thus the necessity for purity or freedom from injurious chemical action in tanks or circulatory apparatus is one of the principles upon which success depends.

It has been satisfactorily demonstrated that an abundance of light, and at least some sunlight, is necessary for the healthy development of aquatic plants. This is probably true of almost all living things. The healthy development of plant-life in its turn has its beneficial effect on the development of animal life, aside from the direct benefits conferred by the action of sunlight in liberating oxygen. Even where animals live in a state of semi-darkness, concealed among stones or plants, the air or the water penetrating to their homes is revivified by the potent influence

of sunlight. The establishment of an aquarium therefore demands, as one of the conditions of success, an abundance of light, the same conditions, in fact, necessary to life in the pond. The closer we approach this ideal, the greater the success will be.

The establishment of a marine aquarium at Washington by the United States Fish Commission has furnished the means of making many interesting observations, and has practically demonstrated that it is possible to maintain marine aquaria away from the sea without very great difficulty and without greater mortality, probably, than is usual where the water may be pumped directly from the sea. The chief difficulties are in the transportation of fishes from the sea without injury, some of them being of very delicate nature. This is more easily accomplished at a time when the temperature is moderate, being neither at one extreme nor the other. The control of temperature in the aquarium, owing to our extremes of heat and cold, is a matter of some difficulty, but must be overcome as an element of success. The more nearly we can approach an equalization of temperature, the more satisfactory will be the results, no doubt.

The Washington Marine Aquarium is built in a greenhouse-like annex to the central station of the United States Fish Commission. This style of structure affords the necessary light. Twenty-four aquaria, of from sixty to seventy five-gallons capacity each, are arranged to form a gallery in a cavern or grotto built in imitation of rock, which is lighted wholly by the daylight passing through the water from above; 6,000 gallons of water are used. This is pumped from a brick reservoir outside to a tank at an elevation of about forty feet, from which it descends under the resulting pressure—about twenty pounds—into the aquaria through very small glass nozzles, thus effecting a most efficient aeration. The materials of construction of aquaria, reservoir tanks, circulatory apparatus, etc.—

everything with which the water comes in contact—are hard and soft rubber, wood, slate, glass, and brick, nothing whatever of an injurious character. Most of the loss of salt water is supplied by water made sufficiently salt by the use of sea salt. As a result of the abundance of light afforded, the slate backs and sides of the aquarium, and the bare stones placed in them, are being gradually covered with a dense growth of algæ developed directly from the spores of algæ brought from the sea, just as it is seen developing on sea-walls and rocks, something, perhaps, altogether unknown under the usual unfavorable conditions. The observations of the habits of fishes afforded by these aquaria have been of great popular interest, while the advantages of the observations to the general work of fish culture in opening up new avenues for experiment in practical work may prove to be considerable.

Some recent statements concerning the breeding habits of the common sunfish elicited the fact that the knowledge of the subject is not positive. Referring to this, Prof. Theodore N. Gill was led to say to the writer that "it is a shame that we know so little of the habits of our commonest fishes." To which might be pertinently added, it is a shame that the facilities afforded for observation of fishes are so limited.

It is to be hoped that a great aquarium may be developed in connection with the work of the United States Fish Commission, inasmuch as in addition to its practical usefulness to that organization, and its great popular interest, the experience there afforded will be of general public benefit in affording a sure basis of practical knowledge upon which the great cities of the country or institutions of learning may draw when they decide to take up such work.

GRAYLING IN MICHIGAN.

BY JOHN H. BISSELL, OF MICHIGAN.

Having been asked some questions about this rare member of the salmon family, I assume that the subject may be of interest to your readers who are anglers.

Where is the Michigan grayling found to-day? Any one really wishing to know may take a map of Michigan to follow my answer. Begin at a point on Saginaw Bay at the mouth of Saginaw River, and draw a line west by southwest to the mouth of the Muskegon River, on Lake Michigan, and all of the grayling waters are to the north and west of your line. Let us start again at the same point on Saginaw Bay and fo low the coast northward towards the Straits. The first stream of any size is the Rifle River. I am informed upon good authority that grayling have been found within the past three or four years in the Rifle and its tributaries. I am not sure that the appearance of the fish there is of so recent a date as my informant believed, but with a fairly extended knowledge of such matters I had never before heard of their being there. There is no reason why they might not live and flourish in the Rifle, as its waters are suitable.

The next river to the north is the Au Sable, where grayling have been known since 1841. This is one of the most famous of fishing-grounds. While to those who fifteen years ago used to kill from one to two hundred grayling a day, this river seems to be "fished out;" it still furnishes fair sport to the humble philosopher who is satisfied with a moderate reward for his day's work.

To the north, in Presque Isle, Montmorency, and Alpena counties, is the Thunder Bay River, with its numerous branches of fine water. I have never heard of grayling in any of them, but from their situation and the character of the waters, I should want good proof that grayling were not to be found in the head-waters of this system. This is des-

fined to be a great brook-trout region, as the railway facilities now permit its being stocked.

The Pigeon and Sturgeon rivers, flowing nearly north into the Straits of Mackinac, at Sheboygan, are well stocked with grayling.

From the Straits around to the head of Grand Traverse Bay are the rivers and brooks which contained brook-trout before any were planted by the State. Originally there were grayling in all these streams, but for twenty years or more these fish have been so scarce here that they have really ceased to be grayling streams. South of the Boardman River, which flows into Grand Traverse Bay to our imaginary line, is a distinctively "grayling country." The main rivers are the Manistee and the Muskegon, the whole region spoken of being drained by their tributaries, except two much shorter streams, the Pere Marquette and White rivers.

This comprises the grayling region of Michigan. There is one stream on the Upper Peninsula, about twenty miles from Houghton, where grayling are found—the east or north branch of the Ontonogon River, crossed by the D. S. S. & A. R. R.

The rivers and their branches above mentioned are most conveniently reached from the interior of the State by the Michigan Central Railway (Mackinaw Division) for the eastern and northern, and by the Grand Rapids, Indiana, & Chicago and West Michigan for the western streams.

Over a large part of the territory described the grayling has beyond question become very scarce, mainly by reason of the indiscriminate fishing of the citizens, lumbermen, and hunters, as well as fishermen from other States. The lumbermen and hunter have speared and netted and used dynamite for meat during the close season. The others have killed more than they could use. The running of logs has undoubtedly done great injury to the grayling by the disturbance of their spawning beds, as they use the

channel of the main stream, not seeking the brooklets and shoals, as the trout usually do. Still there are grayling yet to be had, and most delightful sport it is to capture them with delicate tackle.

Nothing has been done by the State for preserving the grayling beyond experiments to determine to what extent the grayling can be bred in captivity like the brook-trout. The experiments have not been successful. Grayling kept in stock-ponds have gone for several seasons without showing any signs of spawning. The experiment is now being prosecuted in a large wild-pond—that is, a portion of a natural grayling stream screened off, where the fish remain in entirely natural conditions of bottom and shade without any molestation. Unless the approaching spawning season turns out better than 1888 and 1889, I think the State Fishery Commission will conclude that the only feasible way to increase the grayling will be to establish one or more camps on the Manistee, or other stream where spawners can be secured, and handle the fish there, taking the eggs from fish caught in spawning season, as is done with white-fish and shad, and hatching in shad-boxes or some similar appliance, in the river, turning loose the fry intended for the stream where operations are conducted and transporting to other localities in carrying-cans.

There is no doubt that if nothing is done to save them they will become practically extinct in the next five or ten years.

There are some inaccessible places where they will undoubtedly linger many years; but they are or will become practically extinct when they are so few and so scattered that their pursuit no longer furnishes reasonable sport to a reasonable and modest angler.

The grayling waters of Michigan are cold, clear, rapid streams, flowing through bottom-lands and sand regions, and in no case, to my knowledge, over rock formations, an alternation of the most beautiful ripples and pools.

EXPERIMENTS IN THE IMPREGNATION OF PIKE-PERCH EGGS.

By Herschel Whitaker, of Michigan.

The eggs of the wall-eyed pike, after having been for some time in water, measure about two millimeters (about 1-12th of an inch) in diameter. The egg has an enveloping membrane (or zona radiata) of the usual form. Outside this is a second thinner membrane, which wrinkles and stains more deeply in the hæmatoxylin than does the inner zona radiata. The eggs are very adhesive, and it is to this outer membrane that the adhesiveness is due. There is probably also a third membrane within the zone, but this has not been determined with certainty. Within these membranes is the yolk, having a diameter of 1.4 mm. (about 1-18th of an inch). The yolk is spherical, and in one side of it is imbedded a spherical oil-drop having a diameter of .8 mm. (about 1-31st of an inch). The oil-drop causes the surface of the yolk-sphere to protrude to one side. The oil-drop being lighter than the yolk, is always turned upward, so that in looking at the egg from above the oil-drop appears to be in the middle of the yolk, while in looking at the egg from the side the oil-drop appears to be at the top of the yolk.

I shall speak of that pole of the yolk in which the oil-drop is imbedded as the upper pole, and of the opposite side as the lower pole. A line drawn about the yolk, half way between these two poles, will be spoken of as the equator. When the egg is at rest the lower pole of the yolk rests upon the egg membranes, so that the space which separates the yolk from the zona is altogether above and at the side of the yolk and oil-drop. This space may be spoken of as the breathing space. Surrounding the yolk and oil-drop is a layer of protoplasm, which forms an investment for them and separates them from the water in the breathing space.

This layer of protoplasm is extremely thin over the greater part of the yolk, and is tightly stretched over the protuberance formed by the oil-globule. It is not, however, uniformly thin, but in one place has a disk-shaped thickening. This thick disk of protoplasm (germinal disk) is concave towards the yolk and convex on its opposite side, and is fitted like a saucer against one side of the yolk. Its position is such that its center is upon the equator of the yolk, so that in looking at the egg from above one sees the edge of the germinal disk. Outside the disk the layer of enveloping protoplasm is so thin that it cannot be easily seen except by the use of reagents. So long as the yolk is within this enveloping layer of protoplasm it is entirely transparent and colorless. If the enveloping layer be ruptured so that the yolk passes out and comes into contact with the water, it becomes instantly opaque and of a milk-white color.

The foregoing description applies to the egg after it has been some time in the water. As the egg leaves the female the egg membranes are not separated from the yolk by a water-filled space, but are everywhere in close contact with the layer of protoplasm which invests the yolk. When the egg is placed in water, the water passes rapidly through the egg membranes and accumulates between them and the yolk. In this way the membrane becomes gradually separated from the yolk by a water-filled space —"the breathing space."

By this passage of water through the membranes they become tightly stretched and tense, so that an egg which at first feels under the finger like a piece of soft putty, becomes hard to the touch by the absorption of water, and feels like a shot. This "filling" of the egg takes about two hours.

The foregoing account of the structure of the egg is sufficient to an understanding of the mechanical arrangements that it presents.

As it seemed likely that for some reason a large per cent. of the eggs failed to be impregnated, my attention was first directed to determining the first differences between impregnated and unimpregnated eggs.

In order to determine the question with certainty for this particular animal, the following experiment was tried (quoted from note-book):

April 16, 8:45 a.m.

After washing the surface of the body of a female fish in the region of the external opening with weak acetic acid, in order to destroy any spermatozoa, the eggs were stripped into dishes containing water. Into one dish milt was immediately stripped; the other was left without milt. These were marked lot 1 and lot 2 respectively.

Lot 1. Examined at 1:45 p.m. (the eggs having been kept in a cold room), and found segmentation going on. The germinal disk is divided into either two or four cells.

Lot 2. Examined 8 a.m., April 17th, twenty-four hours after impregnating lot 1. The eggs were firmly set in a mass on the bottom of the dish. One hundred taken at random were examined with following results:

Showing normal germinal disk without trace of segmentation	82=	82%
Showing abnormal germinal disk with possible traces of first or second segmentation	4=	4%
Injured by rupture of protoplasmic investment of yolk, so that yolk had escaped and egg had turned white	14=	14%
Total	100=	100%

This experiment was afterwards repeated without, however, counting the eggs, and always with the same result.

Segmentation of the germinal disk is, therefore, the first easily recognized sign of impregnation.

In order to determine the percentage of unimpregnated eggs among those taken by the men and ready for ship-

ment to the Detroit hatchery, the following counts were made:

April 17th, 1 P.M., 252 eggs taken at random from a tub, after stirring the eggs in the tub, were examined with the following results:

Segmented normally (i.e., impregnated).....	141=	56%
Unsegmented, normally (not impregnated).....	26=	11%
Injured by escape of yolk (white eggs).....	85=	33%
Total.....	252=	100%

The eggs marked as unimpregnated were set aside, and were found to be still unsegmented after twenty-four hours.

This was several times repeated on other lots of eggs, with similar results.

It shows that about 33% of the eggs are injured mechanically by the rupture of the protoplasmic investment of the yolk, while only about 11% perish from lack of impregnation. Even superficial examination shows that in nearly every case this rupture of the yolk takes place over the oil-globule. A consideration of the mechanical arrangement of the parts of the eggs shows that this is its weak spot.

In the natural position the yolk sphere lies with its lower half against the egg membranes. These membranes, therefore, support this half of the yolk, surrounding it as if it were resting at the bottom of a cup.

The upper half of the yolk is, on the contrary, not of the same form as the investing membranes; its spherical surface is interrupted by the protruding oil-globule.

The result of this arrangement is that when any pressure is brought to bear on the egg membranes, so that the space within which the yolk lies is reduced, the yolk is able to resist this pressure by fitting itself against the egg membrane at every part of its surface except over the oil-

globule. The strain, therefore, comes on that part of the protoplasmic investment of the yolk which covers the oil-globule, and here it bursts. In almost every case the white spot which indicates the rupture of the yolk investment makes its appearance at the oil-globule, usually at its equator.

Owing to the fact that the eggs are adhesive, it is the practice of the men in taking them to stir the eggs with the hand. By this means they detach the eggs that have adhered to the sides of the pail, and separate from one another those that have adhered together in bunches. This stirring takes place shortly after the eggs are placed in the pail and before they have filled with water. In this condition the space between the membranes and yolk is either absent or it is so small that it forms rather an aid than a hinderance to the bursting of the yolk investment.

It is therefore desirable to find some means of handling the eggs so they will not adhere to the vessel in which they are placed, and so they will not adhere to one another to such an extent as to render it necessary to separate them by the hand.

As to the first point, the men handling the eggs have found that they do not adhere to an ordinary unpainted wooden pail which by use has become rough inside, while they do adhere to the galvanized iron pails now in use. I have observed that while the eggs adhere strongly to glass, they adhere but slightly to cloth. I have no doubt that by the substitution of wooden pails for metal this difficulty will be overcome.

It is likely that a metal surface might be oiled or otherwise so prepared as to prevent the adhering of the eggs.

With regard to the second point, it has been found that if water be added to the eggs *very slowly*, while at the same time they are kept in motion by rocking the containing vessel, they do not then adhere to one another. This is true whether or not milt be mixed with the water.

Two lots of eggs were taken from the female and placed in two similar glass dishes, and to one milt was added. Water was then gradually added to each lot with continual agitation of the eggs by rocking the dishes. This was continued until the dishes had been filled with water and until the eggs had "filled." In neither dish did the eggs adhere to one another or to the dishes. Eggs taken from either dish and transferred to another dish containing a larger quantity of water adhered at once.

In order to test the effect on the eggs of not introducing the hand, about two quarts of eggs were impregnated in a galvanized iron pail. The water was added slowly and the pail kept in motion. The eggs did not adhere to one another, but adhered in a layer one or two eggs thick over the bottom and sides of the pail. Without distributing those eggs that had adhered to the pail, those in the center were removed, and 154, taken at random, were examined with results as follows:

Injured	15=	10%
Not impregnated	0=	0%
Impregnated and afterwards segmented	139=	90%
Total	154=	100%

A second trial resulted as follows:

Injured	12=	7%
Not impregnated	2=	1%
Impregnated	165=	92%
Total	179=	100%

An attempt was made to determine the result of using a wooden pail and taking account of all of the eggs, whether they had adhered to the pail or not. About a quart of eggs was used, and they were examined shortly after being impregnated. They had not adhered to the pail nor to one another, and the percentage of injured eggs did not appear to be more than five. Unfortunately, the eggs

were afterwards mixed with others and the whole lot roughly handled before an opportunity was had of making a careful examination of them. The suspension of operations shortly after this prevented a repetition of the experiment.

It is to be noted that when the eggs are permitted to adhere to the pail and to one another, so that the percentage of those injured is large, the percentage of those impregnated is also greater. The same method of handling that reduces the percentage of injured eggs reduces also the percentage of those unimpregnated.

From the two causes about 45% of the eggs examined could never have developed. Since the percentage of eggs lost during the present year is estimated at 40, there remains 15% still to be accounted for.

A lot of eggs, 45% of which are dead, requires much more handling than would be the case if all were sound. Such a lot of eggs also invites the attacks of the fungus which spreads from the dead eggs to the living ones, and is likely to kill those in turn.

In such a lot many living eggs become clogged among the dead ones, and are probably either smothered or poisoned.

In short, if the loss of eggs which takes place at first from mechanical injury and lack of impregnation can be stopped, it is fair to expect that the subsequent loss will be much reduced.

THE STURGEON; SOME EXPERIMENTS IN HATCHING.

By Hoyt Post, of Michigan.

Of the numerous fish which abound in the great lakes and deep rivers that surround the State of Michigan, one of the most valuable, commercially, is the sturgeon. Nearly every part of it is utilized in some way; the flesh

is eaten, either fresh or pickled, and when dried and smoked is sold as halibut. The bladder, which is large, is converted into isinglass and glue. The skin is sometimes tanned, and even the dorsal cord is cut and dried and used as food. Every bit of waste is tried out for oil. The head is cooked and eaten by the Indians. The roe is much the most valuable part of the fish. In the full-grown fish it weighs from fifteen to forty pounds and upwards, and at times constitutes nearly one-third the weight of the fish. From this caviare is made. The eggs are rubbed with the hand through a sieve until they are separated from the connecting membrane, and then a fine German salt is added, and the product thoroughly stirred with the hand and drained. It is then dried and packed in kegs for shipment. It is eaten as a relish and used as a substitute for meat in sandwiches. It is quite rich, and has a decided fishy, oily, and salty flavor. It is highly prized by the Russians, and is said to be much used in fast seasons in Italy, Greece, and Turkey. It finds a ready market in this country in St. Louis, Sandusky, New York, Philadelphia, and Pittsburgh.

The sturgeon is taken largely in pond-nets, and a good many are caught by set lines in the narrow, deep channels that traverse the St. Claire Flats, near Detroit. A strong line is stretched upon stakes on either bank of these channels, and from this depend many shorter lines to which are attached large hooks which rest on the bottom. The sturgeon, in rolling upon the bottom, becomes entangled in these hooks and is captured with a gaff.

The Michigan Fish Commission last year tried the experiment of artificial propagation of this valuable fish. A station was selected at Algonac, a small village on the St. Clair River, where a caviare factory was in operation. The fish that are handled there are caught principally in the channels of the St. Clair Flats by the Indians, Canucks- and half-breeds in the manner above described; they are

towed by a tug in a covered yawl from the places of capture —a distance of from three to ten miles—to the station at Algonac.

In the early part of June a pen about forty feet square was made adjoining the factory, by means of an old seine, between the bank of the river and some old spiles which had once been part of the dock; this pen was from one to five feet deep, with sandy bottom, and a swift current of clear water swept through it.

On June 6th six females were placed in this pen, and on the next day eight males, and on the 18th of June ten more were added; but they did not do well in confinement, on account of the injuries they had received from the gaff when captured. On June 17th the fish commenced dying, and six were taken out, when it was found the eggs had become hard and baked, and were almost the color of gold. The milt of some of the males had shrunk to almost nothing, and in others appeared to have ripened somewhat. On June 27th the remainder of these fish, having become very weak, were all taken out. Up to this time only six spent fish had been taken, though upwards of 4,000 were handled; and none were captured that were ripe except two that were taken on the 20th nearby, in the North Channel. Of these two, one was nearly spent and the other was about half gone. The fish were but just alive. A male that was taken in the same catch was cut open and the milt-bags crushed into a tub containing about six gallons (say four inches deep) of water, and the half-spent female was laid across the tub and split next to the vent, and the eggs allowed to fall into the milt. The tub was then kept in motion in the water for three and one-half hours, until the eggs became pretty well separated and ceased sticking. Two tubs were used, and one man handled each tub, standing in the water above his knees. There were probably in all about 40,000 eggs, of which perhaps one-half were thoroughly separated and fertilized.

The fertilized eggs measure about forty-nine to the square inch, while the eggs in caviare go about sixty-eight to the square inch.

These eggs were taken from the tub and put into about a dozen Seth Green shad-hatching boxes and placed in the river, harnessed together and attached at the upper end to the dock and anchored at the lower end, so as to float freely in a swift current of clear water of about twelve feet in depth. The temperature of the water was about fifty-nine to sixty-one degrees. For two days the eggs appeared to be doing well, but on the third day a fungus began to appear and spread rapidly, and thereafter it was difficult to tell the good eggs from the bad ones; on the fourth day the good eggs showed a brown side with a yellow streak through it; on the fifth day the young fish could be seen in the egg; on the seventh day motion could be detected, and on the eighth day hatching commenced, and was complete on the ninth day.

The number hatched was estimated at from eight to ten thousand, and they were released in the river at the place of hatching, on July 2d, the twelfth day after they were taken.

The eggs are a rich, dark bronze color, and are very tender, so that they will not bear hard stirring or rough usage; this necessitates great care and patience in the first handling. The milt seemed to form a heavy coating on the eggs that were fertilized, which would stick the egg to everything it came in contact with. The adhering of good eggs to each other did not seem to hinder hatching, but wherever a dead egg came in contact with good ones it destroyed them all; and many good eggs were lost in removing the fungused ones.

Afterwards, about July 5th, eighteen sturgeon—twelve females and six males—caught in nets, were procured at La Butte's Point, in Canada, above Detroit, and were towed by row-boat in a crate about ten or twelve miles to a

large fish-pond made of sheet piling, in Detroit River, at the Fort Wayne fishery, below the city of Detroit. This pond was in clear water, in the current, and detached from the shore, with soft bottom and of an average depth of about six feet. The fish arrived in apparent good condition. One small male, supposed to be about four years old, was killed to ascertain the growth of the milt, which was found to be well developed. A small platform or slide was erected at one end of the pond, and a small seine was used to handle the fish. They were carefully handled twice a week for more than two months without any success. No eggs were taken from them.

Finally, upon opening a female, the eggs were apparently blasted. The milt of the males also appeared to have dried up or shrunk away. A male and a female were left in the pond until October, and at that time, when taken out, the female had shot her eggs, and appeared in good shape, with new eggs forming.

The facts stated in this paper as to the experiment in hatching sturgeon eggs are principally derived from Mr. Aaron W. Marks, the assistant superintendent in charge of the work. He was formerly a pupil of Seth Green, and assisted him in about the year 1876 in, perhaps, the first successful hatch of sturgeon in this country. That hatch was made at New Hamburg, on the Hudson. The number of eggs taken was about 200,000, and they were taken from a single fish. The hatch was about 140,000. The manner of treating the eggs was about the same described above, as adopted at Algonac last year.

Further experiments in this line will doubtless be made in Michigan the coming season.

THE ORIGIN OF ARTIFICIAL FISH CULTURE IN THE UNITED STATES.

By E. D. Potter.

I had intended on this occasion to speak upon the subject of propagating the different kinds of fishes with which I have had some experience, and the earlier and the improved methods which from time to time have been adopted in bringing that art to the perfection which it has attained; but, unfortunately, at Christmas I was attacked with that malady which has held so many in its "Grippe" in the Old as well as in the New World, disqualifying them for labor in the ordinary avocations of life. I have suffered from its effects for the last four months, most of the time confined to my house.

I offer this as an apology for not carrying out my original intentions. However, as but few persons now living, beside myself, since the death of the lamented Dr. Garlick, who were present at the birth of the first fish artificially produced in America, it might be interesting to some of the gentlemen of this Society to hear some account of the first fish artificially propagated upon this continent.

In the winter of 1853 an account was published in the *National Intelligencer*, of Washington, of the experiments of two unlettered fishermen, Gehin and Remy, of the Vosgen mountains, in Lorraine, then a province of France, in which they had succeeded in the incubation and hatching of a great number of the fishes of that region. This account fell under the notice of Dr. Theodatus Garlick, of Cleveland, who at once entered into the scheme of making experiments in the artificial propagation of the brook-trout. (*Salmo fontinalis.*) A few miles from Cleveland was a deep ravine through which passed a small, cold stream, fed by several cold springs issuing from the adja-

cent banks. Across this ravine was thrown a dam, raising a deep pond covering over half an acre of ground. The next thing was to procure the parent fishes. An expedition was started to Port Stanly, in Canada, and another to Sault Ste. Marie, in Michigan, both of which were successful, procuring in all some fifty trout of good breeding size. These were placed in the pond in June, 1854. A breeding-place was leveled off at the head of the pond, covered with gravel. I spent the season in Cleveland, and visited the pond daily with Dr. Garlick, and found the fish doing well. About the first of November, on visiting the pond, we discovered two small trout making a spawning bed, and in the course of ten days the bed was covered with fish. The next thing was to prepare hatching facilities. A small cabin was erected over one of the largest springs, about ten feet square. Six boxes were procured about one foot square. There was over a dozen feet fall from the spring. These boxes were terraced from the spring down, with a spill from one box to the other, guarded by a screen filled about two-thirds full of fine gravel, and the hatchery was complete.

I shall never forget the expression of the countenance as he lifted the first pair of gravid fish from the pool. The usual operation of stripping the fish and fecundating the eggs was performed, and the eggs gently spread over the gravel in box number one, and the water was let on. In the same way the boxes were all filled and the work was done. A padlock was placed on the door, and the Doctor was happy. We visited the hatchery often to remove unfecundated eggs, of which very few were found. On visiting the hatchery, about the latter part of January, the eyes appeared in the eggs, and about the first of March, 1854, on visiting the works, there lay prone on his side on his gravelly bed the first baby fish artificially propagated on this continent. Then followed the hatching till the boxes were alive with the young trout. Dr. Garlick soon after wrote

a full account of his methods, and the success attending his first experiments was widely circulated, and soon Seth Green, of New York, Samuel Wilmot, of Canada, Nelson Clark of Michigan, and others, all making improvements of Dr. Garlick's process, until fish propagation has become a national industry, and, fostered by adequate appropriations, is furnishing cheap and wholesome food for millions of people.

DANGER TO FISH-EGGS IN TRANSIT.

By Fred Mather.

In a note to *Shooting and Fishing* I made use of a term that seemed to demand explanation; and while I do not intend at this time to say anything about methods of packing fish-eggs for foreign shipment—a thing that I have had much to do with—I wish to say something about their condition on receiving them. The remark alluded to was: "I have noticed that foreign eggs often appear good, but [as often] hatch deformed fish," etc. The bracketed words should have gone in. This requires explanation, because it may appear to reflect on the fish culturists on the other side. In former years I have reported eggs from Europe to be good because they were not dead, and my reports of loss of eggs and fry have, on some occasions, been out of all proportion to the after-mortality. The reason of this lies in the fact that an injury to a living thing is not always fatal (a notable instance of this may be found in the first chapter of "Tristram Shandy"), and fish-eggs may be injured in transit by heat, concussion, or a lack of moisture, so that the embryo will come into the world only to die.

When eggs have come across the sea I now report that a certain number appear to be good, reserving a positive decision until the eggs hatch and the fry begin to take

food. High temperatures, lack of moisture, and concussion are the principal, if not the only, causes of injury to the embryo.

It is my present opinion that concussion is more immediately fatal than a high temperature; it kills within a few days. Lack of moisture is shown at once by indented eggs, and upon the degree of indentation rests the damage. I have experimented with such eggs, and have found that those only slightly indented have produced fairly good fish, while others somewhat dryer did not. A high temperature on eggs of *Salmonidæ*—and it is of these that I speak—makes weak embryos, if they live to break the shell. They hatch head first, and all fish culturists know that such fish have a small chance for life, or, that they have not strength enough to straighten from the coil in which they have been, and are "whirligigs," spinning round in one direction at every effort to move. These die of starvation because they cannot swim.

A lot of salbling eggs received from Germany a year ago looked first-rate, but one-fifth of the embryos had not strength enough to straighten after hatching, the cause being a high temperature through lack of ice in the packing, which was my own "wet" method. This is the main risk in this method, while the "dry" packing is all risk. I know by letters received that many eggs are prematurely reported to be good, *i. e.*, because they are not dead, and that the injury to an indented egg is not taken into consideration by some fish culturists; hence I write of it, although aware that there are men at this meeting who understand this source of injury to a fish-egg, but it is not for them that this is written. Another result of high temperature, *en route*, is a softening of the egg, either the outer covering or some part beneath, and these embryos hatch, but do not live to take food.

I have seen soft trout-eggs which seemed to have cast one

skin and retained a thin one. These were always eggs that had received a high temperature some time in transit, and the embryos only hatched to die.

To the journal named I wrote the following for its issue of April 3rd, 1890: "In consequence of an unguarded expression I have been compelled to write a treatise on fish-eggs in order to save myself from appearing to be unfair to the fish culturists of Europe, and also to explain why the eggs of brown trout sent by the *Fishing Gazette*, of London, to *Shooting and Fishing*, in my charge, were not reported to be in as good condition as they looked to be when opened. When I receive eggs from Europe that look good, a doubt about their history in transit arises, and I have learned to be careful in reporting their condition, unless such as may have turned white. When they hatch we can judge of chances of life. I can now say that the eggs sent by Mr. R. B. Marston, from the hatchery of William T. Andrews, of Guilford, England, have produced a fine lot of fish. Of the original 10,000 we found about 1,000 dead—notes not handy, and can't be exact—and sent, as per your order, 3,000 to Mr. Peter Cooper Hewitt, Ringwood, N. J. The remainder will produce fully 5,500 strong fish up to the feeding point."

Deformed fish seldom live, and those which spin round and round never do. These deformities are the result of injury to the egg, and cannot be detected until the shell is broken; hence I will be careful in future in reporting that eggs are really good after coming across the sea, because my superior officers naturally expect a certain number of good fry from each thousand reported good eggs.

Cold Spring Harbor, N. Y., May 1st, 1890.

EXPERIMENT IN TROUT HATCHING AND REARING IN ARKANSAS.

By P. P. B. Hyerson, President Mammoth Spring Fish Farm.

The Mammoth Spring Fish Farm Company was organized and incorporated December, 1888, and received their first 100,000 brook-trout eggs January, 1889, and their next 125,000 of brook and rainbow trout, February, 1889. The eggs came from Gilbert, of Plymouth, Mass., and were packed in wooden cases of 50,000, with moss and ice, the temperature of the weather being 50 to 60 degrees here. The eggs came through by express in good order, and in ten days from receipt of same—January 21st and February 1st—they began to hatch. The percentage of loss in hatching these 225,000 was about 20 per cent. Gravel was used instead of wire. The young fry appeared healthy and thrifty, and at six weeks old they began to throw off the sack. However, at thirty days old our hatchery met with an accident from an oversight of those in charge. The water was allowed to come into the hatchery from the spring without being filtered, and, unexpectedly, millions of insects (a water-beetle) got into the hatching-troughs among the young fry, and before they could successfully be transferred into other quarters, where the water was filtered, the mortality became alarming and ran into many thousands per day; so that at six weeks old, when the young fry began to throw off their sacks, their numbers were reduced 70 per cent. At ninety days old we had not over 50,000 of both brook and rainbow trout. At this period there appeared a trouble with many of the eyes of the trout, and one, and sometimes both, would protrude out, and finally the fish would either go totally blind or die; so that at the age of five months we did not have on hand over 25,000 to 30,000 trout. After this the mortality

became very light, and, save from carelessness, or rather from oversight in placing our plant in proper position, not to be affected by the draining of the large stone dam below us, we suffered comparatively little loss. So at six months old we found about 20,000 stock on hand measuring 4 to 5 inches; at eight months, 6 to 7; ten months, 8½ to 10 inches; twelve months, 10½ to 12; fourteen months, 12½ to 13½ inches. At twelve months we found them full of spawn, and now at fourteen months they are very heavy with spawn. We frequently find from 1,000 to 15,000 eggs in them, with strong indications of their depositing the spawn during the next three months—a phenomenon we would look upon probably unfortunate for us. As October would be soon as we should feel perfectly safe in working out their spawn; yet it may be that the first being acclimated, and our spring ranging even through the summer at 60 to 70 degrees, and they being in all other respects precocious and extremely far advanced and developed for their age, will possibly be a success in early spawning. The question will occur at once, How do you account for this remarkable rapid development? etc. Well, Mammoth Spring is 70 feet deep, 190 feet in diameter, and discharges a volume of water 60 to 62 degrees temperature, equal to a capacity of 40,000 cubic feet per minute. Some 600 yards below the spring is a masonry dam 14 feet high; hence the volume of water covers some 16 acres. This 16 acres abounds in almost innumerable *varieties* of aquatic weeds and mosses, and upon one of these plants there is bred millions of periwinkles (snails)—an inexhaustible supply. Now, these plants and their periwinkles afford the fish a superabundance of animal life which, together with the beef-liver we feed them, causes a marvellous growth, and a healthy growth too. Again, there is a sufficient quantity of iron in the water to ward off disease, and a scientist will at once detect the presence of iron in the beautiful tinge the

rainbow exhibits upon the California trout and the bright red spots upon the brook trout. We feed only beef-liver, but the animal life that clings to the plants counteracts any taste the beef-liver might convey to the trout. Our supply of water is inexhaustible; hence this is a large factor of success. Our ponds are separated from the main spring pond by a dirt lever. The English watercress covers our pond, and each sixty days we have to thin it out or it will be impassable for the trout to swim in. This article is lengthening out, I fear, to a size of interest to the writer only, and I will say that any reader of same that may wish any items of our farm they will be cheerfully furnished upon application. Any pisciculturist reading this will see that the writer is not of his class, but rather a poor excuse for an amateur, but the facts are here to show for themselves. We have rainbow and brook trout 13½ inches long at that number of months old.

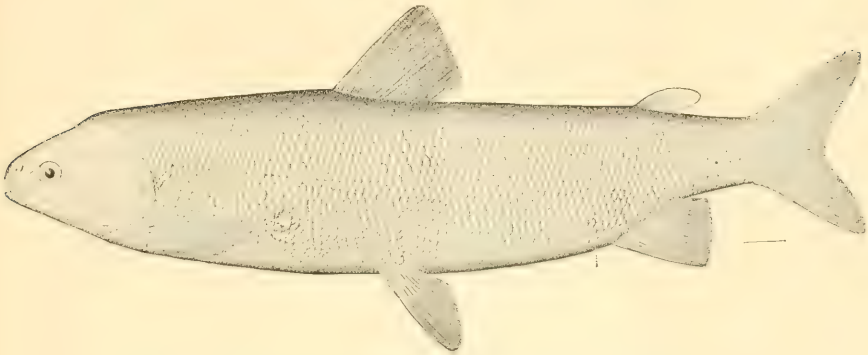


Fig. 1.—The Broad Whitefish. (*Coregonus richardsoni*).

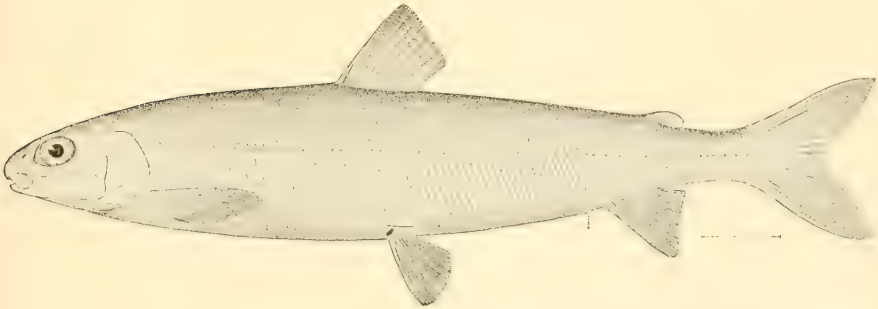


Fig. 2.—The Round Whitefish. (*Coregonus quadrilateralis*).

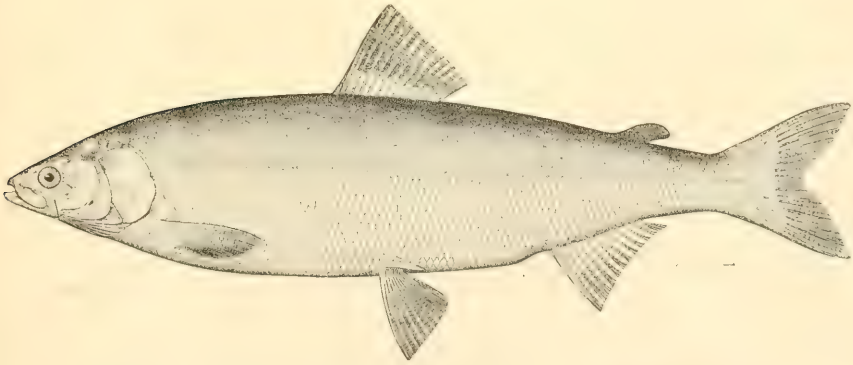


Fig. 3.—The Lauretta Whitefish. (*Coregonus laurettae*).

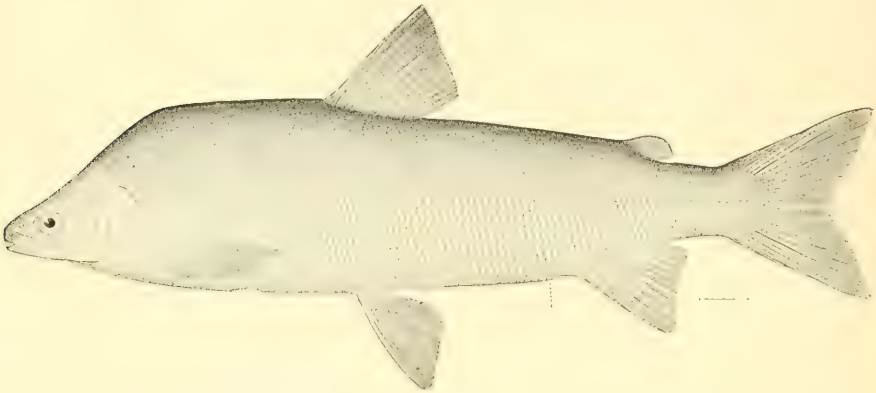


Fig. 4.—Nelson's Whitefish. (*Coregonus nelsoni*).

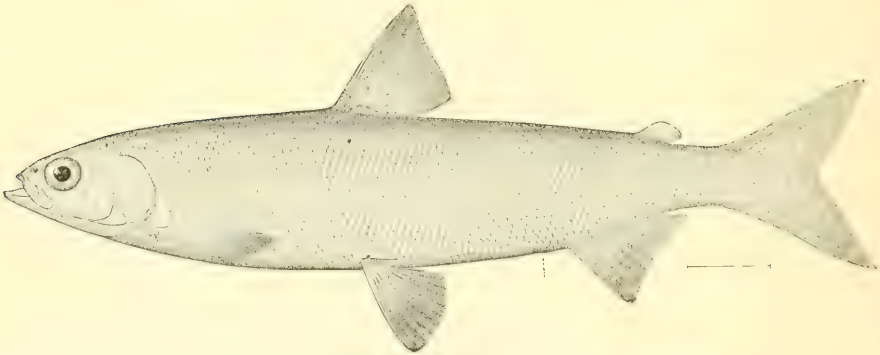


Fig. 5.—The Small Whitefish. (*Coregonus pusillus*).

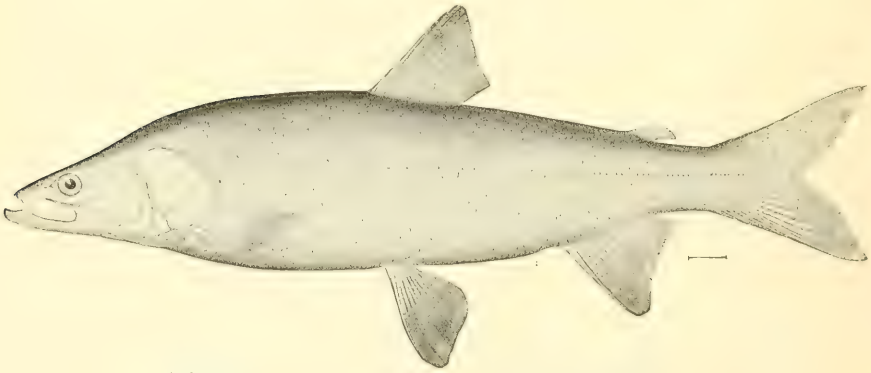


Fig. 6.—The Inconnu. (*Stenodus mackenzii*).

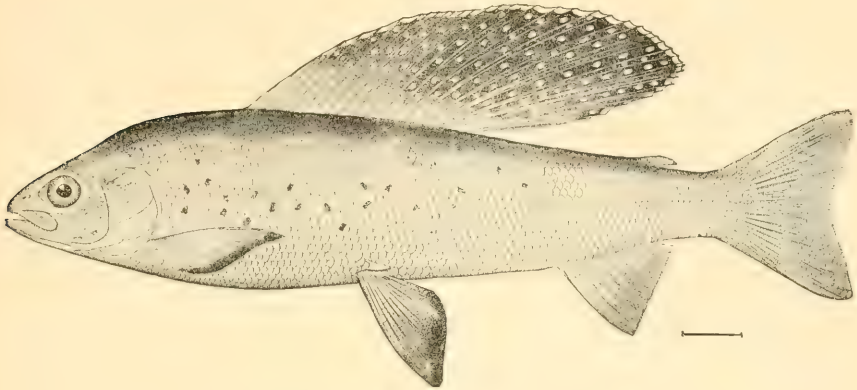


Fig. 7.—The Alaska Grayling. (*Thymallus signifer*).

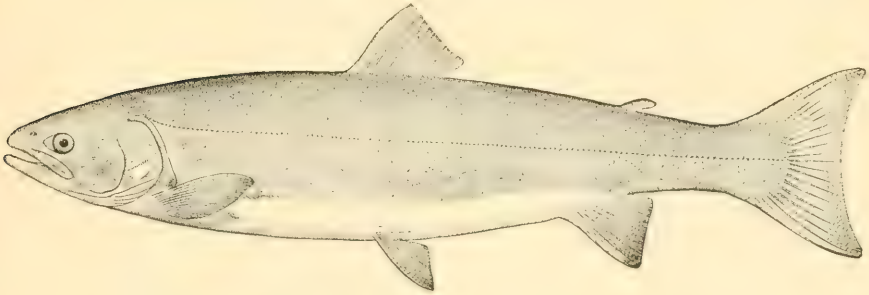


Fig. 8.—The Dolly Varden. (*Salvelinus malma*).

Fig. 9.—The Lake Trout. (*Salvelinus namaycush*).

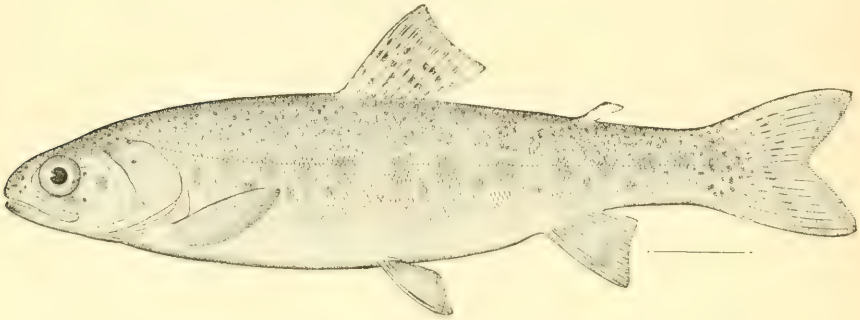


Fig. 10.—The Rainbow Trout. (*Salmo irideus*) *Young.*

Fig. 11.—The Rainbow Trout. (*Salmo irideus*) *Adult male.*

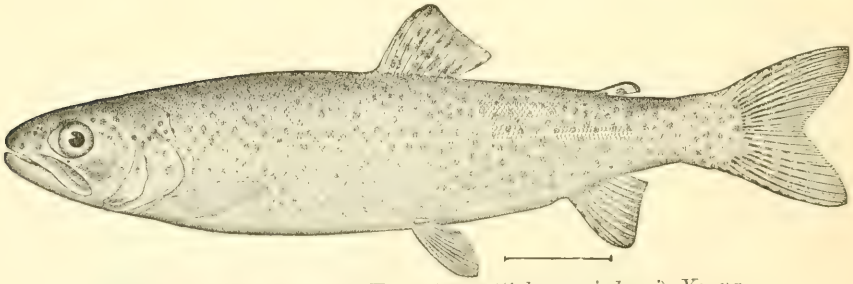


Fig. 12.—Gairdner's Trout. (*Salmo gairdneri*) *Young.*

Fig. 13.—Clark's Trout. (*Salmo purpuratus*).

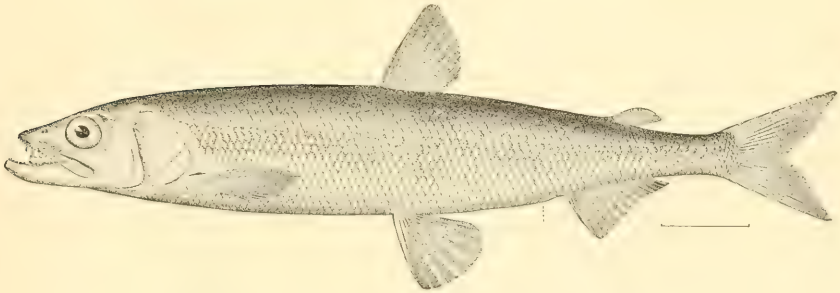


Fig. 14.—The Smelt. (*Osmerus dentex*).

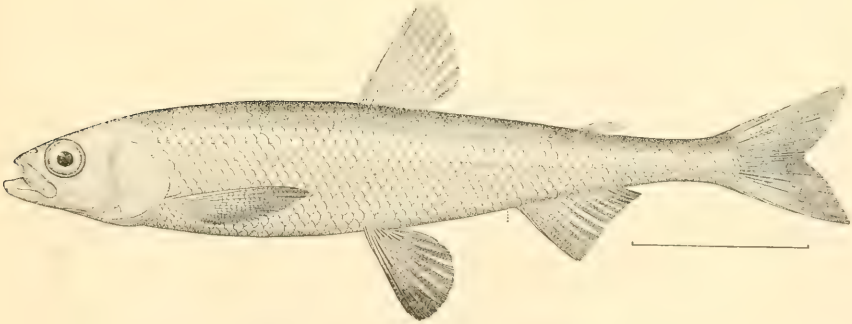


Fig. 15.—The Surf Smelt. (*Hypomesus olidus*).

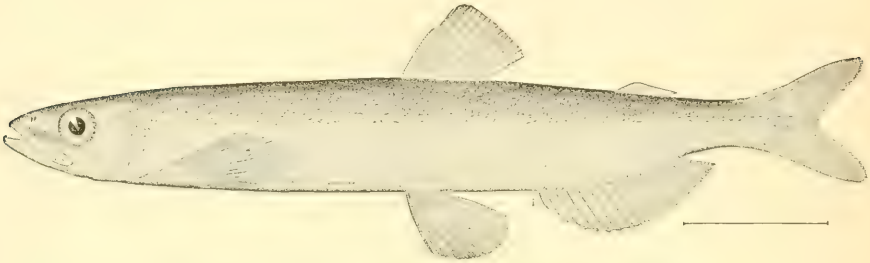


Fig. 16.—The Capelin. (*Mallotus villosus*).

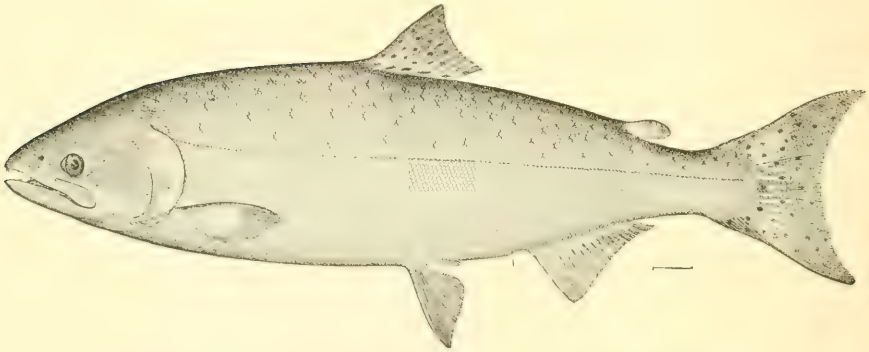


Fig. 17.—The King Salmon. (*Oncorhynchus chouicha*).

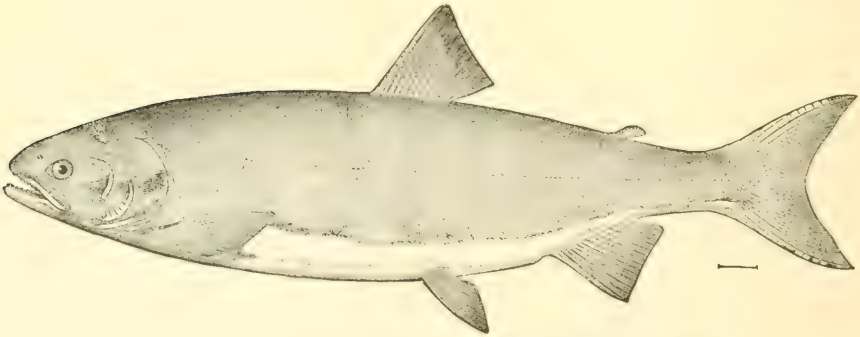


Fig. 18.—The Dog Salmon. (*Oncorhynchus keta*).

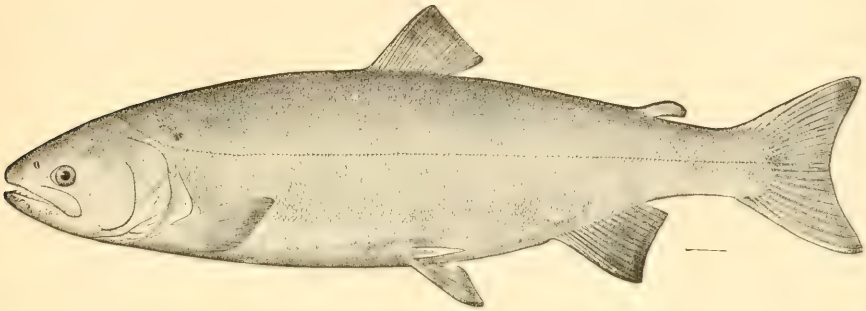


Fig. 19.—The Silver Salmon. (*Oncorhynchus kisutch*).

Fig. 20.—The Humpback Salmon. (*Oncorhynchus gorbuscha*).

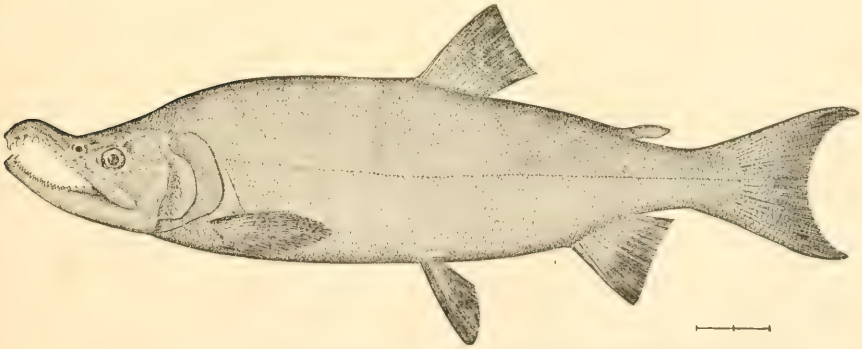


Fig. 21.—The Red Salmon. (*Oncorhynchus nerka*) *Breeding male.*

THE ALASKAN SALMON AND THEIR ALLIES.

By Tarleton H. Bean, Ichthyologist of the United States Fish Commission.

The greatest wealth of Alaska is represented by its fishes, and among these by far the most important are the members of the salmon family and other closely related forms, such as the white-fishes, grayling, smelt, and capelin. The salmon alone represent an annual value for canning purposes of about $3,000,000, derived almost entirely from three species.

The undeveloped resources which may be obtained from the salmon-like fishes have undoubtedly equal importance with the material now utilized.

In March of the present year, I delivered an address on the salmon of Alaska, in the National Museum, under the auspices of the scientific societies of Washington. This lecture was published in part in *Forest and Stream* of April 3rd and April 10th, 1890, and is made, to a considerable extent, the basis of the remarks which follow:

For eighteen centuries literature has noted the passage from sea to stream of the anadromous salmon. Nobody knows whence it came, no one can tell whither it strays. River and lake, perhaps since tertiary times, have furnished it a birthplace and a scant subsistence, while generous ocean has given it sea room and ample nourishment, converting it gradually into a thing of beauty, majesty, and mystery—the crowning reward of the angler's skill and a prime recompense of the toil of fishery.

No principal division of the earth's surface within Arctic and temperate limits, except South America, lacks representatives of the salmon family. Even in South America man has attempted to supply what nature has omitted, but we are not yet informed of the result of the experiment. Tasmania and New Zealand have demonstrated the prac-

ticability of acclimatizing the river-trout and sea-trout of England, while France and Germany are congratulating themselves upon the successful introduction into their waters of our rainbow-trout and quinnat-salmon from California.

In the distribution of the *Salmonidæ* Alaska received a generous share. Lying entirely within the area in which the family is indigenous, plentifully supplied with long water-courses, rapid snow-fed streams, and cool, deep lakes glistening in mountain valleys, over beds of clean gravel and boulders intermingled with sheltering water-plants, free from obstructions to the movements of the migratory species, its invitation to the salmon to come in and possess the waters and multiply therein was readily accepted.

Ichthyologists at present recognize about one hundred species in the family under discussion, divided among the genera of true white-fishes, nelma white-fishes, grayling, Pacific and Atlantic salmons, brook-trout, the short-lived ai of Japan, and the lenok of Siberian rivers and lakes. All of these genera, except the last two, occur in our outlying province, and they are represented by seventeen known species, or about one-sixth of the entire number.

The rivers and lakes of Alaska contain five species of white-fish, the largest one (*Coregonus richardsoni*, Plate I,* fig. 1) sometimes reaching a weight of thirty pounds. For many years this was believed to be identical with the common white-fish of our great lake fisheries, but it differs from this in many particulars. The species was known to the Russians as the "*muksun.*" In the report of the Commissioner of Agriculture for 1870, p. 386, Dall refers to it as the "broad white-fish," which, he says, "is usually very fat, and very good eating. It abounds in both winter and summer; spawns in September in the small rivers falling into the Yukon." This is the species which Milner named *Coregonus*

* The line under the tail of the figures represents one inch of the length.

kennicotti, in honor of Robert Kennicott. Captain E. P. Herendeen, of the Signal Service Expedition to Point Barrow, found this white-fish in Meade River in October, 1882. This stream is a tributary of the Arctic Ocean to the eastward of Point Barrow. The southern limit of this species is not known, but it probably extends at least as far south as the Bristol Bay region. The great size and fine quality of its flesh make it one of the most important food-fishes of the territory.

The round white-fish, shad-waiter, or chivey of New England (*Coregonus quadrilateralis*, Plate I, fig. 2), extends through the upper great lake region, the Northwest Territory, and other parts of British Columbia, into Alaska. Specimens have been obtained as far north as the Kuwuk, or Putnam River, a tributary of Hotham Inlet. This fish does not reach a large size, seldom exceeding two pounds in weight, but it is very abundant and very palatable, and, consequently, is an important food resource.

A third species, called *Coregonus laurettæ*, Plate I, fig. 3, abounds from the Bristol Bay region to Point Barrow. It is a little larger than the round white-fish, but seldom exceeds three pounds in weight. It resembles the so-called lake herring (*C. artedi*) of the great lakes, and is an excellent food species.

The fourth species is known as the hump-back white-fish, and was named in honor of Mr. E. W. Nelson (*Coregonus nelsoni*, Plate II, fig. 4). It bears considerable resemblance to one of the Siberian species, from which, however, it can be readily distinguished. As food for man it has little value, but enormous quantities are consumed by the dogs. This species is found in all parts of the territory from the peninsula of Alaska northward. Breeding males have a very large hump developed on the nape, which is compressed to a thin edge.

The fifth species of white-fish (Plate II, fig. 5) is the

(C. pusillus)

smallest of all, and has a reputation of being more bony than any of the others. It is used chiefly by native travelling parties and as food for dogs. This fish seldom exceeds a foot in length, and an average weight of less than one pound, but it extends over a very large portion of Alaska, and is represented by a vast number of individuals. As far as our information goes it is found in all parts of the territory except the southeastern portion.

The largest and handsomest fish of this category is the so-called Mackenzie River salmon or *inconnu* (Plate II, fig. 6), which is known to the Russian-speaking people as the *nelma*. This species is intermediate between the white-fish and the salmon. It has a strongly projecting lower jaw, on account of which the additional name of shovel-jawed white-fish has been applied to it. This beautiful species attains to a length of five feet, and individuals weighing fifty pounds are recorded. It occurs in the rivers during the greater part of the year, is in the finest condition in the early summer, and is "full of spawn from September to January, when it disappears." The species is known to occur from the Kuskoquim to the Kuwuk. The largest individuals are recorded from the Yukon. It is found also in the Mackenzie. A closely related species is found in the Volga and other rivers of Russia, and is attributed also to the Obi, Lena, and Colima, which flow into the Arctic Ocean.

The grayling (*Thymallus signifer*, Plate III, fig. 7) is a very common fish in Alaska, especially in the northern portion of the territory, and it is one of the most attractive of all the Alaskan fishes. At one time the grayling had the reputation of being the only fish in the fresh-water of Alaska that could be caught with hook and line. It is known also as the "blanket fish," and occurs southward at least to the Nushagak region, where McKay found it "very abundant in small rivers and lakes." He speaks of it as "a good

food-fish, much sought after by the natives in the fall, along with the white-fish and the great smelt." The high and beautifully colored dorsal-fin of this species, the rich purple lustre of the sides, and the jet-black spots not far behind the head, make it one of the most conspicuous and beautiful species of the fresh-waters.

The red-spotted brook-trout of California, also known as the dolly varden (*Salvelinus malma*, Plate III, fig. 8) is one of the best-known and most abundant fishes of Alaska. In the sea-run condition, when its sides are uniform silvery and do not show the red spots, it is called the salmon trout, and, preserved in brine, forms a staple article of commerce. In Alaska the species increases in size northward. Individuals measuring thirty inches in length and weighing eight or ten pounds are frequently obtained. Natives of northern Alaska make waterproof clothing from the skin of this trout. The dolly varden abounds in all parts of the territory, even in the Aleutian Islands and in the extreme northern limits. It is known to occur also in the Mackenzie and in the tributaries of the Saskatchawan—this basin apparently representing its eastern limit. The dolly varden takes the artificial fly very freely. On one of the islands of the Shumagin group several hundred individuals were so captured in one hour by a party from the United States steamer Albatross in 1889. Salmon eggs prove very effective also in taking this trout, and it is very destructive to the eggs of the various species of Pacific salmon. The young trout are destroyed in enormous numbers by gulls, terns, and other aquatic birds.

The lake trout, Mackinaw or namaycush, tuladi, togue, lunge, etc., etc., of the great lakes, New England, Labrador, Idaho, and British America (Plate III, fig. 9), has been obtained in the Putnam, or Kuwuk, River, where it reaches a fine state of development. The southern limit of this species in Alaska is not known. This is the largest trout of North

America and the most widely distributed. Its great size and the good quality of its flesh render it a very important species wherever it is known. This is one of the most variable of the North American trout in color, and much confusion has arisen from this circumstance. Individuals from the Kuwuk are similar in appearance to Labrador specimens, differing only in being slightly darker.

The rainbow trout of California (Plate IV, figs. 10 and 11), appears to extend northward into southeastern Alaska, but is very little known in the territory, and, consequently, is not of much importance there. One specimen of this trout was taken at Sitka by Captain Beardslee about ten years ago.

Gairdner's trout (Plate IV, fig. 12), known also as the steel-head salmon, or "*soomgah*" of the Russians (*Salmo gairdneri*), reaches a very large size in Alaska, and extends northward at least to the Bristol Bay region. At Sitka this species is called "*Ah-shut*" by the Indians. We found gravid females at that place in June. This trout generally finishes its spawning before the arrival of the salmon, and is charged with the destruction of salmon eggs in large quantities. The species has not much importance, commercially, although it reaches so large a size, attaining to the proportions of the Atlantic salmon, which it resembles in shape and color; but small quantities are dried by the natives and at the various fishing stations. This is the trout which is shipped from the Columbia River early in the spring to markets on the east coast, and sold in the fresh state under the trade-name of "Kennebec salmon." It will undoubtedly become an important species before many years. At the present time it is practically a waste product of the salmon fisheries of Alaska, and the same may be said of the dolly varden.

Clark's trout, Plate V, fig. 13, recently styled the red-throat (*Salmo purpuratus*), is very abundant in Alaska, extending

northward at least to the Bristol Bay region. In the streams it can be readily taken with various baits, and greatly increases the pleasures of angling. As a food-fish its quality is excellent, and it reaches a weight of 20 pounds or more. The species is black-spotted, the spots being larger and less numerous in Alaskan individuals than in most of the varieties which range southward in the Rocky Mountain region. The crimson streak around the throat is a conspicuous characteristic color-mark in all the many forms of this well-known trout.

Before passing to a review of the Pacific salmons we must recall the fact that Alaska has a bountiful supply of small fishes which are closely related to the *Salmonidæ*.

A true smelt (Plate V, fig. 14) and two kinds of surf-smelt (Plate V, fig. 15), are among the common fishes, the first being a food-fish of considerable value. The capelin (Plate VI, fig. 16), abounds on all parts of the coast, and is one of the most important food species of the cod and salmon. The eulachon, or candle-fish, is extremely abundant in southern Alaska, and is considered one of the finest pan-fishes known. A kind of fat is expressed from it which the Indians use as a substitute for butter, and some pharmacists in the place of cod-liver oil. The species is so full of oil that when dried it will burn with a bright flame, so that when the overworked Indian has finished a bountiful supper of fish—doubtless procured and prepared for him entirely by his frivolous wife—he needs merely to touch a match to the tail of a dried eulachon and light himself to bed. In addition to their value directly as food for man, these allies of the salmon play a very important part in attracting the larger commercial fishes of the salmon family to certain localities.

The largest and finest of the Alaskan salmon is the king, or chowichee, known also as the Takou, Columbia River, chinnook, and quinnat (Plate VI, fig. 17). This valuable fish

occurs in the large rivers, as a rule, but runs into some of the small streams also, notably the Karluk and some of the rivers of Cook's Inlet. The Yukon and the Nushagak are the greatest king-salmon rivers in Alaska. The average weight of this salmon is above 20 pounds, and individuals weighing upward of 100 pounds are on record. At St. Paul, Kadiak, Mr. B. G. McIntyre weighed one which registered 87½ pounds without its viscera, and the entire fish must have exceeded 100 pounds. Captain Wm. Kohl has recently told me that he once obtained reliable information in Cook's Inlet of a salmon weighing about 140 pounds, and individuals of equal size are reported in the Yukon. These large fish are interesting in connection with the solution of the problem whether all king-salmon die after spawning, as some competent observers positively assert they do. The flesh of this species is superior in flavor to that of all the rest. In Alaska the bellies are salted, but the fish is used chiefly in the fresh state and for canning. Three of these salmon will make a case of 48 pounds. This is one of the greatest travellers in the territory, ascending the Yukon more than 1,500 miles from its mouth. The natives of Karluk watch from the headlands for its arrival in May, and set up a great shout when they have discovered this pioneer of the salmon hosts. Like the other species, it can be seen 1½ miles off shore in great schools, which break up before approaching close to the land.

The dog-salmon (*hyko* of the Russians), Plate VI, fig. 18, is not used by Americans, but it is one of the most important species to the natives. It is found chiefly in the small rivers and creeks, and is usually abundant in all parts of the territory as far north as Hotham Inlet, and probably Point Barrow. When it arrives from the sea its flesh has a beautiful red color, but it deteriorates rapidly in fresh-water. The jaws become en-

larged and distorted during the breeding season, and the flesh unpalatable. To the exaggerated size of the teeth at this time is due the name dog-salmon. The average size of the species is about 12 pounds, but individuals of 20 pounds are not uncommon. Early in July the fish-drying frames on the shores of Cook's Inlet are brilliant with the flesh of the dog-salmon. The natives cut off the head, split the fish in halves, which remain attached at the tail, remove the backbone, and gash the sides at short intervals, to facilitate the drying process.

The fur-traders lay in a large stock of this dried salmon, which is known as *ukali*. Many small streams of Alaska never contain any other salmon than dog-salmon and humpbacks, and for the very good reason that when these fish begin to run in they occupy the whole of the water and sometimes a narrow strip of the adjacent land besides.

The silver-salmon (Plate VII, fig. 19), is not so highly esteemed in northern Alaska as it is in the Puget Sound region; it is used to some extent for canning, but it is far less important for this purpose than the red-salmon. Its average weight is less than 15 pounds, and the maximum about 30 pounds. Running late in the fall, when the fishing season is nearly closed, it is not much sought after by the whites. The natives, however, dry it in large quantities.

The humpback (Plate VII, fig. 20), so called because of the enormous hump developed on the back of the male during the breeding season, is the most abundant salmon of Alaska, and, doubtless, of the world. It has given rise to more tales suspected of being fish-stories than any other fish in the territory. One collector in the Norton Sound district, speaking of its advent from the sea, remarked that "they appear at the surface of the water like the pin-drops of an April shower." A gentleman who lived eight years at Karluk informed me that about the 6th of July, and con-

tinuing for five weeks, there was in the Karluk River a glut of humpbacks which kept all other salmon out of the stream. It was impossible to pull a boat across the river. A haul was made with a 90-foot seine at 6 A.M., and the men were dressing fish from that haul until 6 P.M., caring for about 140 barrels, or about 11,200 fish, during twelve hours. After this they were occupied three hours in clearing the seine, in which the remaining salmon were about four feet deep. I do not think of any way of intensifying the statement of fact here recorded, for it is a fact repeatedly observed and abundantly verified. When the humpbacks enter a stream in force they simply fill the water from shore to shore and from bottom to top. This is the smallest of the Pacific salmons, averaging about five pounds in weight and seldom reaching ten pounds; but it makes up in numbers what it lacks in size, and it occurs throughout the territory and eastward to the Mackenzie River. As a food-fish, in the sea-run condition, it is excellent. It is salted in moderate quantities for disposal in San Francisco and other markets. Natives dry it, either with or without salting, and store up vast numbers for use in winter.

The red-salmon, or red-fish (Plate VII, fig. 21), also known as blueback and *sawqui*—the *krašnya ryba* of the Russians—next to the humpback is the most abundant salmon of the territory. Commercially, it is the most important fish, and, indeed, the most valuable product of Alaska. The Government has a prospective revenue of $1,000,000 annually from its seal islands. The people engaged in the salmon-fishery last year took about $3,000,000 worth of fish from Alaskan waters, and they were chiefly the little red-salmon. This is not a large fish, for it averages only seven or eight pounds in weight; individuals weighing fifteen pounds are occasionally seen. Like the king-salmon, it travels the whole length of rivers, pushing on to their sources, but.

unlike its big relative, it spawns chiefly in lakes. We have traced it with certainty as far north as the Yukon. It is said that the species will not enter a river which does not arise from a lake, and abounds only in snow-fed streams.

The marine life of the Alaskan salmon is unknown from the time the young, in their newly-acquired silvery dress, leave the fresh-water nursery to become salt-water sailors, until they have ended their cruise, obtained their liberty, and come ashore, when, as in the case of so many other salt-water sailors, their serious trouble begins. Salmon remain in fresh-water until the second or third spring of their existence, and, not having a bountiful supply of food, they grow very slowly, and seldom exceed eight inches in length when they start seaward. In the ocean they feed on the capelin, the herring, and a small needle-shaped fish called the lant. They are reputed also to consume large quantities of pink-fleshed crustaceans, and derive from them their attractive color. Opposed to this theory is the fact that many other sea-fishes whose food consists almost entirely of such crustaceans are never pink-fleshed.

There is no fishery at sea for any of the Pacific salmons as there is in the Baltic for the Atlantic salmon. After the great schools have broken up and the scattered fish come into the bays, some of the species can be caught on a herring-baited hook by trolling.

The king and silver salmon are captured in this way. As a rule the fish remain at sea until they are about ready to deposit their eggs, and then they approach the coast in great masses. A few young males accompany the schools every year, and may or may not return to sea without entering the rivers. The adult fish come up from the sea at a certain time of the year, the king-salmon arriving first in the month of May in Southern Alaska and about

the 6th of June in Norton Sound. The dog-salmon and the red-salmon appear in June, the humpbacks in July, and the silver-salmon in August. The length of their stay at the river mouths before ascending and the rate of ascent to the spawning-grounds depend upon the urgency of the breeding condition. In the long rivers the king-salmon travels from twenty to forty miles a day; this species and the red-salmon are reported to be the greatest travellers. The silver and dog salmon, however, are recorded by Dr. Dall as traversing the Yukon at least 1,000 miles. As a rule, they frequent the smaller streams, and the little humpback runs into mere rivulets.

From the time the salmon enters fresh-water it begins to deteriorate in flesh and undergoes remarkable changes in form and color. Arriving as a shapely fish, clad in shining silvery scales, and with its flesh pink or red, it plays around for a little while between salt-water and fresh, and then begins its long fast and its wearisome journey. No food is taken, and there are shoals, rapids, and sometimes cataracts to be surmounted; but the salmon falters not, nor can it be prevented from accomplishing its mission by anything but death or an impassable barrier. Its body soon becomes thin and lacerated, and its fins are worn to shreds by contact with sharp rocks. In the males a great hump is developed on the back behind the head, and the jaws are lengthened and distorted so that the mouth cannot be closed. The wounded fish are soon attacked by the salmon fungus, and progress from bad to worse until they become unsightly. In the mean time the body colors will have varied from dark gray in the humpback, with the lower parts milky white, to a brilliant vermilion in the red-salmon, contrasting beautifully with the rich olive-green of its head. The excessive mortality of salmon during the ascent of the streams and on the breeding grounds has led to the belief that none of the spawning

fish leave the fresh-water alive. There is a substantial basis for this view in the long rivers, and it is doubtless true that a journey of 500 miles or more is followed by the death of all the salmon concerned in it.

The nest is a very simple affair, or it may be wanting. The humpback struggles and crowds up a few rods from the sea, and deposits its eggs between crevices in the boulders covering the bottom, or sometimes they are strewn in thin layers over a large area in shallow water without covering of any kind. The king-salmon seeks the head-waters of streams, and excavates a nest in clear, shallow, gravelly rapids. The dog-salmon spawns in small rivers and creeks.

The silver-salmon does not usually ascend streams to a great distance, and I have seen it return to salt-water alive, after spawning. The nest is made among gravel and stones, from which all dirt and slime has been removed. Both sexes take part in the building operation, and the male especially guards the nest. Turner states that the silver-salmon use their snouts in collecting material for the nests, and he has seen them with the nose worn off completely.

The red-salmon spawns around the shores of deep, cool lakes, and in their tributaries, preferring waters whose highest temperature rarely exceeds 55 degrees. The nest is a shallow, circular pile of stones about as large as a man's hand, and some of them smaller. The eggs are placed in the crevices between the stones.

The enemies of the salmon are numerous. Small fish, called sculpins, or miller's thumbs, swarm in the nests, and eat large quantities of the eggs. Trout devour great numbers of eggs and young salmon. Gulls, terns, loons, and other birds gorge themselves with the tender fry. When the young approach the sea they must run a cruel gauntlet of flounders, sculpins, and trout; and in the ocean a larger and greedier horde confronts them. There the adults are

attacked by seals and sea-lions. Before they have fairly entered the rivers huge nets are hauling them to the shore almost every minute of the day, during six days in a week. When they return to their spawning-grounds, bears are waiting to snatch them from the water and devour them alive. The salmon, it appears, would have been better off had it never been born in fresh-water, where its dangers are cumulative and deadly.

The methods of taking salmon are many and various, as might be expected from the extent of the territory and the variety of its fishing population. Arrows and spears are still employed by natives, and trolling-hooks are successfully used in certain bays; but all these partake more or less of the character of angling refinements. The dip-net, seine, and gill-net are universally applied; the latter even in winter-fishing, under the ice. Baskets and traps of several kinds are very useful in river-fisheries, particularly in winter.

Dr. Dall has given a full description and figures of traps constructed by Indian tribes of the Yukon and the adjacent region; these will be found in the Report of the Department of Agriculture for 1870.

Fish-traps of modern type are freely and, it is said, injuriously, used in some parts of Alaska by white fishermen, the injury charged being that of preventing the ascent of the spawning salmon. In 1889, at Ice Bay, a trap was reported which was three-fourths of a mile long, and spanned the river from bank to bank, making it impossible for a fish to pass up-stream. It is said that many of the other traps, of which there were more than fifty in operation in the territory in 1889, are so arranged as to prevent the ascent of the salmon in the rivers. According to our information, these traps are built in places that can be fenced across by driving piles about six feet apart, and stretching wire screen, which is securely fastened to

the piles. In most cases a wing is commenced beyond high-water mark, and extends to low-water mark, where a pocket, about forty feet in diameter, is placed. Then another wing is built out into the stream as far as the depth of the water will allow. All the fish which come within these leaders are caught, and the mesh of the trap is so small that no salmon over a foot in length can get through it.

The Russians built impassable racks of timbers and rocks, which enabled them to kill every salmon that came into the stream, if they desired. These were called *zapors*, and have been legislated out of existence, we trust. It was doubtless picturesque in the early days to see an Aleut standing on the crib-work of the *zapor*, with his spear gracefully poised and ready to transfix the silvery salmon; but it was like the boy's sport with the frog, and we are glad it is ended.

The great bulk of the salmon now caught in Alaska are taken in seines, varying from 600 to 1,500 feet in length, and many of them more than 20 feet deep. The mesh is generally about 3¼ inches. The seines are set from seine-boats, similar to those used for shad on the Potomac, and are hauled by from twenty to thirty men. Experience has shown that windlasses and similar appliances for saving labor are undesirable adjuncts of the fishery, at least on Kadiak, where the seining is almost entirely limited to salt-water. Fishing goes on at Kadiak six days in the week, subject only to the presence of salmon and suitability of the weather. Night does not stop the work, except for a few hours, as it is short in this latitude. At Karluk, the principal red-salmon station in Alaska, the seining beach is less than half a mile long, and the seiners are obliged to wait their turns to set. Several seines are in the water almost constantly, one behind the other.

Upward of 150,000 salmon have been taken here in a day. A first-class cannery can use about 26,000 red-salmon daily.

After the fish are caught they are carried in dories and other boats along the beach, and through the river mouth to the cleaning-houses on the river bank; or, when it is too rough, they are taken across the spit in hand-barrows. Large lighters and scows are also used as fish-carriers, and these are towed by steam launches. In the cleaning-houses the salmon are prepared for the cannery by cutting off the heads and fins and removing the viscera. Then they are washed, and finally thrown into hand-carts, to be hauled into the cannery, where they pass through various processes, almost all of which are carried on by machinery. First, they are cut into lengths suitable for the size of the can. These pieces are carried along and fed into cans, inequalities in the filling being supplied by hand-work. The cans are then topped in the topping-machine, from which they pass to the soldering-machine; and then follow the processes of venting, cooking, steaming in great retorts, cooling, japanning, and labelling. The cans are then boxed and stored in warehouses until a cargo is accumulated, and then, by means of scows and lighters, towed by steam launches, they are carried to vessels lying in the roadstead, and soon start upon a voyage to San Francisco, Portland, or Astoria, and eventually to other sides of the globe—for these are the greatest globe-trotters of modern times.

Thirty-six canneries were operated in Alaska in 1889, located principally in the southern part of the territory, none of them north of the Nushagak River, in the Bristol Bay region. Nearly one-third were established on the Kadiak group of islands, and these secured fully one-half of the Alaskan catch. Sixty-six vessels were engaged in carrying the equipment and workmen for these canneries and the products of their industry. There were 13 steamers, 4 steam schooners, 1 ship, 13 barks, 2 brigs, 10 barkentines, and 23 schooners.

Hundreds of boats of various kinds—dories, seine-boats, Columbia River boats, besides scows, lighters, and steam launches—are employed in the business. The seining is done chiefly by white men, and the work inside the canneries by Chinese. It is estimated that 4,000 men are engaged in the salmon fishery. The capital invested in 1889 was nearly four million dollars, and the value of the pack, at an average price of five dollars per case, was about $3,000,000.

Is this tremendous drain of eight and one-half millions of salmon in a year likely to endanger the food supply of the natives? At present many of the Alaskans work for the fishing companies, and receive more than they could earn if left to themselves. Again, the dog-salmon and the humpback, which are the most abundant of the species and the most valuable for the natives, are not yet important commercially. Canneries have not extended their operations north of the Nushagak; and the territory beyond this river teems with all kinds of Pacific salmon, and especially with the two preferred by the natives.

One great source of trouble for the Alaskan people is caused by the illegal sale of intoxicants by some unprincipled persons. By this means their usefulness is destroyed, a naturally harmless disposition is incited to mischief, and there is a steady increase of victims of pulmonary diseases. Will this industry decline in value from year to year, as it has on some of the more southern rivers? Undoubtedly it will, if over-fishing and injurious methods are continued. Impassable barriers obstructing the ascent of breeding-fish will unquestionably exterminate the species in a few years. Continual seining across the mouths of rivers will certainly hasten the same unfortunate result. The necessity of protecting this valuable resource must be apparent to every intelligent person. Alaska to-day furnishes one-half of the American yield of salmon, and it

will be our own fault if the industry is destroyed. We must regulate the fishing by suitable laws, and refuse injurious privileges on Government lands. The supply must be kept up, and increased also, by artificial propagation. Fish culture cannot find a more promising field or a more propitious and urgent occasion. There are still plenty of breeding salmon; sheltered harbors in accessible localities; rivers not subject to excessive fluctuations of level, and not obstructed by natural barriers; and there are unlimited supplies of suitable water to be conveyed by gravitation alone. Materials, labor, and transportation are cheap. There are no dams, no mill-refuse, no pollutions from sewers and factories. The climate is favorable, and the population is in sympathy with fish cultural work. Surely here is an opportunity not to be neglected, and the time to improve it is now!

SMITHSONIAN INSTITUTION,
Washington, D. C., May 7th, 1890.

THE PAST AND PRESENT OF FISH CULTURE, WITH AN INQUIRY AS TO WHAT MAY BE DONE TO FURTHER PROMOTE AND DEVELOP THE SCIENCE.

BY JOHN GAY AND WM. P. SEAL.

It is now almost a score of years since the passage of the bill, by Congress, which resulted in the establishment of the United States Commission of Fish and Fisheries. This may be said to be the beginning of the practical development of fish culture in the United States, for the first time, at least, carrying it on on a scale of magnitude sufficient to produce appreciable results. The record of failures and successes since that time are matters of history, and

familiar to all fish culturists. Failure is as much a part of the development of any economic theory as is success, and it is only through repeated failures that success is finally achieved. It is unfortunately the case that every failure in human effort is seized upon by those hostile or indifferent to form adverse argument, while the successes, not being attacked, attract little attention, and are often overlooked. It is probable that in the earlier years of the United States Fish Commission the high character and attainments of Prof. Spencer F. Baird alone sustained the popular interest in the work, and tided it over the shoals of legislative hostility or indifference.

Looking backward, we can see the gradual evolution of a complex but systematic scientific organization grappling with questions absolutely new and untouched, the development of methods simple and efficient from those heterogeneous and crude, and the final creation of an enthusiastic body of trained experts thoroughly imbued with a faith in the latent possibilities to be achieved in the great future of fish culture.

The fact that so great a scientific authority as Prof. Huxley should have expressed a doubt as to man's ability to diminish or in any way to control the harvests of the sea, and that, too, from the standpoint of actual investigation, together with many failures, through inadequate measures, has no doubt in the past had the effect of producing at least a very conservative feeling in the minds of many regarding the possible limits of the fish cultural attainment.

The difficulties to be encountered and the influences to be overcome were fully appreciated by the great founder of practical fish culture, Prof. Spencer F. Baird. As a preliminary to a brief review of the more notable successes of fish culture, it will be well to recall Prof. Baird's retrospect concerning the depletion of our game and fishes,

and his forecast of the progress to be expected in fish cultural development.

Concerning the influence of civilized man on the abundance of animal life, he said (Fish Cultural Report, 1878, p. 45):

"It may be safely said that wherever the white man plants his foot, and the so-called civilization of a country is begun, the inhabitants of the air, the land, and the water begin to disappear. The bird seeks a new abiding place under the changed conditions of the old; but the return of the season brings him again within the dangerous influence, until taught by several years of experience that his only safety is in a new home. The quadruped is less fortunate in this respect, environed as he is by more or less impassable restrictions, such as lofty mountains, deep rivers and lakes, and abrupt precipices, and sooner or later reaches the point of comparative extinction, or reduction to such limited numbers as not to invoke a continuance of special attack.

The fish, overwhelmingly numerous at first, begin to feel the fatal influence in even less time than the classes already mentioned, especially such species as belong to the fresh waters and have a comparatively limited range. The case of this rapid deterioration is not to be found in a rational and reasonable destruction for purposes of food, of material for clothing, or for other needs. The savage tribes, although more dependent for support upon the animals of the field and forest than the white man, will continue for centuries in their neighborhood without seriously diminishing their numbers. It is only as the result of wanton destruction for purposes of sport, or for the acquisition of some limited portion only of the animal, that a notable reduction is produced, and the ultimate tendency to extinction initiated.

Of the abundance of animal life in North America in the primitive days of its occupation by the European

immigrant we have an ample history in the accounts of the earlier travellers. Buffaloes in enormous herds reached almost to the Atlantic coast, wherever extensive plains existed. The antelopes rivalled in numbers those of Central and South Africa. The deer of various species were distributed over the continent from the Arctic regions southward, and from the Atlantic to the Pacific. The moose existed far south of its present limit. The elk was a familiar inhabitant of Pennsylvania and Virginia. Wild fowl, such as ducks, geese, swans, etc., of many species, were found during the winter in countless myriads in the Chesapeake and other southern bays and sounds.

Now what remains of this multitude? The buffalo has long since disappeared from the vicinity of the Mississippi River; the deer is nearly exterminated in many localities, though still holding its own under favorable circumstances, and the antelope is limited to restricted areas. The wild fowl, congregated at one time in bodies many miles in extent, are now scarcely to be seen, although proportionately more abundant in the winter season on the coast of California, and towards the mouth of the Rio Grande, in Texas, than anywhere else.

Perhaps a still more striking illustration is seen in the fishes. It is still within the recollection of many old people (showing how plentiful the fish must have been) that the apprentice and pauper in the vicinity of Connecticut River protested against eating salmon more than twice a week. This noble fish existed in all the waters of New England as far west as the Connecticut, and even to the Housatonic, though we have no evidence that they ever occurred in the Hudson River, or farther to the south. The shad was found in every stream of the coast from Georgia to the Gulf of St. Lawrence, and although still ascending most of these waters during the spring, has been sadly reduced in abundance.

Within even fifty years no waters of the same extent in the world could show such numbers of shad and herring as the Potomac River, below Great Falls. Martin's "Gazeteer," of Virginia, published in 1834, at Alexandria, states that the preceding year twenty-five and a half millions of shad were taken by the various Potomac fisheries, as well as 750,000,000 of fresh-water herring. This, by a moderate estimate, would amount to 600,000,000 pounds of fish secured in six weeks in this single system of waters.

This "Gazeteer" also states that during the same year nearly 1,000,000 barrels of fish were packed on the Potomac, requiring as many bushels of salt. These were consumed in the United States, or shipped to the West Indies and elsewhere. What is the condition of things at the present time? In 1866 the catch of shad on the Potomac had dwindled to 1,326,000; 1878, to 224,000—the latter not one per cent. of the yield of 1833. The catch of herring in 1833 (estimated), as stated at 750,000,000, had been reduced in 1866 to 21,000,000; in 1876, to 12,000,000; and in 1878, to 5,000,000—again less than one per cent. of the yield of the first-mentioned period.

A similar reduction has taken place in the abundance of striped bass, or rockfish, a species inferior to none in its excellence and economical value for food.

John Josslyn, Gent, in 1660, says that 3,000 bass were taken at one haul of the net in New England. Thomas Morton, in 1632, says, of the Merrimac, that he has seen stopped in the river at one time as many fish as would load a ship of a hundred tons, and that at the going out of the tide the river was sometimes so full of them that it seemed as if one might go over on their backs dry-shod.

Mr. Higginson, in 1630, says that the nets usually took more bass than they were able to land. Even so recently as 1846, 148 tons are said to have been taken on Martha's Vineyard at two hauls of the seine. *Per contra*, the catch

in the Potomac in 1866 amounted to 316,000 pounds; in 1876 to 100,000; in 1878 to 50,000. Many instances of the enormous abundance of the anadromous fishes in different parts of the country in former times could easily be adduced. Similar illustrations of the former abundance of fish inhabitants of the salt water can be brought forward to any extent. In the early days of the Republic the entire Atlantic shore of the United States abounded in fish of all kinds. Where cod, mackerel, and other species are now found in moderate quantities, they occurred in incredible masses.

The halibut, one of the best of our fishes, was so common along the New England coast as not to be considered worth of capture, and was considered a positive nuisance when taken. It is only within a few years that our people have come to learn their excellence and value; but they have disappeared almost entirely from the in-shores of New England, and have even gradually become exterminated in nearly all waters of less than 500 feet in depth.

It would be impossible, after all this lapse of years, to present more striking conceptions of the problems of fish culture than those abounding in the writings of Prof. Baird at those early periods.

Concerning the probable progress of fish culture, he says (Report, 1887, p. 18):

"A patient whose constitution has been undermined by disease of long continuance is unreasonable in expecting good results and a radical cure after a short application of approved remedies, yet he and his friends may be disappointed if the recuperation from the excesses or lesions of many years is not manifest in as many days. In reality the reverse is rather the rule, the time of recovery more frequently being much longer than the continuance of the morbific influences."

The expectations in regard to the results of fish culture

are somewhat of the same character. Although decades of years, even a century, may have witnessed the continuance of agencies for the diminution of fish in our waters, the public mind is unsatisfied, and perhaps inclined to severe criticism, if the recovery of a supply is not appreciable within the first two or three years of effort. We are, however, clearly entitled to maintain, in view of the experience of foreign countries and our own, that no reasonable anticipation in this respect will be disappointed, and that the proper measures of legislation and of artificial propagation will exhibit a marked result long before the end of the present generation. In no instance can even the beginning of a success be achieved in a shorter period than four or five years, as the young, especially of the anadromous fish, such as the shad, the alewife, and the salmon require that period for arriving at maturity. The parent fish are first obtained, the eggs extracted and fertilized, and after being hatched out, the young are finally deposited in the waters to take their chances. Whatever be the extent of time during which the progeny remain in the sea, they are more or less withdrawn from observation, and it is only when the young fish has reached full maturity and revisits its place of deposit for the purpose of spawning that its presence is appreciated.

It sometimes happens, too, that for one reason and another the first deposit of young fish proves to be a failure. They may be introduced while in a sickly condition, so that a difference of temperature causes them to succumb, or else in such small numbers that in the presence of an unusual abundance of its enemies they may all perish. What special agencies there may be in the ocean, after they reach it, we are unable to say; but from the wider dissemination their chance of escape is greater.

Again, we may misunderstand the period required for the maturity of a certain species. While four years may be considered the general average for cod and herring, five

are probably required for the Eastern salmon, and it is not improbable that the California salmon will show itself only after the lapse of six years from its birth.

The Value of Fish Culture.

The value of fish culture and the extent and value of the fishery industries are well known to the members of this body and to those directly interested, but with the great mass of our population they are not properly appreciated.

Prof. Baird has truly said (Report, 1890):

"It may be safely stated that, as a source of animal food to man, the sea is the great fountain-head, and that without this resource the supply of such food would be comparatively limited and far inferior to the demand of the various populations of the globe. In the much greater population of ocean to land this reservoir of food is practically inexhaustible; and not only do the people living near its shores find a daily supply for consumption in a fresh state, but, by proper methods of preparation and preservation, the product of the sea can be fitted for long-continued keeping and for transportation to distant markets, where fishing is difficult, or into the interior, where it is impracticable."

And again:

"It is difficult to make a comparison as to the comparative amount of animal food drawn from the ocean and the land; but it is stated ('Report of the British Sea Fisheries, 1886') that the weight of fish supplied to the London markets in 1880 was 130,000 tons, being more than 400 tons for every working-day, and equal to 1,000 fat oxen per day; and that the price paid to the fishermen for this food was only one-eighth of that paid to the first producer of beef."

It is stated in the "Report of the United States Fish

Commission for 1873, '74, '75," concerning the value of fish culture, "That a further evidence of the importance of this effort is shown by the fact that China, with its enormous population—greater to the square mile than any other part of the world—derives the greatest portion of its animal food from the interior waters of the Empire, the methods of fish cultivation there being conducted in a very efficient manner, and every cubic yard of pond and stream thoroughly utilized."

A statement of a German fish culturist, given in the "United States Fish Commission Report of 1878," is as follows:

"Christian Wagner, of Oldenberg, Germany, says: 'The area of my property would scarcely support a laborer and family, while by pisciculture it gives employment to fifteen men, three horses, and a steam-engine. The profit to myself is much greater than farmer or gardener could make off it; for the water is much richer than the field if pools are cultivated like land.'"

As to the extent and importance of the fisheries of the United States, we are told, in the report on the Fishery Industries, by Prof. G. Brown Goode and associates, that in 1880 the number of persons employed in the fisheries was 131,426, of which 101,684 were fishermen, and the remainder shoremen. The fishing fleet consisted of 6,605 vessels, aggregating 208,297.82 tons and 44,804 boats, and the total amount of capital invested was $37,995,349. It is believed that the census of 1890 will show an increase of not less than twenty-five per cent. on these figures. While the production of salt fish is decreasing, the sale of fresh fish is increasing in a greater proportion, owing to the wonderful advance made of late years in methods of refrigeration, rendering possible their preservation for an indefinite period.

This review of some of the more salient features of the fundamental ideas governing fish development and of the

great economic value of fish culture, with which you are familiar, is only for the purpose of giving a perspective, as it were, to the ideas herein to be suggested for consideration as a possible means of further promoting this great cause. It is well, also, at times to review the ground over which we have passed, so that by noting the successes our enthusiasm may be newly awakened.

We have now reached a point in the history of fish culture when we may proudly point to great results achieved in the actual and undoubted restoration of depleted waters, and from which we may fairly hope for a realization of the dreams of the enthusiasts, who have patiently plodded along in the paths laid out by the pioneers of fish culture, undismayed by the discouragements awaiting them at every turn. What has been, and is, should give a suggestion of what may be. Doubtless, in the minds of many, we have, in some directions at least, almost achieved the limits of possibility. To others, however, familiar with the statistics of output and production, increased production is only a matter of increased propagation. When we consider that in the case of the shad alone, the survival of five per cent. of the fry distributed by the United States Fish Commission will supply the entire shad-catch of the Atlantic coast, we begin to get some idea of the possibilities resulting from work carried on on a scale of adequate magnitude. When we realize that in this fish alone, since 1880, the catch has been doubled, resulting in an addition of over $1,000,000 per annum to the food production of the country, the great economic value of fish culture becomes more apparent. The great influx of shad during the present season, completely glutting the market, shows a continued rapid ratio of increase as the work of propagation is increased. The introduction and rapid spread of shad on the Pacific coast is a further proof of the beneficent effects of fish culture.

The whitefish is another notable example of the great

value of, and necessity for, extensive artificial propagation. The valuable paper by Mr. Fred Mather, read at the last meeting of the American Fisheries Society, gives evidence that in the case of that noble fish, the salmon, nothing is needed for its restoration, and perhaps a considerable extension of its range, but adequate outpout of fry.

Fish culture, therefore, we may fairly conclude, no longer needs defence, but may move forward serenely to a realization of the brightest conceptions of those who first conceived its value.

It may be well now to inquire what may yet be done by the American Fisheries Society to further promote and stimulate this great work. As to the past influence of the Society the "Report of the United States Fish Commission for 1875, '76" pays it the following tribute:

"The American Fisheries Society is an organization which has also performed a large part of the work of progress referred to. Its annual meetings begun in 1871, and continued since, invoking the presence of large numbers of experts in fish culture, as well as many members of State Fish Commissions, and giving an opportunity for the interchange of ideas and suggestions, and of forming personal acquaintances between those who are endeavoring to promote the common object. It must not be forgotten that the first authoritative suggestion of the propriety and importance of federal action in regard to the stocking of the common waters of the United States was made by this body, a committee having been appointed at the meeting of 1871 to memorialize Congress on the subject, as mentioned in the previous portion of the report. The valuable counsel and advice of the officers and members of this Association have always been at the service of the United States Fish Commission, and have been made use of in many important instances."

It is with some diffidence that the following suggestions

are presented for consideration as an inquiry as to whether this Society might not in the future occupy a still broader sphere of usefulness in promoting the great work of fish culture.

First. Should not this Society urge and demand the absolute elimination of politics from all questions concerning the organization or government of the United States Commission and the various State Commissioners? The continued attacks upon the autonomy of the United States Fish Commission are at once a menace and a warning. There are perhaps none of us who are not aware that the success of fish culture depends upon an expert knowledge gained through years of experience, and that the direction of such work can only be successful in the hands of one who is thoroughly familiar with the past and present aspect of fish culture, and who has comprehensive ideas of the possibilities in its future.

Second. Would not the influence and power for good of this Society, as a great national organization, be greatly enhanced by the establishment of State branches, having again county organizations, as in the case of other bodies having a far-reaching influence; thus to secure the sympathy and co-operation of all classes of our citizens, to disseminate a correct knowledge of the value of fish culture, and to establish an efficient system of observation and espionage of the waters of the country, without which laws are inoperative? It is well known that in the more remote districts there is utter disregard of the laws enacted for the preservation of game and fish, and that this is owing largely to ignorance or a misconception of the effects of such legislation, in the main believing it to be solely for the benefit of certain favored classes. To disseminate a proper knowledge of the work and to enlist more general sympathy would alone constitute a broad field of usefulness.

Third. Would not it be possible, through a national

organization, having branches throughout the States, to bring about a closer sympathy and co-operation among the States concerning restrictive legislation and more uniformity in methods of work? Also, to secure for the State fish commissions and the National Fish Commission more liberal appropriations as the scope of the work advances?

Fourth. Would not the preparation and dissemination of the latest and most approved literature of the subject in a popular way in the form of tracts, or through matter prepared systematically by a committee of publications for the public press, tend greatly to advance the knowledge of fish culture, or would such work be beyond the scope of usefulness desirable for the American Fisheries Society?

Fifth. Would not the collection of all the literature of the subject for purposes of reference and preservation be worthy the efforts of the Society? This of course would only be possible in the event of a permanent national organization having a proper repository.

Sixth. Would not the establishment by the American Fisheries Society of a system of rewards (medals such as are bestowed by similar bodies abroad) for able treatises upon the various branches of the science of fish culture or for the development of new and valuable ideas or methods of work tend to encourage and stimulate a more rapid development in this direction? Such medals are usually highly valued, and are undoubtedly an active stimulus to human effort.

Seventh. Would the establishment of a national school of fish culture, under the auspices of the United States Fish Commission, tend to a more general dissemination of a knowledge of fish culture and more harmonious conduct of such work throughout the country?

Eighth. There being honest differences of opinion concerning certain effects of the fishery industry upon the

fisheries themselves, would not an impartial investigation by a national organization, of the scope and influence herein proposed, tend to remove prejudice or to influence the correction of destructive methods?

As to whether or not a realization of the objects sought to be attained in fish culture may best be promoted by the independent action of heterogeneous organizations scattered throughout the country, working without unison, and often without sympathy, or by a mighty homogeneous organization, reaching from the Atlantic to the Pacific, and from the Great Lakes to the Gulf, is a matter worthy of the consideration of this body. In the minds of some, perhaps, the idea will appear Utopian; but there are some at least who feel that the time has arrived when to realize the fullest benefits possible to fish culture such a far-reaching organization is imperatively demanded.

FISH PROTECTION.

By Dr. James A. Henshall, of Ohio.

Fish protection is as important as fish culture.

After a deposit of young fish is made in suitable waters it is of the most vital importance that not only the fish, but the water itself should be properly protected, to insure the best results from such planting.

There seems to be a widespread popular fancy that the introduction of fish in any waters should be followed by a great and continual increase of such fish, without further care or consideration. Nothing could be further from the truth; but it is owing to this erroneous opinion of the people at large, and the stocking of unsuitable waters, or the introduction of unsuitable fish in other waters, that fish culture and the restocking of waters is often looked upon with doubt, if not contempt.

Different waters vary greatly in their characters and conditions, and fishes vary very much in their habits; therefore the successful stocking of waters requires much intelligent thought, consideration, and experience.

We should as soon expect to raise lobsters and oysters in the Ohio River as California salmon or brook-trout; but where the proper conditions exist and the right kind of fishes are introduced, the results will fully justify the experiment, and fish culture will achieve a triumphant success: for instance, the artificial culture and introduction of white-fish in the Great Lakes and the shad on the east coast. In fact, these results could be confidently anticipated, because the character of the waters of the ocean and of the Great Lakes are so well understood, are reasonably pure, and contain an unlimited abundance of food for both old and young fishes, and if these fishes are properly protected by the rigid enforcement of wise laws, there need never be any complaint as to the scarcity of either.

But the stocking of small lakes and streams is an entirely different matter, because of the wide difference in their character and condition. In the first place, it is necessary that the character and condition of a stream should be thoroughly and intelligently investigated before any attempt should be made in the direction of stocking it with fish of any kind; and if found reasonably pure, with an abundance of fish-food, then the kind of fish to introduce should be the next consideration. Then both of these matters being accomplished, the most important consideration is to follow—the proper care and protection of the fish *and the water*, without which it were better that the work had not been begun.

If a stream that is known to have failed in its fish supply is polluted by the refuse of mills and factories on its banks, it is useless to attempt to restore its fish-life by the introduction of a fresh supply so long as the poisonous

emanations continue. Even if the water is not poisoned to such an extent as to cause the death of the fishes, it is fatal to nearly all of the ordinary fish-food, which amounts to the same thing.

This is a matter that is not often thought of, but it is a very vital one, nevertheless, and one that lies at the very root of the cause of the decline of fishes in our inland streams. To destroy the food of fishes is to destroy the fishes themselves, or compel them to evacuate streams thus depleted of food for more favorable locations, if possible.

A farmer who shuts up his poultry in an empty house, or turns his cattle into a newly-ploughed field, and expects them to thrive and grow fat, is not more foolish than the fish culturist who plants a lot of young fishes in a polluted stream with the expectation or intention of restocking it or of restoring it to its former abundance.

Then, again, a stream may be reasonably pure, but be so obstructed by dams of saw-mills, grist-mills, etc., that fishes passing over them at certain times cannot return. It is useless to stock such streams with migratory or anadromous fishes. Only fishes of quiet and non-migratory habits should be introduced, and yet millions of brook-trout have been planted in just such streams, only to pass down over the dams, never to return.

Brook-trout streams are usually depopulated by the axe of the lumberman. In the first place, by cutting off the timber at the head of a brook, the sunlight finds entrance to its once cool, moist and mossy banks, where the feathery fern and the trailing arbutus and the partridge-berry once luxuriated, and where the larval and insect food of the baby-trout was bred in myriads; the mosses and ferns wither and die, the arbutus and the ground-pine shrivel up, the soil gives up its moisture, the insects disappear, and when the newly-hatched trout absorbs its yolk-sack, its little life

follows in the mournful train. Then the lumberman fills the little brook with logs, the spring freshets come with the melting of the snow and the warm rains, and the spawning-beds of the doomed trout are ripped up and ploughed out, and the jewelled trout disappears forever. True, if the water is pure, the stream may be restocked from year to year with yearling trout, but never again will they breed naturally, owing to the altered conditions and the lack of food for the young at the heads of the brooks or breeding-places.

As I said before, the question of fish-food, and more especially of the food for the newly-hatched fishes, is the most vital one to be considered in the re-stocking of waters. It is the food of the very young fishes—the microscopic crustaceans—that is the first to succumb to the pernicious effects of polluted waters, and it is to this cause more than to over-fishing, or seining, or dynamite, that we must impute the disappearance of the fishes from our streams.

It is important, then, that the fullest protection should be given the fishes by a proper protection of the waters in which they live. To do this every dam should have a fish-way, in order that migratory fishes can pass up the streams. This would insure the right of way to their spawning-grounds. Then, strict laws should be enacted by the legislative bodies of every State in the Union to prevent the offal and refuse of manufacturing establishments from being discharged into the streams.

No man, or company of men, have the moral or legal right to pollute or poison the waters of any flowing stream, thereby rendering the water unfit for the stock of the farmer or for domestic uses, and poisonous to the fishes or their food. If it were a fact, and could be proved, that the smoke or gases from the chimneys of factories when blown over the fields and habitations of men were poisonous to animals

and detrimental to the growth of crops, it would at once be remedied by law, or the factories suppressed as nuisances; and the law is just as able and effective and powerful in the one case as in the other.

The refuse from manufactories of all kinds, as saw-mills, distilleries, paper-mills, pulp-mills, starch-factories, oil-refineries, etc., usually found on the banks of streams, should be required by law to be run into pits and converted into fertilizers or other products, or burned, or otherwise disposed of. In most cases such a law would be a blessing in disguise to the manufacturer, for the refuse or offal could be made a source of profit, as is now being proved in several instances in various parts of the country.

If this were done, and our beautiful streams restored to their normal condition of reasonably pure waters, the work of the fish culturist and the fish commissioner would be returned a million-fold, and in many cases the fishes would multiply and increase naturally.

The net and seine fishing of the estuaries and at the mouths of coastwise streams should be regulated by good and effective laws, so that a reasonable proportion of the fishes would be enabled to pass freely and unharmed up the streams for the purpose of spawning. And the young should be protected at all times, and their catching or sale be declared illegal.

Just and rigid laws should likewise control the fisheries of the Great Lakes and large streams, and the protection of the young fish especially provided for.

The fishes of the inland streams and the *water* of the streams should be effectually protected by similar laws, which should provide close seasons during spawning-time, the prohibition of nets and seining, spearing, or the use of dynamite.

The penalties for violating these laws should be so severe as to cause a due respect for the same; but above

and beyond everything else, the pollution of the streams should be prevented.

THE SISKIWIT.

By R. O. Sweeny, Sr.

Some time ago, in a communication to Mr. G. Brown Goode, of the Smithsonian Institution, which communication was elicited by some previous correspondence with my distinguished friend, Mr. Fred Mather, upon the subject of the siskiwit of Lake Superior—in the material set forth in my letter, which was very largely the result of my own personal and careful investigation of the fish themselves, with statements from the fishermen and dealers carefully collated and compared, to secure only facts if possible—among the items so stated was that setting forth that the "siskiwit were spawning all the time," ripe fish being taken at all seasons. This anomalous condition of affairs being so at variance with my actual knowledge of the habits of fishes generally, I hesitated to put it forth without most carefully questioning the fishermen and those who have actually seen the fish lifted from the nets, and testified as to the eggs always dripping from the fish. This unusual, if not unique, habit or condition of the siskiwit has always challenged my investigation, and since my residence again upon the lake, have gathered a few more items, which may prove not uninteresting.

The siskiwit—and I find there are two of him recognized by the fishermen—are deep-water fishes, living down in the icy and mysterious profound from 600 to 1,000 feet! At this enormous depth, in this truly wondrous lake, the pressure is so enormous that the wooden floats of the nets, though thoroughly seasoned and boiled in oil repeatedly, to make them waterproof, are dragged up with difficulty,

so heavy, so water-soaked, and misshapen by the pressure as to be hardly recognizable as the symmetrical floats prepared with such care and sunk only a few hours before, many of them so crushed and broken as to be useless ever after.

There are curious things going on in the deeps of this great abyss. One locality is pointed out, and is called by the fishermen "The Hospital," because of the great number of crippled and misshapen fish raised from the bottom; with its sharp, jagged rocks, among which a fierce, strong current seems ever surging, I conjecture to be the cause of the great number of maimed and unsymmetrical fish taken at this particular spot.

In the neighborhood of Isle Royale, in water from 120 to 150 fathoms, on a blue clay bottom, over which myriads of worms seem to swarm and upon which the siskiwit delight to feed, it is a noticeable fact that the deeper the water the fatter the fish. Indeed, the deepest-water fish are so exceedingly fat that when brought to the surface, relieved from the enormous pressure, seem almost jelly-like and ready to burst, in fact the floating oil on the surface of the lake show many of the oil vesicles are ruptured, even the bones of the head are so soft and tender that the hook or gaff tears through them, so little resistance is offered. That the relief from the deep water pressure has greatly changed the appearance of the fish there is no doubt, and the flabby, almost liquid, animal at the surface, when at its chosen habit, at from 150 to 200 fathoms, is firm of texture and as active of every function as those of the watery strata above. Upon examination, fish were found *in various stages* of development; in some the eggs are firm and hard and undeveloped, in others fully developed, soft, and ripe, ready for spawning. The males are also in the same stages of readiness; from some the milt flows freely and in great abundance; others seem spent, while others, again, seem immature and the milt undeveloped.

In November, several seasons ago, when taking our regular supply of the eggs of Namaycush, we took some of the Siskiwit eggs for intended observation of their peculiarities. Under some conditions they are slower in hatching than Namaycush, the fry are lighter in color, very decided difference in looks and behavior; they are not as active, and slower in swimming up, seem to be more delicate and susceptible to the "blue bag" development than the Namaycush, feed about the same as Namaycush, and were doing well up to middle of March, when by one of those aggravating incidents hard to guard against in experimental work, they were turned in with a large lot of Namaycush for distribution by one of the men who thought they were so few; they took up more room than they were worth.

This fish, hitherto described in foregoing pages, is of the larger and deepest-water species from the profundity about Isle Royale and that neighborhood. The largest specimens I can learn of weighed 60 lbs.—females always larger than males, whose flesh is always firmer than the spawners. The smaller species of Siskiwit rarely exceeds 30 lbs. for the female and half that weight for the male. They are taken in water at 100 to 120 fathoms. The flesh of the male is hard and firm, even when compared with Namaycush. Another very great peculiarity of his is the abundant and inordinate secretion of milt with which he is provided. In quantity and efficiency the milt of one Siskiwit is superior to the yield of six good conditioned Namaycush. It is a well-known fact that certain foods stimulate the generative functions in warm-blooded vertebrates, and no reason appears why the same should not occur among fishes. This may explain the ever-apparent readiness to spawn of certain individuals at all times among the Siskowet.

THE AMERICAN FISHERIES SOCIETY AND ITS PROCEEDINGS.

By Fred Mather.

This Society is now twenty years old, and has issued eighteen reports of proceedings of its meetings. By an error the second meeting, held at Albany, N. Y., February 7th and 8th, 1872, was called the first Annual Meeting (see first Report of Proceedings of the American Fish Culturists' Association, page 9); therefore the present meeting is actually the 20th instead of the 19th. The meeting of organization, held in New York, December 20th, 1870, was the first. Under this date the first printed Report (Albany, The Argus Company printers, 1872) opens as follows:

"New York City, December 20, 1870: A meeting of practical fish culturists was held in this city to-day, in compliance with a call issued November 1st by W. Clift, A. S. Collins, J. H. Slack, F. Mather, and L. Stone." It then relates that Mr. Clift was chosen Chairman and Mr. Stone Secretary; a permanent organization was formed and a Constitution adopted. The Report of this meeting appeared in newspapers only, until it was copied into the Report of the second meeting in 1872, which, as before stated, was erroneously called the first.

The earlier Reports are not to be obtained now, and I doubt if more than half a dozen complete sets are in existence. As an original member, having all the Reports, it has been thought that a review of the proceedings, in the nature of an index with notes, might be of value, and the following is offered:

LIST OF REPORTS PUBLISHED.

1. Proceedings American Fish Culturists' Association, "organized December 20th, 1870," Albany: The Argus Company, printers, 1872, [56 pages including two meetings].

2. Proceedings American Fish Culturists' Association "at its Second Annual Meeting, February 11th, 1873, Albany: The Argus Company, printers, 1873" [34 pages]. This meeting was held at the office of George Shepard Page, No. 10 Warren Street, New York City.

3. Proceedings American Fish Culturists' Association "at its Third Annual Meeting, February 10th, 1874 [48 pages], Rochester, N. Y.: Evening Express Printing and Engraving Company, 1874." Held at the office of Mr. George Shepard Page, 10 Warren Street, New York.

4. Proceedings American Fish Culturists' Association, "at its Fourth Annual Meeting, February 9th and 10th, 1875. Rochester, N. Y.: Evening Express Printing and Engraving Company, 1875." Held at Mr. Page's office, New York [43 pages].

5. Proceedings American Fish Culturists' Association, "at its Fifth Annual Meeting, February 8th, 1876, Rutland: Tuttle & Company, printers, 1876." This meeting was also held at the office of Mr. Page, New York [20 pages].

6. This Report contains two meetings; the title-page, on which the first seal of the Association appears, reads as follows: "Transactions of the American Fish Culturists' Association; Special Meeting held at the Centennial Exhibition, Philadelphia, October 6th, 1876; Sixth Annual Meeting February 14th, 1878, New York: John M. Davis, printer, 40 Fulton Street, 1877" [131 pages]. On page 46 is the heading: "Sixth Annual Meeting. The American Fish Culturists' Association held their Annual Meeting at the New York Aquarium on Wednesday, February 14th, 1877."

7. Transactions American Fish Cultural Association, "Seventh Annual Meeting, February 27th and 28th, 1878. Held at the Directors' Rooms of the Fulton Market Fishmongers' Association, New York: John M. Davis, typographer, No. 40 Fulton Street, 1878" [124 pages]. The

name of the Association was changed, as above, at this meeting.

8. Transactions American Fish Cultural Association, "Eighth Annual Meeting, held at the Directors' Rooms of the Fulton Market Fish-mongers' Association, in the City of New York, February 25th and 26th, 1879. New York: John M. Davis, typographer, 40 Fulton Street, 1879" [66 pages].

9. Transactions American Fish Cultural Association, "Ninth Annual Meeting, held at the Directors' Rooms of the Fulton Market Fish-mongers' Association, in the City of New York, March 30th and 31st, 1880. New York [no printer's name, but was done by Mr. Davis, as above], 1880" [72 pages].

10. Transactions American Fish Cultural Association "Tenth Annual Meeting, held at the Directors' Rooms of the Fulton Market Fish-mongers' Association, in the City of New York, March 30th and 31st, 1881. New York [no name, but Davis did it], 1881" [136 pages].

11. Transactions American Fish-Cultural Association [the hyphen appears in the name for the first time], "Eleventh Annual Meeting," held at above rooms on April 3d and 4th, 1882, [157 pages. Davis was the printer, but his name does not appear on title-page].

12. Transactions American Fish-Cultural Association, "Twelfth Annual Meeting, held at Cooper Institute, in the City of New York, June 6th and 7th, 1883" [83 pages. Davis printed it, but his name does not appear].

13. Transactions American Fish-Cultural Association, "Thirteenth Annual Meeting, held at the National Museum, Washington, D. C., May 13th and 14th, 1884. New York, 1884," [253 pages. Davis printed it, but his name is not on title-page]. The name was again changed at this meeting.

14. Transactions American Fisheries Society, "Four-

teenth Annual Meeting, held at the National Museum, in Washington, D. C., May 5th and 6th, 1875. New York, 1885" [106 pages; no printer's name, but Davis did it].

15. Transactions American Fisheries Society, "Fifteenth Annual Meeting, held at the Palmer House, Chicago, Ill., April 13th and 14th, 1886. New York, 1886" [100 pages; no printer's name, but Davis did it].

16. Transactions American Fisheries Society, "Sixteenth Annual Meeting, held at the National Museum, Washington, D. C., May 31st and June 1st, 1887. New York, 1887" [72 pages; no printer's name, but was done by Davis].

17. Transactions American Fisheries Society, "Seventeenth Annual Meeting, held in Elk's Hall, Detroit, Mich., May 15th and 16th, 1888. New York, 1888" [115 pages; no printer's name; the work was done by Martin B. Brown, New York].

18. Transactions American Fisheries Society, "Eighteenth Annual Meeting, held at the rooms of the Anglers' Association of Eastern Pennsylvania, Philadelphia, May 15th and 16th, 1889; Spangler & Davis, 529 Commerce Street, Philadelphia" [87 pages].

These Reports are filled with interesting papers on subjects not only connected with fish culture, but also on molluscs, crustaceans, ichthyology, chemical composition and nutritive value of food fishes, fish-ways, statistics of fisheries, and other subjects of interest, by some of the foremost scientists and fish culturists of the world. After many of the papers a discussion on the subject follows, which is often of as much importance as the paper itself, inasmuch as it gives, in terse language, the views of others on the subject, and frequently causes the writer to elucidate some point which, while perfectly clear to himself, has not been treated in detail.

It is fortunate for the owners of the earlier Reports that

they are all of uniform size to bind together, those already published making two, or better, three, handy octavo volumes, and comprising, as they do, so many subjects which cover a wide field, making almost a library of fish culture and kindred subjects.

THE CONSTITUTION AND AMENDMENTS.

1870.

ART. 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. [Amended, 1878, after the final word "fish culturists" was added, "and the treatment of all questions regarding fish, of a scientific and economic nature," VII., 118; also changing the name from the American Fish Culturists' Association to the American Fish Cultural Association, VII., 76; again changed to present title, XIII., 238; again, 1884, name changed to "American Fisheries Society," XIII., 230–238].

ART. 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 this Association, *ex-officio.*

[Amended to read that "all those who had paid $5.00, and signed the Constitution, were made members of the Association without further action," III., 4. Last paragraph making Commissioners honorary members stricken out, III., 5.

Amended, 1874, by striking out the words "all fish culturists," and inserting "any person." III., 5.

Amended, 1875, making annual dues $3.00.

Amended, 1880, members who do not pay their fees for two years to be dropped, IX., 34.

Amended, 1884, to elect corresponding members, XIII., 239.

Amended, 1881, honorary members to be approved by a two-thirds vote, X., 3].

ART. III. *Officers.*—The officers of this 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.

[Amended to include a Recording Secretary, VIII., 50.

Amended, 1871, to read: The officers of the Association shall be a president, secretary, treasurer, and executive committee of three members, and shall be elected by a majority vote. Vacancies, etc.*

Amended again in 1877, increasing the Executive Committee to five [III., 5]. Again in 1878, increasing the Committee "from three to seven members," VII., 76.

In 1882, President and vice-President to hold office one year, and are then "ineligible for the same office until after an interval of one year," XI., 4.

Art. IV. *Meetings.*—The regular meetings shall be held once a year, the time and place being decided upon at the previous meeting.

> [NOTE.—In 1879 it was decided "to meet again in March or April, 1880, at the call of the Executive Committee," VIII., 60. Up to 1884 there is no record of the date of any meeting being fixed at a previous one. See 13th Report, page 7—a foot-note to the Constitution].

*The transcript is made *verbatim* with punctuation as used, and capital letters as omitted. F. M.

ART. 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.

NOTES ON THE CONSTITUTION.

A Committee on the nomination of officers was appointed at the meeting in 1871,* and the rule continued until the meeting of 1882, when nominations were made. See XI., 15. In 1884 a Committee was again appointed, XIII., 122.

A Committee to revise the Constitution was appointed in 1885, XIV., 7. It was last published in full in the Report for 1887, and some changes of phraseology made which escaped the writer's notice, but nothing important.

OFFICERS.

A history of the Society would not be complete without a record of its officers; therefore, with the exception of the members of the Executive Committees, who change yearly, and have of late years been simply ornamental, the following record is given:

Presidents: Wm. Clift, Mystic, Conn., 1870–'73, four years; R. B. Roosevelt, New York, 1874–'81, eight years; Geo. Shepard Page, New York, 1882; James Benkard, New York, 1883; Hon. Theodore Lyman, Brookline, Mass., 1884; Col. Marshall McDonald, Washington, D. C., 1885; Dr. Wm. M. Hudson, Hartford, Conn., 1886; W. L. May, Fremont, Neb., 1887; John H. Bissell, Detroit, Mich., 1888; Eugene G. Blackford, New York, 1889.

*This Committee practically appoints the officers, and has, at times, given dissatisfaction. I have steadfastly opposed this method, but have always been voted down, because the Committee disposes of the question in the least time, and the members are always in a hurry to get away. I believe it to be the very worst way to select officers, its only advantage being in saving time.

F. M.

Vice-Presidents (none until 1874): Geo. S. Page, New York, 1874–'81; James Benkard, New York, 1882; Geo. S. Page, New York, 1883; Col. Marshall McDonald, Washington, D. C., 1884; Dr. W. M. Hudson, Hartford, Conn., 1885; W. L. May, Fremont, Neb., 1886; Dr. H. H. Cary, Atlanta, Ga., 1887; S. G. Worth, Washington, D. C. 1888; Herschel Whitaker, Detroit, Mich., 1889.

Secretary: Livingston Stone, Charlestown, N. H., 1870–'72; A. S. Collins, Caledonia, N. Y., 1873–'75; M. C. Edmunds, Weston, Vt., 1876; Barnet Phillips, New York, 1877–'78 (up to 1877 there had been but one Secretary).

Corresponding Secretary: Barnet Phillips, New York, 1879–'83; R. Edward Earll, Washington, D. C., 1884; W. V. Cox, Washington, D. C., 1885; W. A. Butler, Jr., Detroit, Mich., 1886–'87; Henry C. Ford, Philadelphia, Pa., 1888; C. V. Osborn, Dayton, O., 1889.

Recording Secretary: James Annin, Jr., Caledonia, N. Y., 1879–'82; Fred Mather, Cold Spring Harbor, N. Y., 1883–'88; Frederic W. Brown, Philadelphia, Pa., 1889.

Treasurer: B. F. Bowles, Springfield, Mass., 1870–'75; E. G. Blackford, New York, 1876–'88; Henry C. Ford, Philadelphia, Pa., 1889.

TREASURER'S REPORTS.

B. F. Bowles,	1873,	balance on hand	$29 08
"	1874,	"	18 83
"	1875,	"	72 58
"	1876,	no report. *	
E. G. Blackford,	1877,	no figures. †	
"	1878,	due Treasurer,	$232 25
"	1879,	"	131 70
"	1881,	"	26 73

* Mr. Bowles died previous to this meeting.

† The Report of special meeting, VII., 7, says: "Report accepted."

E. G. Blackford,	1882, due Treasurer,	$57 26	
"	1883, "	89 55	
"	1884, balance on hand,		$205 75
"	1885, due Treasurer,	102 58	
"	1886, balance on hand,		37 63
"	1887, due Treasurer,	80 17	
"	1888, balance on hand,		61 65
"	1889, due Treasurer,	5 29	

INDEX OF AUTHORS AND SUBJECTS.

In compiling this index great care has been taken, yet there may be errors in it. Cross references are given when the subject seems to demand it. For instance: Dr. Bean writes an article on "Hybrids in Salmonidæ;" it is indexed under "Bean," "Hybrids, "Hybrids, claimed to be fertile," "Salmonidæ," "Hybrids for the table," and "Trout, hybrid," covering the main points of interest.

The references are to the number of the Report, not to the year—as: "XIII., 91," for Thirteenth Report, 91st page.

Trusting that the index may be of value to those who may wish to look up any subject that has been treated of, or discussed by the Society, or who need to refer to the opinions or the writings of individuals, the following is offered.

INDEX TO AUTHORS AND SUBJECTS.

* Often Mr. Green had no heading to his papers, and when he did, he had a habit of straying over so many other subjects that it is difficult to index them.

* This was premature; no fish resulted.

*In this case the writer mistakes the Adirondack "frost-fish" for the smelt, being led astray by Mr. Wilson, whom he quotes. The spawn of the smelt is adhesive, but that of *Prosopium quadrilaterale* is not. At this late day I don't see how I made this blunder. F. MATHER.

*This is an error. I had then never seen the eggs of *Microgadus*, and accepted the bunches which the fishermen brought me, and called tomcod eggs. The next year I took eggs from the fish and learned that they were free eggs. What the eggs were that I sent to Prof. Ryder I do not know.
F. MATHER.

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OF THE

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Jones, John D., 51 Wall Street, New York.
St. Clair Flats Shooting and Fishing Club, Detroit, Mich.
Anglers' Association of Eastern Pennsylvania.

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Benecke, Prof. B., Konigsberg, Germany; Commissioner of Fisheries.
Brady, Thomas F., Esq., Dublin Castle, Dublin, Ireland; Inspector of Fisheries for Ireland.
Chambers, Oldham W., Esq., Secretary of the National Fish Culture Association, South Kensington, London.

Day, Dr. Francis, F. L. S., Kenilworth House, Cheltenham, England; late Inspector-General of Fisheries for India.

Fedderson, Arthur, Viborg, Denmark.

Giglioli, Prof. H. H., Florence, Italy.

Hubrecht, Prof. A. A. W., Utrecht. Holland; Member of the Dutch Fisheries Commission, and Director of the Netherlands Zoological Station.

Juel, Capt. N., R. N., Bergen, Norway; President of the Society for the Development of Norwegian Fisheries.

K. Ito, Esq., Hokkaido, Cho., Sapporo, Japan; Member of the Fisheries Department of Hokkaido, and President of the Fisheries Society of Northern Japan.

Landmark, S., Bergen, Norway; Inspector of Norwegian Fresh water Fisheries.

Lundberg, Dr. Rudolf, Stockholm, Sweden; Inspector of Fisheries.

Macleay, William, Sydney, N. S. W.; President of the Fisheries Commission of New South Wales.

Maitland, Sir J. Ramsay Gibson, Bart., Howietown, Stirling, Scotland.

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Olsen, O. T., Grimsby, England.

Sars, Prof. G. O., Christiana, Norway; Government Inspector of Fisheries.

Smith, Prof. F. A., Stockholm, Sweden.

Sola, Don Francisco, Garcia, Madrid, Spain; Secretary of the Spanish Fisheries Society.

Solsky, Baron N. de, St. Petersburg, Russia; Director of the Imperial Agricultural Museum.

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Walpole, Hon. Spencer, Governor of the Isle of Man.

Wattel, M. Raveret, Paris, France; Secretary of the Societe d'Acclimation.

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Benkard, James, Union Club, New York.
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Dewey, J. N., Toledo, O.
Dieckerman, George H., New Hampton, N. H.
Donaldson, Hon. Thomas, Philadelphia.
Doyle, E. P., Secretary New York Fish Commission, New York.
Dunning, Philo, Madison, Wis.

Earll, R. E., National Museum, Washington, D. C.
Ellis, J. F., U. S. Fish Commission, Washington, D. C.
Endicott, Francis, Tompkinsville, N. Y.
Evarts, Charles B., Windsor, Vt.

Fairbank, N. K., Chicago, Ill.
Ferguson, T. B., Washington, D. C.
Fitzhugh, Daniel H., Bay City, Mich.
Foord, John, Brooklyn, N. Y., Editor *Harper's Weekly.*
Ford, Henry C., Philadelphia, Pa.
French, Asa B., South Braintree, Mass.
Frishmuth, E. H., Jr., 151 N. Third Street, Philadelphia.

Garrett, W. E., P. O. Box 3006, New York.
Gay, John, U. S. Fish Commission, Washington, D. C.
Gilbert, W. L., Plymouth, Mass.
Goode, G. Brown, National Museum, Washington, D. C.

Hagert, Edwin, 32 N. Sixth Street, Philadelphia.
Haley, Albert, Fulton Market, New York.
Haley, Caleb, Fulton Market, New York.
Harper, Thos. B., 709 Market Street, Philadelphia.
Harris, Gwynn, Washington, D, C.
Harris, W. C., Editor *American Angler,* 10 Warren Street, New York.
Hartley, R. M., 627 Walnut Street, Philadelphia.
Hayes, A. A., Washington, D. C.
Henshall, Dr. J. A., 362 Court Street, Cincinnati, O.
Hergesheimer, Wm. S., 1119 N. Eighth Street, Philadelphia.

Hessell, Rudolf, U. S. Fish Commission, Washington, D. C.
Hicks, John D., Roslyn, Long Island, N. Y.
Hill, M. B. Clayton, N. Y.
Hinchman, C. C., Detroit, Mich.
Hofer, J. C., Bellaire, O.
Hudson, Dr. William M., Hartford, Conn.
Humphries, Dr. E. W., Salisbury, Md.
Hutchinson, E. S., Washington, D. C.

Isaacs, Montefiore, 42 Broad Street, New York.

James, Dr. Bushrod W., N. E. corner Eighteenth and Green streets, Philadelphia.
Jessup, F. J., 88 Cortlandt Street, New York.
Johnston, S. M., Battery Wharf, Boston, Mass.

Kauffman, S. H., *Evening Star* Office, Washington, D. C.
Kellogg, A. J., Detroit, Mich.
Kelly, P., 346 Sixth Avenue, New York.
Kingsbury, Dr. C. A., 1119 Walnut Street, Philadelphia.

Lawrence, G. N., 45 E. Twenty-first Street, New York.
Lawrence, F. C., Union Club, New York.
Lee, Thomas, U. S. Fish Commission.
Little, Amos R., Philadelphia.
Long, James Vernor, Pittsburg, Pa.
Loring, John A., 3 Pemberton Square (Room 8), Boston, Mass.
Lowrey, J. A., Union Club, New York.
Lydecker, Major G. I., U. S. Engineers.

Mallory, Charles, foot Burling Slip, New York.
Mansfield, Lieut. H. B., U. S. Navy, Washington, D. C.
Mather, Fred, Cold Spring Harbor, Suffolk Co., N. Y.
Marks, Walter D., Paris, Mich.
May, W. L., Fremont, Neb.
McDonald, Col. M., Fish Commissioner of the United States, Washington, D. C.
McGown, Hon. H. P., 76 Nassau Street, New York.
MacKay, Robert M., 1517 N. Thirteenth Street, Philadelphia.
Middletown, W., Fulton Market, New York.
Milbank, S. W., Union Club, New York.
Miles, Jacob F., 1820 Arch Street, Philadelphia.

Miller, S. B., Fulton Market, New York.
Miller, Ernest, Fulton Market, New York.
Miner, C. Harry, New York.
Moore, George H. H., U. S. Fish Commission.

Nevin, James, Madison, Wis.

O'Brien, Martin E., South Bend, Neb.
O'Connor, J. J., U. S. Fish Commission, Washington, D. C.
Osborn, Hon. C. V., Dayton, O.

Page, George S., 49 Wall Street, New York.
Page, W. F., U. S. Fish Commission, Washington, D. C.
Parker, Dr. J. C., Grand Rapids, Mich.
Parker, Peter, Jr., U. S. Fish Commission.
Pease, Charles, East Rockport, Cuyahoga Co., O.
Pike, Hon. R. G., Middletown, Conn.
Post, Hoyt, Detroit, Mich.
Post, W., Knickerbocker Club, New York.
Powell, W. L., Harrisburg, Pa.

Rathbun, Richard, U. S. Fish Commission, Washington, D. C.
Ray, Hon. Ossian, M. C., New Hampshire.
Redmond, R., 113 Franklin Street, New York.
Reinecke, Theodore, Box 1651, New York.
Reynal, J., 84 White Street, New York.
Reynolds, Charles B., 318 Broadway, New York.
Ricardo, George, Hackensack, N. J.
Robeson, Hon. George M., Camden, N. J.

Schaffer, George H., foot Perry Street, New York.
Schieffelin, W. H., 170 William Street, New York.
Schuyler, H. P., Troy, N. Y.
Sherman, Gen. R. U., New Hartford, Oneida Co., N. Y.
Simmons, Newton, U. S. Fish Commission, Washington, D. C.
Smiley, C. W., Smithsonian Institute, Washington, D. C.
Spangler, A. M., 529 Commerce Street, Philadelphia.
Spensley, Calvert, Mineral Point, Wis.
Spofford, Henry W., Smithsonian Institute.
Steers, Henry, 10 E. 38th Street, New York.
Stone, Livingston, Charlestown, N. H., U. S. Fish Commission.
Stone, Summer R., 58 Pine Street, New York.

Swan, B. L., Jr., 5 W. 20th Street, New York.
Sweeney, Dr. R. O., Duluth, Minn.

Streuber, L., Erie, Pa.
Thompson, H. H., Bedford Bank, Brooklyn, N. Y.
Tomlin, David W., Duluth, Minn.

Walton, Collins W., 1713 Spring Garden Street, Philadelphia.
Ward, George E., 43 South Street, New York.
Weeks, Seth, Corry, Erie Co., Pa.
West, Benjamin, Fulton Market, New York.
Whitaker, Herschel, Detroit, Mich.
Whitney, Samuel, Katonah, N. Y.
Wilbur, H. O., Third Street below Race, Philadelphia.
Wilbur, E. R., *Forest and Stream*, New York.
Wilcox, Joseph, Media, Pa.
Wilcox, W. A., 176 Atlantic Avenue, Boston, Mass.
Willets, J. C., Skaneateles, N. Y.
Williams, A. C., Chagrin Falls, O.
Wilmot, Samuel, Newcastle, Ontario.
Wilson, J. P., U. S. Fish Commission.
Wood, Benjamin, 25 Park Row, New York.
Woodruff, G. D., Sherman, Conn.
Woods, Israel, Fulton Market, New York.
Worth, S. G., U. S. Fish Commission, Washington, D. C.

American Fisheries Society.

1891.

TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY.

TWENTIETH ANNUAL MEETING.

HELD IN THE

LECTURE ROOM OF THE NATIONAL MUSEUM,

WASHINGTON, D. C.

WEDNESDAY AND THURSDAY, MAY 27TH AND 28TH, 1891.

NEW YORK:

JOHN M. DAVIS, TYPOGRAPHER, 40 FULTON STREET.

1891.

Officers for 1891-92.

President, Dr. JAMES A. HENSHALL ..... *Cincinnati, O.*

Vice-President, Dr. J. C. PARKER ..... *Grand Rapids, Mich.*

Treasurer, HENRY C. FORD ..... *Philadelphia, Pa.*

Recording Secretary, EDWARD P. DOYLE..... *New York City.*

Cor. Secretary, Dr. TARLETON H. BEAN..... *Washington, D. C.*

Executive Committee.

S. H. KAUFFMANN ..... *Washington, D. C.*

Dr. H. H. CARY ..... *Atlanta, Ga.*

Dr. W. M. HUDSON ..... *Hartford, Conn.*

W. A. BUTLER, Jr ..... *Detroit, Mich.*

L. D. HUNTINGTON ..... *New Rochelle, N. Y.*

B. B. PORTER ..... *San Francisco, Cal.*

W. L. MAY ..... *Fremont, Neb.*

Local Committee.

EUGENE G. BLACKFORD, Chairman, ... *New York.*

FRED. MATHER, ... "

EDWARD P. DOYLE... ..... "

TWENTIETH ANNUAL MEETING

—OF THE—

AMERICAN FISHERIES SOCIETY.

PART FIRST.

MINUTES OF MEETINGS.

FIRST DAY'S MEETING.

Meeting was called to order, Wednesday May 27th, at 2 P.M., President Eugene G. Blackford in the chair.

The minutes of the Nineteenth Annual Meeting were read by the Secretary, and, on motion, approved as read.

Letters of regret at their inability to attend the meeting were read from Colonel Marshall McDonald, Dr. T. H. Bean, and Judge J. W. Wilson.

The letter from Colonel McDonald was as follows:

DEAR MR. BLACKFORD: I am confined to my bed as the result of a surgical operation, and will not be able to attend the meeting, but everything will be done by the Commission to make the meeting pleasant and successful. Mr. Kaufmann, of the "Star," is chairman of the local committee, and will do everything practicable in arranging for the meeting. The Woodmont Club will entertain the

Society on Wednesday evening with a dinner at Harvey's. We are in a lull as regards fish cultural work here, but the aquaria will probably interest members, and I would like you to look into our pond culture with the shad. We have about 2,000,000 in the West Pond near the monument, and probably half will survive and be turned out in the Potomac as fish three inches long. When we make this system general in our rivers, and pursue on a sufficiently large scale, I hardly see any limit to the abundance we can create. Similar methods will doubtless be applied in time to the salmon, whitefish, and pike-perch. I think it will be of interest to call the attention of members to this work. I shall urge the broadening of our organization so as to invite and include in its membership individuals and representatives of all associations, societies, or clubs interested in the fisheries, whether from a practical, economic, scientific, or sentimental standpoint. It would be a great thing to accomplish under your administration. It would lift us at once from a society of fish culturists to a plane of the Deutsche Fischerei Verein. Such an organization, popularized and exploited as it may be, would attract to its membership men of influence and character in all professions and business pursuits, and would become a power in directing, influencing, and controlling public opinion. It is a matter of profound regret to me that I cannot be with you, as I have many things to talk about.

Yours faithfully,

MARSHALL McDONALD.

Mr. Kauffmann, from the Woodmont Rod and Gun Club, addressed the Society, reciting what had been done towards arranging for the entertainment of the members, and extended the invitation from the Club to dine at Harvey's on Wednesday evening.

On motion of Dr. Cary, of Georgia, the invitation to dine was accepted with thanks.

The following persons were then proposed for membership: Professor Bashford Dean, L. D. Huntington, Peter W. Lynch, and Frank J. Amsden, seconded by Mr. Blackford.

H. A. Sherwin, seconded by Mr. Ford.

Hugh M. Smith, seconded by Mr. Seal.

W. R. Huntington, seconded by Dr. Henshall.

B. B. Porter, seconded by Fred. Mather.

On motion of Mr. May, of Nebraska, and by unanimous consent, the persons named above were elected members of the Society.

The following persons were then proposed for membership, and seconded by Mr. Amsden: William Barnum, Charles H. Babcock, and William S. Kimball. They were on motion unanimously elected.

The Treasurer of the Society, Mr. Ford, presented his report as Treasurer, for the year.

TREASURER'S REPORT.

Credits.

1890.	May 12, By balance from last account....	$ 76 85
1891.	May 25, By annual dues received.....	204 00
		$280 85

Debits.

1890.	June 16, To cash paid bills, C. V. Osborn, for expenses May meeting, 1890.....	$ 8 88
	Aug. 25, To cash paid Spangler & Davis for printing notices annual dues.....	1 00
	To cash paid envelopes and postage for annual dues notices and receipts.....	6 48
	Sept. 8, To cash paid bill to Photo-engraving Co. for plates (fish) in report.....	13 62
1891.	Jan'y 2, To cash paid John M. Davis, printing annual report.....	152 00
	May 26, To balance cash on hand.....	98 87
		$280 85

On motion of Mr. Clark, of Michigan, the report was received and ordered referred to an auditing committee of three.

The Chair appointed Mr. Cary, Mr. Mather, and Mr. Rathburn as such committee.

The Chair addressed the meeting in relation to the annual dues:

"The low sum of three dollars paid annually by the members of this Society is fixed solely for the purpose of covering the cost of the publication and the expenses incidental to our annual meeting. These reports of the papers read, and the discussions arising from them, are distributed only to the members of our Society. If you examine the report, you will find that we have between two hundred and three hundred members, and that at our annual meeting we hardly ever have over twenty per cent. of that membership present, but the interest of the absentees in our Society is not to be gauged by their want of attendance at our meetings. I know, personally, that a large proportion of them keep up an active interest in fish culture and fishery matters, and in justice to them, we decline to furnish our reports to any person not a member of our Society. I speak of this because we have a great many applications for the report of the Association, and so that our members may indicate to their friends that the only way in which they can receive a report of our meeting is by joining the Society. Three dollars annual dues should not deter any one from joining. Colonel McDonald suggested in conversation this morning, that in connection with the idea of broadening the scope of our Association, it might be well if the Society concurred with his views in the matter to appoint a committee to take into consideration the proper means to pursue for increasing the interest and membership of our Society. He thought that all the clubs and societies organized for the protection of game and fish, including Natural History Clubs, that pay particular attention to

ichthyology, should all be brought into active sympathy with this Society. The idea, of course, is a good one, and the only question is how shall we get at it? It is not to be expected that we can hold large meetings of the National Society either at Washington, Put-in-Bay, Ohio, or New York City, because a large proportion of the people interested in our objects and aims are not in a position to sacrifice the time and to spend the money required in travelling to distant points to attend the meeting; but, as I said, we cannot gauge their interest by their attendance at our meetings, but by their active co-operation in keeping up their membership and maintaining good financial relations with the Treasurer. Is it your pleasure to take any action of this kind on the suggestion of Colonel McDonald? I would like to hear from Dr. Henshall on the subject."

Dr. Henshall said: "Mr. President, I am very much in favor of what you said. There are a great many organizations in the different parts of the country for the protection of fish and game, and I am confident that a majority of them would become members of this Society if they were approached in a proper manner. A great many do not know that the doors of the Society are open to anglers and persons who are in favor of fish and game protection. If they did, I am sure that the membership of this Society would be greatly increased."

On motion, the following resolution was then unanimously adopted:

Resolved, That the question as to the best method to be adopted to increase the membership and extend the influence of the Society be referred to a committee of three, to be appointed by the Chair.

The Chair appointed J. A. Henshall, A. N. Cheney, and F. J. Amsden as such committee.

On motion of W. L. May, a committee of three on nominations for officers for the ensuing year was ordered.

The President appointed as such committee W. L. May, A. N. Cheney, and Richard Rathburn.

Mr. Amsden extended an invitation to the Society to hold its next meeting in Rochester.

No action was taken.

Dr. J. A. Henshall then read a paper entitled "The teeth of fishes as a guide to their food habits."

After the reading, the Chair said: "I would state that it has been our custom always, after the reading of a paper, to invite discussion of the topic that is presented. Is it the pleasure of any gentleman to ask any question or to discuss the paper that has just been read?"

Mr. Ford said: "I merely wish to corroborate the statement made by Dr. Henshall as to the black bass; that it is not so destructive a fish as is generally supposed. I presume I have examined the stomachs of at least a thousand black bass. The Delaware is a great shad river; it is full of shad; but of the great number of black bass that I have examined, I never found but two shad in their stomachs. I attribute this partly to the fact that the shad swims in the deep water of the river, while the black bass seeks its food along the shore. The bass are not so destructive to the shad as a great many people tell us."

Mr. Mather said: "Dr. Henshall mentions what is, I believe, a fact, that the black bass is not as destructive as the brook trout; that it does not eat fish as freely. I will state that while fishing with Mr. Huntington one day this Spring, I took a trout, with a fly, about ten inches long, and in its throat it had a sun-fish an inch and a half long."

Mr. Cheney said: "In Lake George, where the lake trout have had any quantity of food for years and years, a sun-fish was taken there two years ago from the stomach of a lake trout, thus corroborating what Dr. Henshall has stated."

Mr. Seal said: "In the aquaria of the Fish Commission at the Central Station, the Atlantic salmon, the land-locked

salmon, and I think I can say the same of the Pacific salmon, and all of the trout, will take the small sun-fish as food. They prefer, however, the common minnows or shiners."

Mr. Kauffman said: "I would like to ask Mr. Cheney if he does not think that locality has something to do with the spawning of black bass? The spawning season, we understand, is about over in the Potomac. They spawn a great deal earlier in the lower grounds than they do in the mountain regions."

Mr. Cheney answered: "Yes;" and then said, "I would like to have some gentleman inform us what size trout attain before spawning?"

Mr. Clark answered: "There is one point that Mr. Cheney would like to know. He asked what is the size of a spawning trout. I have taken eggs from a brook trout less than four inches long. We have a law in our State that trout less than six inches should not be caught; but as I said, I have taken eggs from a trout that was four inches long."

Mr. Seal said in regard to temperature: "I think the temperature has much to do with the time of spawning. We have had yellow perch to spawn in December and again in March, and we have had gold-fish to spawn this year in February. The temperature then was 62°. If the temperature is constant and high enough, the fish will spawn at any time. The character of water in this respect varies greatly, and in some waters they will spawn much earlier. Again, older fishes spawn much earlier than young ones. It is the case with the gold-fish and perhaps with all fishes."

Mr. Clark said: "Is it not a fact that nearly all fishes, the spring spawners and the fall spawners, depend altogether upon temperature, the spring spawners needing a a warmer temperature, and the fall spawners a colder temperature? That has been my experience."

Dr. Henshall answered: "In regard to the black bass I would say with Mr. Seal that it is a question entirely of temperature. I have watched the spawning of black bass all the way from Canada to Florida, and it is entirely a question of temperature. Beginning with Florida as early as March or April, and getting a little later as you go North. I lived in Wisconsin, where within a radius of ten miles there were forty lakes. Some of these lakes were deeper than others, and in the spawning of those bass, even in that circumscribed limit, there was a difference of between two and three weeks; those in the deeper lakes not spawning until later in the season. In Evergreen Lake the fish did not get through spawning until the later part of August, and the fishing began in September."

Mr. Frank Clark then read a paper entitled "Rearing and distributing trout at the Northville Station of the United States Fish Commission."

After the paper was read, the Chair called for discussion.

Dr. Parker asked: "I would like to inquire of Mr. Clark what has been the expense of rearing, say 10,000, of those trout until they are one year old?"

Mr. Clark answered: "It is rather difficult to tell what it would cost to rear 10,000. Of course, with such a small number as that, you would need the same help that you would to rear a much larger number. I cannot tell the exact proportionate cost, but I think that our total liver bill last season was something like $800; that included the feeding of fish that gave us about 120,000 eggs, in addition to feeding 150,000 fry to be held until one year old."

Mr. Mather said: "While Mr. Clark was reading his paper, he looked at me, because he knew that I did not agree with him. The losses would amount to something, and the expense will be large, and I do not believe that it is economy to-day for the Fish Commission to raise trout to be a

year old. I believe, with Mr. Clark, that one yearling trout planted in a stream is as good as thirty-five or possibly fifty-five, but the expense attending it, I think, is greater than will warrant."

Mr. Clark said: "I do not agree with Mr. Mather at all on the point of expense. There are a great many things in regard to this expense that most people do not take into account. If you have an establishment where you are keeping fish and furnishing eggs, either shipping the eggs to other States or getting the fish eggs from the fish as we are doing, you have got to have about the same force. I venture the idea here that the Michigan Commission or the New York Commission can raise 100,000 yearlings with the same force they have to-day. In regard to the loss, I would say that the trout that we held last spring for spawning gave us nearly 1,250,000 eggs; of these, I think my report will show the loss to be about 300,000, certainly not to exceed 350,000. Another point: when we put a certain number of fish in the stream, we know that there are that many there, but that is not the case with the fry. The planting of fry is all very well, but when planting fish, we know that a certain number is there, because the carmen count them before they are planted."

Mr. Mather said: "In the hatchery that I have charge of we do not actually count the eggs, but we measure them in troughs; the men keep an exact account of the dead eggs, and my books will show the loss every day from the time the eggs are laid down until they are distributed. If I ask the foreman how many trout are in any particular trough, he will tell me, and I will send one man 10,000 and another man 10,000 and another man 5,000, and with a trough holding 25,000, we know that this takes them all; one man may get more fish than another, but we know that 25,000 fish have gone somewhere, so that I think our system is about as accurate as it can be. I do not think we make any mistake in that respect. It is only a question

of feeding young fish, and as to whether it is profitable to feed them until they are a year old or not, and I do not think it is."

Dr. Parker said: "This is an economic question. It seems to me that we really do not know the absolute expense of keeping them until they are a year old. It becomes more apparent to me that we really do not know much about it now, and cannot tell whether it is profitable or not to rear them until they are a year old."

Mr. Clark said: "I will make it a point at our next meeting, with the advice of Colonel McDonald, to bring a short paper here, showing as near as I can possibly come to it, the exact cost of rearing trout to a year old."

The Chair: "This question is now being discussed by different Fish Commissions as to whether we shall continue distributing fry, or whether we shall adopt a system of rearing the fish in ponds to a certain age, and then turning them out; but the true test will be rather in the results we shall obtain hereafter, than in the question of expense. I can see no great difficulty on the score of expense. The New York Fish Commission is pursuing both plans. We distribute millions of fry every year and a few thousand yearlings. We do not encourage applications for yearlings, but we are making a judicious distribution of them in certain localities where we can keep track of them; but, as I said before, I think this whole question will settle down finally as to which method will give us the best results in the stocking of streams. We do not doubt that the distribution of fry has repaired the waste of open fishing in New York streams. We know that streams from which the fish had almost entirely disappeared have been made prolific of trout by stocking them with fry. So far as that goes it is a success, but whether we could have achieved greater results by rearing them to a greater age is a question we have not yet determined. An applicant will ask our Commission for a million fry with which to

stock a stream; when we meet to consider applications we give that man what we think is sufficient to stock his stream. If it were known that we were going to distribute yearlings the Commission would be overwhelmed with applications, and all sorts of influence would be brought to bear upon us for an allotment of yearling fish, for applicants in two years could reap the results of such planting."

Mr. Seal said: "I believe it is possible to rear trout wholly on natural food, but to produce the fish in enormous numbers immense quantities of the food would be necessary. This is the principle that has been adopted in certain parts of Europe, in France and Spain, where they enter largely into the production of fresh-water shrimp and other crustaceans for that purpose. I believe that the time will come when the area used in producing the food will be much greater than that in which the trout are raised. I know that the crustaceans can be raised in enormous numbers."

The Chair said: "The question of fish food brings up a matter that many of you, doubtless, have noticed in the newspapers. It was from a report by one of our consuls in France or Spain, communicating to the Government here the results of his visit to a trout-breeding establishlishment, which had a method of producing fish food in a small box, at a slight outlay; the amount of food produced, and the cost, as shown in the report, was simply wonderful. It was as though the man had solved the question of perpetual motion. I bring this to your notice for the purpose of ascertaining whether any of the gentlemen connected with the United States Fish Commission have any knowledge as to the subject."

Mr. Seal said: "You will find that paper in the Fish Commission Bulletin for 1887. From my experience, I have not the slightest doubt that those crustaceans can be produced in prodigious numbers; I have never had any difficulty in propagating gold-fish and rearing the crusta-

ceans in tubs in any desired quantity, by extending the area devoted to it. It is simply a question of providing a greater space devoted to plants which provide the food for these little animals, but what their natural food is I do not know. I think it is known, however, what they feed on. I suppose it is still more minute life, animal or vegetable, or the plants themselves."

The Chair said: "Has this plan been pursued to any extent in this country?"

Mr. Seal said: "I do not know that it has. My experience has been with other fishes than the trout, but in an amateur way. I am convinced, however, that it is possible to do it on a large scale."

Dr. Parker said: "It seems to me the question of weight would come in somewhere. It would take a great many of these little objects to make a pound of trout."

Mr. Seal said: "It takes some time to raise a pound of trout, and I have no doubt but that in the necessary time, enough of these little objects could be raised in a comparatively small quantity of water to afford the necessary food. It is my belief that, given the proper conditions, enough of them to rear a yearling trout may be produced in a cubic foot of water."

Mr. Ford said: "The Pennsylvania Commission has had a practical illustration of the subject of yearling trout by putting, some four years ago, 150 yearling trout in a small spring-water stream, and about 2,000 fry in another stream not far removed from it. The result has been that in the stream where the fry were deposited a much larger proportion of trout has been realized than in the other. I do not know what is the practice in New York State, but with us we very seldom send out any trout before the last week in March, when they have obtained quite a growth. Six or seven years ago we hardly knew what to do with our trout; the applications were few and far between. During the past year we hatched two and a half millions of trout,

and we had applications for 4,000,000. We limit the application to 2,500 for each applicant, and this year the applications so much exceeded our supply that we had to cut them down considerably."

Mr. Mather said: "In relation to this subject of natural food, it would be very desirable to accomplish the results spoken of. I saw the report referred to about the man who grew his fish food in a little box. There was also another method mentioned by which a man could rear fish by moving them from one pond to another, just as you would drive cattle from one pasture to another. I wrote to the director of the fish-culture establishment at Heiningen on the subject, and he wrote back saying that the man had only a few hundred trout. Mr. Peter Cooper Hewitt of New York City, came to see me about the subject, and asked me if I knew anything about it. I told him that I did not. He wrote himself to the man, however, and this spring, when I asked him if he ever heard anything from him, he shook his head, and said, 'No.'"

Mr. Seal said: "I believe it is much easier to produce this food in large areas of water than to drive the fish from one pond to another. I can produce in tubs just as much of this food as I want, but, of course, it is limited by the area. By doing the same thing in ponds, enormous quantities can be raised. These other crustaceans that I speak of are, of course, a more valuable food for the trout."

Mr. Clark said: "We have a pond that has not been used for some time and is grown over with moss or water-grass. In this the fresh water-shrimp will accumulate in great numbers; take a pailful of water from this pond, and after shaking it up, you will find the bottom of the pail covered with these shrimps."

The Chair said: "The question that concerns us as Fish Commissioners is the question of economy in raising fish for distribution. Up to the present time, as I said before, it has been simply a question of expense."

Mr. Amsden then addressed the meeting as to the objects of the Society of which he is Secretary. When he concluded Mr. Seal said:

"As I understand it, one of the fundamental ideas in fish propagation, particularly in the case of the whitefish and shad, is to make them so abundant by artificial means that there need be no restriction whatever in the fishing. I believe that will be found to be a part of the late Professor Baird's theory and intention in regard to the work."

The Chair said: "I know that was Professor Baird's idea, and that was what he hoped for, that by the co-operation of the States, the artificial propagation of fish could be carried on on such a scale as to make it unnecessary to have any protective laws. If such a thing is possible or practicable, that would be the easiest and simplest way of disposing of the question, for I think all the gentlemen here who have had anything to do with legislation for the protection of fish and game will bear me out in saying that there is no more difficult problem to handle than that. Mr. Cheney has given you a little of his experience; others have spoken of it, and concerning my own experience in the last State Legislature, when I was summoned to give my advice on the Game Laws, I can say but little to the credit of Game Law legislation. The entire question seems to be one of influence and of locality; no one had ideas general and broad; one senator would want one thing, and another senator another, and when their amendments would go to the Assembly the assemblyman from the same locality would want them changed. It is extremely difficult to obtain proper fish and game legislation. I hope this matter of the propagation of fish could be shown to be a remedy for excessive fishing and render unnecessary fish and game laws. This would clear the way for us very much. A former President of this Society, Mr. Robert B. Roosevelt recently remarked that he had about reached the

point of despairing of ever accomplishing anything in the way of fish and game protection by law."

Mr. Seal said: "I think the increase in shad-hatching on the Atlantic coast is a case that points to possibility. It is a matter that is familiar to all the members of the United States Fish Commission, but perhaps to a number of others there is nothing known about it. In 1885 the catch was in the neighborhood of 5,000,000. Last year it was estimated at 10,000,000, and appears to be increasing at the rate of a million a year. The output of shad fry by the United States Fish Commission alone is now so great, that if seven or eight out of each one hundred survive they will equal the entire shad catch of the Atlantic coast. On the Pacific coast the catch is becoming as abundant as on the Atlantic."

Mr. Cheney said: "I understand what has been done in the way of increasing the shad and whitefish, but I would like to know if the gentleman ever expects to stock a stream with brook trout in one night."

Mr. Seal said: "Certainly, not."

Captain Collins here presented his paper entitled "The Fisheries at the World's Fair." Before reading, he said, "I had expected from Henry Ives Cobb, the architect of the Fisheries Building, the plans of the buildings, which I desired this Society to see, so that a good idea could be be formed of them. I have been disappointed in this, though I understand the plans are now being printed on a reduced scale, and it will be possible for me in a few days to send them to all members of the Society, and to others who are interested in making an exhibit in Chicago in 1893."

After the reading of the paper the Chair called for discussion.

Dr. Parker said: "Regarding the matter of influence of fish in settling the country, I think the most direct illustration of that is in the effect that the brook trout has

on the people of northern Michigan. It has done more to settle up that section of that country than any one fact that has occured in the history of the country."

The Chair said: "It is understood that we are to assemble here to-morrow morning, at 10 o'clock, and I would like to urge upon members the importance of their being here at that time, as I would like to have transacted certain business before taking up the reading of the papers."

On motion of Mr. Mather, the Society then adjourned to meet Thursday, May 28th, at 10 o'clock, A.M.

Minutes of an adjourned meeting of the American Fisheries Society, held Thursday, May 28th, 1891.

At 10 o'clock the Chair called the members of the Society to order, and asked for reports of Committees.

Dr. Cary presented the report of the Auditing Committee approving the Treasurer's account. The report was, on motion, adopted.

Mr. Cheney, of New York, presented the following report from the Committee appointed to make nominations for officers for the ensuing year:

Mr. President and Gentlemen:

Your Committee present the following nominations for officers for the American Fisheries Society for the year ensuing:

President, DR. H. A. HENSHALL.....Ohio.
Vice President, J. C. PARKER.....Michigan.
Treasurer, HENRY C. FORD.....Pennsylvania.
Recording Secretary, EDWARD P. DOYLE. New York.
Corresponding Secretary, DR. TARLETON H. BEAN, [Washington, D. C.

EXECUTIVE COMMITTEE.

S. H. KAUFFMAN.....Washington, D. C.
W. A. BUTLER, JR.....Michigan.
L. D. HUNTINGTON.....New York

H. H. CARY.....Georgia.
B. B. PORTER.....California.
W. L. MAY.....Nebraska.
W. M. HUDSON.....Connecticut.

On motion, the report was ordered received, and on further motion, the Secretary was directed to cast one ballot for the ticket for officers presented by the Committee. By unanimous consent the Secretary cast the ballot, and the officers were declared elected.

Dr. Henshall reported as follows from the Committee appointed to consider means for the increase of the Society's membership and the widening of its influence.

"Gentlemen: Your Committee, to whom was referred the matter of devising some plan to enlarge the membership of the American Fisheries Society, have had the same under consideration, and would respectfully offer the following report:

"That in order to increase the interest in the American Fisheries Society to extend its influence and to augment its usefulness, it is of the utmost importance that its membership should be largely increased; and whereas there seems to be an impression that only those directly interested in the culture or scientific investigation of fishes are eligible to membership, therefore, be it

"*Resolved*, That all anglers and members of fish and game protective organizations, and all persons who feel an interest in the fish and fisheries of the United States, be and are hereby cordially invited to become members of the American Fisheries Society, and to lend their aid and co-operation in carrying out the objects of said Society; and be it further

"*Resolved*, That the above resolution be published in all papers and periodicals devoted to the interests of fish and fishermen; also that a circular letter embodying the said resolution be printed and sent to members of the Society for distribution; also,

"*Resolved*, That a Committee be appointed to carry out the provisions of this report."

On motion, the report was received and adopted, and the President appointed the following Committee: J. A. Henshall, Edward P. Doyle, and Dr. Tarleton H. Bean.

The question came up as to the place for the next meeting.

Dr. Parker, of Michigan, named Rochester. Mr. Cheney, of New York, named the City of New York.

The President announced that the members would decide by ballot, and appointed Mr. Porter, of California, and Mr. Mather, of New York, as tellers. The vote was as follows:

New York, 12; Rochester, 6.

The President declared that New York was the choice of the meeting.

Dr. Cary moved that the Woodmont Rod and Gun Club, of Washington, be made an honorary member of the Society.

The motion was unanimously adopted.

On motion of Dr. Parker, of Michigan, the thanks of the Society were tendered the officers of the Woodmont Club for the dinner given the members of the Society the evening previous.

On motion, the time for the next annual meeting was made the last Wednesday and Thursday of May, 1892.

Mr. Amsden offered the following resolution, which, upon motion, was unanimously adopted:

WHEREAS the object of the American Fisheries Society is not only to foster the game fish of the country, but to do everything in its power to cheapen the cost of fish food;

AND WHEREAS the Great Lakes, a vast body of water on our northern border is an international water, lying between us and a foreign country;

AND WHEREAS the work of protection and propagation of fish in these waters is being conducted by the several States and Canada, each independent of the other, with

slight probability of ever arriving at a harmony of action;

And whereas the Federal Government with its great scientific, mechanical, and financial resources, its power to make agreements with Canada, and its ability to enact and enforce regulations, can undertake this work with far greater results, therefore, be it

Resolved, That we respectfully petition and urge on Congress the importance and duty of its assuming this work; that speedy action be taken to secure uniform laws with Canada, regulating the fishing on the Great Lakes, and when done, that ample appropriations be made for their enforcement and also for the propagation of food fish in such waters.

On motion, a vote of thanks was given Mr. Mather, of New York, for the very valuable index of the proceedings of the Society published in the last annual report.

On motion of Mr. Cheney, the following persons were appointed a Committee on Local Arrangements for the next annual meeting: Eugene G. Blackford, Fred. Mather, and Edward P. Doyle.

An interesting discussion then occurred as to rainbow trout.

A member asked: "I would like to know why the rainbow trout will sometimes abandon the streams in which they have been placed?"

Mr. Cheney said: "The rainbow trout which are brought into our streams do not remain there. Undoubtedly the brown trout will live in warmer water than the brook trout, but if going to cold water has any effect on them, why should the rainbow trout stay in streams there? If the waters of England are too warm for the brook trout and they stay there, why do not the rainbow trout stay there also?"

Mr. Seal said: "The rainbow trout will stand a much higher temperature than any of the others. We are able to keep them comfortably at as high a temperature as 75°

at Central Station. Last summer the last trout died at 82°. The other species died sooner."

The Chair said: "New York State has practically discontinued the breeding of the California trout."

Mr. Clark said: "In our streams the best work has not been done with California trout on account of temperature."

Mr. Ford said: "There are two streams in Pennsylvania that I now have in mind in which trout were planted. The trout left one of those streams, which is a comparatively cold stream in the spring, and ran into the other, which is still colder."

Mr. Mather said: "What Mr. Ford said is just what occurred to me; that if the water of the stream is not warm, the trout will not run down to another where the water is warmer, but will naturally run to where the water is cold. I think perhaps there are other conditions that we do not understand why our brook trout run down stream and go away as our rainbow trout do here, but certainly I should think the temperature would drive them out."

Mr. Seal said: "I find that in Mexico they appear to accomplish more with the rainbow trout than we can here, but they cannot do much with any of the other species of trout."

Mr. Mather then read a paper on the breeding habits of the yellow perch. After the reading of the paper, the Chair called for discussion.

Mr. Seal said: "I would like to add the following information on the subject. We have numbers of yellow perch spawn in our aquaria at Central Station; they spawn from November to April. This is due to the high temperature. One of our watchmen, Mr. William Maynard, observed their manner of spawning, which is very much like that of the gold-fish in the extrusion of the eggs and fertilization, except that it takes place on the bottom. The spawn is deposited in two parts. We measured the

spawn of a single fish, and found it to be seven or eight feet long. It is really a tube extruded in folds arranged like the bellows of an accordeon, and when closed is only a few inches long. We found one of them with half of the spawn extruded, and that side was flat, while the other was full and round. By squeezing out the other half, we were able to see how the spawn was deposited."

A paper was then read by Mr. William T. Seal on the transportation of living fishes. In response to the request of the Chair, Dr. Cary said: "Some years ago I remember reading in the *Fish Commission Bulletin* that a number of carp, I think about fifty, were shipped to various parts of the country by express in a small tin pail holding about six quarts of water. I myself carried in a small fish bucket, about the same size, fish from Washington to New York, and from New York back to Washington and then to Atlanta, Ga., without losing a single fish. The question I want to ask is, if a given number of fish can be better carried in a small quantity of water than in a large quantity?"

Mr. Seal said: "It is not the quantity of water at all, but the fact that where the water is shallow there is greater agitation and consequently better aeration. The shallow bucket referred to by Dr. Cary is the one that has been adopted by the United States Fish Commission. Where there is much depth of water the surface is much agitated, and the bottom may be wholly unaerated and foul."

Mr. Mather said: "The case that Dr. Cary cites was with carp, but that will not work with the trout. In the transportation of trout and salmon we have for the past three years at the hatchery which I superintend abandoned the use of the siphon and strainer tube, and have used a garden syringe about twelve or fifteen inches long, which we like much better than anything else."

Mr. Clark said: "The line that I was working on was not in transporting fish, but in seeing what I could do in a hatchery in keeping them there. In my experience I found

I could keep a given number in closed jars, where they were perfectly still, from six to ten hours longer than in an open jar."

Mr. Seal said: "How do you account for this? It is contrary to all we know concerning the diffusion of gases."

Mr. Clark said: "It is a good deal like going back to the old gravel methods. We can get better results with gravel than on trays. After the eggs are advanced to a certain stage, they do as well on the trays as they do on the gravel, but up to that time we get from five to twenty-five per cent. better results on the gravel. What causes the difference in the air-tight vessel and the open one I cannot say."

After the discussion the Chair announced that several papers had been received from members who were unable to attend the meeting. He asked that unanimous consent be given to the Secretary to print them. This was given.

On motion of Dr. Henshall, a vote of thanks was given the Directors of the National Museum for their kindness in allowing the Society the use of their lecture-room.

The meeting then, on motion, adjourned *sine die.*

EDWARD P. DOYLE,
Recording Secretary.

PART SECOND.

ON THE TEETH OF FISHES AS A GUIDE TO THEIR FOOD HABITS.

By Dr. James A. Henshall.

The food of fishes is either vegetable or animal, as in the case of all other vertebrates. When vegetable, it, of course, consists of aquatic plants and *Alga*, while the ani-

mal food may be batrachians, fishes, crustaceans, mollusks, insects and their larvæ, etc.

A fish's diet may be restricted to but one of these various classes, or it may go through the entire bill of fare like a Christian; but the general character of the food of a fish may usually be determined by the structure and position of its teeth, so that an examination of the teeth of a fish will indicate whether it is herbivorous, carnivorous, or omnivorous.

The teeth of most fishes, when they exist in the mouth, may be in patches or bands of equal teeth, and may be either villiform or brush-like, setiform or bristle-like, cardiform or card-like, or rasp-like, or they may be of unequal size and sharp and conical, compressed or lancet-shaped, or blunt, broad, or truncated, molar-like, canine, incisors, etc. The teeth may be situated on the jaws, vomer, palatines, pterygoids, tongue and gill arches, or the mouth may be entirely toothless, and the teeth confined to the pharyngeal bones of the throat, or they may exist in the œsophagus, or gullet.

Fishes with unequal, sharp, conical, or canine teeth are piscivorous, and feed upon small fishes, which they swallow whole; and those with lancet-shaped teeth, while also piscivorous, cut or lacerate their prey before swallowing it. Fishes with pavements of molar-like teeth feed upon crustaceans and mollusks, while those with toothless jaws are herbivorous, or if carnivorous, feed upon minute animal organisms, and are in no sense piscivorous.

Beginning with toothless fishes, that is, with no teeth in the mouth, are the minnows (*Cyprinidæ*), and suckers (*Catostomidæ*); they are both herbivorous and carnivorous. All of the minnows, with intestines several times longer than their bodies, feed principally upon vegetable matter, and the others upon insects and their larvæ and minute crustaceans (*Entomostraca*). Minnows have a few very small pharyngeal teeth, with or without grinding surfaces.

Those having teeth with grinding surfaces are herbivorous, and those without these masticatory surfaces are carnivorous. The pharyngeal teeth of the suckers are larger and more numerous than in the minnows, and may be sharp, or more or less truncated. They feed upon vegetable matter and micro-organisms extracted from the mud, and some of them on thin-shelled, minute mollusks.

The larger toothless fishes, as the sturgeons, whitefish, mullets, etc., feed upon minute animal organisms, mostly crustaceans. Some of the large toothless fishes, as the shovel-nosed sturgeon, paddle-fish, and saw-fish, have the snout prolonged into organs for stirring up the mud or sand of the bottom in order to obtain the small animal forms upon which they feed. The paddle-fish has the gill-rakers developed into a beautiful straining apparatus for securing these minute creatures. The saw of the saw-fish is not used, as has been frequently asserted, as a weapon for disabling its prey for food, though it is used as a weapon of defense. Its use in procuring food is by stirring up the mud or sand of the bottom, and the food, as in the case of the paddle-fish and shovel-nosed sturgeon, is composed of small forms. I have frequently observed schools of half-grown saw-fishes feeding in shallow water by raking the bottom with their saws, which are well-fitted for this purpose. Their food seemed to be principally small crustaceans and mollusks.

Fishes with small, feeble, sub-equal teeth, as the herrings (*Clupeidæ*), anchovies (*Engraulidæ*), silversides (*Atherinidæ*), etc., as we might imagine, feed upon minute or microscopic invertebrate forms, mostly crustaceans, which exist in countless myriads in both fresh and salt water.

Fishes with bands or patches of villiform or brush-like teeth, as the sunfishes (*Centrarchidæ*), catfishes (*Siluridæ*), striped basses (*Labracinæ*), etc., feed principally on crawfish, crabs, shrimp, etc., insects, and occasionally small fishes. The black bass is not, as popularly supposed,

a piscivorous fish—indeed, not so much so as the brook trout, which has stronger, sharper, and more unequal teeth. The principal food of the black bass is crawfish, as the shrimp, squid, and crab, is of the striped bass, though neither fish will object to a minnow, if it can catch it, when hungry. The minnow is a good bait for the black bass, as the menhaden is for the striped bass, but it must not be surmised from this fact that they are piscivorous in their habits.

A minnow on a hook is in a disabled condition and cannot escape, and most fishes will take it under these conditions, whereas if it was free it would easily get away. Fishes have been found in the stomach of sturgeons, but that is no indication that it is piscivorous, which it could not be with its toothless jaws and sucker-like mouth entirely below the projecting snout; but finding a disabled or dead fish on the bottom, it swallows it. So, whenever the black bass, striped bass, white perch, or the cat-fishes, or any fish with brush-like teeth, finds a disabled fish of suitable size, on a hook or otherwise, it is taken in. I have demonstrated this fact time and again by dropping a hook baited with a minnow in the midst of a school of similar fishes, when it would be singled out and seized by a larger fish which had failed to notice those that were free.

I cannot refrain from saying, in this connection, that the black bass has been greatly misrepresented and unjustly maligned and grossly abused as a piscivorous fish, and often by those who ought to have known better. It has been accused of depopulating rivers of young shad that have been planted in them, while the striped bass of the same waters have escaped such imputation. It has been charged with the destruction of brook trout in certain waters, while the cat-fishes have not had a word raised against them. But happily the charges have been proven false, and the black bass has been acknowledged to be not so black as it has

been painted. I lately saw a statement in public print from the superintendent of a fish-hatchery that the pike-perch (*Stizostedion vitreum*) was not so voracious or destructive to other fish as the black bass or mascalonge! Comment is unnecessary.

I found this prejudice existing in England, and the opposition to the introduction of the black bass into British waters was very pronounced. Mr. Marston, of the London "Fishing Gazette," informed me that the prejudice had been imbibed from American writers and anglers, who, in order to convince British anglers of the fine game qualities of the black bass, had unwittingly overdone the matter, and conveyed the impression that it was a more voracious and piscivorous fish than their pike! I wish to say right here that the reason of the failure to stock certain waters in England successfully with black bass is that said waters were not suitable for the small-mouthed bass—the kind experimented with. If the large-mouthed species had been introduced I have no doubt but it would have done well. It is eminently fitted for the sluggish, grassy broads of England, and would not be so destructive to other fishes as their perch, not to mention their pike. We have in America thousands of small lakes, many of them without inlet or outlet, where the black bass has existed from time immemorial with the pike, pickerel, perch, sunfishes, suckers, ciscoes, and even brook trout, without detriment to either of these species; indeed, if any species suffers, it is always the black bass.

The piscivorous fishes which swallow their prey whole are those with cardiform teeth, as the pickerel, or with sharp and conical teeth as the dogfish (*Amia calva*) of fresh waters, or with canine teeth, as the mascalonge, barracuda, pike-perch, snappers, weak-fish, etc. All fishes with unequal, sharp, conical or canine teeth may with certainty be pronounced entirely piscivorous in their habits, feeding principally or entirely upon small or young fishes.

or which are small enough to be swallowed whole. Sometimes, however, their eyes prove to be larger than their stomachs, and they perish in the attempt to swallow a fish many sizes too large for their capacity.

Fishes with lancet-shaped teeth, as the kingfish and Spanish mackerel, or with strong, compressed teeth, as the bluefish, are entirely piscivorous, but bite, cut, or lacerate their prey before swallowing it. The teeth of such fishes are miniature shark-teeth, and they are equally as destructive to their smaller congeners.

Fishes with prolonged or produced jaws, armed with strong, sharp, unequal teeth, as the marine and fresh-water gar-fishes, morays, etc., are also wholly piscivorous.

Fishes with incisor teeth, as the sheeps head, pin-fish (*L. rhomboides*), scup, etc., have also molar-like teeth, and feed on crabs, shrimps, or mollusks, and are not at all piscivorous. By the aid of its human-like incisors the sheeps head can readily remove barnacles and other mollusks from rocks, timbers, etc., and crush them with its powerful molars.

The drum-fish (*P. chromis*), and the fresh-water drum (*A. grunniens*), have villiform teeth on the jaws, but a strong pavement of rounded teeth in the throat for crushing the shells of mollusks, which is their principal food, though, as might be judged from their villiform teeth, they occasionally swallow small fishes and crustaceans.

Thus, by observing the character and position of the teeth of fishes we have a sure and certain indication of the character of their food, that is, of their principal and natural food. Of course, there will be exceptions, but they only prove the rule. A herbiverous fish will occasionally swallow animal food, while a carnivorous fish will sometimes swallow vegetable matter. A fish that lives mostly on crustaceans, may consume twenty-five per cent. of fishes, and *vice versa*. They should be judged, however, by what they feed on mostly and habitually, when situated so that

they can exercise their choice in the matter, for change of environment may involve a change of diet. The horse and dog may take kindly to sweetmeats occasionally, but the one returns to his oats and the other to its vomit, notwithstanding, and it would be foolish to magnify their vagaries into confirmed habits.

REARING AND DISTRIBUTING TROUT AT THE NORTHVILLE STATION, U. S. FISH COMMISSION.

By Frank N. Clark.

Some six years since the question was brought up as to the practicability of rearing trout for distribution instead of planting the fry. This subject was suggested by Colonel McDonald.

As such splendid results had been achieved with planting carp partially grown, it was suggested that better results might be obtained with planting partially-grown trout. The work was inaugurated by the U. S. Fish Commission at the Northville station in the winter of 1886–87, and for that season we succeeded in distributing in the following December, January, February and March, some 11,000 fish.

From this beginning the work has been quite successful, until the season of 1890–91 we have distributed to Dakota, Nebraska, Iowa, Minnesota, Wisconsin, Indiana, Ohio, and Michigan, something over 150,000 yearlings and fingerlings; and I confidently believe, in the near future, that from the Northville station alone we shall reach the 1,000,000 mark in our work of rearing and distributing yearlings.

Much has been said and written upon this subject detrimental to the work of feeding fish that are to go into wild streams. It has been suggested by many that the trout, after their introduction into the stream, would naturally be in search of the food they had been accustomed to, while in the feeding-tanks or ponds, and before they acclimated themselves to other food, would starve.

I would ask our fish culturist friend if it is not a fact, beyond satisfactory contradiction, that in nine cases out of ten that the stream adjacent to any fish-culture establishment where trout are bred, and where trout partially grown are invariably escaping, does not become, in a few years, better stocked than streams where perhaps 100,000 have been planted.

I call to mind a stream in Michigan that was planted with 500 yearling brook trout in 1887, and again in 1888 we visited the stream and planted 500 more of the same variety, and from my own observation at that time I saw and counted twelve large trout near where we made the plant. These fish were also seen by our own car-men as well as train-men.

I have no doubt that many of the State Commission think it necessary to plant fry in order to satisfy their constituency, as applicants with whom I have corresponded, when we notify them that their application has been passed upon and an allotment of 100 or 500 trout have been assigned to their stream, seem to feel insulted, and expect from 3,000 to 25,000. This we have no difficulty in overcoming, after they have received the fish and have noticed the size as they are planted.

In this connection it would, perhaps, be well to give a slight description of our plan of rearing trout at the Northville establishment. Not that we think it any better plan than others, or any different than many, but that it may bring out discussions at this meeting that may be valuable to all.

Our eggs, after impregnation, are placed on gravel, in troughs with slight partitions, perhaps two inches in height and fourteen inches in width by eighteen in length. In this space we place from 10,000 to 15,000 eggs; they are allowed to remain on the gravel until the eye-spots show, when they are removed to trays where they are hatched and held until about one week before the sack is entirely absorbed, when they are removed to the feeding-tanks.

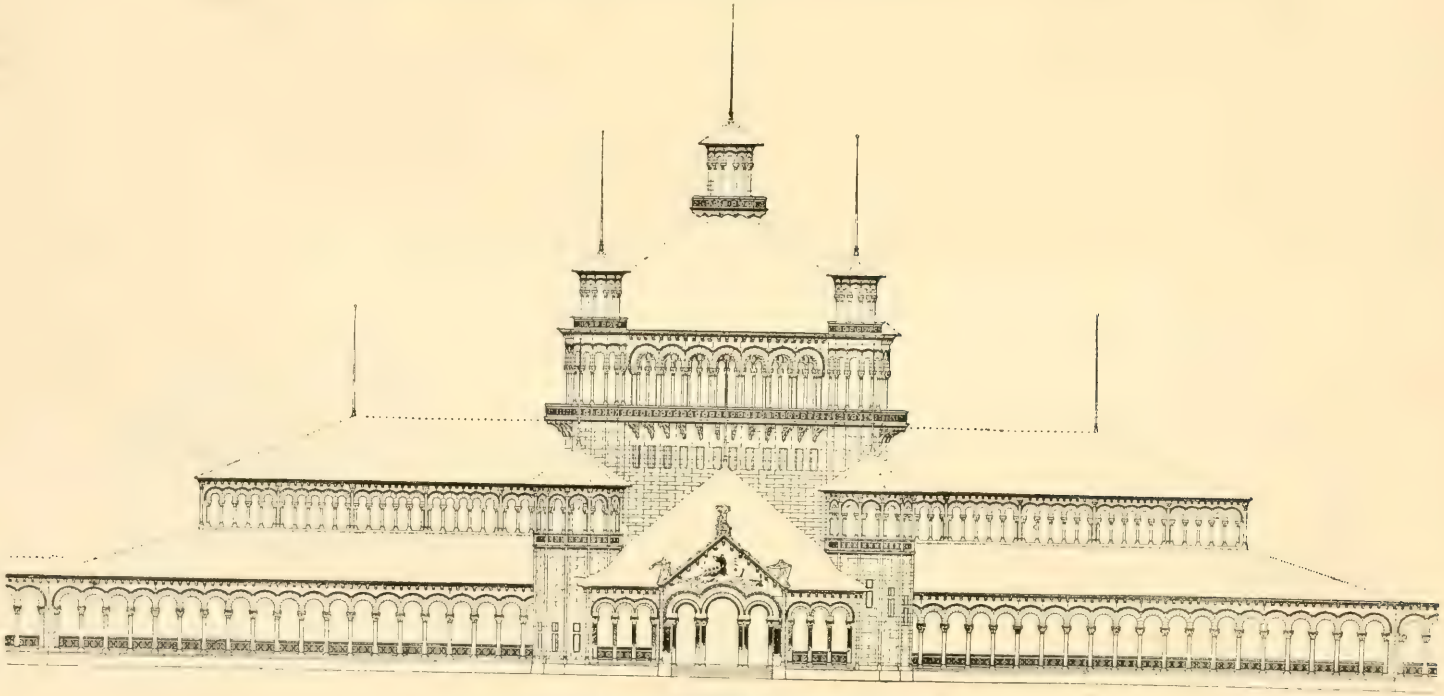
These tanks are constructed of 1½ inch plank, and made from four to six feet in length by two feet in width and one foot deep, with a fall from one to the other of nine inches. In these tanks we first place 10,000 trout, and as they grow they are gradually thinned out until distributed or placed in rearing-ponds.

In feeding, beef's liver is used, which is prepared at the slaughter-house in Detroit and shipped daily by express, arriving at Northville in the evening for the night watchman to strain for the next day's use—the quantity depending upon the size and quantity of fish to be fed. At the present time we are feeding about seventy-five pounds per day to about 350,000 trout.

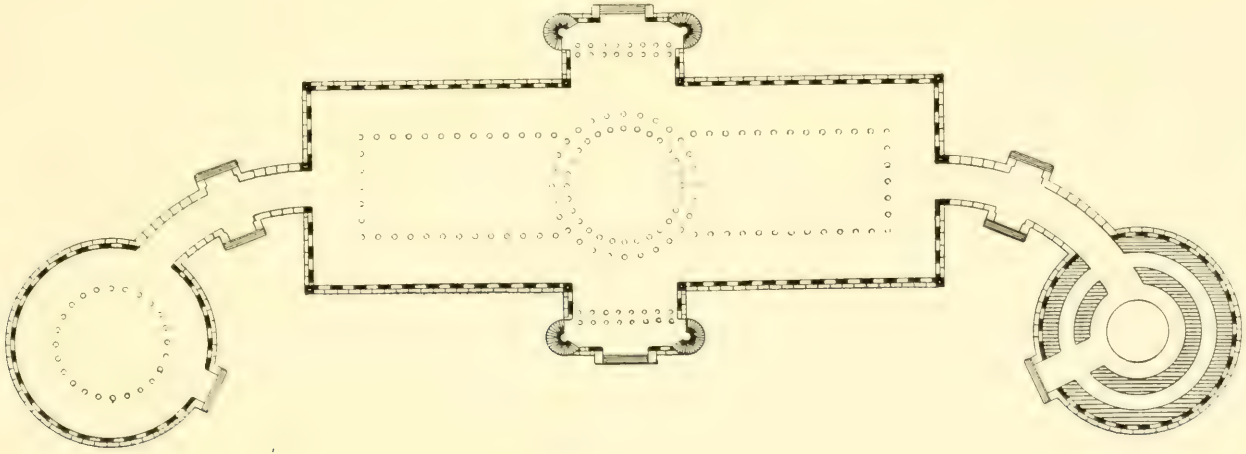
It is intended that the same person shall do the feeding at all times; by so doing he will be the best judge as to quantity to be given. For the first two months the trout are fed eight times per day, all feeding being done between daylight and dark, and always at the same hour. After two months this is reduced to six feedings per day, for one month, and then reduced to three feedings per day until distributed.

Salt is introduced into the feeding-tanks twice a week, giving to each tank about six quarts, making it quite brackish. We also introduce muck twice each week, aiming to make the water very muddy.

The introduction of muck and salt is done when a full head of water is running, so it will pass off quickly. Experience has taught that the introduction of salt and



FISH AND FISHERIES BUILDING.



GROUND PLAN OF THE FISHERIES BUILDING.

muck is absolutely necessary to keep the trout in the best of health and to avoid fungus.

Three times per week the refuse from the fish, as well as the muck which does not run off, is removed by the use of syphons, and once per week the tanks are rubbed down with brushes.

I enter into the details of this matter more particularly, because I do not call to mind that any one has ever given this subject publicity.

THE FISHERIES AT THE WORLD'S FAIR.

By J. W. Collins.

It is doubtless safe to assume that all who are prominently identified with commercial fishing, with angling, with fish culture, or with the scientific study of questions relating thereto, will feel an interest in that section of the World's Columbian Exposition which will be specially devoted to an exibition of all that pertains to them. It may well be a matter of special gratification that the fisheries will receive more consideration at this exposition than has ever been accorded them elsewhere under similar circumstances. And it should be all the more satisfactory to Americans, because heretofore there has never been adequate and suitable provision made at any exposition in this country for a fishery exhibit, and all attempts in this direction have been limited by small appropriations and inadequate space.

It is true that there have been numerous fishery expositions in different European countries, some of which have been national and others international. It is also well known that the United States has participated in two of these, and that the highest honors were awarded to America

and Americans at Berlin and London. But, while the National Fish Commission succeeded so well in securing recognition for our fisheries abroad, and though all honor is due Prof. G. Brown Goode, who so ably represented this country on those occasions, it nevertheless will be apparent to all that, while it was then practicable to illustrate the principal features of American fisheries and fish culture, it was not possible, with the means and time available, to make a thoroughly exhaustive presentation of them.

Never before has the occasion presented itself to do this, and, as has been stated, it should be a matter of much satisfaction that the management of the World's Fair have arranged to construct a group of buildings specially designed for the purpose of a fisheries exhibit—an action which should result in the most hearty co-operation of all who are interested in fishing and the industries dependent thereon, and the inauguration of such an effort on their part as will result in making this section of the Exposition equal to any in completeness and attractiveness.

Before proceeding to a more detailed consideration of these buildings, permit me to say that the exhibit of the United States Fish Commission, illustrative of its work and functions—including scientific exploration, fish culture and fisheries, but exclusive of live fish—will be located in the Government building immediately opposite the centre of the main fisheries building, with which it will be connected by a bridge crossing the ornamental lagoon.

For the reception and accommodation of general exhibits of fish, fisheries, and fish culture, both domestic and foreign, there will be a group of three buildings, most admirably and appropriately located on an island in the lagoon at the northern part of Jackson Park near the outlet to Lake Michigan. These buildings have been designed in the Spanish Romanesque style by the well-known architect, Mr. Henry Ives Cobb. They will be somewhat unique, but

unexceptionally graceful and pleasing to the eye, while their ornamentation, form, and dimensions have been considered with the special object of adapting them to the purposes for which they will be erected. Withal, they will have a warm tone of color, which will offer a pleasing contrast to the other Exposition buildings. The illustrations herewith presented will doubtless render unnecessary any elaborate description, since a consideration of them will enable one to form a correct estimate of the leading features of Mr. Cobb's design.

The main or central structure is rectangular in form, 450 feet long and 150 feet wide. This will be the great central hall, where will be displayed all that pertains to commercial fishing and fish culture, including apparatus of capture, boats, vessels, products, models of fish-breeding establishments, ponds, etc.

Connected with each end of the main hall by an elegant curved arcade is a polygonal building about 135 feet in diameter. The one at the east, nearest the lake shore, will be devoted to an exhibit of living specimens of fish and other forms of aquatic life. Let me say that this building will have a grand central rotunda 180 feet in circumference, around which will be placed the largest aquaria that it is practicable to use; while in the centre will be a pond twenty feet in diameter, with a beautiful fountain, beneath the spray of which will disport many ornamental fishes. Entering the galleries near the side of the building, the visitor will pass between two rows of large aquaria, in which, as in those previously alluded to, there will be representations of the fauna of the Atlantic, the Gulf of Mexico, the Pacific and interior waters, including the Great Lakes. No words of mine will, I believe, convey anything like an adequate idea of the beautiful architectural effect of this aquarial building, to the construction and equipment of which the Exposition authorities have very generously contributed. I will not, therefore, attempt

a description, but will content myself with the hope that all present will be there to see it in the summer of 1893.

In this building the United States Fish Commission will make a great national exhibit of our fishery resources, embracing many varieties of fish, marine invertebrates, etc. And right here let me say that it is the purpose of the Commission, as it is of the Exposition Management, to give consideration to species that are economically important, while the occasion will be improved to call attention to the great work that has been done by the State and National Governments in the artificial propagation and acclimatization of fish and other aquatic species, thereby restoring and maintaining abundance in waters that had become depleted by over-fishing or other causes. It is impossible to over-estimate the consequence of this work, either in the present or future, and it is beyond question desirable that this opportunity should be improved to make the public better acquainted with it than ever before.

The western building of the group is similar in form and construction to that devoted to the live-fish display. Here it is expected there will be assembled a magnificent and exhaustive exhibit of all that pertains to angling; and let us hope that the thousands of enthusiastic and public-spirited anglers in America and other countries, as well as all those interested in the manufacture and sale of angler's outfits, will join hands in making this the grandest display of this kind that has ever been seen. For never in the world's history has there been such satisfactory provision for showing all the details of the gentle art. Not only will there be ample room for installation of exhibits, but here, right in the shadow of the building, fly-casting and bait-casting tournaments can be held, and the art of the angler may be tested, from shore or boat, in friendly trials of skill, and in the exhibition of the various modes and methods of angling.

As to what may be embraced in this fisheries exhibit, I

believe the classification adopted is sufficiently broad in its scope to permit the inclusion of anything which will be strictly germane to fish or fishing. This seems to cover the whole field, and under it not only will it be proper to show living and mounted specimens of all forms, from microscopic animals to whales, together with aquatic or marine vegetation, and the apparatus for their capture, but it will also include the products of the fisheries and their manipulation in all their varied forms of methods and material. Beside this, there will be ample opportunity to illustrate angling of every description, together with fish culture and the literature of fishing and all that pertains thereto. Indeed, I can think of nothing which would be of value to the fisheries exhibit which cannot properly be included under the classification referred to.

I have thus briefly outlined what has been and will be done by the Exposition Management to provide for a great fisheries exhibit. It now remains with others to make this one of the most attractive and successful features of the World's Fair, as I believe it will be; for it must be fairly assumed that those who are interested in fishing, and all that relates to it, will not permit this grand opportunity to pass unimproved. From information now at hand we have reason to expect marked enthusiasm in this matter on the part of all the fisheries interests in this country, and that as a result there will be gathered at Chicago, in 1893, a magnificent and exhaustive display illustrative of angling, commercial fishing, fish culture, and the science of the seas. It will thus be possible for the citizens of other countries who are our customers to find there an infinite variety of fishery products—the harvest of the seas, lakes, and rivers—and the whole world may see object-lessons which will convey in the most emphatic manner information concerning the methods and magnitude of our fisheries, and their history and development from the earliest settlement of the country. In the same way the world

may learn what has been done in America by the States and Federal Government to maintain and increase the supply of fishes by artificial propagation, etc., and may become familiar with the results which have been achieved here by scientific exploration of our inland waters and the ocean depths.

I have reason also to believe that the fisheries of several foreign countries will be fairly illustrated. It is not necessary to speak of how much this will add to the interest or importance of this part of the Exposition, since I am sure this will be understood by all. But it is certain that it must be of great moment to us as a nation to gather here the arts and appliances which are used for the capture and preparation of fish in other lands; for, in addition to the interest we may naturally feel in seeing the exhibits of foreign countries and comparing them with our own, it must be assumed that our fishermen can learn many things of value and importance to them by a study of such exhibits.

But, aside from the mere question of trade and the enthusiasm which comes from recollection of sport we have enjoyed in angling, or the official zeal felt by those who are charged with great responsibilities, there is a peculiar reason why our love of country should prompt us to a special effort to bring prominently to the notice of the world an American industry which has played so prominent a part in the history and development of this nation.

It is not, perhaps, so well known as it ought to be that fishing was the first industry prosecuted in the Western World, and that it led to the settlement of regions that offered small attraction of other kinds. It is, nevertheless, an historical fact that fleets of fishing vessels followed close in the wake of Columbus, and, within a few years after his discovery of America, fishermen of Spain, Portugal, England, and France were plying their lines on the banks of Newfoundland. The very names of some of our

headlands, islands, and bays are suggestive of fishing and the abundance of fish in their vicinity. Captain John Smith gave the name of Cape Cod to that famous arm of Massachusetts, because, as he said, cod were so abundant near there that they "belabored" the sides of his ship.

It was fishing that led to the settlement of New England. When the delegates from the Puritans went to King James and asked for permission to settle America, he, with true Scottish thrift, asked what profit might arise. They answered, "Fishing." This seemed to impress the King very favorably, for he said: "So God have my soul, 'tis an honest trade; 'twas the Apostles' own calling." And so this little band of pilgrims established themselves on the rugged, rock-bound coast of New England, in a harbor which they described as being in the shape of a fish-hook.

The free school, one of the grandest and most important heritages of American children, was first established and maintained from the income of the fisheries at Cape Cod.

The part which our fishermen took in the establishment of the independence of this country forms one of the most striking and glorious pages in the history of the Revolution. Indeed, it is perhaps not too much to claim that the result of that struggle might have been very different had it not been for the courage and aggressive energy of the men who had been trained in our fisheries. On more than one occasion they saved the American army from defeat, and enabled it to achieve important victories. I will not stop to recount them in detail, but will simply say that we have it on so high an authority as General Knox, Washington's chief of artillery, that the victory at Trenton—one of the most important of the Revolution—was due, more than anything else, to the part taken in it by fishermen. Years after the close of the war, when General Knox was a member of the Massachusetts Legislature, Marblehead applied for a charter for a bank. There was opposition to it.

Then General Knox arose and stated the claims of Marblehead and the reasons why they should be recognized. "I am surprised," said he, "that Marblehead should ask so small a privilege as that of banking, and that there should be opposition to it. Sir, I wish the members of this body knew the people of Marblehead as well as I do. I could wish that they had stood on the banks of the Delaware River in 1777, in that bitter night when the Commander-in-Chief had drawn up his little army to cross it, and had seen the powerful current bearing onward the floating masses of ice, which threatened destruction to whomsoever should venture upon its bosom. I wish, that when this occurrence threatened to defeat the enterprise, they could have heard that distinguished warrior demand: 'Who will lead us on?' and seen the men of Marblehead, and Marblehead alone, stand forward to lead the army along the perilous path to unfading glories and honors in the achievement of Trenton. There, sir, went the fishermen of Marblehead, alike at home upon land or water; alike ardent, patriotic, and unflinching, whenever they unfurled the flag of the country."

The privateers of that period were manned mostly by fishermen, and their captures of British merchantmen undoubtedly had much to do with the conclusion of the war and the establishment of American independence. Sabine remarks that the books of Lloyd's Coffee House show "that from May, 1776, to February, 1778, the American privateers (173 in number) made prizes of 733 British vessels, which, with their cargoes, were worth more than $25,000,000, after deducting the value of the property retaken and restored. * * * * * * * The mercantile interests became at last so clamorous as to render the war unpopular, and to embarrass the Ministry in their measures to continue it."

I deem it unnecessary to enter into a fuller discussion of the public services of our fishermen, who, in the second

war with Great Britain, manned our war ships and swarmed in every sea on privateers, and who, at all times, whenever the occasion demanded it, have "rallied 'round the flag" to maintain and uphold it against all aggression. But I will say that this is a matter that should not be passed unnoticed, and is one that should prompt us to make an additional effort, if need be, in gathering and placing on exhibition at the World's Fair all that may tend to illustrate every phase and condition of those industries in which we are especially interested, and for the conservation and maintenance of which we are in duty bound to exert ourselves to the utmost of our ability.

KENNERLY'S SALMON.

By Tarleton H. Bean.

The smallest known of the Pacific salmons was first described by Dr. George Suckley, in 1861,* under the name of *Salmo Kennerlyi*—Kennerly's Trout, or Chiloweyuck red salmon trout. In 1862† Dr. Theodore Gill proposed for this species the new generic name *Hypsifario*, because of its "compressed body, projecting snout," etc. The remarkable changes in the genus *Oncorhynchus* during the course of spawning were at that time less known than at present. About 1882 Dr. David S. Jordan examined the *Salmonidæ* in the National Museum, in Washington, D. C., and came to the conclusion that Kennerly's salmon is identical with the common red salmon, or blue back of the region (*Oncorhynchus nerka*), and this belief was generally accepted as final. The material bearing on this relation-

* Annals Lyc. Nat. Hist. N. Y., 1861, page 307.

† Proc. Acad. Nat. Sci., Phila., 1862, page 330.

ship, however, was chiefly the actual red salmon collected by Captain Charles Bendire, U. S. A., and the individuals were considerably larger than the Kennerly's salmon to be discussed in this article. Since the time of Dr. Jordan's study of the Museum specimens, we have received new material and recent information which enable us to place the species, as I think, in a different light, and to contribute something of interest to its life-history. On November 26, 1888, and October 8, 1889, Professor O. B. Johnson, of the University of Washington, Seattle, Wash., collected for the Smithsonian Institution a large series of these small salmon in a little stream, tributary to Lake Washington, near Seattle. In March, 1891, Dr. George M. Dawson, of Ottawa, Canada, sent the writer a photograph of one of the fish which he found in Nicola Lake, British Columbia, September 7, 1890. Each of these gentlemen added something to our knowledge of the habits of the species.

This recent material includes only salmon in or near the spawning condition, yet it seems to me now sufficient to warrant the separation of Kennerly's salmon from the red salmon as a sub-species at least, and I would write its name *Oncorhynchus nerka*, sub-species *kennerlyi*. In the first place, Kennerly's salmon becomes sexually mature when only eight inches long, and seldom exceeds ten inches at any time of life. It has about thirty gillrakers, while the red salmon has about forty. Its fins are much larger than those of the red salmon. It lives permanently in fresh water, most of the year in deep parts of lakes, from which it runs up small tributaries in autumn to spawn.

Names.—The describer of the species called it Kennerly's Trout; he records also the name Chiloweyuck red salmon trout. The Indians of the Chiloweyuck Lake region styled it *Tsimia*. According to Dr. Dawson, "The Kamloops Indian, or true Shuswop name of the fish, is *Kuk-en-owh*. The Okonagan Indian name, *Kuk-en-eh*, slightly differs."

Size.—In Dr. Suckley's original description the size of

adults is stated to rarely exceed ten or eleven inches. Among the examples forwarded by Professor Johnson were mature males and females little more than eight inches long; the spermaries of the males were well developed, and the ovaries were full of large and apparently ripe eggs. Dr. Dawson wrote as follows: "This salmon is probably seldom over a foot in length, generally about ten inches."

Distribution.—Kennerly's salmon was first described from Chiloweyuck Lake, near the Frazer River (latitude, 49°), east of the Cascade Mountains. Mr. Gibbs had it from the Nahoi-al-pitkun River, west of the Cascades. It has been reported also in Sweltscha and Pekosie Lakes. Dr. Dawson saw it in "Nicola, François, Fraser, and Okonagan Lakes, the first three tributary to the Fraser, the last to the Columbia." Professor Macoun informed Dr. Dawson "that he caught it with a spoon-bait on Arrow Lakes, Kootanie Lake, and on the Columbia River a few miles below Arrow Lakes, in June and July last. All the lakes mentioned are in part of their extent deep and clear, and all are or may be reached by the salmon from the sea (generally, I think, the *saw-qui*), except Kootanie Lake, which is cut off by a fall." In a letter dated April 3, 1891, Dr. Dawson writes: "Shuswop Lake may be added as another certain locality for the little land-locked salmon. In one of my note-books for 1877, under date of August 6th, the following note occurs: 'Indians now spearing by torch-light in the mouth of Eagle Creek a species of small salmon, which they assure me does not go to or come from the sea, but is now ascending from the lake to spawn.' * * * * Eagle Creek flows into Shuswop Lake near the present position of Sicamous Station on the Canada Pacific Railway. The date here given is nearly a month earlier than those previously quoted. * * * * * Nicola Lake is about ten miles in length; it is on the course of the river of the same name, which is a tributary of the Thompson. The lake is a little north of latitude 50°. From Nicola Lake it runs up the Upper Ni-

cola River (scarcely more than a large brook); and * * * on September 7, 1890, the run was just beginning. About the same date in 1876 I found the fish running up the little river which connects Fraser Lake with François Lake (latitude, 54°). In the first week in September, 1877, they were very abundant in streams along the west side of Okonagan Lake, and last autumn, September 16 and 17, 1890, I noted them again in these streams, particularly in that known as Bear's River." The saw-qui mentioned by Dr. Dawson is the red salmon (*Oncorhynchus nerka.*) Professor Johnson's specimens were obtained from the vicinity of Seattle, Wash., which is now the most southern locality known for the fish. The species will doubtless be found in many other large lakes of British Columbia when these waters are examined.

Colors.—Dr. Suckley described the color in the following terms: General color of body red, dingy along the back, paler on the sides, and fading into pure white on the belly. Small, irregular black spots above the lateral line. Pectorals bluish, their tips slightly grayish. Dorsal and ventrals red. Tail spotted. Dr. Dawson's description states "the back is dark gray, slightly reddish; the belly bright silvery, shaded with gray. Flesh red, about the same as that of the saw-qui (*Oncorhynchus nerka*)." In June and July, when captured by Professor Macoun, the back was a steel-gray color, with no trace of red.

Habits and Abundance.—Dr. Kennerly found this salmon running up small brooks from August 10 to Sept. 1, when they suddenly disappeared. Vast numbers of the fish were seen in a small tributary of Chiloweyuck Lake. In company with Captain Woodruff and several men Dr. Kennerly went to the brook August 17, and the party caught 180 of these fish. He was informed by an Indian that these salmon never descend into smaller streams and never go to the salt water. At the mouths of all the small streams emptying into Chiloweyuck Lake they appear about Au-

gust 10 in such immense numbers that they can be caught with the hands. The chief enemy of the little salmon was the *chewagh*, or salmon trout of the region. The *chewagh* is the Pacific red-spotted salmon trout of Dr. Suckley (*Salmo Campbelli*), now known as the Dolly Varden, or *malma*. In trying to escape from their enemies, according to Dr. Kennerly's belief, the small salmon crowded into shallow brooks, where they were readily taken in hand nets. Their real mission in the brooks was probably to spawn. Professor Johnson observed that Kennerly's salmon was not accompanied by any large fish except an occasional silver salmon (*Oncorhynchus kisutch*). Out of a thousand or more taken the females were as plentiful as the males. The Professor states further that the large red salmon (*O. nerka*) is not so common at the mouth of Lake Washington as the little salmon, and does not run up the stream much south of the Noohsack River. Dr. Dawson wrote me as follows: "The Indians all affirm that this salmon lives throughout the year in the various lakes in which it occurs, only leaving them to run up certain streams to spawn in the autumn. In my note-book, under the date of September 16, and referring to Bear's River (again a small stream), I find the following: 'A great number of little salmon-like fish, apparently running up to spawn. It is singular that though they have evidently been long in the stream (from the livid red color of many of them, their frayed fins and tails, with white fungoid growth in places), they have not got farther up the river, which offers no particular impediment to their ascent. They cannot all have spawned, as many still hold spawn and milt. Indians say that they all die in the streams and do not return to the lake. Many were dead along the stones, and the crows had collected in great numbers in the vicinity. This was within a quarter of a mile or less from the mouth of the river on the lake.' "

Capture.—Dr. Dawson continues: "Wherever these

fish occur, the Indians make a special business of catching them in weirs and traps each autumn."

ASSOCIATES.—In Kootanie Lake, according to Dr. Dawson, "there is also a larger fish, different from the lake trout," which he considers a land-locked variety of the spring salmon (*Oncorhynchus chouicha*). On this point I have been informed by Captain Bendire that occasionally, in great freshets, the obstructions on Kootanie River are passed by salmon from the sea, and these become land-locked when the floods subside.

WASHINGTON, D. C, May 25th, 1891.

TRANSPLANTING FISH.

No branch of fish culture, in my opinion, deserves more careful attention and study than transplanting, which is now being so successfully conducted by the U. S. Fish Commission, under the able management of Dr. S. P. Bartlett.

Much valuable time and considerable sums of money have been wasted because of a want of knowledge in this work. I have suffered my share of the discomfiture in this direction—therefore this paper.

Chagrin River, on which my home, Chagrin Falls, O., is situated, has two branches of about equal size, each containing clear water, coming chiefly from springs running from the conglomerate sandstone of the vicinity. On each branch, about a mile above the forks, is a fall sufficiently high to prevent fish from ascending. Eight years ago the north branch was stocked with less than 100 small-mouth black bass fry, taken from the stream below the falls. The south branch was stocked the same year with 3,000

fry of the same variety from Lake Erie. Four years ago the north branch was found to be well stocked, while not a small-mouth black bass could be found after diligent search in the south branch. The south branch was then stocked with fry from the north branch, and the stream is now well stocked. The lake fish undoubtedly returned to the lake as soon as they could get there.

The same experiment was made with channel cat-fish with the same result: all went to the lake, or at least never showed up, while the same fish, taken from the same water, Chagrin River, near its mouth on Lake Erie, placed in Geauga Lake, a small pond, practically land-locked, multiplied and did well. A pond on Chagrin River, into which the cat-fish were placed, is nearly as large as Geauga Lake.

The lesson is obvious: fish taken from large lakes and planted in small waters with outlets will not remain, but will return to the larger water or try to; while if taken from waters similar to those into which they are to be placed, good results will follow.

Transplanting for the purpose of crossing is now acknowledged to be highly beneficial, as fishes, the same as other animals, become dwarfed by inbreeding in confined waters.

J. J. STRANAHAN.

RELATION OF THE AMERICAN FISHERIES SOCIETY TO PROTECTIVE FISH LAWS.

BY A. N. CHENEY.

The American Fisheries Society is now, according to Mr. Mather's corrections of the proceedings, twenty-one years old, or, rather, this is the twenty-first meeting of the Society, under one name or another. During that time it has given rise to excellent suggestions, or birth to worthy

ideas which have spread abroad and borne fruit all over this land, and the one across the sea, and to every one of them the members point with becoming pride. I do not mean that resolutions have been offered and passed to carry into effect any certain plan for the benefit of fish culture or fish propagation; but the good has emanated from the papers read before the Society, and the discussions which followed them, just as certainly as though it came from formal resolution attested by president and secretary.

It seems to have been an unwritten law that this Society should take no part in framing laws for the protection of fish in any State or Territory, and no member, as such, has ever been seen in the lobby or before a legislative committee seeking to influence legislation of any kind. The Society has come to be a power and an authority by its own right. In the article numbered "one," reciting the name and objects of the Society, as amended, we read:

"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 Society; the uniting and encouraging of the individual interests of fish culturists, *and the treatment of all questions regarding fish of a scientific and economic nature.*"

Now, the question arises in my mind, admirable as the work of the Society has been, has it done its whole duty in the "treatment of all questions regarding fish of a scientific and economic nature." I do not now propose that the Society shall resolve that any particular legislation is best, nor that any member, as such, shall appear as an advocate before any fish-law committee of a State legislature, but there is a way to make the power of this Society felt in every State, in the direction of proper laws for the protection of our fishes.

The members of this Society gather here, or at the ap-

pointed place of meeting, from nearly every State. They are Fish Commissioners, fish culturists, fish experts, expert fishermen, ichthyologists, and men generally who have made and are making an intelligent and accurate study of our fishes. No body of men knows better the habits of the fishes in their own States and in other States, and when gathered here discussion will draw from them the spawning-time of every fish protected by law, and these recorded spawning-times will become a part of the proceedings of the Society by authority. With the spawning seasons defined as closely as may be, the law-makers of any State in making a close season for any particular fish need not go wrong.

I firmly believe that to-day there is less known about the spawning seasons of our game fishes by fishermen generally than about the playing of the crack ball-teams.

I speak feelingly and from experience on this subject. As Angling Editor of *Shooting and Fishing* I often write privately to correspondents who ask about the spawning season of our best-known fishes, rather than expose their ignorance in print.

The saving of a grand game and food fish from extinction is certainly a "question of an economic nature," and I believe the black bass is slowly being wiped from the waters of this country because of inadequate laws, or no laws. This is partly through cupidity, partly through ignorance.

Take the case of New York State. The black bass season opens on the border May 20th; the general law opens the season May 30th, and special laws open it in different waters from July 1st to August 1st.

These special laws were obtained by sportsmen who realized that June fishing was doing a great injury to the bass, and while these laws were being obtained the general law of the State, which was then June 1st, was changed to May 30th; and the only reason ever given, to my knowledge, was that it enabled fishermen in New York City to make

use of Decoration Day, a legal holiday, to fish in a neighboring lake. I canvassed the State some years ago and found that everywhere black bass spawned thoughout the month of June; and Mr. Mather, of the New York Fish Commission, informed me that on Long Island, our most southern waters, bass were not through spawning June 25th. But black bass require something more than a mere close season to cover the act of spawning, for they watch over their young after they are hatched—the only fish protected by the law that does, for I am not aware that the sunfish and bull-head are protected. If black bass are taken a week after the ova is hatched, every black bass fry will be eaten by other fishes always in waiting to do this very thing. Last year we had a Commission in New York to codify our fish and game laws, and one of the Commissioners asked my opinion regarding the protection of certain fishes. I urged with all my power that the black bass season should not open anywhere in the State before July 1st. He agreed with me fully, but said the Commission had been obliged to compromise on June 15th as opening date. Compromise on the question of the extermination of a fish! Well, the code went to the Legislature, and one of the first acts of that body was to knock the compromise into a cocked hat and make the opening season as before, May 30th. It is my opinion that a game-law committee would hesitate about taking such a responsibility upon itself, if it could be shown that this Society had put on record the fact that such action merely legalized the taking of black bass from their spawning beds or from their helpless young. As a fact, I have seen a bass with young just hatched on the 25th day of August, but this was probably an isolated case. I have known a bass to remain with its young for six weeks, and this is probably not an unusual thing.

I certainly hope that this Society will take steps to define, as closely as may be, the spawning seasons of our

game fishes, feeling sure that such action will have great weight with our law-makers. And this will but lead to other and similar fields of usefulness, in which the Society may be of great service in aiding to keep up our stock of fishes by common sense methods. I will refer to but one, and that is the short trout law. The object of a short trout law is that the trout may have the opportunity to spawn at least once before they can be legally captured. I am aware that a number of trout of the same age are not all of the same size; but one State has a six-inch law, another a five-inch law, and still another asks for a four-inch law. This Society could determine, between its fish culturists and fishermen, from their observation of tame trout and wild ones, what the average size of a trout is that spawns for the first time, and thereafter law-makers would have a guide as in the case of spawning seasons.

BREEDING HABITS OF THE PERCH.

By Fred Mather.

When I agreed to write something about the breeding habits of the "yellow perch," the local name of boyhood days came to the front, and it now seems best to call the fish *the* perch. This is the old English and the modern English name of a fish that inhabits both continents, if you accept the dictum of some of our savants, or, is an American fish closely related to the European perch, if you follow others. In the northern and western States it is known as "yellow perch," from its prevailing ground color; in the Carolinas it becomes "barred" or "brown" perch, because of the color of its vertical stripes; in Virginia it is the "ringed" perch, for the same reason, while

in Louisiana the bars or rings have suggested the name of "raccoon perch." So, take your choice between *Perca pluviatilis*, *P. Americana*, or other names, we know just what fish we are talking about.

This is the first fish that I hatched, and it came about this way. In 1867, just twenty-four years ago, after a period of some six years' hunting and trapping in what was then the north-western frontier, and some three years service with the Union army, I met my old tutor in Biology, Professor Porter Tyler, on our old stamping ground the Popskinny Creek, some few miles below Albany, N. Y. I call him "Professor" Tyler; he was an illiterate man, who by turns was a hunter, trapper, and railroad brakeman, just as the season required his services, and the irreverent spoke of him as "Old Port. Tyler," and called him a shiftless old vagabond who was too lazy to work. Now "Port." was a bachelor of perhaps forty when I first met him in a swamp where he was shooting woodcock without a dog, and had over a dozen, while I, a boy of fifteen, with two dogs, had only one bird.

But we had many a hunt together after that, and I learned to love the old man, and from him the knowledge of how fish-eggs were impregnated was first brought to my notice. "Freddy," said he, "when a fish lays her eggs, there aint nothin' in 'em, and the old he-fellow goes over 'em and fills 'em up. I've seen these perch spawn in the nets and on bushes, on moonlight nights, and have seen the he-ones go over 'em and fix 'em." This was too late to look up the perch-spawning that year, but the words opened up a new field.

Next spring, 1868, I gathered some strings of perch-eggs from the nets and bushes and tried to fertilize some taken by hand. On application, Professor James Hall, New York State Geologist, gave me the privilege of aquaria with running water, in the State Geological Rooms on State Street,

Albany. Some fish hatched, but whether from the natural or artificial impregnated eggs is not known.

Last year some perch were received from Dr. S. P. Bartlett, Illinois, among a lot of black bass, five females and one male, and again an opportunity offered to note their breeding habits.

The eggs of this fish are laid in a long ribbon, which is perhaps a foot long and two inches wide, double and wrinkled, the eggs being encased in a mass of jelly, or viscid envelop, which is laid over twigs or other objects, but does not adhere to them. The perch spawns early in spring, and the eggs require from ten to fifteen days to hatch; the young swim from the start, and take food in three to four days after hatching.

The fish which I had this year spawned in an aquarium, but only two lots were impregnated. My foreman, Mr. C. H. Walters, watched them three nights to see the spawning of a perch, but did not chance to be there when it was done; for the wonder is how such a great mass comes from so small a fish. None of my fishes were over seven inches long, but they cast a spawn that was larger than they were, and the only way to account for it is that water is absorbed and the mass swells. From what Mr. Walters tells me and from the testimony of Professor Tyler, added to my own observations among the nets, where the spawn is often laid, I believe that this fish casts its spawn between midnight and daylight.

The Popskinny (old way of spelling this aboriginal name was Popsquinnea, but it is now known to the boys of Greenbush as "the island creek"), was an arm of the Hudson River, or bayou, that made an island between Douw's Point and Castleton, and in my early days was a famous fishing ground for such coarse fish as perch, pike, black and rock bass, cat-fish, sunfish, eels, etc., and as late as 1868 I took a pike of ten and a half pounds in it, as an extract from the Albany *Express* of March 31st, of that year, tells a

reader of my scrap book. The *Express* calls the fish a "pickerel," and the bayou the "dead creek," a name given it since the N. Y. C. & H. R. R. R. filled in its roadway across it and stopped the flow which kept its channel deep. To-day it is merely a couple of stagnant arms of the river and not worth the wetting of a school-boy's line. Some ten years ago I visited this scene of juvenile angling triumphs in early spring, and where we used to cut down hundreds of bunches of perch-eggs and drop them in the water after a fall of a spring freshet, and before the sun had injured the embryos, we only found two small bunches of eggs to return to the water.

About three days before hatching the embryo of the perch is not only interesting to the naturalist, but attracts the attention of the casual observer by its motion; with the regularity of a pendulum the many embryos in a mass move with a succession of beats or jerks that are almost as much in unison as the strokes of a drum-corps.

The perch is a fish that I have derided as a game and a table fish, in years a-gone, but at a dinner given to this Society by the St. Clair Flats Shooting and Fishing Club, of Detroit, at its annual meeting in 1889, they were served in a style that met the approval of the dwellers by the sea, who say that all fresh-water fish taste "muddy."

On investigation it was found that the fish had been skinned before cooking, and as this was a new thing to an old duffer, like the writer, it is possible that some younger "duffers" may not know of the dodge.

When I came to Long Island, in 1883, at the early age of fifty, it was strange to hear everybody say that "fresh-water fish are muddy." Having seldom eaten any other fish than those of fresh water, and never perceiving a flavor of mud, I marvelled thereat, but, after a year's sojourn and a diet of salt-water fish, a change came o'er the flavor of my piscine palate, and even the aristocratic brook trout tasted muddy—the only exception being the whitefish

(*coregonus*) of the Great Lakes; but when fresh-water bass or perch are skinned, this muddy, or weedy, taste is not found, and therefore some things which I have said of perch and of skinning fish a dozen years ago should be, and hereby are, recanted.

That the perch is a very predaceous fish nobody can deny, but, like the black bass, its menu comprises many things beside fish, and as gravel is not necessary for it to spawn in, it can thrive where the latter cannot. It was a favorite with Walton as it is with many an inland angler to-day, and where trout will not live it is worthy of cultivation.

TRANSPORTATION OF LIVE FISHES.

By William P. Seal.

The problems involved in the transportation of fishes, owing to the rapid fouling of water thus used, and of the difficulty in procuring suitable water in transit in some parts of the country, especially as sometimes happens where recourse must be had to the water of artesian wells, are among the most interesting and perplexing encountered in the practical work of fish distribution, as well as in the collection and transfer of specimens for exhibition and observation.

In the case of the transportation of salt-water fishes inland it is impossible to provide for a change of water, and thus artificial aeration alone must be relied on.

A patent recently granted for a system by which it is claimed fish may be transported in hermetically sealed vessels by charging the water with air under compression has led to considerable discussion and speculation. The varying conditions resulting from differences of tempera-

ture, the original character or quality of the water, the size and character of the fish (some species requiring more oxygen than others, and large fish needing more than small ones), and many other variable influences, tend to make the consideration of such a method a very complex problem.

A series of experiments conducted for the purpose of determining the value of such a system would have to be very comprehensive indeed. Numbers of expensive chemical analyses would have to be made, and the comparisons would have to be very careful, all involving a long period of experiment and observation. The researches through which our knowledge of the diffusion of gases in the atmosphere have been derived have occupied the minds of eminent physicists through long periods of time, devoted to patient and laborious experiment.

It is probable, however, that for all practical purposes the question can be discussed and its practicability determined by examination from a purely theoretical standpoint.

It is an undoubted fact that fish may be kept in hermetically sealed vessels for a considerable time without the action of plant-life or artificial aeration. The possibilities in this direction increase with decrease in the temperature, the number and size of the fish, and with fish requiring a smaller amount of oxygen. When a certain proportion of oxygen is exhausted of course the fish must die. As to whether the idea can ever have a positive practical value, however, is at least very doubtful.

In the first place, any apparatus developed in accordance with such a system, and adapted to purposes of distribution, would tend towards complexity in construction and manipulation, whereas simplicity is the great desideratum.

The advantage that would apparently arise from the adoption of hermetically sealed vessels is that as air is absorbed and held in suspension in water, or expelled

therefrom, in direct accordance with its temperature, there would be no escape for whatever air might be forced into it under compression, as would be the case in an open vessel. It would be absolutely retained there until consumed by the fish, while if not so controlled it would immediately escape to the atmosphere until the water would hold only its normal proportion in accordance with its capacity under the existing temperature, and the charging with air would have to be constant.

The great advantages offered by this aspect of the question—the storing of an excessive amount of air in the water, and air-space of the vessel—would naturally at first thought appear, to those engaged or interested in any way in the carrying or transportation of live fish, whether the angler with his live-bait supply, in the extensive operations of fish cultural distribution, or in the supply of aquaria, as offering strong possibilities of usefulness.

But there is another aspect of the case. While the oxygen which affords the life-giving principle would be stored up and held in confinement for the use of the fish, in a sealed vessel, the carbonic acid gas, and the gases generated by decomposition of organic matter (the excretions and exhalations of the fish), the death-dealing principles, would also be prevented from escaping and held there like the choke-damp in mines to promote death and destruction when they became excessive, and, at the same time, the amount of oxygen would be constantly diminishing.

The proportions in which most of the gases are dissolved by water seem to be but little known, the text-books dealing with the subject in a general way only, but it is certain that they are more readily absorbed at low than at high temperatures. In the case of air it has been stated by a competent authority that for every sixteen degrees of lower temperature double the volume would be taken up.

As the noxious gases, as well as oxygen and air, are thus

only held in suspension in a certain proportion in accordance with temperature, it is evident that they are not likely to collect in amount sufficient to be injurious, except in the absence of a normal proportion of oxygen. It is probable also that the gases resulting from decomposition are very largely oxydized in water, and the only element of danger with which we have to deal to any extent is carbonic acid gas.

In the atmosphere, on the contrary, it is thought by Dr. Angus Smith that the injurious effects resulting from the presence of noxious gases are due to those generating from decomposition, rather than from carbonic acid gas.

Suggestions tending to the elimination of the carbonic acid gas from water used in fish transportation by the use of lime-water, or other chemicals, have been advanced, but these are in the same line, inducing complexity of method and requiring almost scientific accuracy and judgment on the part of the persons employed.

It seems to me a rational conclusion that any form of close confinement or of chemical elimination of noxious gases in the shipment of fishes is not only complex and useless, but may be either positively injurious or dangerous, and that whatever improvements are made in our systems will be in the direction of more efficient and automatic aeration.

According to Parkes, "As it falls through the air, rain becomes more highly aerated (average twenty-five cubic centimeters per liter), the oxygen being in larger proportion than in atmospheric air (thirty-two per cent. or a little more); carbon dioxide constitutes two and one-half or three per cent. of the gas." The same results in aeration are attained by an efficient method of passing air through the water.

The use of much ice in carrying fishes must undoubtedly induce inflammation of the gills and mucus membrane to a greater or less extent. Ice-water is heavy and non-aerated.

as the air is expelled in freezing, and it must be well aerated before it is capable of supporting life. The one advantage that it offers is that it will hold the air longer in suspension when once introduced, and will retard decomposition and consequent generation of noxious gases, but a more rapid and constant means of aeration will probably produce better results.

Recent experiments made by the U. S. Fish Commission show that trout and other fish which require a very large amount of oxygen will live comfortably at quite high temperature—70° to 80° F.—if the water is constantly charged with air by artificial means, demonstrating that it is not strictly the high temperature that affects them unfavorably, but that the water when it reaches a certain elevation of temperature does not contain enough air in suspension to supply them with the amount of oxygen they require.

In the transportation of fishes for the live fish exhibit at the World's Columbian Exposition, it is proposed to adapt a car to the purpose, on which will be constructed a tank holding if possible 3,000 gallons of water, the inner sides of which will be so protected with soft material that injuries to the fish from striking against them will be reduced to a minimum. There will also be an efficient system of aeration.

It has been found through experiments made by the U. S. Fish Commission with salt-water fishes, that as the area of environment is increased the tendency to fear and nervous excitement, and consequent liability to injury, are reduced, and fishes which in small aquarium tanks had become diseased, and sometimes apparently at the point of death, on being placed in the reservoir were restored to health.

Large fishes in transportation are generally very much bruised and torn, and in fresh water they are soon infested with fungus. The handling of them with nets in transferring them to medicated baths, to destroy the fungus

and heal the skin, is, with the more tender and excitable species, more productive of harm than good. Strong salt water is the bath most frequently used.

It has been found since the establishment of a salt-water aquarium at Central Station that any of our fresh-water fishes will live and thrive in brackish water at least one-fourth the strength of sea-water (say 1.007), and this treatment appears to be a sovereign remedy for the attacks of fungus and animal parasites and diseases common to them in fresh water. Some of the cases in which injuries have been healed by it were very remarkable.

It appears to be certain also that many, and perhaps all, marine fishes will live in brackish water, and as many species pass into and live for considerable periods in fresh water, it is quite possible that some of them might be permanently established in our great lakes and rivers.

In the handling of large fish a piece of cheese-cloth passed around them and grasped at the corners is superior to any net, as it is soft and even in texture and clinging closely to them prevents their floundering about in such a way as to injure the skin or tear off the scales.

In Europe and especially in Germany many ingenious devices have been developed for the transportation of live fish, and the custom of taking their fish to market alive is no doubt a stimulus in this direction, and deserves our commendation and emulation.

The subject is an interesting one and offers a fine field for the inventive genius of American fish culturists.

CONSTITUTION.

ARTICLE I.

Name and Objects.—The name of this Society shall be "The American Fisheries Society." It object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of the interests of fish culture and the fisheries; 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 the payment of three dollars, become a member of this Society. In case members do not pay their fees—which shall be three dollars per year—after the first year, and are delinquent for two years, they shall be notified by the Treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting,

ARTICLE III.

Officers.—The officers of this Society shall be a President and a Vice-President, who shall be ineligible for election

to the same office 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 form a council and transact such business as may be necessary when the Society is not in session—four to constitute a quorum.

ARTICLE IV.

Meetings.—The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or in default of such action, by the Executive Committee.

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, provided at least fifteen members are present at said meeting.

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