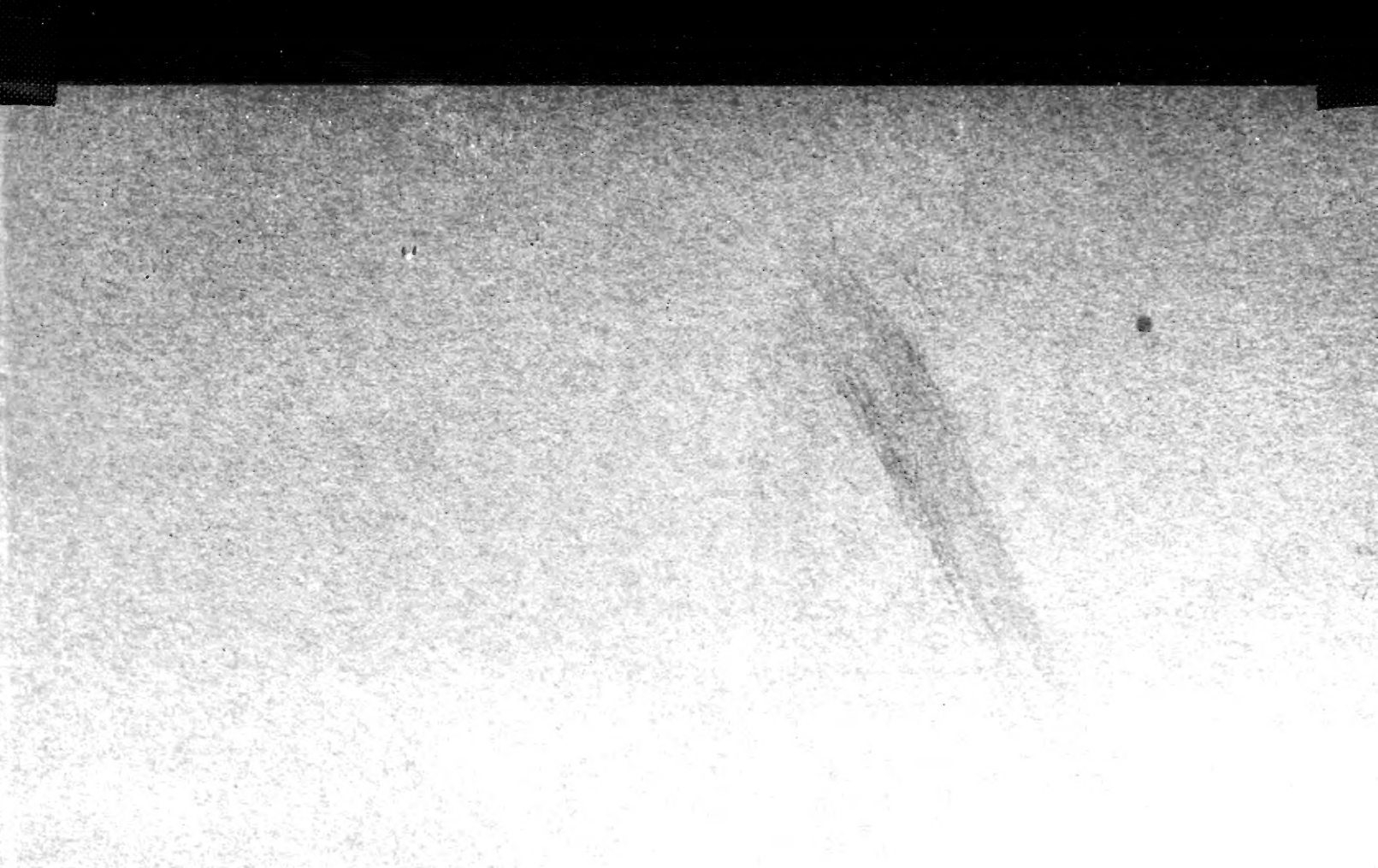

MERICAN FISHERIES SOCIETY

TRANSACTIONS

Volume 18

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.

OFFICERS FOR 1889-90.

PRESIDENT, EUGENE G. BLACKFORD, *New York City.*
V.-PRES'T, HERSCHEL WHITAKER, *Detroit, Mich.*
TREASURER, HENRY C. FORD, *Philadelphia, Pa.*
REC. SEC'Y, FREDERICK W. BROWN, "
COR'G SEC'Y, C. V. OSBORN, *Dayton, Ohio.*

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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, according 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 $\frac{3}{4}$ to $\frac{7}{8}$ 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 eyeball 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 strueture 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 vesicle 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.

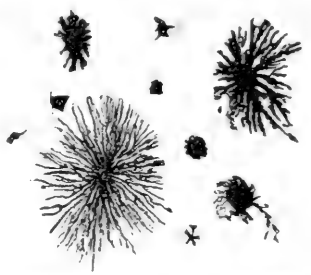
The brilliant coloration of many kinds of fishes during the breeding season may possibly have a relation to sexual selection; indeed, this can scarcely be doubted by any one who has observed the peacocking moments of male fishes. It has also a physiological significance which it is not difficult to comprehend. 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 Trybom, 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., Königsberg, 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.