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TRANSACTIONS

OF THE

PACIFIC
FISHERIES
SOCIETY

1914

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TRANSACTIONS
OF THE
PACIFIC
FISHERIES SOCIETY

AT ITS
FIRST ANNUAL
MEETING

June 10, 11 and 12, 1914
AT
SEATTLE, WASHINGTON

SEATTLE, WASH.
PUBLISHED BY THE SOCIETY
1915.

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Officers

1914-1915

Elected at the First Annual Meeting in Seattle, Wash., for the ensuing year, including the meeting to be held at San Francisco, Cal., in 1915:

<i>President</i>	CARL WESTERFELD, San Francisco, Cal.
<i>Vice-President</i>	HENRY O'MALLEY, Seattle, Wash.
<i>Vice-President</i>	TREVOR KINCAID, Seattle, Wash.
<i>Secretary</i>	JOHN N. COBB, Seattle, Wash.
<i>Treasurer</i>	RUSSELL PALMER, Seattle, Wash.

Executive Committee

BARTON W. EVERMANN, San Francisco, Cal.; C. McLEAN FRASER, Nanaimo, British Columbia; CHARLES F. HOLDER, Pasadena, Cal.;
LESLIE H. DARWIN, Seattle, Wash.; M. J. KINNEY, Portland, Ore.; WARD T. BOWER, Seattle, Wash., and
M. D. BALDWIN, Kalispell, Montana.

By transfer
The White House.

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PART I

BUSINESS SESSIONS

Transactions of the Pacific Fisheries Society

On March 11, 1914, a meeting of persons interested in the upbuilding and perpetuating of the great fisheries of the Pacific slope was held in Seattle, Wash. Those present at the meeting were the following: Carl Westerfeld, member California Fish and Game Commission, San Francisco, Cal.; E. Lester Jones, Deputy U. S. Commissioner of Fisheries, Washington, D. C.; Henry O'Malley, Pacific Coast Superintendent of Hatcheries for U. S. Bureau of Fisheries, Oregon City, Oregon; Prof. Trevor Kincaid, head of the Department of Zoology, University of Washington, Seattle, Wash.; John N. Cobb, editor Pacific Fisherman, Seattle, Wash.; Prof. E. Victor Smith, University of Washington, Seattle, Wash.; E. E. Ainsworth, Seattle, Wash.; William J. Bothwell, Seattle, Wash.; L. H. Darwin, Washington Fish and Game Commissioner, Seattle, Wash.; H. C. Fassett, Assistant Alaska Salmon Agent, Washington, D. C.; Miller Freeman, publisher Pacific Fisherman, Seattle, Wash., and Russell Palmer, manager Pacific Fisherman, Seattle, Wash. M. G. Munly, Esq., Portland, Oregon; R. E. Clanton, Oregon Superintendent of Hatcheries, Portland, Oregon; M. J. Kinney, member Oregon Fish Commission, Portland, Oregon, and Ward T. Bower, Pacific Coast Agent, U. S. Bureau of Fisheries, Seattle, Wash., authorized the use of their names in connection with the formation of the society. It was decided to form a temporary organization of a society to be known as the Pacific Fisheries Society, and to hold a meeting later in the year for the purpose of making the organization a permanent one. The following officers were elected: President, Carl Westerfeld, San Francisco, Cal.; vice-president, Henry O'Malley, Oregon City, Ore.; vice-president, Professor Trevor Kincaid, Seattle, Wash.; secretary, John N. Cobb, Seattle, Wash., and treasurer, Russell Palmer, Seattle, Wash.

The first annual meeting was held at University of Washington, Seattle, Wash., Wednesday, Thursday and Friday, June 10, 11 and 12, 1914.

WEDNESDAY, JUNE 10, 1914.

The meeting was called to order by the president, Mr. Carl Westerfeld, of San Francisco, Cal. The president then introduced Professor Edmond S. Meany, who on behalf of the University made an address of welcome in which he outlined the history of higher education in the United States. President Westerfeld responded briefly for the members.

The secretary, Mr. John N. Cobb, read the minutes of the last meeting, which were approved as read.

REGISTERED ATTENDANCE.

The president then ordered the roll-call of members to be taken. Ten members were registered for the meeting, as follows:

Carl Westerfeld, Henry O'Malley, Trevor Kincaid, John N. Cobb, E. Victor Smith, L. H. Darwin, Miller Freeman, Russell Palmer, Ward T. Bower and M. J. Kinney.

The secretary then read the following list of applicants for membership, all of whom were elected:

For Life Membership—Wm. G. Henshaw and Henry F. Fortmann.

For Membership—

E. A. Sims, B. W. Evermann, Ray B. Heacock, C. G. Conn, I. N. Hylen, T. J. Guaragnella, *J. P. Millett, H. L. Kelly, Jr., Theodore Opsund, *Ira B. Ford, Robert Forbes, C. H. Buschmann, *T. J. Gorman, M. D. Baldwin, Henry Wilke, W. E. Persell, Emery L. Fletcher, Charles A. Kofoid, Fred. Patching, A. E. Culver, Thos. S. Manning, F. M. Newbert, James H. Gyger, George O. Laws, Alfred Greenebaum, Jeff'n F. Moser, Wm. B. Hobart, *W. K. Hancock, *C. McLean Fraser, Frank Berry, *Will A. Lowman, August Buschmann, Hugh C. Mitchell, Carl Spuhn, James T. Barron, Theodore Parsons, H. A. Schulz, *Waldo L. Schmitt, *John M. Crawford, A. E. Doney, Walter I. Mansfield, *E. W. Hunt, Robert I. Duke, F. E. Booth, Martin C. Erismann, Philip J. Brady, Dennis Winn, *Edwin Wentworth, *Benjamin Baldrige, G. H. Lambson, Henry Doyle, W. W. Richards, William F. Thompson, *H. L. Osterud, J. J. Brenner, Dan Hurley, John Blass, L. P. Ouellett, J. B. Bowman, J. A. Morrow, J. H. Deer, W. M. Beach, *Hans B. Joyce, *L. M. Rice, Ernest Schaeffle, *A. H. Mahone, *Harry J. Henvor, *Arch. T. P. Capell, *H. B. Duncanson, H. S. McGowan, Geo. C. Johnson, J. M. Peters, Frank M. Warren, O. C. Hanson, T. C. McHugh, *W. H. Shebley, John F. Siebe, David Starr Jordan, Edward H. Hamlin, Charles F. Holder, N. B. Nidever, Stephen Butts, Charles W. Dorr, *J. R. Russell, *Henry Baldrige, H. B. VanDuzer, *Sydney E. Johnson, *H. P. A. Wold, H. F. Allen, J. H. Scott, D. R. Helser, ——— Ingham,

S. K. Taylor, R. D. Simmons, Chas. Brenner, Thos. O'Neill, *J. E. Parsons, *Clarence L. Anderson, *L. E. Mayhall, John H. Gardner, *C. P. Henkel, *John Leuenberger, *Wm. H. McFarland, *Alexander P. Romine, John D. McGowan, William Shultz, Jack Young, *Edward Cunningham, *Lyle Greenwood.

NOTE.—Those designated by an asterisk were present at the meeting.

On motion of Mr. John N. Cobb, which was seconded, Dr. Hugh M. Smith, U. S. Commissioner of Fisheries, of Washington, D. C., who was present, was elected an Honorary Member of the Society.

PRESIDENT: The United States Bureau of Fisheries has very kindly placed at our disposal the steamer Albatross. The Albatross will make a trip on the Sound this afternoon, leaving Lillico's float at the foot of Spring street at 2:00 o'clock, and all the members of the Society and their friends are invited to be present on this cruise. The naturalist on board, Mr. Schmitt, is going to demonstrate some of the apparatus, and I am sure it will be a most interesting trip, and we will be glad to have you with us.

The Society then adjourned for the day.

The afternoon was spent aboard the U. S. Fisheries Steamer Albatross, which made a short cruise in Puget Sound, during the course of which Mr. Waldo L. Schmitt, the naturalist, demonstrated the interesting scientific apparatus aboard, and the members and their friends also had an opportunity of witnessing a haul with the beam trawl, which brought up a number of interesting specimens.

THURSDAY, JUNE 11, 1914.

The greater part of the morning session was devoted to the reading and discussion of two papers. Dr. Hugh M. Smith, "The Relations of the Federal Government with the Fishing Industry of the Pacific Coast." Trevor Kincaid, "A Proposed School of Fisheries."

Upon motion of Mr. Miller Freeman, the secretary was directed to prepare a resolution expressing the sentiments of this Society with respect to the providing of proper funds for the U. S. Bureau of Fisheries, particularly with respect to the work on the Pacific Coast, and to forward a copy of the resolution to the delegation of the Pacific States in Congress.

Mr. W. A. Lowman, president of the Puget Sound Salmon Cannery Association, in the name of the association invited the members of the Society to a dinner at the Arctic Club at 6:30 this evening, which invitation was accepted with the thanks of the Society.

It was moved, seconded and carried that the secretary, assisted by Professor Kincaid, be authorized to prepare a resolution for presentation to-morrow, not only sanctioning the establishment of a Fishery School, but urging the announcement of the immediate establishment of such an institution in the University of Washington.

The president appointed the following committees: Nominating Committee—Messrs. Miller Freeman, M. J. Kinney, Ward T. Bower, W. H. Shebley and E. Victor Smith. Auditing Committee—Messrs. Henry O'Malley, E. W. Hunt and Waldo L. Schmitt.

Mr. John N. Cobb offered the following amendment to Article III of the Constitution, the article as amended to read as follows:

ARTICLE III.—Officers.

The officers of this Society shall be a president and a vice-president, who shall be ineligible for election to the same office until a year after the expiration of their term; a vice-president, a secretary, a treasurer, and an executive committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session — four to constitute a quorum.

The amendment was adopted.

In the afternoon the members visited the White River State Hatchery, near Auburn. In the evening the dinner given the Society by the Puget Sound Salmon Cannery Association was thoroughly enjoyed by all present. After the dinner a number of impromptu addresses were made by members and others present.

FRIDAY, JUNE 12, 1914.

Report of Nominating Committee.

MR. MILLER FREEMAN: The Nominating Committee recommends the election for the ensuing year of the officers who have filled the respective positions during the time since the preliminary organization was formed in March, as follows:

President, Carl Westerfeld; vice-president, Henry O'Mal-

ley; vice-president, Trevor Kincaid; secretary, John N. Cobb, and treasurer, Russell Palmer.

Moved, seconded and carried that the above be elected as the officers of the Society for the coming year.

The committee recommended that the following be elected as an Executive Committee:

Barton W. Evermann, of San Francisco, Cal.; C. McLean Fraser, Nanaimo, British Columbia; Charles F. Holder, Pasadena, California; Leslie H. Darwin, Seattle, Wash.; M. J. Kinney, Portland, Oregon; Ward T. Bower, Seattle, Wash., and M. D. Baldwin, Kalispell, Montana.

Moved, seconded and carried that the Executive Committee as named be elected.

A telegram from Governor Ernest Lister, of Washington, and a letter from E. Lester Jones, U. S. Deputy Commissioner of Fisheries, Washington, D. C., regretting their inability to be present, were read by the secretary.

PROF. TREVOR KINCAID: I would like to move that the secretary be authorized to send the following telegram to the president of the American Fisheries Society, conveying the greetings of this Society:

Prof. Henry B. Ward, President American Fisheries Society, Urbana, Illinois:

The Pacific Fisheries Society in its First Annual Session sends greetings to its sister society. (Signed) JOHN N. COBB, *Secretary*.

Motion seconded and carried.

The following telegram was received from Prof. Ward in reply:

URBANA, ILL., June 13, 1914.

John N. Cobb, Secretary, Pacific Fisheries Society, Seattle, Wn.:

American Fisheries Society congratulates its new sister on her splendid outlook for the future. (Signed) HENRY B. WARD, *President*.

MR. E. W. HUNT: I move that this Society extend a vote of thanks to Dr. Hugh M. Smith for attending the first meeting of this Society and giving us the benefit of his experience and knowledge. Motion seconded and carried.

MR. MILLER FREEMAN: I move that a vote of thanks be prepared in proper form and sent by mail to the proper authorities, thanking the University faculty for courtesies extended to us during this session. Motion second and carried.

The following papers were read and discussed: John N. Cobb, "Some Neglected Fishery Resources of the Pacific Coast"; Dr. Charles F. Holder, "Angling and Netting and the Conservation of the Marine Fishes of Southern California." The latter paper was read by Mr. Osterud in the absence of the author. C. McLean Fraser, "The Nanaimo Marine Biological Laboratory."

FRIDAY AFTERNOON, JUNE 12, 1914.

The secretary offered the following resolution which he had been ordered to prepare at a previous session:

WHEREAS, it is noticed in the daily press that the Appropriations Committee of the National House of Representatives has failed to include in the Sundry Civil Bill adequate provision for the carrying on of the arduous and important duties with respect to the fisheries of the Pacific Coast laid by federal law upon the U. S. Bureau of Fisheries; and,

WHEREAS, the products of the commercial fisheries of the Pacific Coast sell for an aggregate sum of nearly \$50,000,000, there is invested in vessels, boats, packing establishments, etc., over \$40,000,000, while over 35,000 persons are employed in all branches of the industry; and,

WHEREAS, the present equipment of the Bureau for carrying on this important work is totally inadequate for the proper performance of it. One small steamer alone is available for guarding the 25,000 miles of coast line in Alaska, when at least eight additional vessels, with the necessary agents, crews, etc., should be provided. More salmon hatcheries should also be built, not alone in Alaska, but also in the States of Oregon, Washington, and California. There is no marine biological laboratory available anywhere on the coast for working out the many problems which beset our fishermen, and such is urgently needed. Therefore, be it,

Resolved, That it is the sense of the Pacific Fisheries Society that our Senators in Congress be most earnestly requested to exert themselves to the utmost in securing from that body, at this session, the necessary funds required by the U. S. Bureau of Fisheries for conserving and perpetuating the great commercial fisheries of the Pacific Coast.

Moved, seconded and carried that it be adopted as read.

The secretary read the following resolution regarding the establishment of a Fishery School at the University of Washington, and upon motion it was adopted:

WHEREAS, it is understood by the Pacific Fisheries Society that the University of Washington has in contemplation the establishment of a Department of Fisheries in connection with the College of Science in said institution; and,

WHEREAS, the Society is convinced that the plan is a wise and timely measure, designed to foster the varied interests of the fishing industries of the Northwest; therefore, be it

Resolved, That the Pacific Fisheries Society heartily endorses the plan of establishing such a department and urges upon the authorities of the University the carrying out of this project with the least possible delay, and furthermore, the Society pledges itself to aid and support such department by every means within its power in case it is brought into existence.

Prof. E. Victor Smith read a paper on "Salmon Hybridization," which was discussed by the members.

TIME AND PLACE OF MEETING.

After some discussion as to the place and time for holding the next meeting it was decided to hold the meeting in San Francisco, the date to be fixed by the Council.

The following papers were read and discussed: L. M. Rice, "The Artificial Propagation of Salmon"; S. Butts, "Improvements Necessary in the Hatching of Salmon"; W. H. Shebley, "Feeding and Rearing of Salmon Fry in California"; R. E. Clanton, "Rearing and Feeding Salmon Fry in Oregon"; M. J. Kinney, "Feeding Salmon Fry."

PRESIDENT: I am now going to ask Mr. O'Malley to preside, as I find it growing so late that I have to be going; but before I go I want to thank all the members for their courtesy shown me here and for the assistance they have rendered in making this meeting a great success. I hope that all of you will be able to attend the meeting next year, because I think we can do much good if we proceed along the lines we have mapped out for this Society. I will now say good-bye, and Mr. O'Malley, will you preside?

The Society adjourned after the discussion on the above papers.

PART II

PAPERS AND DISCUSSIONS

WHY THE PACIFIC FISHERIES SOCIETY WAS ORGANIZED

By CARL WESTERFELD

Member California Fish and Game Commission

Some months ago the rapid development and growth of the fisheries on the Pacific Coast led a few who were interested to meet in Seattle and organize the Pacific Fisheries Society. It was their object to bring about the co-operation of all those who are interested in fisheries. The American Fisheries Society has accomplished much, but it has so vast a territory to cover that it was thought an organization established on the Pacific Coast could better take care of our local interests.

Heretofore, each state has been pursuing its own course without much reference to what was being done in neighboring states, and with little more reference to what had been done by the U. S. Bureau of Fisheries. The result has been that we have not always had that concerted and perfectly harmonious action which we should have; the state and county and local fisheries departments have each been working in their own way without any co-operation; no organization has existed on the Pacific Coast which has held meetings at which the heads of fisheries departments and fish culturists could foregather to discuss questions of vital interest to fisheries, and exchange ideas and make plans for the betterment of the existing conditions of fisheries and obtain the help and co-operation of the persons interested.

There are in the waters of the West Coast of America, as far as known

1. More than 400 species of fish.
2. Several hundred species of crustaceans.
3. Several hundred species of mollusks.
4. Many species of marine algæ.

Of the fishes, more than 200 species are already known to possess considerable food value, but we have not utilized more than 20 to 25 species to any extent, and only 15 to 18 extensively. Of the crustaceans and mollusks, only a few species

are utilized, although many more possess food value. Of the many species of marine algæ, scarcely any use is made, although in Japan they constitute a very important article of food.

The resources of our waters are as yet utilized only in very small part. It should be the purpose of this society to promote the development and proper utilization of the fishery resources of the Pacific Coast.

The ocean fisheries present a field of practically unlimited development. Obviously, the development of the ocean fisheries cannot be started until we know from past research, or such research as may be provided for, just what the location, extent, nature and possibilities of the various productive areas and species may be.

To bring about the more adequate and proper utilization of the natural food, animals and plants that teem in the waters of our coast and in our fresh water streams and lakes, co-operation is necessary among the people interested.

1. The commercial fishermen.
2. The companies, great and small, engaged in putting up and handling fishery products.
3. The wholesale and retail dealers in fresh fish, oysters, clams and crabs.
4. The fish culturists and members of the State and Federal fish commissions.
5. The anglers or those who go a-fishing for the joy and pleasure it brings.
6. The naturalists who are studying the problems of species, life histories and geographic distribution.

Proper development of the fisheries, proper utilization of the products of the fisheries, the education of the public, the creation of a demand for fishery products, the proper and adequate protection of the fisheries through intelligent fish cultural work and the enactment of proper laws and regulations can be brought about only through action and intelligent co-operation on the part of the various classes of persons and interests named above.

Each must be willing to listen to the other and make use of the information and knowledge he is able to impart.

Many, if not most, of the failures in this world could be avoided if we would listen to and profit by the experiences of others who are working in our, or related, lines.

Taking up the classes seriatim:

1. The methods of the commercial fishermen are, as a rule, crude and very destructive to the fisheries. They are provincial in character. An exchange of ideas among the commercial fishermen themselves, and conferences with the naturalists, the fish companies, the dealers in fresh fish and the fishery officials and fish culturists would help the commercial fishermen immensely.

2. The fishery companies take too little interest in the fishermen and their methods.

3. The handlers of fresh fish, as a class, pay little attention to the manner of displaying the fish in their stalls. They seem not to know that many, very many, would-be purchasers are turned away every day by the unattractive appearance of the fish offered for sale.

4. Fish culturists sometimes fail of the success they should attain and the State and Federal fish commissions fail to attain the success that should be theirs because they do not keep in touch with the students of fish and fishery problems on the one hand and the commercial fishery interests on the other.

5. The anglers' viewpoint is unique, and, in most part, can be greatly improved by an association and an exchange of ideas with the naturalists, fish culturists and commercial fishermen.

6. That naturalists, as a rule, have not been sufficiently concerned with the practical phases of the fishery problems. They have not always taken the trouble to put the results of their study and investigation before the fishermen, the fish culturists and the fishery officials.

All of this goes to show the necessity for co-operation among these various classes of people.

It is practically certain that the industrial development of the next generation on the Pacific Coast will mean the destruction of the most important fresh water fisheries if the establishment and maintenance of factories and other indus-

trial plants on our streams and the appropriation of water from the streams for irrigation and water-power is not wisely and energetically controlled by the Federal and State governments.

The waters of our bays and streams are being polluted and the streams dammed and drained. In many instances water is so valuable for farming purposes that none is left for fish. Proper fishways and screens should be installed, but a rigid enforcement of the laws is frequently difficult to obtain because district attorneys and other prosecuting officers are often loath to offend large corporations for fear, as they say, of driving capital and industries out of their counties. In order that an enforcement of the law may be obtained, it is necessary that the people themselves be educated to the full realization of the importance and value of the fisheries. No law, however wise or beneficial to the public, can be properly enforced unless backed by public opinion and a favorable public opinion must be created by educating the people.

There must be a unity of assault upon objectionable practices, a unity of action in educating the people by giving the widest publicity to matters pertaining to the fisheries, and there must be a co-operation of all persons interested. There is no better or easier place to promote this co-operation than in the meetings of such a society as this.

These are among the reasons why the society was organized, and they are among the reasons why it should thrive. If it can bring about the co-operation indicated, it will prove of the greatest benefit to the fisheries of this coast.

THE RELATIONS OF THE FEDERAL GOVERNMENT WITH THE FISHING INDUSTRY OF THE PACIFIC COAST

By HUGH M. SMITH

United States Commissioner of Fisheries

From time to time, in the past few years, there has been a demand for a formal enunciation of policy on the part of the Federal Government with regard to its fishery activities on the Pacific Coast. While the Federal Government, as represented by the Bureau of Fisheries, has no different policies for different parts of the country, there are conditions on the Pacific Coast which do not exist elsewhere; and it is quite natural and proper that the exceedingly large and diversified fishing interests of California, Oregon, Washington and Alaska should want to know just what they may depend on or expect from the Federal Government in the way of aid, counsel, co-operation, and exercise of administrative authority.

I have recently taken this matter up with the Secretary of Commerce, who has a very lively interest therein, and have secured his concurrence in and approval of the statement of official policy which will now be outlined.

As to Artificial Propagation of Food Fishes:—This is the most effective form of aid which can be afforded to the fishing industry by the Federal Government. It will be extended in all fields as fast as circumstances or facilities will permit, and will be along the most modern lines, including the rearing of young salmon to the fingerling stage.

In Alaska, the artificial propagation of salmon by private interests should not be further sanctioned as a reason for tax exemption. This does not imply any criticism of private salmon culture *per se*, but of the system which, at this time, has few defenders and many opponents. The culture of salmon and all other fishes in public waters in Alaska should be under government direction and at government expense. The hatcheries now maintained by the salmon canners should be fairly appraised and taken over by the government.

As to the Planting of Non-Native Fishes:—Closely related to artificial propagation, and of great importance to the fishing industry, is the introduction into Pacific waters of non-indigenous fishes, from other parts of America or from abroad, which may be beneficial, but may, on the other hand, be decidedly injurious.

For years the Bureau of Fisheries has been discouraging or resisting—not always successfully—the attempts of anglers and others to have the government make plants of well-known predaceous game fishes of the east into waters already containing salmon and trout, or communicating with such waters. Everyone here must appreciate the great harm that can come from such introductions in streams that are the spawning grounds of salmon, through the destruction of their eggs and young.

The policy has been adopted of referring all such applications to the state fishery authorities; and I may say that there seems to be entire accord between the states and the government in this matter.

I should like to see this policy endorsed by a strong resolution of this society and by formal action of the state fishery officers; and I am almost ready to advocate legislative action that will prohibit the planting of pike, black bass, pike perch, catfish, etc., in the Pacific states. The Bureau of Fisheries in this, as in other cases, is nothing more than the agent or servant of the states. We hope that you will insist on a course that obviates our becoming parties to any act that, in its influence on the local fishing industry, may be worse than a crime; that is, a blunder.

As to Regulation of the Fisheries:—In the sections where the bureau has control over the fisheries, its authority will be exercised primarily with a view to the maintenance of the fish supply and the permanence of the industry. Regulative measures will be framed after due investigation, and will represent the minimum requirements of the various species. In other words, there will be the greatest freedom of fishery consistent with the preservation of the supply in the interest of all concerned.

As to Technical Aid to the Fishing Industry:—It is be-

lieved that a legitimate and important field for governmental aid to the fishing industry is systematic work in behalf of the fisherman such as is done at agricultural experiment stations in aid of the farmer. For this purpose, the bureau has recommended the establishment on the Pacific Coast of a fishery experiment station, to be fully equipped with expert personnel and apparatus for (1) demonstrating the economic value of neglected aquatic products and the best means of preparing them for market, (2) improving the methods of preparing and handling fishery products, (3) experimenting with new fishing appliances or methods, (4) devising the best means of treating fishing twine and nets so as to prolong their existence, and (5) in general conducting practical experiments, tests, etc., for the benefit of the fisheries and dependent industries, and also in the interest of artificial propagation. Such a station, as well as any other instrumentality of the bureau, should undertake any special experiments, investigations, or inquiries requested by the fishing interests when the results will have public value or application.

As to Promotion of Fishery Trade:—The Department of Commerce, through the Bureau of Fisheries and other agencies, will institute special inquiries, by duly qualified assistants, regarding foreign markets, for the purpose of extending the trade in fishery products, particularly canned salmon and other similar products.

In the belief that federal inspection of fish-packing plants, and federal certification as to the quality of products and the agreement of product and label, will promote the industry, and especially the export trade, the bureau is willing to ask authority to undertake this duty, provided it is desired by a majority of the fish packers, and provided, further, that such service cannot be more appropriately performed by another branch of the government.

As to Fishery Investigation:—The important and much-needed work of surveying the off-shore fishing grounds and making known their resources, especially in the remoter parts of Alaska, will be continued as actively as the facilities and funds available will permit, and will be made a regular feature of the bureau's operations. It is the intention to keep the

steamer "Albatross" regularly employed on this kind of work.

As to Pacific Coast Headquarters:—In order to keep in close touch with fishing interests and to be of the greatest possible direct assistance to the fishing industry, the bureau has established permanent branch headquarters in Seattle, and will keep in charge a properly qualified assistant. This office will be made a repository of reports, charts, and data pertaining to the fisheries of the Pacific Coast; and will be maintained solely with a view to its usefulness to the local fisheries. The success of the venture will depend largely on the fishing interests themselves, whom we expect to make their needs known and see that they obtain what they want.

As to Increasing the Facilities for Proper Performance of Duties Imposed by Law:—It is felt that the existing facilities for making the inspections and enforcing the fishery laws and regulations in Alaska are entirely inadequate, and are even such as to bring the department into disrepute. Congress has been asked to provide increased personnel and vessels, and there will be an annual appeal to Congress until the service is properly equipped for carrying out its functions.

DISCUSSION

PRESIDENT: I think we are all glad that we have had the pleasure of hearing Dr. Smith tell us about the activities of the United States Bureau of Fisheries, and it seems to me that each and every one of us ought to get in and work as hard as we can in order to help out in the matter of obtaining appropriations for the carrying on of this important work. It is particularly important to the northwestern part of the United States, and to Alaska. In order to carry on this work effectively the Bureau of Fisheries must have money and we must keep this matter continuously before the people until we finally force Congress to give an appropriation that is adequate to carry on the work that is absolutely necessary. I know from personal experience in California that we are always a little bit short of money, and from what I learn from the Bureau of Fisheries, they have the same complaint to make, only possibly to a more marked degree than we have, and it is the duty of this society, and the duty of each one of us, among other things, to keep before the people the question of getting Congress to furnish the appropriation that should be given to the United States Bureau of Fisheries. Now, if any one has any suggestions to offer in discussion we would be glad to hear them.

MR. FREEMAN: This matter of the providing of sufficient funds for the United States Bureau of Fisheries to carry on its operations is absolutely necessary. We know, particularly on the Pacific Coast, the great need of adding to the services of the Government. For many years the request has been made—and the feeling has grown stronger—that we have to have these services. We know that the fisheries resources are wonderfully important; we realize the necessity of their

development, and, what is of even more importance, their conservation. It must be on some systematic plan. There is only one authority by which it can be properly done, and that is through the Federal Government, which, equipped with the machinery, talent, experience and all that it has, is best fitted to carry on these operations, and the reason why up to this time these operations have been so limited is solely because of the lack of support by Congress. The reason for that lack of support is that the fisheries are generally out of sight of the majority of the people, in which they differ from the farming interests and the commercial interests, and it is impossible to arouse a sufficient amount of interest among the members of Congress to get them to take an active part in urging the providing of necessary funds. I want to urge, therefore, the adoption of a resolution, in fact I move that the Secretary be empowered and authorized to draft a proper resolution for presentation before the close of this session which will cover this matter, expressing the sentiments of this body with respect to the providing of proper funds for the Bureau of Fisheries, particularly with relation to the Pacific Coast, and forwarding a copy of the resolution to the delegations of the Pacific States in Congress.

PRESIDENT: Are there any other remarks that anyone wishes to make at this time with regard to the paper that has been read here?

MR. KINNEY: I do not think that there is any leading industry of the United States that is as much neglected as the fishing industry—that is, so far as general support goes. It is a very large industry. I want to make some comparisons. Our county, at the mouth of the Columbia River, is a fishing county. Our industries are salmon and lumber. Now, we have been working to get appropriations for maintaining hatcheries. I should like to see a county appropriation maintaining a county hatchery at Astoria or elsewhere on the river within the county limits. I am not a politician, but I have taken that matter up several times, with the result that I found it was much easier to get an appropriation of \$400,000 for county roads than it was to get \$10,000 for fisheries, much easier, and yet the fishing industry is our main industry, the one upon which we place our main dependence. I have taken up with our senators and representatives during the last ten years the matter of larger appropriations for hatcheries. As many as ten years ago I took this question up, and I have seen every one of our senators and representatives from time to time. I am not a politician, but I have urged this upon them. Senator Bourne probably was the first one to get a bill for the Columbia River through the Senate, but it never got through the House, and was laid on the table. The third bill is now in the House. It seems to me that the appropriations for Federal hatcheries ought to be doubled; they ought not to be increased a little, but they ought to be doubled. It is of vital importance to the prosperity of the United States that these fisheries should be taken care of. Meat is getting scarcer and higher, and as our population increases, we shall find a time when the fish will actually support the majority of the American people. On the Columbia River today we do not pack more than one-half what we did thirty-five years ago. We should take this into consideration and protect all other streams to the utmost.

PRESIDENT: It seems to me that the best way to accomplish these things is to give all these matters the utmost publicity. I find that people refuse to give these appropriations for matters of this kind largely because they are ignorant of the importance of them, and when the people are educated up to the importance of our fisheries I think that they will be generous in their appropriations. I think that some scheme by which these matters can be brought before the people, and the people

educated up to the importance of them, would be work to which this society could well devote a part of its time. We would like to hear from anyone here who has suggestions to make. We want the matter fully discussed. The more discussions we have, the more viewpoints, the more ideas we get.

Probably Mr. Fraser could give us some idea how they manage those things in British Columbia, I understand they usually get good appropriations there.

MR. FRASER: It seems to me that this discussion is a little bit out of my line. While I am very much interested in it I really have no say in the outcome. I do not know that we are very much better off in Canada in regard to appropriations than you are in the United States. It seems to be the same way with governments all over. There is not very much difference in the way things are arranged all the way through as far as that is concerned. The Canadian hatcheries, in British Columbia at least, are not more numerous or any better financed, so far as I am aware, than they are in Washington, Oregon or the other Pacific States. There are but ten federal hatcheries in the Province of British Columbia. These are principally for the hatching of salmon, although there is something done with the various trouts, viz., steelhead, cutthroat and rainbow. The work in general is so much similar to that done here that I cannot add anything that would be of special interest.

A PROPOSED SCHOOL OF FISHERIES

By TREVOR KINCAID

Professor of Zoology, University of Washington

For some time the proposition of establishing a school or department of fisheries in connection with the University of Washington has been before the authorities of the latter institution. This is by no means a new idea, as the suggestion has been mooted for a number of years. The recent centralization of the fishing industry of the northwest in Seattle, together with the location of the Pacific Coast office of the United States Bureau of Fisheries in this city, has brought the project to the front in a manner that merits careful consideration.

The University of Washington, located as it is on Puget Sound, in the midst of one of the greatest fishing districts of the world, occupies a strategic position which suggests the possibility of close co-operation through its scientific departments with the various industrial activities resulting from the expansion of the fisheries. The advantages to be derived from the establishment of such a school are rather obvious and it seems to be merely a question as to whether the time is now ripe for the initiation of the project.

We have observed on the Pacific Coast, and the same may be said of other sections of the country, an enormous expansion of the fishing industry. The harvest of the sea grows apace as new sources of aquatic wealth are opened up for the benefit of mankind. With this expansion comes an increased complexity in every phase of the industry. The older methods of fishing have given place to new ones of the most advanced type, while in the preparation of marine products for the market a revolution has been worked through the invention of labor-saving machinery and the perfection of sanitary processes. On the commercial side the markets of the world, both domestic and foreign, have been opened up to receive great supplies of cheap and nutritious sea food.

The expansion and differentiation of the industry has gone forward along so many lines that the time has arrived when

highly trained men are called for to handle various phases of the work. On the biological side the fisheries have become more and more complex, because of the establishment of fishing along such diverse lines and over such a wide field of operations that we have been brought face to face with an increasing variety of biological problems which demand solution in order that the supply of sea life may be not only maintained but vastly increased. On the technological side we note the extraordinary development of the canning industry. The evolution of labor-saving machinery has been marvelous. It is a far cry from the sun-dried fish of the Indian to the superman of the "iron chink." And this has gone hand in hand with the development of sanitary processes which make the earlier methods appear barbarous by comparison. The methods of fishing have undergone a corresponding increase in complexity, from the time when the Indians gathered in their simple way the products of the sea to the present day with its fleet of vessels plowing the waters of the Pacific, from California to the Arctic seas. That the methods of taking and transporting fish will undergo still further changes goes without saying, and this is particularly true of the deep-sea fisheries, which are as yet only in their infancy. In the commercial field we see the same thing. From the handling of the catch of the individual fisherman in the local market we have seen the industry expand so as to become a large factor in the commerce of the nation, and more recently we have noted the fisheries products of the Pacific Coast flowing into the markets of the world and thus attain international importance.

If we examine the industries based upon the utilization of our aquatic resources it becomes obvious that a veritable army is involved in carrying on the several phases of sea farming. The demand for trained and efficient men is already pressing and will increase with the expansion of the industries concerned. The manner in which this demand is being met presents an interesting subject for study. The men engaged in the fishing end of the work are largely recruited from foreign fishing fields where they have served their apprenticeship, or else are drawn from the ranks of other industries and trained on the ground. Those dealing with the preparation

of marine products for the market are for the most part men who have grown up with the industry and have acquired their qualifications through direct contact with the work in canneries, etc. The business men manning the plants have been drafted from other industries. The scientists engaged in the study of marine resources are largely those employed by the United States Bureau of Fisheries, which has done noteworthy service in this connection, both through the labors of its immediate staff and through the employment of men drawn from the universities of the Pacific Coast and elsewhere. The fish hatcheries are manned by pisciculturists who have served their apprenticeship in the national Bureau of Fisheries or in the stations established by the several states.

It will be seen that the industry is manned in all its branches by men trained largely through the apprenticeship method. This type of education has its great advantages, and any system of training that would deprive a man of the benefits that come from immediate contact with the processes of the industry would be a serious blunder, and any school we may establish must necessarily try to preserve those advantages that spring from this vitally important system and add to them those elements of fundamental training that are so essential to complete preparation. In other words, our aim should be to found a school that would bear the relation to the fishing industry that is borne in their way by the schools of forestry and mining to the basic activities which they represent, and by the agricultural experiment station to industries based upon the products of the soil.

Granting, then, the wisdom of founding a school of fisheries upon the basis suggested, the question arises as to the details of organization. What would be the nature of the curriculum best suited to accomplish the object in view? A canvass of the situation discloses the fact that no fisheries school exists at the present time upon the American continent and, moreover, the institutions of Europe do not present any example approaching the type we have in mind.

So far as we are aware, the only fully equipped school of fisheries in existence is the Imperial Fisheries Institute of Japan. The importance of the fisheries of the Japanese Em-

pire may be judged from the fact that at least one-sixth of her entire population is engaged in industries based either directly or indirectly upon marine resources, a condition further emphasized when it is known that the country does not possess the basis for an extensive production of animal life on land.

When the Japanese government found itself confronted by the problem which presents itself to us today, it sent its agents abroad to study the methods of foreign countries in order that they might place the fisheries of the empire upon a modern basis, but we are informed they found no institution in existence which would serve as a model, and they were compelled to formulate an organization that was of an almost original type.

The Imperial Fisheries Institute was founded by the Japanese government in 1897, and has proven of inestimable service to the Japanese people. The staff consists of a director and nine instructors. The plant is located in Tokyo and fronts directly on the sea. Several ships are at the command of the station and enable the institution to keep in touch with all branches of the fisheries. The instructional work of the institute is of a very practical character and may well serve as a model upon which the curriculum of our own school may be based. The general plan of the Japanese courses, as outlined in their most recent catalogue, is therefore epitomized for purposes of comparison.

Two fundamental divisions of the work of the institute are recognized—research and instruction. One branch of the school is thus devoted to educational work, preparing men to enter actively into the different branches of the fishing industry. In this connection, three lines of preparation are represented, viz., a fishing course, a technological course, and a piscicultural course. From the fishing courses men enter upon the work of taking fish. They have a knowledge of navigation and are thus able to secure positions as masters of vessels. They are also taught sufficient mechanics to enable them to operate machinery. From the technological course men enter canneries and plants engaged in the preparation of products to be used as food or to be utilized in other industries. They

are given a practical knowledge of chemistry and bacteriology. From the piscicultural course the graduates enter upon the work of caring for hatcheries and other plants designed to conserve and increase the supply of marine products. In all cases the period of instruction covers three years, one of which must be spent in actual work in some phase of the industry under conditions over which the institute has more or less control.

Candidates entering the school are called upon for certain fundamental educational preparation, corresponding to the completion of a high school course. Some idea of the curriculum may be had from a list of the subjects taught during the first two years. In the fishing course we find fishery methods, navigation, seamanship, shipbuilding, embryology, oceanography, ichthyology, applied mechanics, mathematics, economics, English, fish curing. In the technology course the items are preparation of marine products, bacteriology, applied mechanics, applied chemistry, chemical analysis, zoology, ichthyology, botany, economics, law. For students in pisciculture the following requirements are laid down: Fresh-water pisciculture, salt-water pisciculture, embryology, bacteriology, oceanography, chemistry, zoology, ichthyology, botany, algology, economics, drawing.

In addition to the above, short courses are offered to men already engaged in the industry who have not had the advantages of special training. A post-graduate course is also provided for the benefit of those desiring more extended preparation along special lines. Again, a special course in deep-sea fishing is offered which trains men in the technique of this important line of work which is in a state of rapid expansion in Japan as with us.

As to the scope of the institution, we get some idea from the number of students enrolled. Since 1897, when the work was initiated, over 600 students have been graduated, and in 1909, which is the most recent catalogue at hand, there were enrolled in the various courses 263 students.

So much for the educational side of the institution. On the experimental or research side, which is co-ordinate, they have men working who are attempting to solve biological and tech-

nological problems relative to the fishing industry. The results of their investigations are published as bulletins for the benefit of those concerned. At the time the last bulletin was published they had under way experimental work dealing with the spawning of fishes, fish migrations, rearing of oysters, hydro-biology, food preservation, chemistry of sea-products, and the use of dyes in preserving nets.

In establishing a school such as has been suggested in the above outline, we will naturally encounter certain difficulties. One difficulty is, of course, that this school is something absolutely new so far as this country is concerned, and anything that is new will have to overcome more or less inertia in getting under way. Other difficulties will suggest themselves, such as the proper manning of the new department and the stretching of the finances of the University of Washington to cover the expenditures involved. Some of these difficulties are not so serious as would at first appear. Many of the fundamental courses in biology, chemistry and technology called for in the fisheries curriculum are already given in the university, so it would be necessary to provide only that additional instruction which is of a distinctively professional character.

The manner in which the new department, if it be organized, will be co-ordinated with other progressive movements is quite suggestive. The United States Bureau of Fisheries has in mind the establishment of a laboratory on the Pacific Coast similar to those already in operation on the Atlantic, which would be a most useful adjunct to the fisheries department. The state has established a permanent office in Seattle, which would be very helpful along some lines. All about us we have plants dealing with marine products which could be utilized as object lessons in giving instruction.

With the proper backing and with the co-operation of the various national, state, corporate and private interests concerned, a school of fisheries would undoubtedly prove of the greatest benefit to all concerned, and the authorities of the University of Washington have planned to move in the matter as rapidly as the means at hand will permit.

DISCUSSION

PRESIDENT: The very able and exhaustive paper that has just been presented by Professor Kincaid has opened up a number of subjects for discussion, and I think we might with great profit devote a little time to taking up some of the subjects if anybody here has anything to offer. I think particularly we might be very glad to hear from somebody connected with the practical side of fishing.

PROF. KINCAID: I would like to hear from Dr. Smith on that; he has a wide field there, and I am sure all would be interested in hearing him.

DR. SMITH: I think that we are under many obligations to Professor Kincaid for his exceedingly comprehensive remarks, which seem to cover the field adequately. I had the pleasure in 1903 of visiting this Japanese Fisheries Institute to which Professor Kincaid has referred, and I can tell you it was an eye-opener. I went out there to lecture on fisheries work as carried on in this country by the federal government, and it very soon became apparent to me that there was nothing whatever we could tell the Japanese. They had already gotten all that was worth while in this country and were making use of it. They have a truly wonderful institution there, which is turning out a large number of graduates who immediately enter the field of practical work, and help themselves and their government.

In our own particular field we have a chronic need of trained men, especially in the fish-culture branch, who are willing to enter at comparatively small pay, with the assurance that they will ultimately receive more adequate compensation if they qualify themselves. I think such a school as Professor Kincaid contemplates for Seattle would turn out graduates who, under an arrangement with the United States Civil Service Commission, could be put directly into the fish culture work of the federal and state governments without examination, upon presentation of a diploma from the University of Washington. This would certainly be all that the Bureau of Fisheries would require. There is a wide field; I do not know of any more promising field in the government service than in the culture of fish. The possibilities of making new discoveries, especially in the line of intensive breeding and selective breeding, are almost inexhaustible. I would expect that a tremendous boon to the fish industry of the entire country would be given by a fisheries school such as this if established here.

PRESIDENT: Mr. Lowman, couldn't you contribute a few remarks on this subject from the standpoint of the man actually engaged in the commercial end of it?

MR. LOWMAN: Mr. President, it seems to me that if a man speaks of any vocation it invariably starts a discussion and brings out statements that seem in each case to be diametrically opposed to each other. The whole thing boiled down is, how many empty stomachs can you relieve, how often can you do it, and how long can you keep it up? That is the gist of the whole thing. It is a question of food for the people of the world, and the fisheries are going to be drawn on more and more. Therefore it brings up the matter of whether or not there is over-fishing. If so, you must remember that you must put up with this and a whole lot more over-fishing. That is the point you have got to take care of in the future, and it is the point, the real point of the whole matter. You are today fishing very, very limited to what you will have to fish in the future, or contrive a method of curtailing the growth of the population. But the question of over-fishing is, I think, a very simple proposition. On the Sound here there is a serious question as to whether or

not there has not been over-fishing even under present conditions and present methods. Over-fishing means that you have fished out all of your surplus and a portion of your breeding stock. If you have done that, what percentage of it did you do by nets and fishing boats as against the paper mills which discharge poisons continuously three hundred and sixty-five days out of the year and twenty-four hours a day; what proportion was done by nets as compared with the carload of cedar bark and fir sawdust which now covers the spawning fields? It is an actual fact that those streams which are the least developed in a commercial way are still the best producers of salmon. It is not so much of a real question as to fish returning to parent stream, or whether they move from stream to stream, as it is how many pounds of net food you can get out of a given quantity of fish and deliver to the consumer at a price he can afford to pay and eat it as a common everyday food, and while I agree most heartily, could not agree more fully, with Professor Kincaid, I think that the biology and other ologies should get down very largely to, as he said, the preparation of fish and the delivery of it to the consumer. Let the practical end of it at least keep pace with the scientific end; let the two go hand in hand. Our hard headed, practical experience, with your scientific investigations, will continue to produce a supply of breeding stock and at the same time produce food for somebody else if he will put up the ten cents.

Our experience is, or at least the idea comes into our minds, that there has been slightly too much of the scientific and not enough of the practical. Maybe we are producing a great deal, but we shall have to produce more and more and not less.

MR. SCHMITT: The establishment of a school of this sort (speaking of the school of fisheries) is a thing that is needed by you practical men and by the scientific men. Men of science need certain special training to take positions with the Bureau of Fisheries. One problem which frequently confronts the Bureau is that of securing properly qualified men. It has been the habit of the Bureau to train its own men, but that takes time and it is difficult to get others to take their places when they leave for other fields of endeavor.

Regarding the relation of scientific studies to practical results; unless we have scientific researches in biology, physics and chemistry, we cannot get the relations of the fishes to each other and their environment; unless we know how much oxygen the fish needs, and how much there is in the water; unless we know the toxicity of various chemical solutions and sawdust infusions we cannot pass upon the effects, on your decreasing river fisheries, of the poisons from the paper mills, saw mills, and other sources. These things are of undoubted importance, and unless we have scientific studies and the proper training therefor we cannot investigate these problems and give you the information you are looking for.

It is for reasons such as these that we need so much a school of this kind in this country, where most of the fishing is done at the present time. Although the east coast has a great many fishing industries, I find the western products, especially halibut, are superseding the eastern in the eastern markets, and for that reason, among others, I am heartily in favor of anything that will tend toward the establishment of a fisheries school on the northwest coast.

PRESIDENT: We have had a discussion on the subject of the establishment of a school of fisheries and we have heard from Professor Kincaid on behalf of the scientists and the University, and from Mr. Lowman on behalf of the canners and the practical men. There are a num-

ber of hatchery men here, and I think some one of them should favor us with a few remarks concerning the establishment of such a school. One of the principal courses would be the propagation of fish, and some of the hatchery men ought to be able to favor us with a few remarks on that subject. I do not want anyone to feel at all backward about getting up and speaking, because this meeting is not so terribly formal.

MR. O'MALLEY: Mr. President, I talked this subject over with Professor Kincaid last fall when we were out on Puget Sound liberating lobsters. I have long felt the need of just such a school. I have had lots of practical experience in the field, but I would like to have some of the scientific training that would naturally come from a school of that character. A lot of assistance for the practical work done by me has come from my association with Dr. Gilbert. He has spent a good many summers on the Puget Sound and Columbia River, and I have been closely associated with him. In checking up my practical knowledge with his scientific knowledge, I feel that we have both helped the other, and I feel that a school of this character, with men coming out into the practical field with trained knowledge, would be of great help. There are many questions of fish culture now before the people of this coast that are of vital importance, and one that is being worked out by Mr. Rich, employed by the Bureau of Fisheries and under the supervision of Dr. Gilbert, is the question as to the time that young salmon proceed to the ocean and what percentage of those that go early and those that go late return in the larger numbers as matured fish. Dr. Gilbert has reached the point with his scale study on salmon whereby such facts can be determined. This will give the hatchery man the information which is most vital to the industry, viz., the proper time to liberate his fish with the view of the greatest possible number returning as adults.

MR. BOWER: Mr. President, may I offer a suggestion? We all agree as to the need of a fisheries school. Now, it occurs to me there is further need of definite, concrete action as to how we can accomplish the end. It seems to me that a plan ought to be formulated whereby the legislature may be approached properly to provide the necessary funds. It seems to me that it is a question of dollars and cents, and if the matter can be worked out to that end, I think the school will be realized. I trust the Society can do something towards that end.

PRESIDENT: I think the point is very well taken. After all mere talking does not get you very far. It is the money that counts, and if we simply got together here and did nothing more than talk we would not have accomplished much. Some steps ought to be taken in order to keep this going after we adjourn, and for that purpose I think it might be well to pass a resolution endorsing the scheme of establishing a fisheries school, and then afterwards in some appropriate way appoint a committee or get the executive committee to push the idea along. We ought to give Professor Kincaid our active support in accomplishing the end which he is so desirous to attain. Now, if there are no further discussions at the present time, I think a motion will be in order to have somebody—our Secretary, or the Executive Committee—prepare a resolution endorsing the plan of establishing a fisheries school, and have it presented and acted upon at our subsequent meeting.

MR. FREEMAN: I make such a motion, and suggest that it be so worded that the request be made for the immediate establishment or the immediate announcement of the establishment of a school of fisheries here. Really the way to go at anything is to simply go at it. The need is evident, the field is wide open. Already we have shown that the conference between Dr. Smith and President Landes seems to be exceed-

ingly desirable from a national standpoint, and such an institution would establish additional prestige and would attract students not only from this country but from foreign countries. I beg to offer then that the Secretary be authorized to prepare such a resolution for presentation tomorrow, not only sanctioning the establishment, but urging the announcement of the immediate establishment of such an institution in the University of Washington.

PRESIDENT: I would suggest that while all these onerous duties are being placed upon the Secretary, that Mr. Freeman and Professor Kincaid and others interested in this—of course we are all interested, but Professor Kincaid has looked into it probably more than any of us—and I suggest that he assist the Secretary in drawing the resolution in order to get it on the books right.

SOME NEGLECTED FISHERY RESOURCES OF THE PACIFIC COAST

By JOHN N. COBB

Editor of the Pacific Fisherman

The Pacific Coast has been so bountifully gifted with salmon that it has from the very beginning been difficult to develop a market for other varieties of sea food, but as the consumption of fishery products throughout the country at large increases, and methods of distribution improve, the people are indicating a desire for a greater variety from which to choose, and this will ultimately furnish an outlet for the many species which are now either neglected entirely or but sparingly used. As it has been impossible to treat of all in the compass of a paper of this class, I have selected the most prominent.

The black cod (*Anoplopoma fimbria*) is very abundant in our northern waters, and large quantities are taken on halibut trawls when set in deep water. The black cod is a most delicious food fish, of firm and flaky texture; it is white in color and rich in flavor. While the market for this species is steadily widening, the supply which could be brought in far exceeds the demand.

Owing to its oiliness, it is not easy to pickle-cure this fish. The best method has been found to be that of double pickling. After being in pickle once the fish are taken out and put in fresh pickle a second time from two to five days. The second pickle is then boiled and the fish are replaced in that fluid after it has cooled, and are then shipped to market.

The eulachon, or candlefish, run in enormous schools in some of our Alaska streams from late in March till in May, but, although a most digestible and nutritious species, very few are eaten by the whites. These are almost invariably pickled. It is not good for canning, as the flesh drops from the bones after cooking, and when the can is opened the contents present a much jumbled and uninviting appearance. The flesh of the eulachon is said to be as restorative to the wasted human system as cod-liver oil.

The oil, which is abundant in the tissues of the fish, has very superior qualities and might be made commercially important if the proper methods were followed in its extraction and refining.

Of the large schools of herring which frequent our coast, relatively but very few are prepared for market, and these usually in a slipshod manner. Were the fresh fish selected with care and an eye to having all the fish in a barrel of about the same size, the fish gibbed and then salted carefully, and after the fish have been cured sufficiently repacked in barrels which are filled so full that the fish cannot be jumbled up, the finished product would fetch prices more nearly consonant with the best foreign herring. I put up some on the Shumagin Islands in 1912 and 1913 which averaged almost one pound each in the round and ran about 225 to the cured barrel, and these brought almost the same price as the Norwegian herring in the California market.

Several attempts have been made on Puget Sound to build up an industry in the canning as sardines of the young herring and a pilchard which frequents these waters, but all have failed through inability to compete with the cheap and abundant labor available for the Maine canneries.

In Alaska are to be found enormous numbers of Dolly Varden trout, and lesser numbers of rainbow, cutthroat and Great Lakes trout. The Dolly Varden trout are the deadliest enemies the salmon have in Alaskan waters, as they devour both the eggs and the young. Owing to their being classed in the states as game fish, it is almost impossible to find a market for them in a fresh or frozen condition. At present the State of Washington, thanks to the broad-mindedness of Commissioner Darwin, permits of their sale in the local markets. A few hundred cases are canned annually in Alaska, and these are prepared in the same manner as salmon. If medium sized fish were selected and packed whole in one and two-pound oval cans, they would present a more inviting appearance, and I believe a big trade in them could be built up throughout the country, as a trout label would be a novelty in the East, and also one to conjure with, as the name stands for a choice article in the minds of the people.

It is a question of only a few years when the shad fisheries of the Pacific Coast will be of first-rate importance. At the present time it is so over-shadowed by its giant brother, the salmon fishery, that it is almost lost sight of. The fish are taken mainly on the Columbia and Sacramento rivers. Most of them are marketed in a fresh or frozen condition, while some thousands of cases of both fish and roe are canned each season. The demand for shad is slowly but steadily increasing.

Whitefish (*Coregonus*) are found in many of the inland lakes and streams of the Northwest and in Alaska. Some commercial use is being made of them in Washington, where they are seined in the lakes and shipped to Chicago and to nearby western states. In Alaska practically no use has yet been made of them except as food by the natives who catch them. They are a delicious fish and will compare very favorably in edible qualities with the Great Lakes whitefish.

Atka mackerel (*Pleurogrammus monopterygius*) is found in large schools mainly along the Aleutian chain. The codfish vessels find schools frequently when fishing around the Shumagin Islands. The fish is rather hard to cure properly, but when the work has been well done it is delicious in flavor. In the early days of the Nome rush, when the steamers made regular stops at Dutch Harbor for coal, a small business was maintained by the natives of Unalaska in selling pickled Atka mackerel to them, but when the vessels ceased making it a port of call the business died out. If the name were changed and a strong effort made to exploit this species, I believe a good business could be built up. It would be necessary to change the common name because the fish is not a mackerel at all and bears no resemblance to one, it having acquired the name because of a fancied resemblance in flavor to the other species. Either of its other common names—"striped fish" or "yellow fish"—would be appropriate.

The cultus cod (*Opiodon elongatus*), several species of sea bass, known locally as red rock cod (*Sebastes ruberrimus*), Sitka black bass (*Sebastes melanops*), etc., various species of flounders, including the deep-sea sole, are excellent food fishes and are to be found in abundance along our northern coast and in Alaska. Most of them now find a limited

market in the coast towns, but eventually they will be shipped to all sections of the West, as their food qualities become better known.

The most remarkable instance of wholesale waste of fishery products is to be seen in connection with the great salmon industry of this coast. In 1913 some 140 millions of salmon were used in a fresh condition, and in canning, pickling, mild-curing, freezing, smoking, etc. Estimating the loss in dressing these salmon at 25 per cent, a most conservative estimate, gives us the enormous total of 101,186 tons of offal. With the exception of about 7,000 tons, which were used at a few small plants, all of this enormous total was thrown back into the water, thus not only wasting valuable material but polluting the water from which the fish originally came. For various reasons, not all of this material could be saved, but the amount that could be worked up into merchantable products would surprise most of my hearers.

Included in this enormous amount of offal are millions of pounds of salmon eggs. Although Siberia prepared 250 tons of salmon eggs as caviar in 1913, only about 24,000 pounds were prepared upon the Pacific Coast of America during the same period. It is a comparatively easy matter to prepare caviar, and with a little experience almost any fairly intelligent person can do it, and it is to be hoped that some of our fishermen will turn their earnest attention to this matter.

The balance of the offal would make excellent fertilizer and oil. A few unthinking persons have blamed the cannerymen for not having done this years ago, but they must be acquitted of most of the blame. For once American inventive genius has lagged behind. In the East, where the preparation of fish scrap and oil from non-edible species is an old and important industry, large plants have been established for the rendering of the fish. On this coast, where non-edible species are rare, fish offal has been the usual source of supply, and as the packing establishments are generally scattered widely, large plants could not be utilized owing to the heavy expense of bringing the offal such long distances. As a result a small plant, capable of handling the refuse of a plant packing from 50,000 to 100,000 cases, was needed, and this has not been available at a

reasonable cost until within the last two years, but as most of the ventures in this line in the past have been failures, the cannerymen are chary of investing until they see such a plant working successfully upon this material alone.

Mussels.—Dr. Smith has told us in a recent circular issued by the U. S. Bureau of Fisheries that we ought to eat the sea mussel. I am happy to inform him that in a limited way this bivalve has for some years been marketed at various places on this coast, but there is room for an immense increase in its consumption. Large beds are frequent along this coast from San Francisco north, especially in Alaska. H. E. Westbrook has recently started to can them at his plant on Smith River, in northern California, and if the product takes well with the consuming public others will undoubtedly take it up. Canning mussels would be a good business for the salmon canneries to take up when the salmon are not running.

Mussels are also valuable for the production of fertilizer, the so-called "mussel mud" constituting one of the best fertilizers known. It is found in places where the mussel beds are exposed to constantly depositing silt, which slowly destroys the mollusks and buries them beneath their offspring.

Clams.—Clams are abundant throughout Alaska; I have personally found them in nearly every section outside of the Arctic and it is credibly reported that there are large beds along the Arctic coast. The razor clam (*Machacra patula*), is especially abundant in southeast and central Alaska. The mud clam (probably *Panopea generosa*) is to be found in the same regions. Almost no use is made of them at present, but some day they will prove a source of wealth to the Territory. The work of canning could easily be carried on at plants erected adjacent to the grounds.

Cockles.—Beds of cockles, sometimes called scallops in Alaska, are known to exist in Funtar Bay, on Admiralty Island, and in Dry Strait, near Wrangell, in southeast Alaska, and would probably be found in many other places if systematic search were made. They are eaten, but not sold.

Crabs.—Crabs are exceedingly abundant in Alaska, and for many years the residents have been catching and eating them. In 1909 the business of catching and shipping them to Puget

Sound was first undertaken. In the beginning all were shipped alive, packed in seaweed, but so many died on the way or arrived in bad condition that finally all were boiled before being shipped. They were shipped during the summer months when a close season on Washington crabs prevailed. Owing to certain peculiar conditions prevailing on the Sound in 1913, none were shipped from Alaska.

Owing to the cheapness and abundance of the canned crabs imported from Japan, the business of canning them has languished on this coast, but as the crabs are said to be decreasing in Japanese waters it may be that eventually our packers will be able to do some business in this line.

Shrimps and Prawns.—These crustaceans are in quite general use in the coast states, but their pursuit has been neglected in Alaska.

Shrimp are found in a number of places in Southeast Alaska, being fairly abundant at times in the vicinity of Wrangell, while the investigations of the Albatross have shown that they are abundant in the waters of central Alaska, south of the Alaska Peninsula. Last summer, during the month of July, I found large numbers in the stomachs of codfish delivered by the fishermen at Pirate Cove, on Popof Island, in the Shumagin Islands. They have been reported from a few places in western Alaska. As the discovery of the presence of shrimp in Alaska has been what we might term accidental, it is probable that other, and even more prolific, grounds would be found if sought for specifically.

Prawns have been found in southeast Alaska, in the vicinity of Wrangell. Some prospecting was done in 1909 and a few of these crustaceans, known to the fishermen of Puget Sound as "big-spots" (which average 5 inches in length), "coon-stripes," (2 inches in length), and "pinks" (1 to 1½ inches in length) were gathered. As this was the first and only effort, so far as my knowledge extends, ever made to find these crustaceans in Alaskan waters, it is my belief that more extended search would disclose them in abundance in other sections of the Territory.

Whale Meat.—In Japan whale meat is of considerable economic importance as a food product, the tail and adjacent parts

and the soft piece under the eye being the choicest portions. It has much the flavor and appearance of beef. There are several whaling stations in operation on this coast, nearly all of which ship the portions mentioned to Japan. Could the prejudice against the whale meat be overcome it would prove a most important addition to our national larder.

Hair Seals.—Many thousands of hair seals frequent this coast, especially in Alaska, and if properly hunted I believe the industry could be made a profitable one, as the hides make excellent leather. A considerable reduction in the numbers of these animals would greatly benefit the salmon industry, as they annually destroy millions of these valuable fish.

Sea Urchin.—The sea urchin, which is quite abundant on our coast, will some day be an article of economic importance. A few are gathered and the meat eaten by Japanese in California and by natives in Alaska.

Sea Cucumber.—The Holothurian, known commonly as the sea cucumber, is a very abundant animal on this coast, but no use is made of it as yet. In the South Seas immense quantities are prepared for market by boiling and smoking, the resulting product being known as beche-de-mer. It is highly prized by orientals, who prepare a most delicious gelatinous soup from it.

Algae.—Despite the fact that the seaweed resources of this coast are not surpassed by those of any other, they are practically ignored. A number of the native tribes gather, prepare and eat considerable quantities of seaweed, while small quantities are prepared by the oriental fishermen operating along the west coast for food, medicine and fertilizer.

Dulse (*Rhodymenia palmata*) is quite common on our Northwest coast, and is an article of diet amongst the Washington and Alaska natives. The natives of Alaska usually gather dulse in the summer, dry it in the sun, press it in boxes, and then put it away for winter use. Other species of this genus grow on the west coast, while several other algae known as dulse in Europe and used in the same way as *Rhodymenia*, are represented by various species on our west coast. Dulse is frequently eaten as a relish in New England by the whites, and is also in quite general use in Ireland.

Vegetable isinglass could be prepared from *Gelidium cor-*

neum, an alga which grows in abundance on our coast; this species is identical with the one from which the Japanese prepare their vegetable isinglass. Other species (*G. coulteri* and *G. cartilagineum*) exist on the coast of California.

One form of agar-agar, now so extensively used in making culture media in bacteriological work, could also be prepared from *Gelidium*.

Laver (*Porphyra laciniata*) is found in abundance along our entire coast, but is not collected, except sparingly, by Chinese, although large quantities are imported by orientals living in this country. Laver grows abundantly in bays and near river mouths. In Japan this alga is cultivated and most of the crop is sun-dried. The green laver, or sea lettuce (*Ulva latissima*), which is abundant on all our coasts, is eaten in Scotland, and is also eaten with meat or as greens by native tribes of our Northwest coast.

The giant kelp (*Nereocystis lutkeana*) is found in great profusion on the Pacific Coast from Southern California northward. The natives of this coast have made considerable use of this alga, while curios are made from the various portions of the plant and sold to tourists visiting California.

In 1906 two professors of the University of Washington invented a process for making a product resembling citron from the giant kelp. When made from the bulb it was a difficult matter to detect the difference between it and the real citron. The flavor was, of course, artificial.

Numerous species of *Laminaria* exist on the northern part of this coast, and the only use to which the plants are now put is for fertilizer. Many of these could be prepared in various ways as food and would doubtless meet with an encouraging reception if properly introduced.

Many species of algæ identical with or similar to those used in Scotland, France and Japan in the manufacture of iodine abound on our Northwest coast, but are never used for this purpose, despite the fact that this country is a large consumer of iodine, and its preparation in crude form is a comparatively simple matter.

Nearly all marine algæ contain iodine, but a few have such a comparatively large quantity that they are used almost exclu-

sively. The Atlantic kelp yields the highest percentage of iodine, while the Pacific kelp yields a much higher percentage of potash, five or six times as much as the Atlantic kelp.

During the extraction of iodine, algin, cellulose, dextrin, mannite, potash, chloride of potassium, and carbonate of soda are also produced. As this country imports annually about \$13,000,000 worth of potash, all of which could be produced from seaweed, we are criminally wasting our resources.

As a direct fertilizer fresh seaweeds have been in use for many years by farmers living on or near the Atlantic coast, but very little use has been made of it in this manner on this coast.

Owing to its large content of water the total quantity of fertilizing ingredients in plants is very small in proportion to the weight of the material. As the plants decompose rapidly, and the water separates from them quickly, during which operations the fertilizing constituents, especially the nitrogen, wastes away in the process, it is important that the plants be used within as short a time as practicable after they have been collected.

Seaweeds have a mechanical action on the soil, tending to make it friable and binding its constituents together. They also have an advantage over barnyard manure in the freedom from seeds of land weeds.

DISCUSSION

PRESIDENT: Mr. Cobb's paper certainly opens a great field for discussion, and I will be glad to hear from any of the members who have anything to say on the matter.

DR. SMITH: Mr. Cobb has certainly sounded a keynote in pointing out the wonderful unutilized resources on this coast and the way in which the general fishing industry of the Pacific Coast may be extended. He has mentioned numerous products about which I would like to say something, but time forbids, and I will only call your attention to the herring resources of Alaska. I have been satisfied for many years, after investigations in western Europe, that the herring in Alaska can become one of the great commercial products. Up to this time we have practically dipped only a few barrels out of the sea annually, and they have been largely used for the making of oil and fertilizer, and more recently for bait in the halibut fisheries; but the vast untouched shoals of herring in the Alaska waters are awaiting some enterprising men to go in there and utilize them. They can be suitably prepared and will certainly meet with as ready a market as the Norwegian and Scotch herring which, as we know, contribute so much to the wealth of those countries. The Scotch herring industry, carried on for the most part on the North Sea and the islands off the northern coast of Scotland,

sometimes amounts to 800,000,000 pounds annually, and practically the entire catch is salted and shipped to countries that are less favorably situated, central Europe, Russia, Germany, etc. There is no reason in the world why herring prepared after the Scotch method in Alaska should not be sent to Europe and other countries that demand that kind of fish. One year in which I was in Scotland looking into the herring fisheries, there were 2,800,000 barrels of salted herring prepared and sold at what was considered a very handsome profit.

PROF. KINCAID: Mr. President, in this connection I would like to mention some observations made at our marine station located at Friday Harbor, bearing upon the edibility of certain marine animals. Several years ago we had in our party a young man of a particularly daring gastronomic disposition and we appointed him our official taster. He was apparently not afraid of anything along this line, and so we turned over to him a considerable series of animals taken from the waters of the archipelago and when he reported favorably other members of the party tested these culinary curiosities. The most striking discovery we made was that the giant barnacles (*Balanus evermanni*), occurring in such profusion in the northern section of Puget Sound, are really very delicious indeed. When cooked and eaten in the fresh state they were just as palatable as any shrimp or crab could be; and since they can be gathered in great quantities and will survive shipment in the living state for long distances, there is no reason why the future should not develop a barnacle fishery in the Northwest. Individual animals of this species are frequently found attaining a height of six inches and a diameter of five inches, indicating that these are truly the giants of this branch of the crustacean series.

MR. COBB: I would state, to give you an idea of what difference the preparation of a product in a proper manner will make in the value of the same, my experience with the herring we put up on the Shumagin Islands. For the ordinary trade they were too large—as herring are generally sold by the piece a medium sized fish goes better than a very large one—but we prepared them in the best manner we could, grading them by size very carefully. The larger ones averaged about 225 to the barrel. Previous to this, Alaska herring had been selling for about \$7.00, the highest price we could get, and the merchants in San Francisco objected strenuously to paying even that. When we brought these from Alaska and exposed them for sale, the lowest price we received for them was \$11.00—they all went at \$11.00 or better, and the merchants have been very anxious to get more of them since.

MR. FRASER: In connection with the herring question, I might mention the fact that this year at Nanaimo there has been an experiment carried out in connection with putting up pickled herring. One firm brought out a Scotchman and about eight Scotch lassies to put up herring during the season. There was no trouble in disposing of the fish, as they were considered to be every bit as good as the Scotch herring. In general they are not so large as the Scotch herring, as the average weight is only about a quarter of a pound, and I have not seen any Pacific herring weighing as much as a pound. The British Columbia herring industry is centered around Nanaimo. At the highest price received in the season 1912-13, viz., \$29 a ton, the herring fishing is quite profitable, but during last season the price dropped to about \$5, a price likely to make the balance on the wrong side of the ledger.

MR. COBB: I would state that the size herring I referred to are found only in two sections of Alaska—Cook Inlet and the Shumagin

Islands. Southeast Alaska herring will run about the same as Nanaimo; they would probably average four or five hundred to the barrel.

MR. FRASER: How long are those herring?

MR. COBB: About fifteen to eighteen inches long.

MR. FRASER: I notice Jordan and Everman put the length at eighteen inches, and I was wondering where they got it.

PRESIDENT: Are there any further remarks on this paper of Mr. Cobb's? I am sure that papers of that kind would undoubtedly be of great interest to the fishing community at large, and we hope through the medium of our report to give it the widest circulation possible.

ANGLING AND NETTING; THE CONSERVATION OF THE MARINE FISHES OF SOUTHERN CALIFORNIA

By CHARLES F. HOLDER, *of Throop College of Technology*
(Read by Mr. H. L. Osterud.)

At the present day one may contemplate the Rise and Fall of the Dutch Republic with serenity, but the rise and fall of the sport of sea angling and the fishing industry of Southern California has been accompanied with not only wailing and gnashing of teeth, but even more hostile exuberance.

It is a somewhat singular fact that Southern California has been more or less neglected by the government. The people are virile, intelligent, and in the main from the East, but the Middle West, not interested in sea products, predominates to a large extent among citizens, which possibly explains the fact that there has been no fierce and continued demand for aid. Los Angeles is a most vigorous city with 450,000 inhabitants, but it has no garrison—is entirely unprotected. Its coast has one lighthouse. Its islands have no lights. It had until last year no laws protecting its sea fishes to amount to anything; in fact, has been left to itself. It so happened I was born on the New England coast and became familiar with the marine fishes, as my father, with Louis Agassiz, dredged Massachusetts Bay, and in 1859-60 I accompanied him to Tortugas on the Florida reef, where I resided five years, observing the fishes. In 1885 I was forced to come to Southern California for my health, and have constantly observed the sea fishes here, and the keen struggle between the alien fishermen and the few who believed in fish conservation.

I am, you will observe, presenting my own views and am not quoting any authorities. I saw the gradual reduction of marine fishes on the Atlantic Coast. In 1869 I followed the shad in their migration north. In the St. John's I used them as shark bait, they were so common. I remember shad in the Connecticut, Hudson and other rivers, but today the Eastern net catch of shad in the Potomac for the entire season of

1913-14 was not equal to the catch of *two days* ten or twelve years ago. They have been netted to possible extinction by unscrupulous netters who have looted the United States of a great industry. The sturgeon, each individual of which is valued at \$125, is almost gone. I have seen Florida looted of its birds. I have known 10,000 robins to be killed in one day in a certain state. In a word, the alien is with us. He comes from a land of no game laws, and he brings his habits of destruction with him. In 1910 I was in Italy. Every living creature has a price. A seine was hauled in front of my hotel on the Riviera every hour. The crop of echini and sea anemones was failing; even they were eaten, and a fish was a jewel.

In 1886 I visited Santa Catalina Island, twenty miles from Los Angeles, an island of 55,000 acres, 22 miles long, with a lee, a perfect fish refuge and spawning ground to be seen without a special gift. Every rock was piled with abalone or haliotis, a valued shell for the pearl and for the meat. The spiny lobster or crayfish was just as abundant. The waters were alive with fishes of great economic value. There were many kinds. Two swordfishes (*Xiphias* and *Tetrapturus*), the great jewfish (*Stereolepis*), the yellowtail (*Seriola*), the tuna (*Thynnus*), the albacore, bonito of two varieties, barracuda, whitefish, sheepshead, rock bass of many species, groupers or rockfish of large size, white sea bass, surf-fish, roncador, and dozens more, not to speak of sardines, anchovies, mackerel, and a group of the rarest fish in the world, *Lutvarus*, *Regalecus*, *Opha*, etc.

In a word, gentlemen, this was a fish paradise. You could catch thirty-pound yellowtails from the beach, and the men looked into their boats in the morning for flying fish which the white sea bass chased out of the water at night. The climate in winter was like an Eastern October; in summer like a New England September; clear, stormless and delightful, up to all the praises that have been awarded it by temperamental enthusiasts. I saw the change, the coming of the alien—the Japanese, Chinese, Italian, Greek, the Portuguese—and the lax care of the authorities. The crayfish gradually became rare. The Chinese looted the shores of abalone. They sent the meat to China and the shells to Germany by the ton. Gangs worked in platoons; one five feet from shore, another at seven, another at

nine or ten, another at ten or twenty. And so they moved down Santa Catalina and San Clemente, an island equally large, and took every shell, little and big, and all animal life.

I protested in the press and made myself unpopular to no avail. The Greeks killed the gulls to bait their lobster traps. We stopped this, and only last month I secured protection to sea lions. The gasoline boat now arrived and the demand for fish jumped.

Twenty-nine years ago I came to the conclusion that the islands were spawning grounds and the source of supply to all Los Angeles county and far beyond. All the fish spawn here; the yellowtail, white sea bass, sheepshead, whitefish, black sea bass, in the kelp; others alongshore in open water. The sardines spawned in the bays, particularly Avalon bay. From April to October was the main spawning time, especially August and September.

From 1885 to 1895 vast schools of tuna (tunny) came regularly June 15th and remained until August or September. The gasoline boats now enabled the Greeks and Italians to get offshore and back quickly. They began to net the islands with seines. One hundred and fifty seines, fast to the kelp and running offshore long distances, have been counted in a mile and a half. The entire coast was netted at night with seines and gill-nets of all kinds, and during the day dozens of big boats followed the fish with purse-nets and took them by the ton. The tuna was not caught; it was driven away. It came inshore day and night, to feed and spawn, ran into the maze of nets, was frightened off, and ten years ago left almost entirely.

This was one of the most valuable fishes to Southern California. It attracted anglers from all over the world. It is estimated that the tuna alone brought half a million dollars to California per annum fifteen years ago, money that was spent all over California and in Washington and Oregon, as the anglers came west on the Atchison, Topeka & Santa Fe and Sunset line, and after the tuna left, went north and east over the northern routes.

At last the fish disappeared altogether. Today tuna fishing in the Mediterranean is one of the assets of Italy, and it would be almost equally valuable here today. But nothing could with-

stand the looting, the fences, hurdles and repetition of nets. The raids of the netters was appalling. Sardine canneries were now started. I organized the Tuna Club about this time to conserve the tuna and other fishes. Distinguished anglers joined it, gave their moral support, and we did what we could to induce the market men to believe that fishes could be exhausted.

We demonstrated that Avalon bay was a spawning ground and endeavored to stop the netting. We asked for *one half* mile, and allowed them sixty miles of the coast line. But they refused, and then we began to fight. I fought them before the supervisors and stopped them in a compromise for three years; then they began again and this wonderful place was only saved from entire looting by getting a law to prevent netting within a mile of a sewer.

This little bay was a source of supply for a vast area. The sardines born here returned, schooled, swam out into the channel as food for large market fishes; there could be no mistake of this. There was a direct relation between the abundance of sardines and an abundant supply of big fish. But the canneries would take from ten to twenty tons of sardines and smelt at a haul with purse-nets.

They would have taken every last fish and reviled Nature for not supplying more. For years we fought, and endeavored to educate the men; a waste of sentiment, and I soon learned that the thing to do was to fight, first, last and all the time. It took me literally twenty years to get a bill passed at Sacramento in the California Legislature to recognize the fact that Santa Catalina is a spawning ground. I took Dr. Jordan, Dr. Henry van Dyke, Dr. Grinnell of Berkeley, and dozens of men to various points—men who knew. Here is the report to me of Dr. David Starr Jordan, the world's greatest ichthological expert:

December 5, 1912.

Dr. Chas. F. Holder,
Throop College of Technology,
Pasadena, California.

Dear Sir—I trust that you may be successful in having Santa Catalina and San Clemente Islands set aside as fish preserves. These two islands and the smooth waters off their shores are the spawning grounds, above all others, of the greatest game fish in the country. The white sea bass, the great jewfish, the spearfish, swordfish, tuna, bonito, albacore, the Japanese tuna (yellow-fin tuna), all spawn on the

rocky and other places about these islands, as well as a multitude of smaller fishes valuable to the angler or to the markets.

Many of these fish spawn in the kelp which surrounds these islands. The netting carried on inshore disturbs these fishes at spawning time, and it is said that there has been a very marked falling off of these species. As Avalon, on Santa Catalina, is the great center of big game fishing, the disappearance of any of these species makes a great loss to the people who have investments there as well as to the visitors who come there for fishing purposes.

It is desired to prohibit the use of seines and all nets for market purposes within three miles of the shores of either of these islands. This allows the professional fisherman the entire Santa Barbara channel, Santa Rosa, San Miguel, and the rest comprising the Santa Barbara group.

, I trust that you and our friends will be successful in getting the statutes passed which shall protect these islands and set them apart as spawning grounds for the great game fishes of Southern California.

Very truly yours,

(Signed) DAVID STARR JORDAN.

Every man who saw the situation agreed with me, and when our bill was at last drawn I had letters from many men advocating it. Our bill recognized the coast of Santa Catalina as a spawning ground, a source of supply of market fishes of Southern California, or a large portion of her coast, and it called for absolute cessation of netting of all sorts within three miles of shore. Line fishing was permitted anywhere, and the men had the entire Santa Catalina channel, thousands of square miles; all San Clemente Island, as large as Santa Catalina; the Coronado Islands, the Santa Barbara Islands, and three or four hundred miles of mainland shore. But they fought for Santa Catalina; they wanted everything, and raised a petition, signed by 3,000 men, in protest.

By this time the normal catch of 1912 was 75 per cent less than that of 1885. It had steadily decreased. The tuna had entirely disappeared. The albacore, canned as "Blue Sea Tuna," now followed by one hundred or more Japanese boats, dropped far below normal, and this was true of all the distinctively pelagic fishes.

The law making Santa Catalina a fish reservation passed and was signed by Governor Johnson in August, 1913. They tried to evade it, and soon several convictions were made. Today, ten months later, a wonderful change has taken place. There have not been so many fish about for fifteen years. They are lying in the kelp beds, yellowtail, white sea bass, and others,

undisturbed, and for a single year the change is marvelous. What would it be in five years of absolute rest? The almost ruined Avalonians, who had an investment of nearly \$300,000 in boats and equipment of all kinds, dependent on the fishing, took on fresh hope; the tuna was expected back and hopes of cheaper fish revived among the consumers of Southern California.

But it was too much, possibly, to expect, when avarice and ignorance were on one side, and mere intelligence and conservation on the other. The canneries wanted sardines. The net men wanted to haul and set nets at night or any time. It was too good to give up, so the market men determined to fight for the island's protected shores. Some sort of an organization was necessary, so the poultry, game and fish dealers of San Francisco started the "People's Fish and Game Protective Association of California." The first officers and founders were as follows:

President, Barclay Henley, attorney for John F. Corriea; vice-president, John F. Corriea, game and poultry dealer; secretary, F. M. Bailey, secretary of Corriea Corporation.

Executive Committee: Cecil Raymond, game and poultry dealer; L. A. Sischo, market hunter; W. H. Maack, wholesale fish dealer; Chas. A. Cook, and John B. Campedonico, game and commission merchant.

They sent their secretary, Mr. Bailey, down to Southern California to secure signers to an initiative petition, and this is going on at present (June, 1914). If they obtain about 30,000 names the question as to whether the three-mile spawning bed law shall be annulled will be voted on.*

The very suggestion of such a move is the piscatorial crime of the century and is being fought with a vigor that does not argue well for peace. The opponents to the so-called "Protective Association" in San Francisco have raised a large sum, and Prof. Taylor, of the University of California, is going over the state in a campaign of education, paying particular attention to the bird and game side of the question. I have done what I could to explain to clubs and the public the sea-fish side, and I have taken particular pains to urge a friendly feeling between dealers and the public.

*Mr. Bailey withdrew Santa Catalina Island from the initiative petition in 1914, after hearing my statement, and thanked me for preventing him from innocently injuring the state fisheries.—C. F. H., 1915

But the fact remains that a man in the fish business, in the poultry business, and wild game business, or a market hunter, as was one of the original officers of this "Protective Society," is not of the exact mental fiber that cares to know anything about conservation. The taking of market fishes here is entirely in the hands of ignorant aliens—Japanese, Chinese, Portuguese and Italians—who come from lands where nothing is known about conservation or wild life protection. They scorn the idea of leaving anything for the man of to-morrow, and even think a man is a fool to consider it.

Conservation is not for them. Congressman Linthicum, of Maryland, tells me that if the shad men on the Chesapeake had allowed but ten per cent of the shad to go up the Potomac it would have insured the supply for another year. Would they do it? No, they preferred to take them all and ruin the greatest and most valuable fishing in America. So on the Pacific. Argument is worthless. Nearly all the fishermen are aliens. They are sent out to get fish at whatever cost, and the American conservationists believe the officers of many of the market fish companies to be actuated by a similar desire.

There is one saving clause to the situation. We have educated the masses of the people, and the tax payer is aware that our fisheries are being preyed upon, exterminated by men who in some cases do not have sufficient intelligence to even protect their own interests. It is the story of the goose that laid the golden egg, and in California they are in the grossest ignorance killing the goose; but such gross ignorance reacts on the consumer. It will increase the cost of living, and the tax payer is awakening to the fact that the American fisheries are being ruined.

It is necessary to give some oversight to the sea-food supply, just as it is necessary to protect the forests. Half a dozen societies, particularly the California Audubon Society, is fighting the good fight for wild life with publicity. Dr. David Starr Jordan is its president and I am one of the vice-presidents. We are doing what we can to make the sea fisheries last for all time, and to aid the ignorant dealers to save themselves.

The conservation of the sea fisheries of Southern California is one of her most important problems. The present year I organized "The Wild Life Protective League of Southern California" to carry on this propaganda of education. It appears to be a fixed idea in the minds of many that the sea cannot be exhausted. If it were not for game laws and the hundreds who are fighting for wild life, hundreds of species would be wiped off the earth with remarkable celerity. When a man gets the idea into his head that gulls, the most valuable scavengers in the world, are only good for baiting lobster pots, or that insect eating birds are only for the pot, or that the beautiful meadow lark ought to be exterminated, such minds and men need the strict surveillance of the American people. Personally, I take great pride in the development of the economic products of the sea and land. I desire to aid in the development of the sea fishes for the benefit of the seiner, of the fishermen, the canner and the market dealer, but as an American, as a modern American, I deem it my duty to state and nation to remember that I am but the custodian of the products of Nature's gifts; I am responsible for them. If the world was going away with us, it would be well and good to kill all the animals, cut down the trees, but our tenure of life is but a drop in the bucket. Man is increasing, and it is the duty of every man of intelligence to remember his children and his children's children, and leave something for them. The man or men who do not appreciate this are a menace to civilization and must be watched and forced to comport themselves in such manner that our great economic questions may be solved to give the future all it needs and at a not increasing price. This, Mr. President, I deem a solemn duty and obligation to every educated, intelligent American.

DISCUSSION

PRESIDENT: In connection with the paper which has just been read, I wish to state that we are having a rather severe fight in California at the present time, as indicated by the remarks in Mr. Holder's paper. He alludes to the fishermen; the fishermen there are both good and bad. The aliens he refers to are extremely bad. We have, on the other hand, a number of fishermen there of the more enlightened type who are in hearty sympathy with the movement Mr. Holder is fostering. We find that the heads of big fish companies there are aiding us in every way possible to keep down the depredations of the aliens. In

connection with the preserve he speaks of at Catalina Islands, it might be of interest to you to know that we have established a number of preserves along the coast of California. We have one at Catalina now, extending three miles out; we have another spawning ground and fish preserve in Cache Slough in the delta of the Sacramento; we have another one in Monterey Bay, and there are others that I can not recall just at the present moment.

We are undergoing a crisis in California now and we are making every effort possible to defeat the objects and purposes of the association which is masquerading in California under the name of the People's Fish and Game Protective Association. It is not composed of the "people"; it is composed of a lot of foreigners who come out to California and wish to strip the waters of all their fish, and have no respect at all for any restrictive measures. Their object seems to be to take everything they can and make as much money as they can, without any regard for the future whatever.

DR. SMITH: Mr. President, Dr. Holder in his paper referred to the condition of the shad fisheries on the Atlantic Coast. That is a subject to which we have been giving a good deal of attention in Washington, and which concerns us very deeply. The shad fisheries of the Chesapeake Bay—and that is by far the most important fishing ground in North America, and the shad is the most important fishing constituent of its fisheries—is in a most precarious condition. This has been brought about just as similar conditions have been brought about in other waters of the Atlantic Coast with regard to other species, not by unscrupulous foreigners or aliens. The fishermen have been operating within their rights, and far from being aliens, they are either Mayflower descendants, or claim to be such. Whatever may be the circumstances on this coast, we must ascribe untoward conditions on the Atlantic coast to the native citizen. The shad fisheries of the Chesapeake Bay and tributaries, which have yielded many millions of dollars annually in former times, have now reached such a stage that the fishery has ceased to be profitable, and I doubt if a single fisherman of the Chesapeake Bay and tributaries during the year 1914 paid expenses. This result has been brought about through the indifference of the states and the state legislatures. Between Washington and the mouth of the Chesapeake Bay, involving both sides of the Potomac River and the western shore of Chesapeake Bay, there are probably, on an average, not less than five thousand pound nets set for shad, and in addition there are thousands of gill nets and a few seines. The large seines which were the predominant apparatus in former years have been almost superseded by the more economic trap or pound net. There are places on the western shore of Chesapeake Bay where until a year or two ago unbroken lines of pound nets extended for several miles from shore. The rivers have had their mouths absolutely blocked, and Secretary Redfield has told a committee of Congress that the shad in order to reach their spawning grounds not only needed a college education, but required the aid of charts and had to be familiar with the navigation laws. It is almost a physical impossibility for fish in many of these important streams to get more than a few miles above the mouths. That is the condition we are up against in the east.

MR. COBB: Dr. Smith's remarks remind me very much of the condition I found prevalent in Albemarle Sound in North Carolina one year. The little county of Chowan has a water frontage of somewhere in the neighborhood of 25 to 30 miles. In that area I found 999 pound nets that year, and they were running out in strings of from five to seventeen each. If a fish could get by there he was certainly a lucky animal.

PRESIDENT: We find in California that we have some foreigners there who assist us greatly in the protection of fish. Take for example the crab men around San Francisco Bay; they are continually co-operating with us for the betterment of laws and conditions around the bay, but the fishermen that Mr. Holder refers to are a set of Japanese and aliens that are located around Los Angeles, and they are particularly bad. They have no respect at all for the law and have never shown any disposition to co-operate with the Commissioner of the State in the protection and propagation of the fish. The situation there is pretty bad in some places. Take for example on the Klamath River; there the nets are stretched across the river to such an extent that it is almost a physical impossibility for a salmon to ascend that stream. The stream is not very wide and is so completely and thoroughly netted that the fish have no chance. We attempted at the last session of the legislature to have certain restrictions passed, but we did not get the full measure of what we thought was right. However, we compromised in order to get anything through at all and the conditions there are now a little better than they were before. We hope, however, to have some better laws passed at the next session to improve the conditions at that point.

PACIFIC COAST BIOLOGICAL STATION, DEPARTURE BAY, B. C.

By C. McLEAN FRASER, *Curator*

In the pre-Darwinian days, when every one had the idea of a separate creation for each species of animal and plant, an institution for studying the relation of species to species, of organ to organ, etc., was not even desirable. Later, when the theory of evolution in some form had become widely accepted, interest was aroused not only in the relation of species to species and organ to organ, but also the relation of species to its environment. In the sea as well as on land, there are always certain localities that are better suited for certain forms as well as for life in general. Naturally, therefore, there is a tendency for those interested in the study of life to seek out these localities. This is done readily on land, since one familiar with the requisite conditions can readily see if these conditions exist in any locality. This is not so true in relation to the life in the sea, as the conditions can not be taken in readily with a glance, but much work of a varied nature has to be done before even an estimate can be made. Since that is the case, it follows that progress cannot be made everywhere at the same time, but instead, certain localities must be picked upon that offer not only an appearance of richness of life but also accessibility and a possibility for using facilities for research. This has led to the establishment of marine biological stations in many localities.

At first these stations were of purely scientific interest, as the mass of the people were slow to see that they, with no scientific knowledge, could obtain any advantage, direct or indirect, from any knowledge that might be obtained from the work of the scientist in this regard. Naturally, under these conditions there was little chance for getting much government support. As time wore on there was a gradual change in the viewpoint. When it became more widely known that the study of the life-history of many plants and animals led to the dis-

covery of new methods for increasing the supply of useful products, for making use of what was previously a waste and for eradicating forms that are harmful, the interest in research became extended beyond the narrow bounds of those directly engaged in it to many others who felt that benefit from such research was to be derived by all. In all countries with democratic government, and perhaps even where autocracy is supposed to hold sway, the acts of the government must to some extent be an index of the opinion of the people, hence as an outcome of this interest various governments began to give assistance, as represented by experimental farms and stations, agricultural colleges, etc., on land, and marine biological stations on the seashore. This assistance has become more and more noticeable, but is still far from being as complete as is desirable, largely because there are still many legislators, probably backed up by constituents, who cannot see that any information in any field of biological research must be of value, directly or indirectly, to every other field. They still separate the economic from the scientific, with the idea that anything scientific can never have any economic value and hence money spent in furthering scientific work is money thrown away.

The government of the United States made an early start and now for over 40 years the laboratory at Woods Hole, in connection with the Bureau of Fisheries, has been doing useful work. During these years the scientific work of the bureau has expanded and other stations have been established. In that regard the Pacific Coast has been somewhat neglected, but if I understand it aright, it will soon be impossible to make such a statement. The extensive work of the "Albatross" all along the coast has helped to make up for this deficiency.

Although Canada gave early support to much exploratory work, she has been somewhat behind in the matter of starting biological stations. It was not until 1899 that the first marine station was established at St. Andrews, N. B. Not so very long afterwards the needs of the Pacific Coast were recognized by the establishment of a station on the north shore of Departure Bay, near Nanaimo, B. C. Much of the credit for the establishment of this station was due to the late Rev. G. W.

Taylor, a field naturalist and omnivorous collector, who, working principally through the Royal Society of Canada, so much impressed the necessity of a station on this coast on the Department of Fisheries, that a start was made and a building erected ready for use in the summer of 1908, under the direction of Mr. Taylor, who was appointed first curator.

Almost any location which affords harbor or wharf accommodation on the west coast would provide plenty of opportunity for investigation, but Departure Bay was chosen on account of some special features. There is no safer harbor on the coast for all weathers and the station site is conveniently situated and easy of access since it is but three miles by water and four and one-half miles by road from Nanaimo, which provides the greater part of the supplies needed and has good boat service to Vancouver and good train service to Victoria. This means much to a station that is kept open the whole year round. It is favorably situated because it is within easy reach of the large archipelago situated along the east coast of Vancouver Island between Nanaimo and Victoria and not so very far from the equally extensive archipelago lying between the north end of the island and the mainland, while across the Strait of Georgia it is not so far to the mouth of the Fraser and the Point Grey fishing grounds. Consequently, quite a large portion of the 25,000 miles of tidewater line of British Columbia is less than a day away. For that reason it is a good center from which to work at problems concerning all the food fish of this part of the coast, with the possible exception of the halibut, as well as for the majority of the species of invertebrates of commercial value. It is pre-eminently a herring center and, since the herring serves as a food supply for a great number of marine forms, that in itself is quite an important matter. Without going outside the bounds of the bay much can be learned concerning the life-history of the herring, coho, spring and dog salmon, steelhead, blue or green cod, rock cod, capelin, the white perch and several of the flat fish, not to mention several other forms that as yet are not considered desirable as food, while the common butter clam and the little-necked clam, as well as the common mussel, are found right at the door.

On account of the volume of fresh water coming into the strait from the Fraser river and several other rivers and streams, water of all degrees of salinity is found within a comparatively narrow range. Within even a smaller range may be found every variety of shore, from extensive tide-flats to the steepest promontories, with every variation in current from the still water of the quiet bay to the tide rip of Dodds or Seymour Narrows. With these may be coupled another fact not to be despised, viz., at all the spring tides in the summer time the low tides come at suitable hours of the day for collecting.

I shall not refer to the richness of the fauna and flora except to say that anyone who has had a chance to compare the marine life of the Pacific Coast, almost anywhere from Puget Sound to Bering Sea, with any portion of the Atlantic Coast, for instance, will be quite satisfied to stay with the west and its problems.

One other point should be mentioned, although it does not apply to Departure Bay more than to many other points on the coast. It is the fact that during the whole year investigation may be carried on in comfort, in which regard we are much better off than similar stations along the Atlantic Coast, even than those very much farther south.

The start for the station was not a very pretentious one. A building was erected with a laboratory accommodation for eight investigators, with library, dark-room, etc., a dining room and four bed-rooms. The caretaker's house, with the kitchen, was built separately but near by. So far these buildings have not been added to but tent accommodation has been provided for some of the summer workers. For a time few facilities were provided but these were gradually added until now a fair provision is made, although much still remains to be supplied. The boat equipment is fairly satisfactory. A 40-foot gasoline launch with 20 horse-power engine provides the most important means for transportation. It is a good sea boat with accommodations for four, or, if necessary, six, on a prolonged cruise, although it is not very often used for trips that take more than a day. An 18-foot launch with a 3 horse-power engine serves for shore collecting and for making short

trips. Several rowboats complete the outfit. The supply of dredges, tangles, nets, etc., is not very extensive, but this will be remedied in the near future. The laboratory is fairly well equipped with glassware, preservative material and general reagents.

In the first couple of years the library facilities were almost a negative quantity, but Mr. Taylor put his library at the disposal of those who worked at the station. After his decease the scientific portion of the library was secured by the Biological Board and in the meantime many other volumes had been obtained. Other additions have since been made until now there are 800 or 900 volumes, apart from a considerable collection of separates. Men in other parts of the country are not likely to realize how much the library means to us here in the northwest. In the east arrangements can be made for obtaining books from Toronto, Montreal, Chicago, New York, Boston, Philadelphia or Washington, and in the south from California and Stanford, but here we have no large library within easy reach. It takes a long time to get books from any of the centers if we could arrange for it, and in any case the express or postal rates make much of it prohibitive.

During the early years of the life of the Canadian stations the direction of the work lay in the hands of the Biological Board, a board consisting of university professors, with the exception of the chairman, who was the Director of Fisheries at Ottawa. The funds for the carrying on of the work, however, were administered through the Department of Fisheries at Ottawa. As some of the officials of this department were not at all times conversant with the needs of the board, the authority which they possessed was not always used to the satisfaction of the board. Somewhat over two years ago, in the spring of 1912, a change for the better was made in this connection, giving the Biological Board of Canada wider powers. The personnel of the board was not changed and Commissioner Prince remained as chairman of the board, but the annual grant through the Department of Fisheries is given as a lump sum to be administered by the board without any reference to the government officials, except that the account-

ing has to pass the examination of the auditor-general. No official of the Fisheries Department, with the exception of the minister himself, has any say in the work of the board, either concerning the matter of disbursements and appointments or the nature of the work to be carried on. The board is therefore entirely non-political and consequently is not handicapped as it might possibly be under other conditions.

The Pacific Coast station has not been overly well supplied with either funds or men since its establishment, but at present the prospects are brighter. That does not mean that the work has been at a standstill, because a good beginning has been made along several lines. That the public at large is not fully aware of the tangible results from these beginnings is partly due to the lack of unity in the method of publication. The board has published three volumes of Contributions to Canadian Biology, each containing a number of papers, but this does not represent by any means the full number of papers that have been published. Apart from these the greater number of papers have appeared in the publications of the Royal Society of Canada, the Geological Survey of Canada and the Royal Canadian Institute, but others have appeared in scientific magazines of Canada, the United States and Europe.

Along with the work that has been done by investigators who have visited the station may be placed the work of those, either in Canada or elsewhere, to whom material has been sent for examination and report. Much of this has been of a taxonomic nature, for in this locality, as in every other, a large amount of work of a systematic nature had to be done at the outset before the other branches of biology could be entered upon with much chance of success. With this as a basis problems bearing on the life-history of forms of economic importance have been worked out.

As has been stated, Rev. G. W. Taylor, curator of the station from its establishment until his death in 1912, was an extensive collector and naturally, therefore, a systematist. Although he confined his attention in taxonomy to fishes, molluscs and decapods largely, he collected in all invertebrate groups and in many cases sent large collections away to be

worked up. In this way a general idea of the most conspicuous forms at least was obtained. This information was readily supplied to other workers who wished to make use of it. Unfortunately, for two years or more before his death he was not physically able to go on with his work as he wished, and many of his notes that would have been of value to science if he had had a chance to assemble them, were not put in shape that could be made use of by others.

After Mr. Taylor's death the writer was appointed curator. His work at the station in previous years in association with Mr. Taylor provided a connecting link with the work already done.

The curator continues the marine investigation throughout the year. All the other workers have held university positions and hence have had to confine their visits to the summer months, but in many cases material has been collected and carried away so that odd moments snatched from regular duties during the year might be applied to a continuance of the work on the problems started during the summer. Now that the board is likely to receive better financial support it is the intention to gradually add to the permanent force in order to have a number of experts along certain lines to be able to give definite first-hand information to the Minister of Fisheries on any scientific question that may arise in connection with his department. Already some attempt has been made to do this, but the questions have been too numerous as compared with the number of investigators to make it possible to give satisfactory information in all cases within a reasonable time. As yet this plan is too tentative for me to give any detailed information concerning it. Certain economic problems, however, are already receiving some attention and others are looming up for attention in the near future. Practically every one of these problems will require years of work, hence it is all the more desirable that the same individual should tackle the problem year after year, and this can be done most satisfactorily by his being able to give his whole time throughout the year.

The most important problems now being attacked are: A study of the life-history of the herring and of the halibut, the

iodine content in plant and animal tissue, the magnitude and value of the kelp beds, and the relation of the salinity of the sea water to its specific gravity which will serve as a basis for a great variety of problems. Incidentally, the work of making a biological survey of the region is slowly progressing. In 1896, in 1905, and in 1908, attempts were made to introduce lobsters into the Vancouver Island waters. In one instance these lobsters did very well for three months or more, after which all trace of them was lost. Later, in 1909, a number were hatched at the station and the young lobsters were liberated in the bay, but nothing has been seen of them since. Under the circumstances at the time it was not possible to follow up the experiments far enough, but there was nothing to show definitely that the rearing of lobsters on this coast was an impossibility. What little evidence there was was in the other direction. The Minister of Fisheries thinks it wise to experiment further in this regard (the U. S. Bureau is evidently of the same opinion, judging from recent developments), and that a better basis may be obtained on which to work a survey of the coast in the vicinity will be made to decide upon the more desirable locations for lobster production. As there are many such that seem similar to those on the Atlantic Coast, where the lobster makes its home, it will require some time to complete the survey, but in connection with it other useful information should be obtained. A start will be made at the survey this summer.

The board, while realizing that all scientific work is economic, has decided that since there are so many problems of special economic importance requiring scientific investigation, that these shall receive the first call and for the present attention will be focused upon them.

Before concluding, I must say a word concerning the station in relation to its only near neighbor, the Friday Harbor station, controlled and operated by the University of Washington and sister institutions. We are about 70 miles apart, across an imaginary line that, since it passes through the Strait of Haro, is so imaginary that it hinders communication very little and scientific communication not at all. The problems to

be faced at the Friday Harbor station are much similar to those at the Departure Bay station, hence any work done at the one must of necessity be of value to the other. There is no danger of either running short of work in the present generation at any rate, hence there is no necessity for or indication of rivalry between the two. It is a pleasure to refer to the cordial relations that have existed, do exist and I have no doubt always will exist, between the workers at the two stations.

SALMON HYBRIDIZATION

By PROF. E. VICTOR SMITH
Of the University of Washington

Some work has been done on hybridization among the members of the family Salmonidæ, particularly among the different species of the genus *Salmo*. The work has been carried on largely among the forms found in Europe and eastern America. It is probable also that almost every hatchery superintendent in the country has yielded to curiosity and carried out with varying degrees of success experiments in cross fertilization of the different species spawning at the same time in his territory. So that this paper has nothing to reveal that is new or startling. It aims to record observations that the author has made on the offspring resulting from a reciprocal crossing of the chinook salmon (*Oncorhynchus tshawytscha*) with the silver salmon (*Oncorhynchus kisutch*).

These crosses have been made in almost every hatchery on the coast, but in most instances careful observations have not been made, consequently many strange and erroneous ideas prevail among the men who have performed the experiments.

Practically no observations have been made on the hybridization of these salmon in the natural state. The adults of these species are readily distinguished and the very few taken that appear to fall between the two have been classified with the one or the other of these species and not as hybrids.

The investigations to be described were carried on during the fall and winter of 1913-14 at the state hatchery near Auburn, Wash. The State Fish Commissioner, Mr. L. H. Darwin, kindly placed the equipment of the hatchery at my disposal. Owing to the distance of the hatchery from the university, personal observations were not made as frequently as desirable.

The experiment was begun during the last week of October when about 6,000 silver salmon eggs were fertilized with chinook salmon milt and about 4,000 chinook salmon eggs were fertilized with silver salmon milt. These figures are rela-

tive, as the eggs were measured and not counted. The eggs were placed in contiguous baskets in the same hatching trough, so that the conditions of water were practically identical.

For the sake of convenient naming, the offspring of the female silver salmon and the male chinook salmon will be called silver hybrids and the reciprocal cross breeds will be called chinook hybrids.

Consider first the observations made of the eggs spawned from the silver female. During the first five days 20 eggs were removed from the basket. These eggs showed no signs of development of the embryos having taken place, and were probably not fertilized. All the rest showed development. Thus, only one-third of one per cent of the eggs failed to be fertilized. The low temperature of the water at this season of the year retarded development so that the eggs were not disturbed again until the 27th of December, when 507 eggs were removed. Of these 55 were so overgrown with fungus that no observations as to the development of the embryos could be made. The remaining 452 showed dead embryos in various stages of development. Thus, during the sensitive period about 8.3 per cent of the embryos died. Between December 27th and January 16th, 105 more dead embryos were removed, and on the latter date 57 more were taken from the basket. The 57 were near the hatching stage. The hatching period, which began about the middle of January, was much longer than that for the pure silvers. Between January 16th and March 2nd, 291 embryos died at the hatching stage and 127 more died just after hatching. Up to this time 1,107 embryos died, or more than 18 per cent of the original number. After this the mortality was not significant and was confined largely to the abnormal forms, a considerable number of which developed.

The abnormalities began to develop shortly before the complete absorption of the yolk-sac. There were about 225 fish in which these peculiarities were pronounced. These fish were considerably longer than their fellows of the same age and developed remarkable strictures in different parts of the body. The most pronounced stricture and the one universally present was located just posterior to the opercula. This stricture gave

the fish the appearance of having a pronounced neck. In most cases the pectoral fins were more or less atrophied and were directed obliquely upward and backward. The head was bent downward and around the neck-like part was developed a collar of a silvery luster. The ends of this collar were not united on the dorsal side of the neck but came quite close together. The next place where another stricture most frequently occurred was between the anal and caudal fins, and this one usually involved the adipose fin. In extreme cases the tail seemed almost severed from the body. The stricture of the caudal extremity was frequently attended with modifications of the anal and caudal fins, the anal fin being atrophied and the base of the caudal being much narrowed. In a few specimens the dorsal fin was considerably reduced in size. Occasionally strictures occurred in other parts of the body, but were less pronounced. The more emaciated ones developed a decidedly lumpy condition over the entire body. The stricture back of the opercula did not seriously involve the œsophagus yet the fish thus deformed took no food. They seemed incapable of co-ordinated movement and all their motions were erratic. When they settled on the bottom of the trough they always turned over on their sides. Those that were normal ate heartily and developed into as well favored and shapely fish as the pure silver or chinook. They were retained in the hatchery and fed until midsummer when they were turned into the river.

The following illustrations represent clearly the malformations of the Silver hybrids:

Consider next the observations made on the 4,000 eggs of the chinook salmon which were fertilized by the silver salmon milt. During the first five days 15 eggs, which showed no signs of having been fertilized, were removed from the basket. In this cross about the same per cent of eggs failed to show development as in the reciprocal cross. Between the 2nd of November and the 27th of December, 17 eggs were removed, all of which showed dead embryos in various stages of development. Between December 27th and January 16th, 80 more were removed, the majority of which died during the last days of this period. Thus, during the early period of development within the egg, the mortality was much greater among the embryos of the silver mother than among those of the chinook mother. Between January 16th and March 2nd, 807 more dead embryos were removed, nearly all of which died during the hatching period. The most serious mortality took place while the fish were in the yolk-sac stages. Between March 2nd and April 9th, 1,468 died, the majority of which had not absorbed the yolk. Up to the last date the total number of deaths was 2,387, or more than 59 per cent.

The relation of the foregoing facts is brought out clearly in the following table:

Dead removed—	Of 6,000 Silver hybrids	Per Cent	Of 4,000 Chinook hybrids	Per Cent
First four days.....	20	.3	15	.34
Before hatching	669	11.1	97	2.4
During hatching	291	4.85	807	20.2
After hatching	*127	2.1	1,468	36.7
Total	1,107	18.4	2,387	59.7

Among the chinook hybrids there were no cases of malformation. A comparison of the external characteristics of both hybrids were made with the pure fry of the silver and chinook at the same stage of development. Twelve normal fish of each were taken at the time the yolk-sac was completely absorbed so far as could be determined by external observation. The

* The few in excess of the 127 that died after hatching were almost all malformed. Of the 225 malformed fish the large majority were taken out alive. If all of these had died the total number of deaths after hatching would have been 352 instead of 127. This would have increased the total number of deaths to 1,332, or a little over 22 per cent.

greatest length and depth of each fish were recorded, the length being measured from the tip of the snout to the base of the caudal fin; the number of parr marks was counted on both right and left sides and count was also made of the number of rays in the anal fin of each, the short anterior rays being included in the count.

The following tabulated statement gives a summary of these comparisons:

	Silver		Chinook		Silver hybrid		Chinook hybrid	
Variation in length.....	24-30.3 mm		30.5-35.6 mm		30.3-32 mm		26-39 mm	
Average length.....	28 mm		32.5 mm		31.3 mm		34.3 mm	
Variation in greatest depth.....	5-7 mm		5.6-7 mm		6.3-7.3 mm		6-8.5 mm	
Average greatest length	6.3 mm		6.7 mm		6.8 mm		7.2 mm	
Variation in parr marks	rt.	lt.	rt.	lt.	rt.	lt.	rt.	lt.
	7-9	6-9	9-13	9-12	8-12	9-12	9-13	8-13
Average number of parr marks.....	rt.	lt.	rt.	lt.	rt.	lt.	rt.	lt.
	8	7.7	11.2	10.8	11.5	10.3	10.3	10.6
Variation in number of anal rays.....	15-17		19-20		16-18		13-14	
Average number of anal rays.....	16.3		19.6		17.2		15.2	

COMPARISON OF COLOR MARKINGS

Silver Salmon.—The dorsal fin has a decidedly orange color, except along the anterior border, which is black. This border extends to the outer tip of the fin but gradually becomes less pronounced as the tip is neared. The caudal fin is of a deeper shade of orange than the dorsal, the color diminishing in intensity from the base distally. The inter-ray spaces are dotted with black while the rays are free from them. In color the anal fin is similar to the dorsal. The rays are without black dots while the inter-ray spaces are dotted with black but not so darkly as in the anal fin. Just anterior to this fin is an irregular green spot. The ventral fins are slightly tinged with orange and are without dots on either the rays or the inter-ray spaces. A still more delicate shade of orange tinges the pectoral fins, which are also entirely free from black dots. Excepting a narrow ventral band running longitudinally, the body is covered with irregularly polyhedral black dots ranging from .25 mm to .1 mm in diameter. There is a uniform gradation from the largest dots on the ventral side to the smallest

on the dorsal. On the back these black dots are very close together and form two narrow longitudinal black bands extending from the head to the base of the tail. These bands are separated by a very narrow light line which is more pronounced in the silvers than in the chinooks. The parr marks are narrower than the interspaces and are divided into two almost equal parts by the lateral line.

Chinook Salmon.—The difference in color markings between the chinook and silver fry is largely one of intensity. Scarcely any of the orange color, which is so decided on the fins of the silver, is seen on those of the chinook. A slight tinge suffuses the dorsal and caudal fins, scarcely a trace is seen on the anal, and the ventral and pectoral are without a trace. The dark shading on the dorsal and caudal fins resulting from the presence of the black dots is similar to that of the silver but less pronounced. Black dots so decided in the anal fin of the silver are entirely absent in that of the chinook, and the remaining fins are without color markings of any kind. The ventral area without black dots is considerably larger than in the silver and the rest of the body is of a lighter shade. The parr marks are broader than the interspaces.

Silver Hybrids.—In external features this hybrid resembles the maternal ancestor much more closely than it does the paternal. The coloration of the fins is quite similar to that of the pure silver, differing only in intensity. Of special interest is the resemblance of the anal fin to that of the pure silver in that the black dots are present on the inter-ray spaces of both silver and silver hybrid but entirely absent in the pure chinook. The color of the body is like that of the silver fry. Considerable variation is seen in the width of the parr marks. In the majority of these hybrids the parr marks are narrower than the interspaces but in a number they were equal to or greater. The extremes of variation were not infrequently to be observed on the same fish.

Chinook Hybrid.—This hybrid in its color markings lies between the silver hybrid and the pure chinook. Its fins are less deeply tinged with orange than the silver hybrid but more

deeply than the pure chinook. A few black dots are scattered over the anal fin, showing the influence of the paternal ancestor. A similar irregularity characterizes the width of the parr marks that was pointed out in the silver hybrids but the average width of the marks is greater and a greater per cent of the hybrids have the parr marks wider than the interspaces.

CONCLUSIONS

In both crosses between silver and chinook salmon a very high percentage of the eggs are fertilized. In the experiments described over 99.5 per cent of the eggs showed development.

The offspring of both crosses were very delicate in the early stages of development and the mortality was very high, being nearly 20 per cent of the silver hybrids and about 60 per cent of the chinook. The mortality among the silver hybrids was highest before hatching and among the chinook during the yolk-sac stage.

In time of development the hybrids followed the maternal ancestor, the silver hatching and developing earlier than the chinook. In external appearance the hybrids exhibit characteristics intermediate to those of the parents, but they resemble the maternal ancestor much more closely than they do the paternal.

The silver hybrids develop in many instances malformations, as strictures in various parts of the body, which did not appear in the chinook hybrids.

DISCUSSION

PRESIDENT: Possibly there are others among the members here present who have had some experience in the line of hybridization, and if there is anything that anyone wishes to offer we should be glad to hear from him.

MR. KINNEY: I would like to ask Professor Smith whether these experiments were both carried on at the same time?

PROF. SMITH: Both experiments were carried on at the same time, in the same trough, and with the same conditions of water.

MR. KINNEY: One placed above the other?

PROF. SMITH: The water flowed directly from one basket to the other.

PRESIDENT: Was there any chance of this malformation being due to bacteria?

PROF. SMITH: I haven't made a microscopic examination of the strictures. I intend to make that later, so I could not answer that question at present.

MR. O'MALLEY: In this connection I might state that during the fall of 1907 the Bureau of Fisheries conducted an experiment similar to that conducted and explained by Professor Smith, namely, a cross between the silver salmon female and the male chinook.

Out of about 5,000 eggs collected, 3,500 were reared to good sized fish and they appeared at all times to be strong and healthy. A part of these were exhibited in a small aquarium with the Bureau's display of live fishes in Seattle at the Alaska-Yukon-Pacific Exposition. These fish were held until they were 12 or 14 inches in length and liberated into the Clackamas River, a tributary of the Columbia River. A year later an opportunity came to try the cross with chinook eggs and silver salmon male but in this case the resulting fish were not as healthy as in the former case. In both experiments deformities similar to those described by Professor Smith occurred.

A MEMBER: Mr. Chairman, I was up at Reed College when the kings were coming out this year, and I noticed a number of them came head first out of the shell, and the others came out tail first. The gentleman at the hatchery told me that in general there was a greater number of malformations among those that came out head first than among those that came out tail first.

PROF. SMITH: From what I learned at the hatchery at Auburn the mortality was much greater among those that came out head first, but no observations were made as to the relative number of malformations.

PRESIDENT: Before we take up the matter of rearing and feeding of salmon fry, we have two other short papers which we would like to have read. Mr. Secretary, will you read them for us?

SAFEGUARDING THE SALMON

By L. M. RICE
(Read by Mr. John N. Cobb)

It is not necessary for me to point out how much depends on our efforts in educating the thinking people of Washington to the necessity of safeguarding the salmon in the streams. We hatchery superintendents who have been long in the service notice the decreasing number of fish which each year come up to the spawning beds, a decrease due no doubt to the improved appliances of the fishermen, and we cannot fail to realize the need of appropriations for hatcheries and legislative protection for the fish.

The day when natural spawning, with its accompanying waste of fish life, would supply the streams has passed. You well know how by artificial or hand-spawning the milt comes in direct contact with each and every egg, so that if performed by an experienced man all are fertilized and few, if any, are lost. I remember well how some years ago when I was superintendent at Kalama, Mr. A. C. Little, then Fish Commissioner, impressed on the minds of all the men the wastefulness of natural spawning, which, in his opinion, was as old-fashioned as child-birth without a midwife. Each of the superintendents was to watch and find where salmon were spawning. We did so and dug up about one hundred eggs, of which an average of sixteen lived. I have always wondered how many of the sixteen were alive a week after they had moved out into the current. We must admit that the fry, held in the hatchery from one to three months, and until the sac is absorbed, has much better prospect of life than has the natural egg in the spawning beds, with a chance of being covered too deeply, of being washed out by splash dams, and of being destroyed by other perils, of which the young salmon hatched the previous year is amongst the worst. This yearling, having attained the length of from four to six inches, develops quite an appetite for the small fry, and consumes them in large quantities until he takes his departure from the spawning

grounds about the first of June. But here again hatchery fry may receive protection, for we can hold them in the rearing pond until their hungry brothers have gone to sea.

It would seem that the unlucky salmon need our assistance, not only at their spawning and in the first weeks thereafter, but also when they start down the river. What with the fish traps and nets, and the breaking of log jams with powder, these fish have a rough trip to the sea. Why does not our legislature require of loggers that they break their jams with the donkey engine?

The very streams appear to conspire against the salmon. For illustration, I will, with your permission, refer to the region where I work—the upper Satsop country. Here there is a branch of the Satsop river known as the Martin or Middle East Branch, which being a swollen stream in the winter, induces large numbers of salmon to go there to spawn. But as the days grow warmer and the summer approaches the stream shrinks until there is a dry bed and the fish die. Countless fish might be saved if the dry beds throughout the state were guarded by dams, so that eggs would not be spawned to die.

DISCUSSION

PROF. SMITH: Did that paper say that the yearlings ate the ones that were turned loose? I just want to know that for my information.

PRESIDENT: Mr. Rice is here and can probably give his views.

MR. RICE: Some of them are more than yearlings, and some of them are turned out under this. They will eat young fry. They swallow them.

PRESIDENT: The questions covered by this paper will largely be taken up when we come to the paper on the rearing of salmon. We will simply pass the discussion until after the reading of that paper.

IMPROVEMENTS NECESSARY IN THE HATCHING OF SALMON

By S. BUTTS

Superintendent, Willapa Hatchery, Lebam, Wash.

Being unable to attend your meeting, it gives me pleasure, however, to present some of my ideas on the artificial propagation of fish and the improvements that I think are necessary, some of which are now in use, but not generally so.

We have in most of the coast streams of Washington and Oregon three distinct runs of fish, viz., the chinook salmon, the silver salmon and the steelhead trout. The first begin to ascend the various streams for spawning purposes about September first; the second, about November first, and the third about February first, the last continuing until about May tenth, which gives us upwards of eight months in which to take spawn, and, consequently, the same length of time in which to liberate the fry.

Fry begin descending the streams at about four months of age. The smaller and weaker ones sometimes remain in fresh water until eight or nine months old. The stronger ones are descending the streams about the time we are liberating the fry of the second run, and both being of a cannibalistic nature, the elder devour the younger ones to an alarming extent. Thus the first liberated fry become the greatest menace to the industry.

Of course, there are always trout and other small fish in our salmon streams, but not in such numbers as the older salmon fry.

The same thing happens when we are liberating the fry of the third run; those of the second run are descending the streams and gorge themselves on the younger ones.

To obviate this great destruction, we should have retaining ponds to rear them in and feed them until they are four or five months old. The erection of the ponds might mean the expenditure of considerable money, but I think it would be economical in the long run.

One other improvement I would suggest is the erection of an ice plant at one or more of the larger hatcheries, so that any of the smaller ones could be furnished with ice when necessary, as the weather is warm in September, and some of the hatcheries are so located that the fishing grounds are quite a distance from the plant. They should have boxes to carry the spawn in from the grounds to the plant, and so arranged as to keep the spawn both cool and damp. It is sometimes necessary to use ice in the lead trough in order to keep the temperature below fifty degrees.

I have had the temperature to reach sixty degrees at this plant and the fry to hatch in twenty-seven days. These fry were premature and the mortality was more than double what it should have been.

DISCUSSION

PRESIDENT: That paper too goes into the subject of a retaining pond, and we might as well have all the papers on that subject, and then have a general discussion. The *Pacific Fisherman* started this discussion by asking for opinions from the various Commissions on the rearing and feeding of salmon fry, and we have a statement from Dr. Smith in a letter to the *Pacific Fisherman* in which he outlines briefly the policy of the Bureau of Fisheries to retain the fry and feed them until they reach the fingerling length, and after that we have a statement from Mr. O'Malley.

MR. O'MALLEY: In this connection I have to say that for many years on this coast we have taken care of our fry until up to the time of the absorption of the yolk sac, then, as a rule, on account of limited funds, and really at a time when they need the greatest care, we have been obliged to liberate them, to be preyed upon by their various enemies. Baker Lake, Washington, is an example, where the destruction of fry from Dolly Varden trout is the worst of any place that has come under my personal observation, and is the more to be regretted as it is the only source of supply of sockeyes to Puget Sound within the United States.

Dr. Smith has adopted the policy in California, Oregon, Washington, and also in Alaska, I believe, to construct suitable rearing ponds at each station to care for as many fry up to the fingerling stage as funds will permit.

This year, at the Bureau's stations tributary to the Columbia, Clackamas, Little and Big White Salmon stations, feeding operations were conducted and between two and three million fish were fed until they reached the age of fingerlings No. 2½. Food in sufficient quantity and at a reasonable cost has been a serious question for many years, but this is now being taken care of by using Columbia River smelt. These are purchased at a cost of \$20.00 per ton f. o. b. the cold storage plants. A charge of \$20.00 for the season is paid for freezing and holding, thus the cost of fish food the past season was about 2⅓ cents per pound, delivered at the hatcheries. This food is prepared by first cooking it until

all bones are softened, then it is pressed into cakes with a press not unlike the old fashioned cider press. Large quantities can be prepared at one time and will keep a long time if held in a dry, cool place. When needed for food, it is grated to the desired size, depending on the age of the fry to be fed. The grating machine is of home made construction and run by power and will grate the food very rapidly. This class of food was used at all our stations the past season after the fish were feeding in good shape, they being first started on liver, and later mush was added, liver being too expensive for extensive use, as it cost 9 cents and 5 cents per pound for beef and hog liver each, respectively, f. o. b. Portland, Ore. We have also used canned culled salmon in conjunction with other food and when properly prepared this gives good results. In all cases with us the mixed diet has given the best results.

PRESIDENT: In California we have had in years past considerable experience with holding and feeding salmon fry, and this work was at that time in charge of Mr. W. H. Shebley, who has prepared a paper which he sent to the *Pacific Fisherman*, and I would be glad to have him read it and tell us what he knows about the feeding of fry.

REARING AND FEEDING SALMON FRY IN CALIFORNIA

By W. H. SHEBLEY

California Superintendent of Hatcheries.

The first salmon fry fed in California was after the establishing of the Sisson Hatchery in 1888. The United States Commission of Fish and Fisheries in 1883 quit operations at Baird Hatchery on the McCloud River. Only 1,000,000 eggs had been taken that season. The salmon had greatly decreased in the Sacramento river, owing to the operations of the mines on the tributary rivers destroying the spawning beds, and the unrestricted fishing on the lower reaches of the river, as well as the wholesale slaughter of the breeding fish by miners, Indians and others during the period that they were entering the tributary streams to spawn.

In 1883 the United States Commission collected approximately 1,000,000 of eggs at the Baird Hatchery during the entire season, this being the smallest take in the history of the work on the McCloud river since the preliminary work of establishing the station in 1872, when the first attempt at the propagation of the Pacific salmon was made by Dr. Livingston Stone. The salmon, although greatly depleted in numbers in the Sacramento river, had ascended as far as Baird in numbers sufficient to give from 2,000,000 to 14,000,000 eggs each season from 1872 to 1883. The latter year the salmon in the Sacramento river seemed doomed to extinction. The falling off this year was due largely to the heavy blasting and other operations on the line of the Southern Pacific Railroad, which was then being constructed from Redding northward along the banks of the Sacramento river to the mouth of the Pitt river, into which the McCloud river flows. The salmon were undoubtedly frightened so that they did not ascend the Sacramento river, besides a great many were taken and destroyed by the grading gangs and used in the camps for food. Thousands of trout and salmon were destroyed by powder used by the Chinese and white laborers, of whom there were 9,000 camped along the river; and while a great many were used as food, there was wanton de-

struction in the way they were killed. The same condition existed in 1884, and Superintendent Stone of the Baird Hatchery recommended that the station be not operated that season. It remained closed from that date until 1888, the year that the Sisson Hatchery was established by the California Fish Commission in an attempt to restore the salmon run in the Sacramento river.

In 1885 the California Commission decided to establish a hatchery for the propagation of salmon, as the federal government had not again resumed operations at Baird. It was decided to establish a hatchery and an egg-collecting station on Hat creek, a large tributary of the Pitt river, where salmon formerly abounded by the thousands during the spawning season. This station was operated for two seasons. The writer was in charge of the work during the last season this station was operated. The work of collecting the eggs was begun early in August and continued until November. Less than 500,000 eggs were collected as the result of the season's work. The spawning beds in Pitt river and Hat creek that a few years before had been covered with salmon were now deserted. In the spring of 1888 recommendations were made to the Board of Fish Commissioners and to the governor of the state to abandon the hatchery or close it down for a number of years, and that a station be established lower down the Pitt river or on the main Sacramento river in an endeavor to collect the eggs from the few remaining salmon that ascended the Sacramento to the spawning grounds. It was demonstrated beyond any doubt during the two seasons that the Hat Creek Hatchery was operated that the spawning salmon that remained did not reach Hat creek nor Pitt river near its confluence with Hat creek in numbers sufficient to justify further operations. It was evident to the writer and others who made a study of conditions regarding the spawning salmon that, owing to the greatly diminished number of fish that ascended the Sacramento river, ample spawning beds were found by the fish lower down and that only a few stragglers ascended Pitt river and its tributaries. Acting under the recommendations of the writer, the Board of Fish Commissioners ordered the Hat creek station closed and began to look for another site.

After a thorough examination and study of the different streams by J. G. Woodbury, the newly appointed superintendent of hatcheries, it was decided to locate a salmon hatchery on Spring creek in Siskiyou county, near the town of Sisson. In the meantime arrangements had been made with the United States Commission to open up the Baird hatchery, collect the eggs at that station and ship them to Sisson, where they could be hatched and the fry reared and fed until they were large enough to liberate in the tributaries of the upper reaches of the Sacramento river. This location and plan of hatching and distributing the salmon fry was concurred in by Mr. Woodbury, representing the California Fish Commission, and Mr. Livingston Stone, the superintendent of Baird hatchery. Mr. Woodbury had been Mr. Stone's assistant at Baird during the time of the establishment of the Baird station, and no better authorities on salmon culture could be found, and to this day no marked improvement over their ideas and work has ever been advanced. The writer had personal knowledge of their plans and consulted and worked with both gentlemen.

The Sisson hatchery was completed and ready for operation in September, 1888. The floods did not interfere with the work and Mr. Stone operated until late in November. Eight hundred thousand eggs were collected from the early fall run, and 2,200,000 from the October and November, or late fall run. These eggs were hatched and the fry fed until they were large enough to care for themselves and then carefully distributed in the upper reaches of the Sacramento river and its tributaries. The work of feeding the fry was continued until 1895, when it was discontinued by the Board of Fish Commissioners, as a matter of economy, and because of a wrong idea that had been advanced by those who were dictating the policy of fish cultural operations in California, that the salmon fry were better off if distributed as soon as the umbilical sac was absorbed. The benefit of feeding the fry was plainly demonstrated by the great increase of salmon in the Sacramento river in the years that followed the return of the output of fry from 1888 to 1896. In 1896 27,000,000 eggs were collected at Battle creek station, a few miles below the mouth of the McCloud river, and 7,000,000 at Baird station from the McCloud

river. During these years a better and more efficient patrol of the bays and rivers was made during the closed season than formerly; the laws regarding the legal size of nets used in fishing were enforced, while the Saturday-Sunday non-fishing law was enforced strictly. This insured a larger number of breeding salmon for the egg-collecting stations. These regulations and the feeding of the salmon fry during the period from 1888 to 1896 were, in my opinion, the principal agents in restoring the salmon to the Sacramento river.

After the appointment of the present Board of Fish and Game Commissioners, during the summer of 1911, and the reorganization of the Department of Hatcheries, it was decided to again hold and feed the salmon fry until they were large enough to care for themselves when they were distributed, as well as to hold a large number of them in the ponds of the Sisson hatchery until fall, and then release them in the upper reaches of the Sacramento river during the early fall, before the winter floods. This method of handling the salmon fry will give them a chance to reach the ocean at an age when they can protect themselves from the predaceous spiny-rayed fishes that inhabit the lower reaches of the Sacramento river and Suisun, San Pablo and San Francisco bays, through which they must pass before they reach the ocean. During the season of 1913 three-fourths of a million fry were held in ponds at the Sisson Hatchery and released during October. This season 21,000,000 salmon fry were held in the troughs, nurseries and ponds and fed until late in the spring. Of this number 2,000,000 were distributed by the California Fish and Game Commission's distributing car in the lower reaches of the Sacramento river, near Walnut Grove and Benicia. Four million were placed in the large ponds at the Sisson Hatchery, in perfect condition, where they are fed daily and looked after by a skilled fish culturist. The remainder were distributed in the tributary streams of the upper Sacramento river. Those placed in the ponds will be released during the early fall, so that they can descend the river slowly and reach the lower reaches of the river and the bays at a time when the spiny-rayed fishes are not so active as they are during the summer months. After the temperature of the river falls the bass and other predaceous fishes are not so ac-

tive in the pursuit of food, and the salmon fry will reach the ocean with less loss than if they are released in the spring or summer.

The Fish and Game Commission of the state of California is now preparing one of the largest and best pond systems in the country for the rearing of salmon fry. Plans are being made to construct enough ponds to hold 10,000,000 salmon fry next season.

The fry at the Sisson Hatchery are first held and fed in the troughs about two months before they are removed to the ponds. Then they are taken out in small lots and fed until all are accustomed to the new surroundings. The pond keeper distributes the food slowly at the different feeding stations in the ponds until he is satisfied that all the fry have received their share of food. By this method the fry all have the same development and growth and there is no danger of developing a lot of precocious fry to exercise their cannibalistic instincts on the others. During the first cold weather in the fall the fry are ready to be liberated. They are then in readiness for their trip to the ocean at a time when there is no danger of their being carried into the over-flow basins, when many of the predaceous fishes have lost their activity, and when the salmon fry are large enough, and conditions of weather and water are such that they will not linger long in the lower reaches of the Sacramento river and bays, but will descend to the ocean with less loss and in better condition than if handled in any other way.

The large island district in the lower Sacramento river, and the bays through which it flows before reaching the ocean, makes the propagation of the salmon a different problem than in any other stream on the Pacific Coast. If it were not for the conditions above mentioned, the fry could be hatched and distributed nearer the ocean, but on account of the large bodies of water inhabited by predaceous fishes at the mouth of the Sacramento river it is necessary to hold the fish as long as possible near the upper reaches of the river and release them at a time when they will make the journey to the ocean in the shortest time possible if the best results are to be obtained.

PRESIDENT: We have another letter here from Mr. R. E. Clanton,

Superintendent of Hatcheries of Oregon, and I think that we should incorporate that in the record of our proceedings. I think that I have been told by Mr. Cobb that a number of the gentlemen here have already read that. There are a number of us, as I have stated on several occasions, that are anxious to leave to catch a train, and for that reason I think that what discussion we have to make on this subject would better start in right now and I would like to hear from anyone of the hatchery men here of their views on the subject of holding the fry and feeding them until they reach the fingerling stage.

REARING AND FEEDING SALMON FRY IN OREGON

By R. E. CLANTON

Oregon Superintendent of Hatcheries.

At the Bonneville Central Station we have thirty retaining ponds in which we are now holding 12,000,000 chinook salmon. These ponds cover an area of between four and five acres. In addition to these, we have just completed a system of creek or natural ponds, which were made in the bed of the creek, having changed the channel by diverting the water through same and bringing these ponds under control. Our capacity for holding and feeding the fry at this station until they are from four to eight months old will be approximately 15,000,000.

At the Klaskanine Hatchery we have at the present time approximately 3,000,000 chinook salmon, having recently liberated 1,000,000 of the older fish. We have at this station six large artificial ponds covering an area of about one acre. In addition thereto, we have a number of natural ponds made by changing the channel of the river and placing same under control. The feeding capacity of this station is approximately 4,000,000 fry.

At the McKenzie River Hatchery we have six small and three large ponds, covering an area of about two acres. Most of the spawn taken at this station was shipped to the Bonneville Central Hatchery, retaining only 200,000 fry, which are now being held. The feeding capacity of this station is approximately 2,000,000 fish.

The above mentioned hatcheries are located on tributaries of the Columbia river, and in addition thereto, we have six hatcheries located on the various coast streams which debouch into the ocean south of the Columbia River in this state, and at these stations 8,569,575 fish are being fed, making the total number of fish being fed and cared for by the department 23,769,575.

In giving the capacity of the different stations, it must be understood that this applies only to retaining and feeding the

fry. Should the capacity be based upon the old system, whereby the greater per cent of the fish were liberated as soon as hatched from the egg, and the balance turned out when the yolk sac was absorbed, the capacity of the different hatcheries of our department would be approximately 100,000,000, as it will be seen that the main building of the Bonneville Hatchery alone is 60 feet wide by 226 feet long, while there are three auxiliary hatcheries there that are 20 feet wide by 100 feet long, all equipped with modern hatching troughs.

Three years ago this department adopted a policy of retaining and feeding, for at least a period of time, all the fry possible at the various stations throughout the state, and as a result of extensive and thorough experiments which have been conducted at the various State plants, an effort to systematize the pond arrangement in order to secure the best possible results with the fish has since been carried on.

We have found that the so-called creek or natural ponds, which are made by placing dams across the small streams in the vicinity of the hatcheries, afford the most natural conditions for the young fish. When the fish are large enough to be taken from the hatching troughs, we have found it necessary to transfer and hold them in the artificial or cement ponds, where the water flow is under complete control, and which are so constructed that their sanitation can be properly attended to by seining the fish to one end while the other is being cleaned and vice versa. It has been found necessary to exercise extreme care at all times to insure perfect sanitation of these ponds. When the danger of the spring freshets is past and the water in the creek or natural ponds is under control, it has been found advisable to transfer the fry to these ponds, where the continual flow of fresh water, and the logs, rocks, etc., which provide shade and shelter, afford more natural conditions. In addition to the artificial food which is given to these fish, they are enabled to secure a certain amount of food which nature has provided for them.

Acting under instructions, the superintendents of the different hatcheries have given the subject of aeration close attention, and it is the consensus of opinion that some parts of the artificial ponds should be agitated to promote the proper circulation

of air, while other parts of the ponds should not be disturbed so as to provide still water for the fish. While we have, no doubt, made some important discoveries in connection with our pond work, we are still carrying on investigations along these lines and hope to arrive at a definite solution of the question which is of the greatest importance to the success of the system of retaining and feeding young fish.

In our efforts to determine upon a scientific and systematic method of feeding the young fish in the troughs and nursery ponds in order to secure the best results at a minimum expense, we have conducted a series of practical experiments at all of the hatcheries, and although we have made some valuable discoveries and rapid strides of improvement over previous methods, we are continuing our experiments unceasingly in the hope of reducing the cost to the greatest degree of economy consistent with the highest degree of health and development of the young fish. So far, our experience has led us to believe that young fry in the early stages of development thrive better upon liver, as this can be ground finer than other foods, and the blood which it contains is highly nutritious. At some of the stations, however, we have been unable to secure a sufficient supply of liver, owing to the remoteness of the hatcheries, and in such instances have substituted a mixture of ground dried salmon and mush (composed of middlings and other wheat product) which has proven a very satisfactory article of diet for extremely young fry. At one of the coast hatcheries, milk curd which was secured from nearby creameries, was also fed to them with satisfactory results. As the fish grew older we fed them on ground smelt, lamprey eels, spent salmon, both dried and salted, and offal from the canneries.

The cheapness of this food has made it possible to retain and feed great numbers of fry with the funds available, which we could not have done had we been compelled to feed liver alone, as the cost of the latter is many times greater.

At some of the stations the different foods are prepared by cooking before being ground and fed. Other superintendents have had equally good success by feeding raw foods. Our experience has taught us that it is absolutely necessary that the quality of food should be fresh and absolutely free from taint

and that due care should be exercised in all cases to insure this condition before utilizing the food. When any of this food is found to be tainted and unfit for use, however, it is placed in the maggots and converted into fly larvæ and fed in this stage. In this way we have found it possible to utilize every part of the food shipped to the hatcheries.

I have not the time to prepare a statement of the amount of food fed last year, but will give you, from our report, the figures showing the total amount of the previous season, which was 50 tons of smelt, 27 tons of eels, 15 tons of wheat products, 8 tons of salmon offal, fresh from the canneries; 5 tons of salmon offal, canned in one gallon cans; 15 tons of liver, 4 tons of salmon offal, salted; 10 tons of dried spawned-out salmon; 10 tons of fresh spawned-out salmon; 5 tons of milk curd, and one ton of salted spawned-out salmon; making a total of 150 tons, or 300,000 pounds, of food at the different stations, which aggregated in cost \$3,400. The amount fed last year and that which will be fed during this season will be a great deal more than the figures given.

FEEDING SALMON FRY

By M. J. KINNEY

Member Oregon Fish and Game Commission

The Fish Commissioners are responsible for the work done at the different hatcheries, and I believe it is their duty to know something about fish culture; at least, as much as bank commissioners should know about the banking business, in order to check up the work and estimate the efficiency of the different hatcheries. Systematic and painstaking reports are necessary, and to carry this out, in 1911 the Oregon Commission sent to each hatchery thermometers for water and for air, scales to weigh the food, and fine balances, with globes to hold water, in which to weigh the fish; kodaks and plain loggers' leveling instruments, with tape, staff, etc., and as complete literature as we could secure on fish culture. Carefully prepared blanks, to be worked out once each month, giving the hourly flow of water for each pond, amount of food fed each pond, number of fish in each pond, and weight of the fish on the first of each month, temperature of the water and temperature of the air, for the monthly reports, and if any fish are liberated, the date and weight of same. If these records are carefully kept it enables the commission to keep an eye on the work and estimate the value of the output.

It matters little to me whether these men are working six or ten hours per day. The true value of results is what I want, and I should prefer that the superintendents put in less time on manual labor and more time in studying the fish and studying nature, as the closer we get to nature the better for the fish.

I advocate that our commission shall pay a liberal reward for the best pond or ponds of 250,000 fingerlings and measure the value of each station by results. This will stimulate the superintendents and feeders to do better work. Auditing the books once a year is worth nothing to me unless the fish are audited. In checking up the working of a sawmill it is necessary to have a careful inventory of the quantity and value of the output. A healthy fish of 100 grains is worth far more

than one of ten grains. Spring fish, when caught, are worth four times as much as fall fish.

In checking pond work I find three important factors: The daily rations of food for each 100 pounds of fish, the quantity of pure running water per hour in each pond for each 100 pounds of fish, and a liberal amount of shade and ripples and cleanliness are absolutely necessary. Our ponds at Klaskanine have made the best records for 1912 and 1913, pond No. 6 and creek ponds. The fish were kept in the first pond until they reached 25 grains, then turned into creek ponds where they had plenty of green trees for shade and ripples to play in, were fed daily three to four pounds per each 100 pounds of fish, mainly fish food, the fresher the better, and had a water supply of 300 to 400 cubic feet of running water per hour the last month for each 100 pounds of fish. In 1912 the fish weighed 143 grains on July 1st, under Mr. Hatton, the superintendent. In 1913 they weighed 130 grains July 1st, practically the same, under Mr. Freeman, the superintendent. In 1914 they are doing well, weighing 140 grains on July 1st.

The best record at Bonneville for 1914 is pond No. 14, which has 300 to 400 cubic feet of pure fresh water per hour per each 100 pounds of fish per day. These fish weighed 70 grains average on May 5th, when they were transferred to the creek pond and mixed with smaller fish, but unfortunately I am not able to furnish a further report of this pond. Fish in other ponds, with less fresh water and less food supply, did not grow so fast. We have squandered a great deal of money in locating hatcheries without looking for an abundant supply of water; same as building an old fashioned flouring mill without looking for an adequate supply of water to turn the wheels.

I have asked our wardens to catch the native fish in the different streams and send them to the laboratory so that we could secure the weight and length and age of these fish for comparison with our pond fish. Our ponds must do as good work as the native fish, otherwise they are not doing standard work. And to note the time and condition that the native fish migrate to the sea.

There are many phases in the successful management of the fish business yet to be worked out. We are trying to establish

some records of expectancy. How many fish we should expect to return from the sea for each million well developed fingerlings of 100 grains weight that we liberate, and whether marked fish from four years' parentage and of a May run will return in May four years hence. These and many such questions we must work out for a forecast record before we can intelligently carry on this work.

Commercially, one spring salmon is worth more than four fall salmon, and I do not favor propagating any of the second or fourth class fish. Raising salmon and trout is much like raising stock, a liberal supply of pure, fresh water, pure, fresh air and good food and cleanliness are absolutely necessary, and in many things you should manage your hatchery the same as you would run a stock farm. No good stock farmer would fill his best pasture with fourth class stock, and I object to liberating anything in the Columbia River excepting standard quality spring chinook fingerlings.

DISCUSSION

MR. DARWIN: I would state that the rearing pond capacity of the State of Washington is as follows:

Kalama Hatchery	2,000,000
Chinook	1,000,000
Samish	350,000
Willapa	100,000
Chehalis	80,000
Dungeness	250,000
White River	300,000
Nooksack	250,000
Snohomish	400,000
Stillaguamish	150,000
Wind River	50,000

The other salmon hatcheries in the State are without rearing ponds.

PRESIDENT: I would like to hear from some of the men from Alaska to see what their experience has been. Mr. Henkel will you favor us with some suggestions on this subject?

MR. HENKEL: In regard to the fry we are speaking of, I have had no experience in Alaska as to the feeding of fry, but I have had experience in planting fry there, and I would state that the worst enemy we have is the Dolly Varden trout. On several occasions I have experimented in the planting of fry and also experimented in the number of fry that a trout would eat in a certain length of time, and I found in a Dolly Varden trout not six inches in length 125 fry. I also found that they would digest the fry in a little less than two and a half hours, so taking into consideration the number of meals they have each day on fry, you can readily figure out the number of fry they would consume in a given length of time. I think that more work should be put in on the extermination of the Dolly Varden trout rather than the protecting of

them, and I am sorry to say that several of the states on the Pacific Coast protect them. A friend at Kodiak, Alaska, a resident of San Francisco, requested me to salt some as he wished to take them out with him. I salted two small butter barrels of the trout, and took them to Kodiak, where he carried them on the boat to take with him. When he landed in San Francisco they arrested him for bringing in game fish. I think if that law were done away with, so that the people of Alaska could salt and ship the trout into the states, there would be a demand for them and a market created in a short time. I have kept trout throughout the year by mild salting, and had them on the table at all times during this period. The salt is very easily soaked out, and by soaking them over night in fresh water one can have fresh Dolly Varden trout for breakfast.

PRESIDENT: With reference to Mr. Henkel's statement concerning his friend being arrested in San Francisco, I wish to set the California Commission right on that subject. They did bring the frozen Dolly Varden trout to San Francisco, and it was against one of the laws on the books at that time to have any trout in one's possession during the closed season, and this was the closed season. The gentleman came to our office and we told him we would assist him in every way possible, but that bringing in the trout was a violation of the law, and of course we could not give him permission to violate the law, that our duty was to enforce the law. We told him to make a test case and that we would not fight it very hard; the matter was dropped and drifted along, and I really don't know what became of it. We told him he had no right under the present law to bring in the trout, but that if he would prepare a bill to be presented at the next session of the legislature, which was to meet in about a month from that time, that we would do all we could to see that it was passed. When the legislature met I took the matter up with his attorney and told him that we were now ready to present his bill, but he said he did not care to have it presented. I do not know his reason, he told me it was a matter of indifference to him, that he did not care anything about it. Evidently he has made up his mind not to bring the Dolly Varden trout down from Alaska.

MR. O'MALLEY (as presiding officer): Is there any further discussion on the papers before us? We have heard from several people, may we not have a few remarks from Mr. Darwin.

MR. DARWIN: I think you can appreciate that I am here at this meeting to learn, and I am quite sure that any remarks I might offer would be properly discounted by those who have had a great deal of experience in fish culture work. I thank you very much, but I am here to learn and observe, and I should very much like to hear from the others.

MR. FRASER: Mr. Chairman, with regard to your own remarks concerning the feeding of fry, I might say that in examining the food they take in I have concluded that they eat almost everything swallowable. Their main diet consists of crustaceans—either small species or larval forms—but these are of great variety; several different kinds may be found in the stomach at one time. Insects, insect larvæ, rotifers, protozoa, eggs and even crustacean sloughs are swallowed, although in the sloughs at least there can not be much nourishment. I should think, therefore, that it would help a great deal to have a range of diet rather than to have any one thing without change.

PROF. SMITH: One question that has arisen in my mind: in turning out a large number of salmon in the streams—millions of them—how are these streams supplied with food to take care of those salmon between

the time they leave the hatchery until the time they arrive in the ocean? I do not wonder very much at cannibalism among them under the conditions, because I fancy—and that is what I would like to ask if anyone knows about it—that there is insufficient life to supply food for the fish you are going to turn out between the time they are turned loose and the time they get to the ocean. It is going to require a tremendous amount of food to satisfy them.

MR. HENKEL: I will say that I have not been here in the states long enough to know what the food is in these waters, but in our observation of the blueback in Alaska waters, we find the waters of the lake have plenty of minute animal life for the fry to subsist on. During the period of two years' sojourn in the lake, we have time after time dragged the lake with small seines and found plenty of crustaceans there for the small fry. We found that the blueback do not enter any streams except those that have lakes at the head of them, and our observation is that they stay in the lake two years before going to the ocean.

MR. O'MALLEY: In connection with liberating young salmon, I want to bring to the attention of this society a method used by the Japanese in Northern Japan. One of their fish culturists visited Clackamas station several years ago and while there we were discussing the different methods in use. The hatchery at the time was filled to its capacity with fry at the age of the absorption of the yolk sac. I asked what time in Japan they liberated their young salmon. He replied, "When about this age (absorption of yolk sac) we place them in a pond or lake, leaving as it were the door open, and the fry are free to go when they choose, necessary food being provided while they remain in the lake." Each year, he stated, they left about the same time, some going early and stragglers remaining late, but the bulk all went inside of thirty days. I considered at the time that they had a pretty good method of liberating their fry, because at the present time the vital question for the salmon culturist is to know the proper time to liberate his fish. This is a question upon which the scientist can give us valuable assistance.

MR. MAHONE: I have been observing for the last two years a little slough near our hatchery at Quilcene. Last year there were several thousand fish in the early part of the season. The water is not very deep and there is a good deal of vegetation there. There were two distinct schools of fish. One was below where our flume crosses the slough that I estimated at one to two thousand. They seemed to all go away together. The fish stayed in the slough until they were five to six inches long. The last spring or late summer, I think February or March, the fish disappeared; I do not know what became of them. Above the flume there was another school, I could not estimate very well, but I think two or three thousand fish at least. They have all disappeared. This year there is a good deal of water. It is fed by springs, and also the hatchery water and the overflow of the hatchery comes out into this slough. We planted, perhaps, during the season a couple of hundred thousand fish in that little slough. They were away from other fish and could not be devoured by them in the slough, and you will find today several thousand fish both from one and a half to four inches long, and the fish look healthy and good. Some gentleman here referred to the fact of eating the old salmon. There were two or three old salmon that died in the slough, and during the time of disintegration thousands of fish gathered around and cleaned up every bit of the fish except the bones. There must have been a good deal of food in this slough, for the fish seemed to be doing well. Regarding food in the river, from observations I have made from time to time I notice little fish all up and

down the river in little pools, and I have been led to believe that there is much food in the rivers, particularly in the Big Quilcene River. The fish seem to be in good condition, evidently are getting plenty to eat, because when we feed fish at all if they do not get enough you can readily distinguish the fact from the big heads and small bodies. I am clearly of the opinion that they get a great deal of food from the rivers.

Another point that came up in our community last spring, that the papers commented on somewhat, and which for a time it was a little hard to tell just what the cause was; some discussion that occurred here yesterday brought the matter to my mind. During quite a storm down the bay one day there were thousands of fish, young salmon, so reported, found on the shores of the bay; they were all dead and crows came and ate them. These fish still had food sacs. Now, the question is, where did they come from? Some supposed they had come from the hatchery, but none of the fish we had planted within a good many weeks of the time of this occurrence had food sacs, these having been completely absorbed. After studying the matter over, I concluded they had been washed out of the river with the gravel by the floods, and into the bay, and the salt water killed them, the wind washing them up on the shore.

Now comes the question brought out by some discussion here—whether fish being put into salt water, in the sac stage, would they live under such conditions.

MR. FRASER: With regard to the growth of salmon in salt water, I have seen large numbers of dog salmon in the sea with a great portion of the yolk still unabsorbed and they seemed to thrive very well. I do not know if it is true concerning other species.

Just another point with regard to the amount of food in the fresh water. It has been shown very distinctly that fish do not grow as rapidly in fresh water as in sea water. The growth of the scales give a good index of this. In the case of all the salmon and trout that spend a portion of their lives in the sea and the remainder in the fresh water, the scales show the more rapid growth in the sea, as the spaces between the rings are wider than when the fish are in the rivers. Hence, although they may get enough food in fresh water to continue their existence, they do not get enough to grow as they would in the sea.

LIST OF MEMBERS, 1914-1915

HONORARY MEMBERS.

The President of the United States, Woodrow Wilson.

The Governors of certain States:

Washington, Ernest Lister.

Oregon, Oswald West.

California, Hiram Johnson.

Montana, S. V. Stewart.

Idaho, John M. Haines.

Nevada, Tasker L. Oddie.

Arizona, George W. P. Hunt.

Alaska, J. F. A. Strong.

Hawaii, L. E. Pinkham.

Dr. Hugh M. Smith, U. S. Commissioner of Fisheries, Washington, D. C.

ACTIVE MEMBERS.

Life members indicated by (*).

Ainsworth, E. E., White Building, Seattle, Wash.

Allen, H. F., Pres. National Oyster Co., R. 3, Box 67, Olympia, Wash.

Anderson, Clarence L., 939 19th Ave. North, Seattle, Wash.

Baldrige, Benjamin, Fish and Game Commission, Startup, Wash.

Baldrige, Henry, Fish and Game Commission, Palmer, Wash.

Baldwin, M. D., Member Game and Fish Com., Kalispell, Mont.

Barron, James T., 1006 Yeon Building, Portland, Oregon.

Beach, W. M., Shelton, Wash.

Berry, Frank, Secretary Puget Sound Purse Seine Fishermen's Protective Ass'n, 2509 North 28th Street, Tacoma, Wash.

Blass, John, Olympia, Wash.

Booth, F. E., Pres. Monterey Packing Co., 110 Market St., San Francisco, Cal.

Bothwell, Wm. J., 2732 47th Street S. W., Seattle, Wash.

Bower, Ward T., U. S. Bureau of Fisheries, 1227 L. C. Smith Building, Seattle, Wash.

Bowman, J. B., Oyster Bay, Kamalchie, Wash.

Brady, Philip J., Globe Building, Seattle, Wash.

Brenner, Chas., Mud Bay, Olympia, Wash.

Brenner, J. J., care of J. J. Brenner Oyster Co., Olympia, Wash.

Buschmann, August, L. C. Smith Building, Seattle, Wash.

Buschmann, C. H., Mgr. Northwestern Fisheries Co., L. C. Smith Building, Seattle, Wash.

Butts, Stephen, Fish and Game Commission, Lebam, Wash.

Capell, Arch. T. P., U. S. Bureau of Fisheries, Oregon City, Ore.

Clanton, R. E., Master Fish Warden, Pittock Building, Portland, Ore.

Cobb, John N., Editor Pacific Fisherman, 1321 L. C. Smith Building, Seattle, Wash.

Conn, C. G., Elkhart, Ind.

Crawford, John M., Fish and Game Commission, Kendall, Wash.

Culver, A. E., Dunsmuir, Cal.

Cunningham, Edward, Mgr. Pacific Net & Twine Co., Pier 8, Seattle, Wash.

Darwin, L. H., Fish and Game Commissioner, Seattle, Wash.

- Deer, L. H., Shelton, Wash.
 Doney, A. E., Sisson, Cal.
 Dorr, Charles W., 375 Colman Building, Seattle, Wash.
 Doyle, Henry, Vancouver, British Columbia.
 Duke, Robert D., 734 Mills Building, San Francisco, Cal.
 Duncanson, H. B., 1913 14th Avenue North, Seattle, Wash.
 Erismann, Martin C., 621 Colman Building, Seattle, Wash.
 Eyermann, Dr. Barton W., Director Museum California Academy of Sciences, San Francisco, Cal.
 Fassett, H. C., U. S. Bureau of Fisheries, St. Paul Island, Alaska.
 Fletcher, Emery L., Ely, Nevada.
 Forbes, Robert, Bellingham, Wash.
 Ford, Ira B., 253 Colman Building, Seattle, Wash.
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 Fraser, C. McLean, Director Biological Station, Nanaimo, British Columbia.
 Freeman, Miller, 1321 L. C. Smith Building, Seattle, Wash.
 Gardner, John H., U. S. Bureau of Fisheries, Birdview, Wash.
 Gorman, T. J., 412 Colman Building, Seattle, Wash.
 Greenebaum, Alfred, 10 Main Street, San Francisco, Cal.
 Greenwood, Lyle, Department of Zoology, University of Washington, Seattle, Wash.
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 Gyger, James H., Fish and Game Commission, Elsinore, Cal.
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 Heacock, Ray B., Fish and Game Commission, P. O. Box 121, Seabright, Santa Cruz Co., California.
 Helser, D. R., Olympia, Wash.
 Henkel, C. P., U. S. Bureau of Fisheries, Oregon City, Ore.
 *Henshaw, Wm. G., 762 Mills Building, San Francisco, Cal.
 Henver, Harry J., U. S. Bureau of Fisheries, Clackamas, Ore.
 Hobart, Wm. B., Kalama Hatchery, Kalama, Wash.
 Holder, Dr. Charles F., 475 Bellfontaine Street, Pasadena, Cal.
 Hunt, E. W., Fish and Game Commission, Tallac, Cal.
 Hurley, Dan, Olympia, Wash.
 Hylen, I. N., Sec. Alaska Fishermen's Union, 93 Steuart Street, San Francisco, Cal.
 Johnson, Sydney E., University of Washington, Seattle, Wash.
 Jones, E. Lester, U. S. Deputy Commissioner of Fisheries, Washington, D. C.
 Jordan, Dr. David Starr, Stanford University, Cal.
 Joyce, Hans, 1917 9th Avenue West, Seattle, Wash.
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 Kelly, Jr., H. L., U. S. Bureau of Fisheries, Oregon City, Ore.
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 Kofoed, Dr. Charles A., University of California, Berkeley, Cal.
 Lambson, G. H., U. S. Bureau of Fisheries, Baird, Cal.
 Laws, Geo. O., Fish and Game Commission, Weaverville, Trinity Co., Cal.
 Leutenberger, John, U. S. Bureau of Fisheries, Clackamas, Ore.
 Lowman, Will A., Anacortes, Wash.

- McFarland, Wm. H., U. S. Bureau of Fisheries, Duckabush, Wash.
McGowan, H. S., McGowan, Wash.
McGowan, John D., Ilwaco, Wash.
McHugh, T. C., Gen. Mgr. Pillar Bay Packing Co., L. C. Smith Building, Seattle, Wash.
Mahone, A. H., U. S. Bureau of Fisheries, Quilcene, Wash.
Manning, Thos. S., Avalon, Cal.
Mansfield, Walter D., Merchants' Exchange Building, San Francisco, Cal.
Mayhall, L. E., Fish and Game Commission, Seattle, Wash.
Millett, J. P., Fish and Game Commission, Seattle, Wash.
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Morrow, J. A., Mud Bay, Olympia, Wash.
Moser, Capt. Jeff'n F., Gen. Supt. Alaska Packers' Association, San Francisco, Cal.
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Nidever, H. B., Fish and Game Commission, Box 86, Vallejo, Cal.
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O'Neill, Thos., Shelton, Wash.
Opsund, Theo., Fish and Game Commission, Salem, Ore.
Osterud, H. L., University of Washington, Seattle, Wash.
Ouellett, L. P., Olympia, Wash.
Palmer, Russell, 1321 L. C. Smith Building, Seattle, Wash.
Parsons, J. E., Bellevue, Wash.
Parsons, Theodore, Fish and Game Commission, Kalama, Wash.
Patching, Fred, Supt. Fortmann Hatchery, Loring, Alaska.
Persell, W. E., Arctic Club, Seattle, Wash.
Peters, J. M., Fish and Game Commission, Olney, Oregon.
Rice, L. M., Fish and Game Commission, Satsop, Wash.
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Schulz, H. A., Fish and Game Commission, Kalama, Wash.
Scott, J. H., Olympia, Wash.
Shebley, W. H., Fish and Game Commission, Sisson, Cal.
Shultz, William, Friday Harbor, Wash.
Siebe, John T., 430 Battery Street, San Francisco, Cal.
Simmons, R. D., Mud Bay, Olympia, Wash.
Sims, E. A., Port Townsend, Wash.
Smith, Prof. E. Victor, University of Washington, Seattle, Wash.
Spuhn, Carl, 602 Concord Block, Portland, Oregon.
Taylor, S. K., Oyster Bay, Kamalchie, Wash.
Thompson, William F., Stanford University, Cal.
Van Duzer, H. B., 581 Jackson Street, Portland, Ore.
Warren, Frank M., 1107 Yeon Building, Portland, Ore.
Wentworth, Edwin, U. S. Bureau of Fisheries, Duckabush, Wash.
Westerfeld, Carl, Member Fish and Game Commission, 854 Mills Building, San Francisco, Cal.
Wilke, Henry, Ketchikan, Alaska.
Winn, Dennis, U. S. Bureau of Fisheries, Afognak, Alaska.
Wold, H. P. A., University of Washington, Seattle, Wash.
Young, Jack, Fish and Game Commission, Deadwood, Ore.

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be the Pacific Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States and the Governors (by name) of the Pacific Coast States, Arizona, Nevada, Idaho, and Montana, and Alaska and Hawaii territories shall be honorary members of the Society.

Any person shall, upon a two-thirds vote and the payment of twenty-five dollars, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a president and a vice-president, who shall be ineligible for election to the same office until a year after the expiration of their term; a vice-president, a secretary, a treasurer, and an executive committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session—four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the council.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by president.
2. Roll call of members.

3. Applications for membership.
4. Reports of officers.
 - a.* President.
 - b.* Secretary.
 - c.* Treasurer.
 - d.* Standing committees.
5. Committees appointed by the president.
 - a.* Committee of five on nomination of officers for ensuing year.
 - b.* Committee of three on time and place of next meeting.
 - c.* Auditing committee of three.
6. Reading of papers and discussion of same.

(*Note.*—*a.* In the reading of papers preference shall be given to the members present.

b. The president and secretary are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

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

TRANSACTIONS
OF THE
PACIFIC
FISHERIES
SOCIETY

1915

TRANSACTIONS
OF THE
PACIFIC
FISHERIES SOCIETY
AT ITS
SECOND ANNUAL
MEETING

August, 9, 10 and 11, 1915
AT
SAN FRANCISCO, CALIFORNIA

SEATTLE, WASH.
PUBLISHED BY THE SOCIETY
1916.

Officers

1915-1916.

Elected at the Second Annual Meeting in San Francisco, California, for the ensuing year, including the meeting to be held at Portland, Oregon, in 1916:

<i>President</i>	MR. HENRY O'MALLEY, Seattle, Wash.
<i>Vice-President</i>	PROF. TREVOR KINCAID, Seattle, Wash.
<i>Vice-President</i>	DR. CHARLES L. EDWARDS, Los Angeles, Cal.
<i>Secretary</i>	MR. JOHN N. COBB, Seattle, Wash.
<i>Treasurer</i>	MR. RUSSELL PALMER, Seattle, Wash.

Executive Committee

DR. BARTON W. EVERMANN, San Francisco, Cal.; DR. C. McLEAN FRASER, Nanaimo, British Columbia; DR. CHARLES F. HOLDER, Pasadena, Cal.; MR. LESLIE H. DARWIN, Seattle, Wash.; MR. M. J. KINNEY, Portland, Ore.; MR. WARD T. BOWER, Seattle, Wash., and MR. M. D. BALDWIN, Kalispell, Montana.

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PART I

BUSINESS SESSIONS

Transactions of the Pacific Fisheries Society

The second annual meeting was held at San Francisco, California, Monday, Tuesday and Wednesday, August 9, 10 and 11, 1915.

MONDAY, AUGUST 9, 1915

The meeting was called to order in the Assembly room of the Mills Building by the president, Mr. Carl Westerfeld, of San Francisco, Cal.

REGISTERED ATTENDANCE

The president then ordered the roll-call of members to be taken. Thirteen members were registered for the meeting, as follows:

Carl Westerfeld, Henry O'Malley, Trevor Kincaid, E. Victor Smith, John N. Cobb, B. W. Evermann, Ray B. Heacock, C. McLean Fraser, W. H. Shebley, E. W. Hunt, Robert D. Duke, N. B. Nidever, and Ernest Schaeffle.

NEW MEMBERS

The secretary then read the following list of applicants for membership, all of whom were elected:

J. J. Cryderman, Lee H. Wakefield, Frank S. Fusco, John Gill, William L. Finley, *Frank W. Weymouth, Henry O. Smith, J. B. Hauer, Frank A. Shebley, Fred Barker, E. P. Mathewson, *J. J. Reynolds, Richard Squire, L. Phillips, Fowler Mallett, *R. S. Johnson, *N. B. Scofield, *Charles L. Edwards, *George F. Sykes, *Nathan Fasten, Edward M. Hodgkins, William A. Peters, *Willis H. Rich, A. D. Ferguson, John W. Pew, Wm. Timson, James Madison, Charles E. Hume, Mansfield Lovell, Frank B. Peterson, J. K. Armsby, Juda Newman, Joseph Durney, Louis Ward, Wm. Adamson, O. P. Jenkins, and H. B. Torrey.

NOTE.—Those designated by an asterisk were present at all or part of the sessions.

REPORT OF SECRETARY

The secretary then read his annual report as follows:

AUGUST 9, 1915.

To the Officers and Members of the Pacific Fisheries Society:

The principal part of the work of the Secretary has been that of editing and publishing the Transactions of the First annual meeting held in Seattle, in 1914. The volume, which comprises 105 printed pages,

was issued early in 1915, the delay being caused by the necessity for providing funds to pay the cost of same. With the aid of our regular funds, the sale of copies of the Transactions, and through the generosity of certain members, the greater part of the cost of same has been met.

As editor of the Transactions the Secretary endeavored to keep down the cost as much as possible by condensing the section devoted to business proceedings, and he thinks an inspection will show that nothing essential has been omitted. The papers submitted by the members have been published virtually as they came from the author's hands, and the same may be said of the discussions.

Anticipating that there would be considerable demand for the first volume of the Society's Transactions, an edition of 400 copies was authorized by the Executive Council of the Society. Of these 137 copies were mailed to members, 2 copies were mailed to institutions (the U. S. Bureau of Fisheries and the University of Washington), to which the Society was under obligations, one copy to the Secretary of Commerce, one copy to the American Fisheries Society, 2 copies to journals for review, while 123 have been sold. The Secretary now has in his possession 134 copies of the Transactions and will be glad to dispose of these at \$1.00 each, the price fixed by the Executive Council.

The deaths within the year of the following members has been reported:

ACTIVE MEMBERS

E. E. Ainsworth, of Seattle, Wash.

Charles W. Dorr, of Seattle, Wash.

C. H. Buschmann, of Seattle, Wash.

At the close of our First annual meeting the Society had an active membership of 126, and an honorary membership of 11. Since then 3 members have died, while up to the beginning of this meeting 17 applications for membership had been received.

REPORT OF TREASURER

A letter was read from the Treasurer explaining why his report had not been received. It was received some time later and the salient facts of it are as follows:

PACIFIC FISHERIES SOCIETY

FINANCIAL STATEMENT

Receipts—

Dues 1914.....	\$182.00
Dues 1915.....	82.00
Applications pending.....	2.00

Total	\$266.00
Sale Proceedings.....	113.00

Total receipts\$379.00

Disbursements—

Total disbursements..... 308.42

Balance on hand.....\$ 70.58

Attest: Jan. 3, 1916.

(Signed) RUSSELL PALMER,
Treasurer.

COMMITTEES APPOINTED

The following committees were appointed by the President :

On Nomination of Officers — Dr. B. W. Evermann, Mr. Ernest Schaeffle, Prof. E. V. Smith, Dr. C. M. Fraser, and Mr. N. B. Scofield.

On Time and Place of Next Meeting — Prof. Trevor Kincaid, Mr. Henry O'Malley, and R. D. Duke, Esq.

Auditing — Mr. Henry O'Malley, Mr. Ward T. Bower, and Mr. Nathan Fasten.

Mr. John N. Cobb introduced the following resolution and the same was adopted :

WHEREAS, Much harm has in the past been done to the commercial and game fisheries of the Pacific Coast through the introduction into its waters of basses, pikes, pike perches and other predaceous spiny-rayed fishes from the east, and

WHEREAS, The United States Bureau of Fisheries has adopted the policy of refusing to supply such fishes for planting in our costal waters, but, unfortunately, in most of our states there is nothing to prevent a private party or parties from planting such fishes; Therefore, be it

Resolved, That we heartily endorse the stand taken by the Bureau in this matter and request that the legislatures of the various states and territories comprised within the geographical boundaries of this Society be requested to enact a law absolutely forbidding the importation and planting of such fishes in their waters.

Mr. John N. Cobb introduced the following resolution and the same was adopted :

WHEREAS, There are many special problems of great economical importance to the fisheries of this coast, among which may be mentioned the migrations of the tuna; the surveying of the oyster grounds and the upbuilding of this important industry, which has been in a declining condition for some time; investigations of the life history of the clam, crab, halibut, salmon, herring, etc.; work which can best be done by the U. S. Bureau of Fisheries, and

WHEREAS, We understand that the said Bureau is sadly hampered or prevented entirely from carrying on this important work by the lack of necessary funds for the maintenance of its present fleet of vessels to carry on the field investigations, and also by the lack of a suitable marine biological laboratory where much of the work can be done, Therefore, be it

Resolved, That this Society most earnestly requests Congress to so increase the appropriations of the U. S. Bureau of Fisheries as to enable it to adequately and properly carry out the much needed Pacific Coast investigations outlined above, also to provide funds for building, equipping and operating a marine biological laboratory on this coast, and the Council of this Society is hereby ordered to aid the Bureau to its utmost when the latter's detailed plans are outlined a little later on.

Upon motion the following committee was appointed to draw up suitable resolutions expressing the great regret of the Society at the passing away of certain of its members since

the last annual meeting: Mr. R. D. Duke, Mr. Ernest Schaeffle and Mr. R. B. Heacock.

Mr. R. S. Johnson, of Washington, D. C., who was present as the official representative of the U. S. Bureau of Fisheries, then delivered the following message of greeting from Dr. Hugh M. Smith, United States Commissioner of Fisheries:

Mr. President and Gentlemen of the Pacific Fisheries Society:

I wish to announce that U. S. Commissioner of Fisheries Dr. Hugh M. Smith sends through me greetings to the Pacific Fisheries Society. He regrets his inability to participate in the work which you are now about ready to take up, but hopes that this second meeting of the Society may prove highly successful. He particularly desires to assure the Society of the hearty cooperation and support of the U. S. Bureau of Fisheries in all matters which have for their object the betterment of the fisheries of the Pacific Coast.

The Society then adjourned for the day.

The afternoon was spent in a most enjoyable automobile trip to the interesting places in and near the city.

TUESDAY, AUGUST 10, 1915.

The morning session was called to order by President Westerfeld in the lecture room of the Young Women's Christian Association, at the Panama-Pacific International Exposition. Mr. Charles A. Vogelsang, who for many years was the Chief Deputy of the Fish and Game Commission of the State of California and who is now a Commissioner of the Panama-Pacific International Exposition, delivered a brief address of welcome to the Society on behalf of the Exposition authorities, which was responded to by the President.

ELECTION OF OFFICERS

The Committee on Nomination of Officers, through Dr. Evermann, its chairman, reported the following nominations of officers for the ensuing year: For President, Mr. Henry O'Malley; for Vice-president, Prof. Trevor Kincaid; for Vice-president, Dr. Charles L. Edwards; for Secretary, Mr. John N. Cobb; for Treasurer, Mr. Russell Palmer.

Moved, seconded and carried that the above be elected as the officers of the Society for the coming year.

The committee also recommended that the following be elected as an Executive Committee:

Dr. Barton W. Evermann, of San Francisco, Calif.; Dr. C. McLean Fraser, of Nanaimo, British Columbia; Dr. Charles F. Holder, of Pasadena, Calif.; Mr. Leslie H. Darwin, of

Seattle, Wash.; Mr. M. J. Kinney, of Portland, Oregon; Mr. Ward T. Bower, of Seattle, Wash., and Mr. M. D. Baldwin, of Kalispell, Montana.

Moved, seconded and carried that the Executive Committee as named be elected.

TIME AND PLACE OF MEETING

Mr. Henry O'Malley, chairman of the Committee on time and place of the next meeting, reported that the committee recommended Portland, Oregon, as the place for the next meeting, and that the date be decided upon later.

Moved, seconded and carried, that Portland, Oregon, be selected as the place for the next meeting, and that the fixing of the date be left to the Council of the Society.

The following papers (both of which were illustrated by lantern slides) were read and discussed: Prof. Trevor Kincaid, "Oyster Culture in Washington"; Prof. Frank W. Weymouth, "The Pacific Edible Crab."

The afternoon session was called to order in the Lecture Hall of the Inside Inn, Panama-Pacific International Exposition, with President Westerfeld in the chair. As he had to leave shortly thereafter Mr. Henry O'Malley then assumed the chair.

Letters of regret at not being able to be present were read by the Secretary from the following members: Dr. Charles F. Holder, Mr. C. G. Conn, Mr. E. Lester Jones, Governor Ernest Lister, of Washington; Governor Emmet D. Boyle, of Nevada; Governor George W. P. Hunt, of Arizona, and Governor J. F. A. Strong, of Alaska.

The following papers were read and discussed: Dr. B. W. Evermann, "Some Side-Lights on Recent Fur Seal Inquiries"; Dr. C. McLean Fraser, "Rate of Growth of Spring Salmon"; Prof. E. Victor Smith, "The Development of Young Salmon Under Varied Conditions of Light."

In the evening a banquet was tendered the members and their ladies by the local fishery interests. It was given at the Tait-Zincand restaurant and proved a most enjoyable affair. Ex-Governor John M. Slaton, of Georgia, was a guest and made a short address. During the course of the evening

remarks were made by President Westerfeld, President-elect O'Malley, Mr. R. D. Duke, Prof. Trevor Kincaid, Dr. B. W. Evermann, Mr. John N. Cobb, and others.

WEDNESDAY, AUGUST 11, 1915.

Session called to order by President Westerfeld in the lecture room of the Young Women's Christian Association, Panama-Pacific International Exposition.

Moved, seconded and carried that the thanks of the Society be extended to the Young Women's Christian Association for the use of its lecture room.

At the suggestion of the Secretary, it was moved, seconded and carried that copies of the Transactions of our First Annual Meeting be given to all those who have become members since that meeting.

Moved, seconded and carried that the thanks of the Society be extended to the California Fish and Game Commission, and to all persons who have extended courtesies to our Society since we began our sessions in this city.

The following papers were read and discussed: Mr. Henry O'Malley, "Economical Foods for Rearing Salmon"; Mr. John N. Cobb, "Oceanward Trend of Our Northwest Fisheries"; Dr. Charles F. Holder, "Some Food and Game Fishes of Southern California: Their Habits, Present Conditions, Need of Protection, Etc."; Mr. N. B. Scofield, "Paranzella, or Trawl Net, Fishing in California"; Mr. A. D. Ferguson, "Extending the Range of the Golden Trout"; Mr. E. Lester Jones, "The Close Relation of the United States Coast and Geodetic Survey to the Great Fishing Interests of the Pacific Coast and Alaska."

In Memoriam

E. E. AINSWORTH

CHARLES W. DORR

C. H. BUSCHMANN

PART II

PAPERS AND DISCUSSIONS

THE PACIFIC EDIBLE CRAB

By F. W. WEYMOUTH

of Stanford University

The edible crab of the Pacific Coast, *Cancer magister*, is found from Lower California to Unalaska in shallow water on exposed sandy beaches or in sandy bays. Through most of its range its habits are not easy to observe directly, but field work made possible through the intelligent interest of the Provincial Government of British Columbia in the life histories of its aquatic animals has furnished many important facts, some of which may be briefly presented here. Part of the time is spent in active search for food, but often the crab is to be found buried in the sand. Here it is not, however, indifferent to its surroundings, but, being provided with an apparatus for obtaining clear water for its gills, it is constantly on the watch for any odor of food in the steady stream of water passing over its organs of smell, and ever ready to come out in pursuit of this food when detected. The food consists chiefly of small fish; shrimps, small crabs and small clams ranking in descending order of importance.

Old individuals attain a considerable size. I have seen males measuring nine and a quarter inches across the back, and though females are never as large, specimens of seven and a half inches have been seen. The age represented by these examples or by those that have reached a marketable size is, of course, a point of considerable interest and practical value. Data on this point is difficult to obtain and even in Europe where the edible crab (a related species) has been studied for many years, the rate of growth is only very incompletely known. A considerable number of crabs have been kept in aquaria and their rate of growth noted, large numbers of crabs have been measured and tabulated to determine the frequency of the different sizes, and from this and other data it seems clear that an edible crab of six inches, the legal size in most states, is not less than four years old and may have reached as great an age as seven years.

It has been found that a female of about four and a half inches is sexually mature, and from this time on lays immense numbers of eggs. The number of eggs increases with increasing size. A crab of five and a third inches was found to have about 750,000 eggs, while one measuring six inches carried 1,510,000 eggs. These eggs are laid in the fall and are carried attached to the hairs of the abdominal legs through the winter and hatch in the spring. For four months following this they live at the surface of the water with many other larval forms and it is at this time that the greatest destruction takes place, many fish feeding almost exclusively on this plankton, as the surface life is called. By June or July the larval life is completed and the crab, now closely resembling the adult in appearance, seeks the bottom and takes up the mode of life that it is hereafter to follow.

Although the range of the edible crab is so great, it is not everywhere abundant enough to support a commercial fishery. At present the southernmost fishery of consequence is that at San Francisco. This, and that at Eureka, are two of the most important on the coast. In Oregon they are fished at Coos Bay and about the mouth of the Columbia. On Puget Sound one of the earliest fisheries was at Dungeness, and even now it is locally known as the Dungeness crab, but the fisheries about Anacortes and at Neah Bay are now more important. In British Columbia the crab is extensively fished at Boundary Bay and at Prince Rupert, as well as locally at many other points. The fisheries of Alaska have never been developed, although crabs are abundant, chiefly through the lack of an adequate market.

The fishing methods are for the most part relatively simple. In the earlier days of greater abundance and less systematic market fishing they were taken in seines along with shore fish or picked up from a skiff with a dip net or perhaps a pitchfork used as a spear. In regions where they are still abundant, campers or Indians may take a few by such means, but more efficient gear is required where a market is to be supplied. Two methods have proved important, and one or the other of these is used according to the requirements of the locality.

The fishing at San Francisco and Eureka is done on

exposed waters off the harbors, and here, as well as at other localities where conditions are similar, the hoop net is exclusively used. This net is but a slight elaboration of the barrel hoop covered with netting with which almost all boys have fished from some old wharf. The framework of the net comprises two iron rings, and these are connected by netting to form, when held by the line, a basin-shaped structure from which the crab cannot crawl, but which lies flat on the bottom when fishing and at that time offers no hindrance to the crab in reaching the bait. Fifteen to twenty of these hoop nets, baited with small fish, are set in four to ten fathoms on the bars, ranged in line with the run of the tide, and left from half an hour to an hour so that the crabs may have time to gather. The fisherman then goes over the line, running up against the tide. The float is first picked up and then the boat is carefully maneuvered until a point directly above the net is reached, when the net is jerked off the bottom and hauled to the surface. For this considerable skill is required, for if the net is dragged over the sand in an unskillful attempt to haul it when the boat is not in the right position, the crabs will be warned and will all escape. When the net has been lifted into the boat, the crabs of marketable size are sorted out, the remainder thrown overboard, the net rebaited and again set. The nets are thus worked over, usually from about sunrise until one or two o'clock in the afternoon, when they are picked up and brought in, as a net allowed to remain out over night is usually silted under so deeply that the line will break before it can be freed.

Where the shifting of the sand in the run of the tides or the pounding of the surf is not so marked as, for instance, in sheltered bays or sounds, it is possible to use a very different kind of gear closely resembling the lobster pot of the eastern coast, and this is true of the fishing at Anacortes and at Boundary Bay. The funnels at either end allow the entrance of the crabs, which are unable to find their way out and are caught. An opening in the side permits their removal when the trap is lifted. The trap may be entirely covered with netting; it is more common to make the funnels of netting and cover the trap with chicken wire; all are tarred to protect them from

the salt water. They are usually left continuously in the water, being hauled three to five times a week and emptied; so that they are actually fishing a greater part of the time than is the hoop net.

With this brief survey of the fishing methods let us pass to a consideration of the present state of the crab fishery on the Pacific Coast. There can be no doubt that the crab is much scarcer than when commercial fishing was started. In a report on the crab fishery written for the Bureau of Fisheries in 1880 it speaks of the large numbers taken in beach seines hauled on the south side of the Golden Gate and states that they were selling "three and four for a quarter" in the San Francisco markets. Anyone acquainted with the crab fishery of San Francisco knows that it would be practically impossible to get any crabs exceeding the legal size of 7 inches in any part of the bay at the present time, and all San Franciscans know that a single crab usually costs more than the three or four of 1880.

There are parts of the northern coast in Alaska and British Columbia where the crabs are still as abundant as they once were in Humboldt Bay, where a skiff could be filled in half an hour by picking them up from shallow water with a pitchfork. But in the neighborhood of all towns large enough to cause any demand, they have already been enough reduced in numbers to force the fishermen to make longer and longer trips to more distant grounds to keep up the catch. To give a graphic point to this general statement let me cite a particular example. Near the city of Victoria is a small lagoon once famous for its supply of crabs, but now, because of its easy accessibility, much depleted. If we compare the size of the crabs taken here with those taken at Prince Rupert, where the grounds, though not in their original state, have been fished for only a comparatively short time, we get some interesting figures. Of 580 crabs taken at Victoria but 15 per cent. exceeded the legal size, here 6 inches, while of 1,088 crabs taken at Prince Rupert 93 per cent. exceeded the legal size, and about 10 per cent. were larger than the largest taken at Victoria. This is a striking example of the effect that close fishing may have on the size of the crabs.

I do not wish to pose as an alarmist, or to predict the speedy extinction of the edible crab, but it is evident on all parts of the coast that the supply is diminishing, and that the most stringent of our protective laws are doing little more than materially to reduce this rate of diminution. What, then, do I consider necessary? Only that we extend to the crab throughout its range as efficient protection as it now gets in any part of it and keep vigilant watch for its future needs. At no point on the coast has the crab fishery been destroyed, and it is a fact taught laboriously and painfully by the history of nearly every fishery in every land, that to preserve a fishery is always possible, sometimes easy; to restore a fishery, well nigh impossible. Let us preserve ours while we have it to preserve.

To put in more tangible form the methods of preserving the crab fishery, I propose to discuss briefly the present laws on this coast, their purpose and what they are accomplishing. At the very outset, however, we meet with a serious obstacle—the almost complete lack of adequate statistics. Aside from the data on the salmon, there is hardly a food fish on this coast on which we have accurate and extensive statistics. It is plain that all protective legislation must be a matter of guess work unless we know whether, under a given set of conditions, the particular animal is increasing or decreasing. Such statistics must be accurately kept and must extend over a considerable number of years before they become of much value, as there are always fluctuations, good years and bad years, that tend to hide the general trend that a long record will show. Furthermore they must cover more than merely the total annual catch. In the history of nearly every fishery there are periods when, due to an increased number of fishermen and boats and improvement in the gear, the yearly catch has been increasing by leaps and bounds while the grounds were being rapidly exhausted, and the catch per man falling startlingly. It is, therefore, necessary to supplement the total annual catch with data showing the number of men employed and the amount of gear used. When statistics of this nature are available the efficacy of any set of protective laws may be

determined, not by the opinion or impression of this or that person, but by easily recognized facts.

The most general law is that providing a size limit below which crabs may not be taken. The first and most important purpose of these laws is to protect a group of animals of mature age, and thus to provide a group of breeders. The female becomes mature at about $4\frac{1}{2}$ inches, the male at a size not yet accurately determined, but at least below 6 inches. The size limit must fall above these figures to be of any value, the difference between the size limit and these figures will determine the number and hence value of the breeders preserved. The larger a female is, the more valuable as a breeder, because the more eggs produced. A female of 6 inches produces twice as many eggs as one measuring $5\frac{1}{3}$ inches, and the yield of eggs is again doubled before 8 inches is reached. The value of the large female is at once apparent from this; to protect her California has a law forbidding the capture of any female at any time, and other states would do well to follow this example. A size limit set as high as 7 inches will, however, accomplish almost as much, as the females do not usually exceed this size. From this fact it follows also that the complete protection of the female does not entail any hardship on the fishery, since so few of them reach a marketable size.

Another purpose of the law, or if not a purpose, at least an effect, is to furnish the market with larger crabs. A crab measuring $7\frac{1}{4}$ inches weighs about $1\frac{1}{2}$ pounds, one of $8\frac{3}{4}$ inches, 3 pounds. The difference in the amount of meat furnished is even greater, as the larger crab may be cleaned to better advantage. This growth, which has doubled the weight, has not taken more than two years and possibly only one, so that it would seem to be economy to wait this extra time and double the harvest. A size limit of 8 inches is not practical, but the principle remains the same; a 6 inch crab weighs a trifle over a pound and "picks" to less advantage than one of 7 inches. The larger crabs not only have more food value, but form a more attractive product, so that from the commercial point of view too low a size limit is a mistake.

At present the legal size is 7 inches in California, $6\frac{1}{2}$ inches in Washington, and 6 inches in Oregon and British Columbia; Alaska has, I am informed, no regulations in regard to the crab. It is highly desirable that our protective legislation be, as far as actual climatic or other conditions permit, uniform, and from the reasons I have just been citing I believe that a legal size limit of not less than 7 inches for the entire coast would do more than any other single restriction to preserve our crab fisheries.

The closed season is another of the common forms of protective legislation. It usually aims to protect some particular class of individuals at some particular season and reduces, as well, the total fishing time of the year. The latter effect depends upon the length of the season, the time of year makes little or no difference. The class of individuals which it is usually intended to protect is the breeding female, but, as we have seen, this is much better met in another way, namely, by the complete protection of the female at all times. Aside from the breeding season, one other time of year is a critical one with the crab and that is the molting or casting season. To consider this we must make a digression and take up some points commonly misunderstood.

On the Atlantic coast the soft shelled crab is considered a great delicacy and is prominent in the markets. It is often asked here why it is that we have no soft shelled crabs. The answer is simple, they cannot be taken on a commercial scale and if they could they would not be desirable. Let us see how this comes about. The soft shelled crab is not, as many people, even fishermen, consider, a different sort or species of crab, but merely one which has recently molted and in which the shell has not yet hardened. Such a crab is for a time, of course, quite helpless and remains hidden until the hardening of the shell has progressed far enough to give it some protection, when, ravenously hungry from its enforced fast, it comes out in search of food. In Chesapeake Bay, where the soft crabs are so largely taken, the fishing is carried on with dip nets in very shallow water, or on a larger scale in deeper water with dredges, so that the fact that the crab is not active at this time does not much affect the catch. On the Pacific Coast, on

the other hand, where the fishing depends almost entirely on the use of bait, very few soft crabs are ever taken.

The edible crab of Chesapeake Bay is much smaller than the Pacific species and even here only the smaller ones are used in the soft condition. These are caught when very soft, or more commonly just before molting, and kept for a time in enclosures until molting occurs, when they are marketed as rapidly as possible. If not marketed promptly the shell has an opportunity to harden at least partially and they become less palatable. Could a supply of the western species be obtained in the soft condition, the shell, from its greater size, would prove far too thick for use in sandwiches, for instance, as the eastern ones are often used. Could young of a size corresponding to the eastern form be taken in commercial amounts, an extremely doubtful supposition, this would entail a loss of breeding individuals which could not for a moment be considered. Consequently the west must forego a supply of soft crab.

This, however, does not end the question. The western species when it does finally enter the traps is not the plump, juicy tidbit that the freshly molted ones are. An enforced fast and an extremely rapid growth sometimes amounting to as much as a fourth of the original width has used up all of the stored fat and the meat is watery, often amounting to only half the weight, when cooked, of the meat of a hard crab of the same size, and the flavor is distinctly inferior. Not only is there a big economic loss in rushing to market a crab that in the course of a month or two will represent twice the food value, but since at this time the crabs are feeble and unprotected, many are injured in handling among the females and under-sized ones, and of those kept for the market an unusual number die in transportation. All these losses can be prevented only by placing the closed season at the time when the soft crabs are usually taken.

Alaska and British Columbia have no closed season, in Oregon and Washington the months of July, August and September are closed, and in California August, September, October and the first half of November. A more complete knowledge of the life history of the crab may indicate that this

season varies with different localities, but the extent of the season should not be less than three months, and if it were uniformly four months it would be much more efficient.

Other measures have been proposed and are in force in various parts of the coast, but none seem of such general importance as to require discussion. Protective measures should always be the simplest that will accomplish the ends in view, as intricate laws are often difficult and costly of enforcement, and what is worse, give rise, through difference of interpretation and ease of mistake, to friction and hard feeling between the very parties who must cooperate in the preservation of the fisheries, the fishermen and the officers of the various fish commissions.

DISCUSSION.

PRESIDENT: I would like to ask Professor Weymouth, are the crabs caught in Washington and Oregon the same species as those caught here in San Francisco?

PROF. WEYMOUTH: Yes; there is only a single marketable form on the entire coast. There are two or three other species large enough to be eaten and abundant, but there is no other crab on the market but this particular species.

PRESIDENT: Any further discussion on the talk that has been made by Professor Weymouth on crabs? Any questions to ask?

DR. EDWARDS: Have there been any determinations about wandering; about the migration of crabs?

PROF. WEYMOUTH: No, I cannot answer the question at all. Of about 250 crabs captured on San Francisco bar, labelled and liberated, partly on the bar and partly inside the bay, there seemed to be no uniformity of behavior. Some liberated outside were recaptured in the bay, some liberated in the bay were recaptured on the bar, and some had traveled north or south outside the bay. Some moved a number of miles while free, but there was nothing that could be called a migration in a definite direction. It has been determined with the European crab that there is quite a definite migration. The females migrate along the coast against the prevailing currents during the breeding season, and there is also a seasonal migration from deep to shallow water. If anything of that sort occurs here, we have not enough data to prove it.

MR. O'MALLEY: Is it true, as sometimes stated by local fishermen, that cold water has a very bad effect if the crabs are exposed to it; that they are killed by frost?

PROF. WEYMOUTH: Yes, they are easily killed by frost, undoubtedly, but I do not think where they live the water very often freezes.

MR. O'MALLEY: I had reference to the transfer from the fishing grounds outside to the place of shipment in Oregon. There is another question I wanted to ask. Do you know of any record or any data on the transporting of crabs in seaweed, or the way we do with lobsters? What is your opinion as to how they will stand transportation under those conditions?

PROF. WEYMOUTH: I think Mr. Babcock, when he was fish commissioner of this state, sent some to the Chicago Exposition, and I believe some were taken to the Atlantic coast, and on those long distances they traveled best in seaweed, not in water. Unless there are very good

facilities for handling the water, they will survive much better simply packed in medium sized boxes, arranged shingle fashion with their heads up and covered with a small amount of seaweed. All seaweed is not equally good; someone was telling me an instance in which the common bladder weed (*Fucus*) was used with disastrous results, the slime from the bladders smeared over the crabs and killed them. Exposure to sunlight and heat kills them more rapidly than anything. Frost would kill them, but low temperature does not have a very bad effect.

GROWTH OF THE SPRING SALMON

By C. McLEAN FRASER, PH.D.

From the Pacific Coast Biological Station, Nanaimo, B. C.

In recent years much attention has been paid to methods of conservation of the supply of food fishes. Among the species abundant in Pacific waters, no species is more worthy of consideration in this regard than the spring salmon, not only on account of the size it attains but also on account of the quality of the flesh.

In order that rational methods may be used, it is necessary to know many facts about the life-history of the species. Much is already known about the spring salmon but much remains to be investigated. In certain respects it can be more easily and more thoroughly studied than other species of the genus. The sockeye apparently moves right on to the open ocean after coming down the rivers in early life and there it stays until it is ready to make the long journey back to the rivers to spawn. During the period that it remains in the sea it is a difficult matter to learn directly anything very definite as to habits or mode of life. The spring salmon, on the other hand, may remain in the inner waters all the time it spends in salt water. It takes the spoon readily and may be obtained at all periods of its existence, at all times of the year. As the herring is its main article of diet, it is fairly sure of a supply throughout the year, but, if the herring fails, it is not averse to making use of sand launces, young salmon, crustaceans of various kinds, including decapods, schizopods, copepods, amphipods, cephalopods, both squid and octopi.

Much can be learned by studying the individual fish if large numbers are caught at different times and under different conditions. In this way particular knowledge is gained of each at a definite period in its life and by getting this knowledge at various periods, much about the whole life history may be worked out. Another method is now coming into prominent use, whereby something of the past history of each individual can be made out by a study of the scales.

Most of the organs of the body have a relative increase in growth similar to one another and to the whole fish, and the scales do not provide an exception. They appear when the fish are very small and remain throughout its whole life unless removed by accident. Their mode of growth is such that a change of conditions of life is at once indicated and hence their great value as a record of events in the life-history of the fish.

The scale consists of two parts, one without any characteristic markings and the other, usually a larger portion, with a number of ridges on the surface in the form of concentric rings, or partial rings, around a central nucleus. Under the most favorable conditions the scale grows rapidly, as the fish does, and the ridges are far apart. When conditions are unfavorable the scale grows slowly and the ridges are close together. Probably the food supply is the greatest determining factor, therefore, in the spring and summer, when the food is most abundant, the structure of the scale has a loose appearance, while in the winter, when the food is scarce, the rings are close together. This is so marked in the scale that those close portions are called "winter checks." By noticing the summer growth and the winter check, the age of the fish may be determined in the great majority of cases without confusion.

As there has been some doubt cast on the validity of the winter check I have taken advantage of a favorable opportunity during the year to come to some definite conclusion in the matter. Beginning early last fall, I was able to get specimens of spring salmon for examination at short intervals, sometimes daily, through the winter and spring. In all scales taken from spring salmon caught from January 6 to March 17, with but one exception, there was indication of retardation of growth at the margin. On the other hand, with very few exceptions, no scales obtained after April 22 and before November 27 had indication of retardation at the margin. From March 17 to April 22 and from November 27 to January 5, some show retardation at the margin while others do not. These observations show conclusively that the check takes place during the winter season, although, since the greater portion of the check does not occur during the coldest part

of the winter, temperature seems to have little to do with it unless indirectly in connection with the food supply. Einar Lea has come to much the same conclusion as to the time of the check in the North Sea herring by using a different method of determination (*Publications de Circonstance*, No. 51, July, 1911).

In some cases the winter checks are not the only checks on the scales, as for various reasons there might be a shortage of food at other times of the year. This shortage is not liable to last over so long a period, hence the check produced seldom causes much confusion in the interpretation of the scale after a certain degree of facility has been attained.

In the purely marine fishes, the summer growth and the winter checks, together with any accessory checks, are the main matters for interpretation, but in such fish as the salmon, another important change takes place in the life of the fish. The salmon is hatched out in the fresh water and lives in it for a longer or shorter time before proceeding to the sea. Unfortunately this, the greatest change, is not recorded on the scale in all cases, for the simple reason that many salmon go down to salt water as fry before the scales have started to grow. On the other hand, some of them do not leave the fresh water in the first year but pass down as yearlings. These have scales and they show quite distinctly the change in conditions of life. The fish that remains in fresh water for a year does not get so good a food supply and consequently does not grow so rapidly as its relative in the sea. The scale shows this, as the growth representing this period is small and the rings are very close together. The first year area of the salmon in the sea is quite wide, sometimes wider than any of the other year areas, and has more widely spaced rings, sometimes passing almost insensibly into the next year's growth, but more commonly showing the check at the margin of the year as the others do. A glance at the scale is usually sufficient to tell whether the fish went to the sea as fry or as yearling. Gilbert, who has done much work on the scales of the sockeye, has named these, fish of the "sea type" and fish of the "stream type." After the first year the two types are

on much the same footing and the growth of the scale shows a similarity of conditions.

Since the scale grows at approximately the same relative rate as the fish itself, it is possible to calculate the growth of a fish, when the length at the time of removal of the scale is known, by a measurement of the year growths in the scale. Since the fish is of some size before the scale starts to grow, it is necessary to take that into consideration before the calculation is made. The spring salmon of the "sea type" is about two inches long when the scale starts to grow. I do not know how long one of the "stream type" is, but as it is nearly one and a half inches long before the yolk is absorbed it cannot be much short of two inches when the scale starts to grow. (The measurement here, as in all other cases in this paper, is the total length not including the rays of the caudal fin). If two inches are taken from the total length, therefore, the remainder may be divided in the same ratio as the scale. To illustrate, consider a fish 34 inches long of which the scales are prepared for examination. A magnified drawing is made and on this drawing the distance along a radius from the nucleus to the end of the first year is $1\frac{1}{4}$ inches, from this to the end of the second year $1\frac{1}{8}$ inches, from this to the end of the third year $\frac{7}{8}$ inch and to the end of the fourth year $\frac{3}{4}$ inch. Two inches are taken from the total length, 34 inches, leaving 32 inches; 32 is divided in the proportion of $1\frac{1}{4}$, $1\frac{1}{8}$, $\frac{7}{8}$ and $\frac{3}{4}$, giving 10 inches for the first year, 9 for the second, 7 for the third and 6 for the fourth. As the fish was 2 inches long before the scale started to grow, it was 12 inches long at the end of the first year, 21 inches long at the end of the second year, 28 inches at the end of the third year and 34 inches at the end of the fourth year.

Since it is possible to calculate with some degree of accuracy the growth in each year, it seemed worth while to examine the scales of a large number of specimens to see especially if the effect of the stunted growth of the fish of the "stream type" during the first year continued throughout life. If it does, rearing ponds, as far as this species is concerned, may be less of a blessing than has been supposed. As yet I have not examined a sufficient number to draw very definite

conclusions but possibly enough to see what the indications are. It must be remembered that conclusions drawn from data obtained in one district should not be applied even to the same species in another district unless investigation proves that the conditions are similar. In the case of different species, even if they are closely related, such application is liable to lead to grievous error.

In all, the growth rate of 218 has been worked out. Of these nearly 100 were caught in the Strait of Georgia near the Biological Station, Nanaimo (these were nearly all young specimens), another 100 were obtained on June 22 at New Westminster, caught in the Fraser River, and the remainder at Vancouver on July 12, caught at the mouth of the Skeena and the Campbell rivers. Of these, 65, or 30 per cent., were of the "stream type" and 153, or 70 per cent., of the "sea type." Of the "stream type," 10 were in the second year, 7 in the third year, 33 in the fourth year and 15 in the fifth year. Of the "sea type," 46 were in the second year, 30 in the third year, 69 in the fourth year and 8 in the fifth year. In the "stream type," the average length at the end of the first year was 5 inches, at the end of the second year 15 inches, at the end of the third year 24 inches and at the end of the fourth year 31 inches. In the "sea type," the average length at the end of the first year was 11½ inches, at the end of the second year 21 inches, at the end of the third year 28½ inches and at the end of the fourth year 33½ inches. To put in tabular form:

	——Length at the end of the——			
	1st	2nd	3rd	4th
	year	year	year	year
Stream type	5	15	24	31
Sea type	11½	21	28½	33½
	——Growth during——			
	1st	2nd	3rd	4th
	year	year	year	year
Stream type	5	10	9	7
Sea type	11½	9½	7½	5

If this was a representative lot of spring salmon for this district, and I know of no reason why it should not be, it may

be concluded that a large majority come down to the sea as fry, 70 per cent. of the total number. This fact may have no bearing on the rearing pond argument, except that in nature it is evident the "sea type" has the preference. It might be that the numbers are more nearly equal in the first place, but since the fry in the fresh water are subject to greater dangers, a greater proportion disappear, a condition that might be remedied by the retention in ponds for a year, but I doubt very much that this is the case. If all the hatcheries were to introduce rearing ponds for all of the spring salmon fry, one question might be settled in the course of time. Since all the hatchery fish would be of the "stream type," an examination of the proportions of the two types in the fish then becoming mature would show by comparison if the number that the hatcheries turn out are really making an appreciable difference to the general supply.

In looking at the numbers of the different ages that were examined, the second and third year figures do not help, because almost all of these were immature fish with no immediate intention of going up the rivers. In the fourth year the numbers 30 and 69 bear much the same ratio as do the totals. In the fifth year there are fewer "sea type" specimens than "stream type," 8 to 15, but the numbers are too small to form a basis for a definite conclusion. From this examination, therefore, there is nothing definite to indicate that the one type is likely to mature more rapidly than the other.

The most definite information comes from the study of the growth in the different years. The fish that lives in the fresh water for a year starts its second year with a big handicap, as it is less than half of the length of one that has spent the most of this time in the sea. A "stream" fish, only 5 inches long, sees the "sea" fish $6\frac{1}{2}$ inches ahead of it in growth. It starts in to reduce the lead, but during the next year it makes but little headway, although it does not fall farther behind. The figures given above indicate a gain of half an inch in the year, leaving it still six inches behind. In the third year it does better, gaining one and a half inches, and in the fourth year two inches, but it is still two and a half inches behind.

This does not seem so very much but it may represent at this stage a difference of five pounds in weight. Unfortunately, no specimens in the sixth year were obtained, as it would be interesting to note if the lead is finally overcome. As comparatively few reach this age, however, this would have little real bearing on the case.

It is largely on the fish in their fourth and fifth years that the canners must depend. If the run were all of the "stream type" it would mean quite a considerable decrease in the average size of the fish caught. To get the same weight of fish it would be necessary to catch a much larger number. This would increase the expense in handling even if the extra number were available. Of course it is said that so many more would be carried past the most perilous period of their lives and hence of necessity there must be a greater number reaching the sea. I am not so sure of that. It is quite true that the fry are preyed upon extensively as soon as they are set free, but those that do escape soon become wary so that they are not easily caught. On the other hand, those kept in rearing ponds are entirely unused to danger, so that they will learn methods of protection or escape much less readily than the younger fish.

We have no very conclusive proof that the artificial hatching of species that are well established in any habitat has been a success, commercially or biologically. No method has yet been devised to prove or disprove it definitely. It sounds well to speak of the hundreds of millions of fry turned out, but we really do not know if it has any appreciable effect on the canner's product. Similarly, in the case of the rearing ponds, the proposition appears to be a good one but until further investigations are made, extending over a number of years, it is just as well not to be too sanguine of results.

DISCUSSION.

MR. O'MALLEY: Gentlemen, this is a very interesting paper, and one which touches upon a very vital problem, a problem which is not only before the Bureau of Fisheries, but every bureau on the coast. I am in favor of feeding young salmon. My personal observations have led me to take this stand, and I am not ready to be convinced that it is not right until large numbers of adult salmon have been examined. I feel it is a problem which must be worked out. It is being worked out by Mr. Rich, on the Columbia River, at the present time. I am not prepared just now to say what he is finding out, but I am sorry he is not here to take up the matter and talk to us about it.

But I do want to bring one thing to light at this time. It is known that this is one of the biggest years on the Columbia River; there are more spawning fish on the spawning beds today than there have been for many years, and the pack is larger than it has been for many years. Another instance, similar to that on the Columbia River, is on the White Salmon River. I think Mr. Rich located that station some years ago. In its early history the station took 17,000,000 eggs. In the last few years feeding operations have been conducted there, and during the past three years it has not been any task to take 35,000,000 eggs, and there was fish enough in the river to provide another twenty million. Whether that is due to the feeding or not I cannot state, and I do not think anyone is in position to say definitely, but there has been a decided difference in the stream, and the same is true in the Big White Salmon River. The Bureau of Fisheries have not had the funds to feed that number here, but the cannery on the Columbia River have often assisted by putting up the funds for the work.

MR. COBB: Is the take at the Bonneville hatchery also increasing?

MR. O'MALLEY: It increased more last year than any other. Years ago the Bureau of Fisheries used to take five and a half million eggs at the present Bonneville State Hatchery and if we got a million and a half we had a good season, but in the last few years they have been taking the salmon eggs further up stream and maturing them there. And the fish come in there in larger numbers as compared with what they did years before. But that is nothing but a large feeding station.

Dr. Fraser's experiment may work out in the northern rivers, where he is working it out, while other conditions would be better or more suited to the Columbia River. Years ago we liberated all our sockeyes, which, judging from Dr. Gilbert's work, it is evident was entirely wrong.

PROF. SYKES: How many fish have been examined, Dr. Fraser?

DR. FRASER: We used 218, extending over one year.

MR. COBB: It is always well in talking about increases in streams to compare not only the hatchery takes of eggs but also the returns in the commercial fisheries. There is no question but that in 1914 the Columbia had a better season than in the previous three years, so far as chinooks were concerned, while the run of Bluebacks was the largest since 1888.

MR. O'MALLEY: 1889, I think.

MR. COBB: Now, this year the chinook canned pack will probably be one hundred per cent. greater than last year, but that does not mean there were that many more fish in the river. This year, owing to the lack of market for these fish in Germany and other European countries, where they are, under normal conditions, marketed in a mild-cured or frozen condition, they are nearly all going into cans. There is probably a fifteen per cent. increase over last year, so far as I now know, while the spring run is still on. But the one hundred per cent. increase in the canned pack, for the reasons noted above, does not represent an actual increase to this extent in the number of salmon actually in the river. For some reason the Columbia, in the last few years, has shown an increase in the run of chinooks. This, doubtless, is an actual increase. If it appeared at one place and not at another, I would not so consider it, as there might be some physical or climatic condition which would prevent the commercial fishermen at one place from catching so many.

DR. EVERMANN: The investigation I referred to in my fur-seal paper is an experiment which would throw light on this very question. The proposition there was to take each year a record of the commercial catch of sockeyes in that region, and then to rack the outlet of Wood River, or the lake, and actually count the number of sockeyes that went

up that stream each season. The sum of the fish caught by the commercial fisheries, plus the number counted as going up the Wood River, would be the total number returning to that region each year. Continue that count over a sufficiently long series of years, and you will reach this important fact: What number of sockeyes must go up Wood River each year to spawn to permit a commercial catch such as is secured each year? What commercial catch can you expect each year from a spawning run of so many thousand fish in Wood River each year?

Now, the answer to that question would give you the ratio between the number of spawning fish necessary and the number which could be caught commercially each year.

Whenever that can be done—and I am sure it can be done on the Wood River—it doesn't make any difference about the nearby streams, but the final result or ratio will be reliable and can be counted upon.

Suppose experience has led us to believe that a maximum of four million sockeyes can be caught off the mouth of any particular stream each year, then the question to arrive at is (leaving out propagation), what number of fish must go up that stream each year and spawn in order to make it possible to catch four million sockeyes each year off the mouth of that stream?

When you get that ratio then it does not make any difference how or where you catch the fish. The whole discussion regarding different kinds of gear, whether you shall use the trap-net, the pound-net, or haul seine or purse seine, whether one or the other is more destructive, that all vanishes. It does not make any difference *how* you catch the fish, or *where* you catch them, or *when* you catch them; the only thing necessary is to let the number go back to the spawning beds to make it certain that, four or five years hence, the required number of adult salmon shall come back. And it would seem that the best way for the commercial fisheries to do is to rack the stream, and then the government and the state officials should see that a sufficient number is allowed to pass by to the spawning grounds, and after that number has passed, then close the rack and let the commercial fishermen catch the rest as easily as they can.

Now, should you let the first run go by or the last? or let some go by and then catch some, and then open the racks again and let more go by? Those are questions of detail which you would have to consider in connection with saving all parts of the run, or saving some and killing others.

PROF. SYKES: Were the fish taken directly from the sea or the spawning grounds?

DR. FRASER: The majority were gotten with spoons right out in the strait. Some of them were just started up the river, but had gotten nowhere near the spawning grounds.

PROF. SYKES: It would be interesting to point out some difficulties one might meet with in case the fish should be taken at the spawning grounds.

In the course of investigations conducted during the past year to determine the age of salmon at spawning, facts were revealed which showed that there could be absolutely no correlation between the length or weight of a fish taken from the spawning grounds and the size of its scales. It seems that not only do the scales not grow uniformly on the entire fish, but that soon after the fish enters fresh water the scales begin to disintegrate, so that by the time the salmon reach the spawning grounds there are practically no perfect scales on them.

The majority of the cases examined showed the edges of the scales worn off, and the number of circuli, or individual rings, found on the scales of a single fish showed a variation as wide as eighty.

DR. FRASER: I think that is plausible, as the scales get smashed up in going up the river. Two or three individuals in Europe tried to figure the ratio between the number of rings and the age, but I think it proved to be a failure. You will find a good many different sizes of scales on the same fish. The scales that I have generally used are those somewhere near the lateral line, and pretty well towards the head. But that does not make much difference, as far as I can see, because no matter whether the scale is large or small, you will find the same ratio on that line.

It looks very much like a piece of the limb of a tree when you cut it across. The loose growth in the spring corresponding to the loose arrangement of the rings. Similarly with the close growth. It is a single band in the case of a herring; but in the case of a salmon there are three or four, or sometimes five of those rings, close together.

The other day, coming down on a boat, we looked at a log and noticed some of the year-growths to be very little; the rings were very close together, while in other years they were a considerable distance apart. There might be a wide piece with a number of rings, from four or five to sixteen or twenty, in one year. And then, when they get a good supply of food in the spring it increases very rapidly. In the young fish the scales rub off very easily when they regenerate; they do not regenerate as perfect scales, but ordinarily it is possible to get a great number of perfect scales on a fish. I have examined big salmon and other fish scales of fish which had gone up the stream.

PROF. SYKES: I had thought to bring that question out. That was the very proposition we started out to investigate, namely, the reliability of theories which held that the age of fishes could be determined by the growth-rings. It had been reported in some of the general literature that each year's growth was indicated by a band of sixteen circuli; an assumption made by Malloch in connection with investigations made on the Atlantic salmon. The question was raised by some member of the Oregon Fish Commission and was referred to me. I detailed an assistant, H. W. Hyland, to carry on the investigation. The results showed, first, the number of rings or circuli, in the growth band, sixteen, is not constant; second, an indefinite number of the rings at the edge of the scale were eaten away by the fresh water; third, entire bands of circuli were either worn away or obliterated. Thus, the scales of fish that have been exposed to fresh water for any considerable period could not be relied upon for age determinations. However, it was observed that the scales just behind the dorsal fin in the lateral aspect suffered less deterioration than on any other part of the body.

DR. FRASER: We found some cases where there were only two or three rings, and some where there were five or six in the same place and at the same time.

MR. SCOFIELD: I think that in work of this kind we should be very careful before drawing conclusions. I know that in the investigations of Dr. C. H. Gilbert he works with the scales of thousands of fish from one stream in order to make the results less subject to error. As his work has progressed, he finds it desirable to collect scales from progressively larger numbers of fish. In one month this summer he has collected scales from 6,000 fish. An investigation of this kind should extend over a number of years, for the fish hatched in one year may not show the same line of development as those hatched in succeeding years.

In connection with determining the efficiency of artificial propagation, there is one experiment, which, as far as I know, has never been proposed—and this need not be taken too seriously—but it has one great advantage in that it requires no outlay of money to try it: Take a stream where it is supposed the run of salmon is being kept up by artificial propagation, and then discontinue hatching operations for one year and watch for the result four years later or whenever the fish resulting from that year's spawning are due to return. It has been suggested that this experiment is not likely to be tried, for if any commission should adopt this method, they would lose, no matter what the result, for if there should be a decrease in the number of fish, they would be criticized for not operating the hatcheries on that year, and on the other hand, if there should be no decrease in the number of fish it would be charged that their hatching methods were no good.

ECONOMICAL FOODS FOR REARING SALMON

By HENRY O'MALLEY,

Field Superintendent, U. S. Bureau of Fisheries.

In recent years it has become well recognized that real success in the propagation of salmon on the Pacific Coast is determined in large measure by the extent to which the young are reared to the fingerling size before being liberated instead of the more obsolete method of planting enormous numbers in the defenseless fry stage a short time before the final absorption of the yolk sac. This pertains particularly to the chinook, sockeye and silver salmons, which are known to pass a part or the whole of their first year's existence in fresh water, a period of residence that has been determined in conclusive manner chiefly as the result of the general investigations and the study of the scales of salmon conducted by Dr. C. H. Gilbert of Stanford University. The demand for fingerlings which has naturally followed this recognition of the great value of fingerlings over fry has developed the necessity of a cheap food that will furnish proper nourishment for the young fish and be obtainable in large quantities, as the cost of liver, which has long been a favorite article of food for young fish on this coast, has become prohibitive except as it may be used occasionally for a brief period to afford a change of diet.

One of the first cheap foods to be utilized in large quantities by the Bureau of Fisheries was the Columbia River smelt, which was first tried at the Oregon stations about five years ago. These fish can be purchased during the run at the height of the season for \$20 per ton at a cold storage plant in Portland. An additional charge of \$20 per ton covers sharp freezing and storing for a period of six months and this, together with transportation charges, makes the average cost of the fish about 2½ cents a pound delivered.

Smelt have been fed both raw and cooked. When used in the raw state the fins and heads are removed and the fish are ground once through the coarse plate of an Enterprise meat chopper, after which they are run through the fine plate twice.

This method, however, has not proved satisfactory, as the smelt are very oily, and in feeding difficulty has been experienced in keeping the troughs clean; also intestinal trouble is feared from the innumerable small, sharp bones. The method which has given most satisfactory results is to place the smelt in 50 or 100-pound lots in a farm kettle and cook them until the bones become softened. After this a quantity of the cooked mass convenient for handling is placed in gunny sacks and permitted to drain thoroughly. The mass in the sack is then transferred to a press of convenient size, operated by an ordinary house jack, and is pressed into cakes 12 inches by 12 inches and varying from $3\frac{1}{2}$ to 4 inches in thickness. The burlap forming the sack is peeled away and is serviceable for further use. Quantities of this food can be prepared at one time, and if kept in a cool, dry place will remain in a wholesome condition for several days. When needed for food it is grated by means of a home-made power grater and screen; the degree of fineness depending upon the age of the fish to be fed. After this operation it presents the appearance of coarse meal and can be scattered over the surface of the water, and is cleaned up by the fish before it reaches the bottom. Prepared in this manner it makes a good, clean, rich food, and one which the fish take readily. The cost of this food is very moderate.

Culled canned salmon, or do-overs, have been successfully used for the feeding of young salmon by heating the contents of the cans thoroughly and pressing and grating in the manner just described for preparing smelt. Particular attention is invited to this method of using canned salmon in feeding young fish, as heretofore there has been considerable complaint that poor results follow the use of this food. If, however, it is prepared as herein mentioned, it will give satisfactory results.

After meeting with success in the feeding of canned salmon, and having noticed each spring for several years the young salmon working on the carcasses of the silver salmon which had spawned late and died on the beds, it occurred to me that the bodies of the parent fish, if properly prepared and preserved, would make a good food at a small cost. With this in mind instructions were issued to the various stations of the Bureau on this coast, including Alaska, to put up a quan-

tity of the spawned salmon for fish food. The fish, after being relieved of their eggs, are skinned, split, and carefully boned, and are then placed in tanks or barrels in alternate layers of fish and salt, water being added when necessary to keep the brine well over the top layer. Quantities also have been prepared at the Bureau's stations in Washington by dry salting the fish in dairy salt and packing in a dry, tight box or other container, weighted down and held in a solid mass for a period of twenty-four hours. They are then taken out and rinsed in fresh water and hung over a pole in the dry house. A slow heat at first is applied to toughen the fiber, following which they are kept in the dry house until quite dry and hard, when they are packed in boxes between layers of paper to absorb any moisture, and held in dry storage until needed. Still another method was tried at the Bureau's stations in California, where a quantity of sun-dried or air-cured salmon was prepared, no salt being used, as climatic conditions are favorable for curing salmon in this manner until late in the the fall.

Several methods of preparing this food were adopted. In all cases, however, the fish were first soaked well, preferably over night in running water, to remove the salt. Some of them were then cooked, pressed and grated; others were prepared by grinding in an Enterprise meat chopper and then mixed with mush made from middlings; while quantities were prepared and fed in a raw state. But in all cases the various superintendents reported favorably on this kind of food, and I believe they are united in the opinion that it is an excellent food, and, with a few feeds of liver and plucks for the purpose of giving a mixed diet, will prove eminently satisfactory. The cost of this food, based on the small lots put up in the past season, was one cent a pound. When prepared in large quantities this cost will be considerably reduced.

This food was used at one of the Puget Sound stations with excellent results. In a slough into which several hundred thousand fish were placed at the time of the absorption of the yolk sac, sides of this salt salmon were laid on the bottom and as they softened up hundreds of young fry could be seen working on these pieces of salmon until they were entirely de-

voured. The fry remained in the slough under the attendant's care and observation, grew rapidly, and developed into splendid fish. The expense of labor under conditions of this character is reduced to a minimum, and in my opinion such work should be encouraged on all salmon streams where natural conditions permit.

In conclusion, I wish to emphasize my belief in the necessity of a mixed diet in feeding young salmon. Instead of any one food used continuously, no matter how good it may be, there should be a change occasionally to some other material. If the food consists of prepared fish, there ought to be an occasional feed of liver and mush. If this can be given as frequently as once a day it will be found to produce the most rapid growth. No matter how good any one food is, or how cheaply it may be prepared, best results will be achieved if a variety of food is used.

DISCUSSION.

PRESIDENT: This question of feeding the salmon fry opens up a good field for discussion, and I should like to hear what any members present may have to contribute from their experience along these lines. Mr. Shebley, what has been your experience in feeding salmon?

MR. SHEBLEY: I think the food prepared by Mr. O'Malley, of a mixture of liver and mush, is good; it is good in very large quantities.

PARANZELLA, OR TRAWL NET FISHING IN CALIFORNIA

By N. B. SCOFIELD.

Trawl net fishing is the catching of fish by means of a net dragged on the bottom of the sea by one or more boats. There are several styles of trawl nets in use in different parts of the world, but in all the net proper is of the same shape — a flat triangular bag of webbing with a wide but low mouth. From the wide mouth the net narrows rapidly to the cod end of the bag, which is so arranged that it can be unlaced to discharge the catch when it is hoisted aboard the operating boat.

In the North Sea, where trawl fishing has been developed to a high state of perfection, the beam trawl was, until a few years ago, the style universally used. The beam, from which this trawl gets its name, is of wood or metal and is employed for the purpose of keeping the mouth of the net spread. The beam is held in a horizontal position a short distance off the ground by means of an iron frame or runner at each end. The beam supports the upper part of the mouth of the net and the lower edge of the mouth is kept next the bottom by a weighted ground line. The trawl is dragged by one line.

As the trawl fisheries developed, larger vessels and larger nets were employed. But there was a limit to the length of the beam beyond which they could not go without making the outfit too difficult to handle. So there was developed the otter-board trawl, which is the one now almost universally used in deep-sea trawling. Instead of a beam, a couple of otter boards are employed to keep the mouth of the net open and extended; one board attached to each side of the mouth. A tow line is attached by a bridle to each of the two boards in such a manner that when the net is towed the boards, by their kite-like action, due to the resistance of the water and the bottom, on which one edge of the boards rest, extends or spreads the opening of the net, so that the two lines with which the net is operated can be dragged by one boat. When the otter trawl is lifted the boards come near together, thus making the net easier to operate than a beam trawl, and a much greater spread of net can be obtained. Trawls of this type now employed

have a spread of 75 to 100 feet, and some of the larger ones have a spread of considerably more than 100 feet.

A third type of trawl is one more primitive than either of the ones just described. It was doubtless developed from a beach seine or bag net, but instead of being dragged on to a beach it is dragged on the bottom, in deep water, a boat towing each end. This method was introduced into California by the Italian fishermen about the year 1877, and it is still the only method of trawling in the state. The nets are known here as paranzellas, and the fishery as the paranzella fishery. When these nets were first introduced they were operated by small sail boats and were necessarily of small dimensions, and were dragged within San Francisco Bay and in the shallow water along shore just outside the harbor. Later, about the year 1888, steam tugs and larger nets were employed and the San Francisco paranzella fishery was soon in the hands of one or two companies.

With the development of the gas engine, the lateen sail of the fishing boats gave way to gasoline as a motive power, and with these "power boats" the fishermen began again to use the small paranzella nets; not near San Francisco but in Monterey Bay and in the southern part of the state.

San Francisco Fishery.—At the present time the San Francisco fishery is conducted by three companies, which operate 3 and 4 nets. Two steam tugs, which average about 75 feet long and about 30 tons register, are used for each net.

The nets are made in San Francisco and are constructed of heavy cotton twine. The forward part of the bag is of about 4 inch mesh, the middle part still smaller and the cod end is of much heavier twine and a mesh of $1\frac{1}{2}$ inches. In fishing position they spread about 50 feet. The tugs work in pairs and steer on parallel courses, each towing one end of the net. Occasionally two nets are towed by three tugs, one tug in the center towing an end of two nets. The "drags" are made either with or against the current; otherwise the net would drift sidewise and not fish properly. Two drags are usually made each day, frequently only one, and the duration of each is $1\frac{1}{2}$ to 2 hours.

Fishing Grounds.—The fishing is practically all done outside the three mile limit and in from 25 to 55 fathoms of water. While there is an expanse of apparently good fishing bottom ten miles wide and nearly fifty miles long, the boats have for years fished mainly in two localities: one 4 to 8 miles S. W. of Point Reyes, the other about 8 miles south of the lightship off the harbor entrance. The boats leave port each morning at 4 a. m., and return in the evening, making a trip each day of the week with the exception of Saturday.

The Catch.—About 90 per cent. of the edible fish caught are “soles,” sand-dabs and flounders; the balance of the catch includes sharks, skates, rock-cod, hake, tom-cod, California halibut, king-fish and coal fish. The local term “sand-dab” applies to the small species of flounders, but more particularly to *Citharichthys sordidus*. The term “flounder” applies to only one species, the variegated finned California flounder, *Platichthys stellatus*. The rest of the species of flounders are called “soles” in this locality.

During the two or three months of winter the catch is not so large on account of stormy weather. The fish too are apparently not so plentiful during this time, and it is the belief of the fishermen that they move out into deeper water during the period of rough weather. During the rest of the year an average catch for one net is about 125 boxes, or 10,000 pounds, of edible fish per day, or about 3,000 pounds for each hour of dragging. The catch of the three companies, estimated roughly, exceeds 6,000,000 pounds of edible fish a year. Comparing the abundance of fish on these fishing grounds with those in the North Sea, the fish are much more numerous here for an equal area of bottom. A six hour drag in the North Sea with a much larger net takes but few more fish than a two hour drag here.

After a drag is completed with one of the paranzella nets, it is hauled in by steam winches and lifted aboard one of the boats by means of a derrick. Frequently the weight of the fish is so great that part of them have to be previously removed with a long handled dip net to avoid tearing the net. The fish by the time they are landed on deck are mostly dead, being either smothered or crushed by the great weight in the net.

The fish are next sorted; the inedible and immature, unmarketable ones being thrown in the sea. Those retained are placed in lockers. Small sharks or dog fish constitute the bulk of the inedible catch and they are not retained even for fertilizer. Skates are quite plentiful usually, but only a few can be disposed of for food. Hake, an inferior, soft-meated fish, for which there is little demand, are caught from March until early summer, often in larger numbers than can be disposed of as food. The rest of the catch that is not utilized is made up of immature, edible fish that are too small to market. These are almost wholly "sand-dabs" and "soles."

Detailed counts of the fish retained and those thrown away have not been made, but careful estimates were made which are approximately correct. The weight of the fish thrown back constituted 20 to 25 per cent of the entire catch. Of the edible fish 10 per cent were thrown back. The number of immature soles and sand-dabs thrown away compared with the number saved was about 1 to 6. A few edible crabs are taken, but in the deep water where the paranzellas work they are usually of good size. The number they take is insignificant. The largest number observed was 50 in a 2 hour drag.

The fish caught by the paranzellas are not cleaned on board nor is any ice used. They are unloaded into boxes in the evening at the dock and in the early morning they are hauled to the company's wholesale market where the bulk of them are turned over to other wholesale and retail dealers. Part are cleaned for their retail trade, or are iced and shipped to out of town customers. The wholesale price of soles and sand-dabs in quantity varies from 1 to 3 cents per pound. The consumer pays the retailer from 10 to 20 cents.

Effect of Fishing.—The paranzella nets operate off shore, where they do not interfere with any other net or line fishing. The crab fishermen have claimed that they are the cause of the growing scarcity of crabs, and they have brought the other usual charges against these nets, such as: They destroy the spawn of the bottom fishes; they destroy the feeding grounds by dragging over the bottom; they destroy great quantities of young fish.

As to destroying the spawn, investigations made elsewhere show that the eggs of all these fish float at or near the surface and therefore could not be destroyed by the nets. As to destroying the feeding grounds, it has been shown by other investigations that even where they have large otter boards dragging on the bottom, they do not materially denude the bottom of organisms on which the fish may depend for food. As to whether they are unduly destructive to crabs, the charge is undoubtedly true for the inshore fishing in shallow water but not for the deep water three miles off shore. The few undersized, or female, crabs they take can be returned alive to the water, but they do not usually return them as carefully as they might. The growing scarcity of crabs is much more likely due to over-fishing by the crab fishermen themselves. The large per cent. of tagged crabs recaptured by the crab nets shows they are being over fished. As to the charge of destroying great numbers of immature fish, they no doubt did in former years destroy great numbers of immature fish when they fished in shallow water near shore, but investigations have shown that the number destroyed where they fish now in deep water is not excessive.

In the recently published results of the trawl investigations on our Atlantic Coast, it is shown that the trawls take the same kind of fish that are taken by the long-line fishermen, and in addition take a great many of the young of what may be called long-line fish, such as cod and haddock. The only fish they added to the market were soles and flounders, and they constituted only 4 per cent of the whole. The committee of investigation recommends confining the trawls within certain limits, where they will not interfere with the line fisheries.

Our conditions off San Francisco are not the same. The operations of the paranzellas do not interfere seriously with any other fishery. The great bulk of the catch is soles and sand-dabs, which would not be caught by other methods. The small soles down to 6 inches in length are utilized for food. The paranzellas have developed a new field and with otter trawls this field could be greatly extended if the market demanded it. Under the present law these nets cannot fish within three miles of shore, and with this three mile strip along

the shore and the bays as refuges for the fish there is no immediate danger of injuring the fish supply. This method of fishing, or any other that extends its operations to the open sea, should be encouraged.

At Santa Cruz paranzella fishing has been carried on for a few years with gasoline power boats. The nets are smaller than those used at San Francisco but they fish in about the same depth of water, about four miles from shore to the west and north of Santa Cruz Point. At the present time there are four outfits, each of which catches about 2,000 pounds a day. The character of their catch is the same as at San Francisco. Most of the fish are shipped to San Francisco wholesale fish dealers.

Until recently, gasoline powered paranzella outfits have operated out of San Diego and San Pedro in southern California. At one time as high as 24 nets were in operation, fishing mostly in shallow water near shore. Their catch was almost entirely California halibut, but their destruction of the young halibut was enormous. Three-fourths of their catch in weight was the young of this species, too small for the market and entirely wasted. For an average catch of 2,000 pounds of fish of edible size, 6,000 pounds of the young were destroyed. It is believed they have seriously injured the halibut supply in southern California for some time to come. Laws have just been passed prohibiting the possession of a paranzella net in southern California and a minimum size limit of four pounds has been put on the California halibut.

As to the future of trawl fishing in California, it is safe to say the otter trawl will in time be adopted, for it can be operated more economically and will do better work. It can be operated at night and land the fish fresh for the morning market. The paranzella cannot very well work at night. The otter trawl can work in much deeper water, thus greatly extending the fishing area. They can work near submerged rocks and close to rough bottom by virtue of the fact that the net follows directly behind the boat and by taking soundings the rocks or rough bottom s are detected before the net reaches them and the course altered or the net raised. By fishing adjacent to rough bottom they will catch a greater variety of

fish. They can work in the stormy weather of winter when the fish bring a good price. The boats would be larger and more seaworthy and have better accommodations for the crew. They have room to clean and ice the fish at sea and on that account can make a longer trip. An otter trawl of a size sufficient to do the work of one of the San Francisco paranzella outfits could be operated at two-thirds the expense.

California will never be the home of a great trawling industry, for the trawl fishing grounds are too limited. On account of the rapid deepening of the ocean floor to the west of the continent, the bottom suitable for trawling is a very narrow strip. This strip extends from Point Conception to our northern boundary, but only in two or three places will it exceed five miles in width and most of it is one to three miles wide. Otter trawls from San Francisco could fish this entire distance if the market would take the fish. The three San Francisco paranzella outfits and the four smaller outfits at Santa Cruz, with their comparatively primitive methods, can for most of the year easily over-supply the market. By adopting the improved methods of handling fish, in use elsewhere, interior markets could be reached. But our people are not fish eaters and unless the public takes more kindly to a fish diet, our trawling grounds will be sufficient for many years to come, as in the past forty years they have been only scratched in two or three places.

OCEANWARD TREND OF OUR NORTHWEST FISHERIES

BY JOHN N. COBB.

While the fisheries of the Pacific Coast are enormous in the aggregate, yet an odd feature is the fact that they are largely restricted to a few species, and are carried on mainly in protected waters. If the salmon, cod, halibut, herring and tuna are eliminated, the fisheries of this coast sink into insignificance. The contrary is true of the Atlantic coast, where the Gadidæ, mackerel, herring, shad, alewives, bluefish, menhaden, weakfish, red snapper, lobster, oyster, clam, etc., etc., form large and important fisheries.

The restriction of our present fisheries to a few species is mainly due to the overwhelming preponderance of the latter having largely closed our markets to less familiar species which are available. As the demand for fresh fish increases, more and more use will be made of our present largely dormant fishery resources, especially those to be found in the ocean adjacent to our coasts.

The coasts of Washington, British Columbia and Alaska are deeply indented by numerous bays, straits and sounds, while along the coast of the latter two sections are to be found hundreds of large and small islands, and all of these together form the largest area of protected waters to be found along the continent of North America. As the great schools of salmon passed through these on their way to the spawning grounds at the headwaters of the rivers debouching into them, while they formed ideal feeding grounds for the herring, smelt, tomcod, etc., they early became, and are still, the chief fishing grounds resorted to by our fishermen.

For a number of years our fisher folk were content to confine their operations largely within this restricted area, but as the demand for fish increased, more efficient forms of apparatus and appliances for handling same were devised and the geographical range extended, until at the present time considerable of their operations are carried on in the open waters adjacent to our coast, where by meeting the fish as they are heading in, or intercepting the schools passing by, a better

grade of fish is obtained, while the length of the fishing season is considerably increased.

It is barely possible that this extension of fishing range may work some havoc amongst the salmon which will be sought after during a greater part of the year, but, on the other hand, it will vastly extend and increase the produce of the other fisheries, many of which have, so far, been but slightly worked.

The Salmon Fisheries.—For many years our salmon fishermen devoted the major part of their energies to the catching of the fish in the bays and sounds adjacent to the rivers, and in the latter, as the fish were on their way to the spawning grounds at the headwaters of the streams. As the prepared products became better known the demand for the raw product increased. In order to supply this larger boats and nets were employed, more efficient machinery was devised for handling the latter, while the fishermen somewhat extended the range of their operations.

Some few years ago it was discovered on Puget Sound and a few other places, that king, spring or chinook salmon, and also the coho, or silverside, would take the hook during the spring months. At first the small catch made in this manner was disposed of in the fresh fish markets, but the rapid extension of the mild curing industry created a heavy demand for the feeding kings, and the industry soon became a permanent one. As the demand increased the fishermen extended their field of operations. At the present time the Puget Sound trollers meet the fish off the entrance to the Strait of Fuca, the Columbia River trollers on the bar, while many of those in Southeast Alaska fish on the Forrester Island ground, which is in the open ocean.

In the early days the salmon fishing season in any one region seldom lasted more than four months. With the new methods salmon have been taken in every month of the year in Southeast Alaska and Puget Sound, although the fish are usually in quite deep water during the winter months and but little attention is then paid to them.

The success of the hook and line men in finding king and silver salmon encouraged the purse seiners to go out farther and farther to meet the oncoming spawning fish, with the result

that to-day the first purse seining by the fishermen of Puget Sound is usually done off the entrance to the Strait of Fuca, while the Columbia river gill netters fish outside the bar off the entrance to the river, some few miles to sea. In Bering Sea, where at one time all the fishing was carried on in the bays and rivers, a few purse seiners now operate in the open sea and the number gives promise of rapidly increasing. In Southeast Alaska the trend of fishing operations is steadily oceanward, and it is probable that in the course of a decade most of the plants will be on the outer fringe of the islands.

The fish when they first reach the coast are sleek and plump, nature having provided for the latter in order to sustain the fish through its long fast in fresh water, and while they do not lose much of this until they get into the streams, they are undoubtedly better for canning, salting, etc., the nearer they are caught to the ocean. The chief advantage of the extension of the fishing area lies in the lengthening of the period during which the packing plants can operate, thus increasing their productiveness and profitableness.

It is possible that eventually the fishermen may, through the invention of newer forms of fishery apparatus, or the improvement of the present forms, be enabled to follow the salmon to their, at present, unknown resort in the ocean, from whence most of them reappear when maturity has been reached as mysteriously as they disappeared when their instinct led them to the open sea to spend the major part of their active life.

The Halibut Fisheries.—Halibut fishing on this coast may be said to have begun commercially in 1888, when the schooners "Mollie Adams" and "Oscar and Hattie," which had recently arrived on the coast from Gloucester, Mass., began fishing on Flattery bank. Previous to this time the fishery was restricted largely to Indians living on Puget Sound and along the coast, who consumed their own catch in large measure.

Investigations during the years 1888 and 1889 disclosed the presence of halibut at various places along the British Columbia coast, especially around the Queen Charlotte Islands.

The industry languished for several years, due to the lack of markets and the excessive rates charged by the trans-

continental railroads, but about 1894 eastern fish dealers began to evince an interest in the Pacific banks, and soon established stations and fleets on this coast, and as they were powerful enough to obtain reasonable rates from the transcontinental railroads, the industry was soon put upon a profitable basis, this result being much aided by the heavy decline in the production of halibut from the Atlantic banks, which had been going on for some time.

From this time on the business rapidly expanded. As the banks nearest Puget Sound ports began to show signs of exhaustion the fishermen extended their fishing operations farther and farther from home, until finally a portion of the fleet was fishing in the upper part of the Gulf of Alaska. In the meantime a small fleet of British Columbia vessels, and a comparatively large fleet of small Alaska vessels, had taken up the fishery also, and worked largely upon the banks adjacent to their home ports, although as the British Columbia banks became less and less productive the local fleet worked more and more upon the Alaska banks. At the present time it is probable that about three-fourths of the halibut caught on the Pacific Coast comes from banks in or adjacent to American territory.

The Puget Sound fleet has found that fishing so far from its base is an expensive undertaking, as larger vessels, which are correspondingly more expensive and require larger crews, are needed for fishing on the more distant, and quite stormy northern banks, and a desire to confine their operations to points nearer home has been steadily growing.

Flattery Bank, which is located from close in shore to some 12 or 15 miles off Cape Flattery, had, as previously noted, been known for some years. Halibut are usually abundant here from early in the spring until the middle of June.

In 1888 and in 1889 the U. S. Bureau of Fisheries steamer *Albatross* made some investigations off the Oregon and Washington coasts and delimited certain areas which appeared to be suitable for halibut, but found very few of these fish on them. Owing to this latter fact the matter was dropped. However, an occasional small vessel would run out a few miles from shore and pick up a small cargo of halibut, but owing to

winds from the land in certain seasons of the year, and the difficulty of getting into the few harbors, owing to the rough seas which generally prevailed on their bars a considerable portion of the time, also the difficulty of shipping the fish fresh to the markets owing to the very meager railroad facilities and the high freight and express rates, the business never thrived.

In 1914 the Albatross was once more assigned to this work. Despite the fact that the vessel had to abandon the work temporarily during part of the summer, considerable was accomplished.

The net results of the 1914 work of the Albatross were, (1) a better delimitation of the shoal area adjacent to the Oregon coast, (2) halibut shown to be on certain areas in considerable abundance during the investigation, (3) large scallops found off Cape Kiwanda in 30 to 40 fathoms, and (4) sand-dabs and other food fishes found in abundance.

Early in May (1915), one of the Seattle halibut schooners, finding halibut temporarily scarce on the Flattery Bank, made a prospecting trip down the coast. When off the Columbia river she found halibut in abundance and speedily secured a full fare. The news quickly spread and soon a large fleet was working on the new bank and on the banks between here and Heceta Bank. With the exception of short periods when considerable "mushy" fish were to be found in the catch, the vessels caught large quantities of fine fish until late in June when, owing to the large proportion of "mushy" fish in the catch, most of them abandoned the region until a more propitious season.

The Columbia Bank, which most of the fishermen claim is a new one, lies directly west of the mouth of the river, about 15 to 25 miles from land. So far as delimited, the bank has the shape of the letter U, with the open end seaward. Later investigations may somewhat change this shape.

The Albatross is now completing the work she began in 1914. A strong effort has been made by certain of us to have the energies of the vessel directed toward a search for banks supposed to lie anywhere from 15 to 500 miles off the Washington coast, and this will be done as soon as the Columbia Bank is completely surveyed.

For a number of years mariners and fishermen have been reporting facts and incidents which seemed to indicate the probable existence of banks off the Northwest coast. Some of the halibut fishermen point to the movement of halibut on Flattery Bank as indicating the strong probability of the existence of such banks. Boats fishing on the westward edge of Flattery report that schools of plump, fine fish frequently appear on the bank, take the hook readily for a few days, and then disappear, to be succeeded by another school in a day or two. As vessels fishing on the eastern side of the bank do not generally encounter these particular schools, at least not until later than those on the western edge, while vessels fishing off Vancouver Island rarely find halibut in abundance, the fish must either come from the west, northwest or south. As the fishing in May last showed wide areas without fish between the Flattery Bank and the bank off the mouth of the Columbia river, and still other gaps between it and the banks farther south, the halibut could not come from the south. While halibut are to be found on nearly all the banks adjacent to the Alaska Peninsula and the Aleutian Islands, lying northwest of Flattery, they are probably too far away to be the source from whence come the Flattery schools.

This would, according to the fishermen, leave only the region to the westward of Flattery as the direction from whence the fish come, and it is to be hoped that this matter will be settled for all time by the Albatross this summer.

It is possible that halibut may be more abundant on the Alaska cod banks than is apparent at present. Investigation has shown that the species is to be found scattered over nearly the whole area of the various banks. Even at the present time a portion of the Portlock Bank is resorted to at certain seasons by a few of the larger vessels and halibut found in abundance.

I had an intimate connection with the cod fisheries prosecuted in the North Pacific during 1912 and 1913, and was thus enabled to carry on observations at first hand. Halibut were fairly abundant on the inshore banks, but the station fishermen brought in only those needed for cod bait. The real abundance of these fish was brought forcibly to my attention

in August of 1913. I had been making some experiments with gill nets for cod, and on the evening of the 20th set, near Pirate Cove, six of these, each 125 yards long, 7½" stretch mesh, and 15 meshes deep.

Upon lifting them the next morning I found 180 cod and 60 halibut meshed or tangled in them. That such a large number of halibut should be taken in nets so unsuited for their capture, and on ground where it was not supposed they would be found, is surprising and indicates that the fish are even more abundant on the inshore banks of Alaska than anyone had dreamed of. Halibut on the inshore banks is a sure indication of a greater abundance on the offshore banks, as it is their habit to make shoreward migrations in search of food.

The fact that their abundance on the offshore banks has not been physically demonstrated before is due mainly to the fact that for a number of years the cod banks in the North Pacific, east of Sannak Bank, have been but little resorted to by the vessels, as fish were more easily procured on Sannak and Davidson banks and on the banks in Bering Sea. Another reason is that the cod fishermen use hand lines in their operations, and as fishing with these in waters deeper than 50 fathoms is slow and tedious work, they generally refuse to work in the deeper waters, in which the halibut are more apt to be found in abundance.

The Albatross has made several investigations of these banks, once for halibut, but fishing trials made by a vessel over such a wide area as she covered must necessarily be infrequent and of very short duration, thus vitiating their value. The most conclusive part of her investigation, when taken in conjunction with the known facts, was the development of the fact that the banks were generally suitable to support halibut life.

At present these banks lie at too great a distance from Seattle to permit of profitable exploitation, but should the banks nearer home become depleted the price obtained will doubtless increase sufficiently to justify the fleets visiting them.

The Herring Fisheries.—At the present time practically all of our herring fisheries are carried on in the numerous protected bays and sounds which indent the Northwest coast line

from the Columbia River to Alaska. Here the fishing season is wholly dependent upon the fish themselves. Herring are notoriously erratic in their movements, appearing with the greatest regularity at a certain spot for a season, two seasons, or for years. A typical example of this was at Yakutat Bay, Alaska. The herring had appeared here in large numbers each season for a number of years. Around 1900 several plants for salting them were in operation on the bay, when a season or two later the fish failed to appear and since then only an occasional straggler has been noticed.

Even when the fish appear in the inshore waters the fishing season is considerably curtailed for two reasons. In Alaska the fish spawn from May to July. For a considerable time after spawning they are thin and of not much commercial value. In the same region, during July and August, the stomachs of the herring are filled with "red feed" (a small crustacean). Should the fish be killed while this food is in its stomach some acid in the "feed" will eat away the fish's belly, causing a disfiguring appearance which renders it unsalable, although perfectly wholesome. This difficulty can be overcome by holding the live fish in a trap or pot until they have emptied their stomachs, when there will be no further danger of disfigurement.

In Europe, where the herring fisheries have been prosecuted for centuries, and are of immense commercial importance, most of the fishing is carried on in the open sea, and, in many sections, at considerable distances from shore. Here a much better grade of fish is found, the schools are in greater abundance, and a much longer fishing season can be had than by waiting for certain of the schools to visit the protected waters. Eventually, as the demand for pickled herring becomes greater, Alaska will be one of the chief producing centers of the world, but before this can occur our fishermen will have to seek the fish in the open ocean instead of waiting for the fish to come to them, as at present.

In certain of the harbors of the Shumagin Islands, Alaska, occur runs of herring, the majority of which will average between three-quarters and one pound apiece. A run of herring of the same size also enters Cook Inlet, and it is probable

that it is the outer fringe of this school that touches at the Shumagin Islands on its way to the Inlet, and that if a proper power vessel, with purse seines, were to seek in the open ocean off this group for the main school a large quantity of these magnificent fish could be secured each season. It is also quite probable that if sought after diligently these large herring would be found along other sections of our Alaska coast.

During the fiscal year 1914 there were imported into the United States 110,413,883 pounds of salt herring, valued at \$3,622,176. During the calendar year 1914 our Pacific Coast fishermen packed approximately 9,000 barrels, weighing 1,800,000 pounds, for food purposes. This shows clearly the enormous increase that would be necessary in order to supply the domestic market alone, without taking into consideration the great herring markets of the world that are open to our packers. As compared with some countries of Europe the herring consumption of the United States is very slight.

The Cod Fisheries.—At the present time there have been surveyed, or we have an approximate knowledge of the existence of some 40,000 square miles of banks on which cod predominate. In the present state of the demand for Pacific cod these are more than ample to supply it for some years to come, but there is hardly a doubt that diligent investigation would disclose still other extensive banks. With the exception of an isolated observation here and there, no effort has been made to seek for cod banks north and south of the Aleutian Islands, west of Unalaska Island. The few isolated observations extant in this region nearly all show the presence of cod, and it is to be hoped that the U. S. Bureau of Fisheries will some time in the near future undertake a comprehensive survey of this region. The same is also true of a large part of Bering Sea.

Miscellaneous Fishes.—One of the chief facts brought out by the investigations of the Albatross off our Northwest Coast was the presence of several species of delicious deep-sea sole, species which would enrich the fishermen were they found in as convenient proximity to the coasts of the nations bordering on the North Sea; various species of rockfish (Genus *Sebastes*), which make excellent food; flounders, black cod, and

a large deep-sea scallop. Even before an extensive demand for these species has been worked up in the sections tributary to the Coast, some of our cold storage plants will be freezing the sole, and possibly other species, and shipping them East, and possibly to Europe.

In the course of time one of the favorite resorts of our fishermen will be an extensive plateau off the northern Oregon coast, upon which many of the present neglected species abound, and upon which otter and beam trawls could be worked easily.

DISCUSSION.

PRESIDENT: Has anyone any remark to make or any question to ask?

PROF. WEYMOUTH: May I ask a question? Are there any laws regulating the halibut fishing, or is there any attempt to make laws to apply outside of the three-mile limit?

MR. COBB: There are no laws affecting halibut fishing in the Northwest.

MR. SCOFIELD: Those "mushy" halibut, are they retained or thrown away?

MR. COBB: When you take a halibut out of the water, it is impossible to tell whether it is "mushy" or not, as the "mushy" appearance does not manifest itself until two or three days after the fish is placed in the ice. Small lumps appear in the flesh and these break. As the fish are not taken out of the ice until the home port is reached it is impossible for the fishermen to tell whether the catch has any "mushy" fish in it until the cargo is broken out. The "mushy" ones are all thrown away.

MR. SCOFIELD: What percentage is "mushy," and what is the theory of the cause?

MR. COBB: In 1914, when quite a number of vessels fished on the banks off the Oregon coast, the proportion was 45 per cent. Fortunately for the fishermen, there seemed to be a few spots where the proportion was much less. But when it reaches 45 per cent., unless the price is high, it is not profitable to catch them. With the catch divided into first and second grade halibut by the buyers and then these "mushy" ones which have to be thrown away, it is almost impossible to make a profit when the proportion of the latter reaches 45 per cent. We find the same proportion prevails on the northern banks as on the southern banks. The fishermen get them in all seasons, but more often in summer than in winter. This may be due to the fact that the catch is vastly larger in summer than in winter. But we know that at times the proportion is larger on the southern banks than on the northern.

DR. EVERMANN: Is the percentage as large as it is on the east coast?

MR. COBB: We have no record of the figures on the east coast.

DR. EVERMANN: Is a "mushy" fish unsuited for food, or is it objectionable simply because it does not present a desirable appearance?

MR. COBB: When you cut it the flesh is mushy and follows the knife, and then you find sac-like bodies in the muscular tissue, of the consistency of hard fat, which, when the fishermen are about ready to land their cargo, break and a whitish fluid flows from them. The fishermen always throw them overboard.

DR. EVERMANN: No one knows whether the mushiness disappears later?

MR. COBB: As the fishermen leave almost immediately on another trip they are unable to hold them long enough to find out anything in this regard. I think they might find out something of value if they would experiment a little with them.

PROF. SMITH: Mr. Thompson, of Stanford University, is working on some of those fish now. He could not determine any cause for the "mushy" condition, so far as I know, but he is still working on them and may find results later.

MR. COBB: It is an expensive matter to the fishermen of the Northwest coast when you throw out 45 per cent. of a catch of eighty to one hundred thousand pounds of fish.

DR. FRASER: Is there any probability of its passing away at any one season of the year?

MR. COBB: It appears at all seasons of the year, apparently.

MR. HEACOCK: May I ask a question? At the time these fish are taken are they spawning fish?

MR. COBB: We know very little about the spawning habits of the halibut. I do not think the spawning has anything to do with it, unless the fish spawn all the year around, as these "mushy" fish are found at all seasons. But the known life history of the halibut so far is very meager.

MR. HEACOCK: They spoke of a condition among the halibut at the time of spawning.

MR. COBB: I do not think it has anything to do with the halibut spawning season, as they find the "mushy" fish at all seasons of the year.

EXTENDING THE RANGE OF THE GOLDEN TROUT

By A. D. FERGUSON

The very title of this paper provokes the question: Why? Based, no doubt, on the fact that the true golden trout has its original habitat in but one isolated section of all the vast Sierra Nevada range of mountains, there is a popular belief, shared in by some trained ichthyologists, that the golden trout, if placed under different environment, will quickly revert to some other type.

In justification of an enterprise which has been carried forward through several years of sustained effort, it might be well to first discuss the question of utility; in other words, what is to be gained by undertaking to establish the golden trout in new and distant waters? It is conceded by all who come in personal contact with the golden trout that they not only are incomparably beautiful, but that they are game as the gamest of all the trout family, a fine table fish, and if but given half a chance, very prolific. But, will they remain golden if taken from Volcano Creek and placed in waters far removed from the lava and volcanic tufa which lines the beds and banks of their native stream?

Dr. Barton W. Evermann, in a bulletin, No. 595, entitled "The Golden Trout of the Southern High Sierras," which bulletin was published in 1906 by the U. S. Bureau of Fisheries, calls the golden trout a distinct species. Dr. Evermann, in his bulletin, names the trout of Volcano Creek *Salmo roosevelti*, and says that these are the true golden trout. Evidently, Dr. Evermann believed the type is permanently fixed, since he recommended (page 30) that the barren waters of the Kern River region be stocked with golden trout, saying: "It would be extremely interesting to try the species in several streams and note the effects of the new environment. The possibility of adding such an attractive fish to the streams of other states is well worth a serious effort."

It may be presumptuous on the part of a layman, but, nevertheless, several years of experience while conducting various experiments with transplanted golden trout, makes me

bold to add to the eminent Dr. Evermann's conclusions some facts in the nature of supporting evidence. Whether or not the golden trout (this paper deals only with the *Salmo roosevelti*) are descended from the rainbow trout of Kern River, as intimated by Dr. Evermann (page 14 of his Bulletin), or are of *mykiss* origin, as classified by Dr. Jordan in the California Fish Commission's Biennial Report of 1903, may be an open question. Some experiments in the nature of radical changes in environment, which I am conducting in the mountains of Fresno County, may possibly enable our scientists to reach an unanimous conclusion. Personally, I hold to the belief that not only are the golden trout not descended from the rainbow species, but that their presence in Kern River antedates the existence of rainbow trout in Kern River, to which Volcano Creek is tributary. A theory which involves questions of geology as well as of ichthyology and which, frankly, is going far for a layman.

To the popular opinion that the golden trout of Volcano Creek owes its brilliance to the presence of similar colors in the volcanic rock and tufa through which the stream flows, many facts are opposed. As against this theory of protective coloring there is, for instance, the fact that only about one-half the stream's course is through volcanic formation; the upper waters being wholly in the typical granite of the Whitney range. Yet, there appears to be no variation of type as between the fish of the upper and lower waters. Stronger evidence that the *Salmo roosevelti* is not dependent on its surroundings for its color is found in the fact that it has apparently lost none of its coloring when established in new waters far removed from its native habitat. The record of the establishment of the golden trout in the theretofore barren waters of Cottonwood Lakes goes back twenty-four years. A few golden trout carried in the year 1896, by S. L. N. Ellis, now a deputy of the State Fish and Game Commission, from Volcano Creek across the Kern-Kaweah Divide and planted in a branch of the Kaweah River, established themselves in their new home. Incidentally, they afforded a startling surprise to Mr. Walter Fry, Superintendent of Sequoia National Park, who discovered their presence in the North fork of the Kaweah

some thirteen years after their involuntary migration. No one having in the meantime followed up Mr. Ellis' experiment, and Mr. Fry never having heard of it, he naturally thought he had made a puzzling discovery. The explanation came out when Fry reported the matter to the Fresno district office of the Fish and Game Commission. By the way, is it not possible that many puzzling phenomena in connection with the existence of various species of fish in unlooked for localities can be solved by discovering a forgotten record of some man's activities? In the Fresno office of the Fish and Game Commission there is a mass of evidence having to do with old-time activities of the pioneers of the mountains, who carried live fish long distances to stock barren waters. Many aged pioneers have contributed, by letter, their quota of information which has enabled us to account for many confusing situations.

For the past six years the State Fish and Game Commission, through its Fresno office, has been systematically planting the barren streams of the Whitney region and of the high Sierras of Tulare and Fresno counties with golden trout stock from Volcano Creek. While the time is short for definite conclusions, the transplanted fish are thus far apparently remaining true to type. It should be noted that all these plants have been made in waters which are in granite formation, entirely unstained by the presence of any mineral.

Since golden trout have never been artificially propagated, we have used in our work of transplanting them into new waters, adult fish drawn from the bountiful supply in Volcano Creek. The enterprise has been carried on by the pack-horse method of transportation, since the source of supply and the waters to be reached are far beyond any existing wagon road. We have demonstrated, however, that the adult golden trout can, with proper care, be transported to any part of the United States, since we have successfully carried them on the backs of pack-mules for as many as fourteen consecutive days. To be carried in cans, on the backs of mules, over rough mountain trails, is a trying test of the hardihood of the golden trout. We early learned that to land our fish in good condition at the end of a long pack-horse carry, it was necessary that the fish be not carried more than six or seven hours out of each twenty-

four. For this period of time the fish will hold themselves well away from the sides of the can, regardless of how rough may be the gait of the pack-mule. After about seven hours the fish are liable to become exhausted and are injured by being thrown against the sides of the can in which they are being carried. From the Volcano Creek northward through the mountains of Tulare, Fresno and Madera counties, there are hundreds of streams which drain the Sierra summit and which were all naturally barren of any fish life whatever. This condition is, in a way, fortunate, since it permits of the establishment of the golden trout in new waters where the stock can always remain pure. And thus the fear once expressed when Volcano Creek was the only source of supply that these incomparable trout might become extinct, is forever allayed. Cut off by high falls from the possibility of other species of trout ascending these streams, there is no danger of the golden trout losing their identity in these waters by mixing with other species. Incidentally, it is a notable fact that the waters naturally inhabited by golden trout are the only waters in the section of the mountains here described isolated, by reason of falls, from the fishes of the main channels, in which fish of any variety were found when the mountains were first invaded by white men.

Whether or not the golden trout will maintain their identity through many generations if placed in waters in which there are other varieties of trout, is yet to be demonstrated. **Mr.** W. H. Shebley, Superintendent of the California State Hatcheries, readily secured a hybrid by cross-fertilization between golden trout and rainbow trout. Since many of the golden trout which are now becoming established in the Kings River and San Joaquin water-sheds must naturally eventually work down into the waters now inhabited by rainbow and other trouts, opportunity will, some day, be afforded investigators to find out if indeed the different species will voluntarily become hybridized.

The success which has met our efforts in transplanting adult fish might well be worth considering by the Fish Commissions of other states who would like to try experiments along similar lines. A hundred adult trout planted in good

condition will quickly populate a barren stream of considerable size. That the golden trout are wonderfully prolific is evidenced by the fact that in our operations during the fall of 1914 we took from the little stream which flows through Whitney Meadows 5,000 fish without apparently seriously diminishing the supply. Like other species, they attain large size when placed in new waters where there is an abundant food supply.

DISCUSSION.

PRESIDENT: Is there any discussion on Mr. Ferguson's paper?

DR. EVERMANN: The excellent paper by Mr. Ferguson interests me very much. The question of how the trout first got into Kern River is an exceedingly interesting one. I believe the ichthyologists are agreed as to the way in which trout came into western America. They are undoubtedly from the Orient, from Asia, and doubtless they came across the Bering Straits and the Aleutian Islands, and then came down the entire western coast, extending down to lower California.

Now, at that time there may have been water connection that enabled them to go into these various streams and systems. But for our present purpose we need to consider only how they got into Kern River and King's River. Whatever the conditions, we can assume they were conditions which permitted the fish to get into the streams, and at an early date in the history of those streams the trout no doubt extended over all those streams where the temperature was suitable. That is, in the early history of those streams, there were no waterfalls. So the fish would get into the larger streams and then run up into the smaller ones. My own idea is that Kern River, some time in the past, became peopled with trout, and that the trout extended into such of the Kern River tributaries as possible, and as far as possible. But as the system became older and older, and certain volcanic conditions took place, barriers became established.

Now, barriers were established in those streams in one of two ways: one, by wearing down, eroding; and the other by lava flow. The barriers in Volcano Creek were a combination of two causes, but chiefly the result of lava flow.

Volcano Creek is eighteen to twenty miles long. About midway in the length of the stream are three or four cinder cones, cones or little volcanoes. The lava and the scorïæ flowed from the volcanic crater, down the canyons and bed of the creek, and most of the bed of the creek in the lower portion is now lava. When the lava reached the smaller falls, near the brink of Kern River canyon, it poured over and cooled and built up the falls there more and more.

Geological investigation shows that the entire stream-bed must have been filled by the lava, which necessarily resulted in the destruction of all the animal and plant life in that part of the stream below the volcanic craters. But such fish as were in the upper half of Volcano Creek escaped; the lava flow did not kill or affect them so long as they remained in their portion of the stream.

Now, that is evidently exactly what took place. A number of fish, one hundred thousand or ten thousand, or whatever number there may have been in the upper eight or ten miles of Volcano Creek, were not fatally affected by the lava flows. As time went on the lava flows became cooler and cooler, and as the stream flowed on, sooner or later the water was able to pursue a definite course on that lower portion and re-establish a little stream from its headquarters to Kern River canyon. The water would be more or less heated at first and would

not form a suitable home for trout; but as time went on and the lava became cooled, then, and not until then, could the trout in the upper end descend to the lower portion.

When they reached the lower portion they found an immense falls down which they could not, or would not, pass. Trout don't do that willingly, but those that do get wiped out among the trout that may be down below. And, of course, no trout could get up from Kern River and none would intentionally go down over the falls; so we have a colony of fish completely isolated and the isolation has been so long continued that the trout have changed in appearance from those in Kern River. And the trout in Kern River, I see no reason for not regarding it as a direct descendant of the original stock from which the Volcano Creek trout has descended less directly.

In the course of time falls formed in the Little Kern River on the west and the South Kern on the south. The trout above those falls became different from those below the falls, just as the trout above the lava falls in Volcano Creek became different from those below. In fact, the trout below the falls nearest the mouths of the tributary streams are the Kern River trout; but above the falls in each of the streams is its own particular kind of trout.

There are several streams on the west side of Kern River, all more or less alike, but no two absolutely alike. I think there are still additional species in some of those streams that must be described.

Now, as to whether these different species of trout will hold their color after transportation and transplanting, it is difficult to say. It cannot be answered without extended investigation. Of course, there will be slight changes in color, as there are no two streams or lakes with precisely the same environment; just as there are no two peas exactly alike. The causes operating on the trout in the two different streams are different—not necessarily very much different, but still they are different.

I am very much pleased at the interest Mr. Ferguson is taking in the golden trout of the Kern River region. He has exceptional opportunities for investigation and study of the habits of these beautiful fish and what effect transplantation will have on them. We are all very glad that Mr. Ferguson has taken up this important investigation.

SOME FOOD AND GAME FISHES OF SOUTHERN CALIFORNIA: THEIR HABITS, PRESENT CONDITION, NEED OF PROTECTION, ETC.

By DR. CHARLES FREDERICK HOLDER

Throop College of Technology, Pasadena, Cal.

The marine fishes of Southern California, particularly those which appeal to the marketman and the sportsman and have a pronounced economic value, are of special interest, due to their pronounced individuality, and to the fact that many of them are more or less peculiar to the region, or at least are taken here in greater quantities than elsewhere. There are, briefly, as follows:

Two swordfishes (*Tetrapturus mitsukurii* and *Xiphias gladius*). The former was not known to Southern California until reported to Dr. Jordan by the writer some ten years ago, though common in Japan. *Xiphias* is more or less rare.

Yellowtail (*Seriola dorsalis*) and (*Seriola* ———), a species I have seen but not caught; its fin colors are a vivid lemon. I am not sure but there are *two* undescribed species here.

Barracuda (*Sphyræna argentea*), black sea bass (*Stereolepis gigas*), white sea bass (*Cynoscion nobilis*), sea trout (*C. parvipinnis*), skipjack (*Sarda chilensis*), oceanic bonito, the opah (*Lampris luna*), the jack (*Luvarus*), leaping tuna (*Thunnus thynnus*), albacore (*Thunnus alalunga*), and yellow-finned tuna (*Thunnus maculatus*). There is a species, I think, intermediate between the long-fin or albacore and the yellow-fin. I have, I am confident, had brief glimpses of two undescribed species.

Sand bass, rock bass (*Paralabrax clathratus*), "halibut," mackerel, medialuna, sheepshead, croaker, surf fish and many more.

Add to these, many species of small fry, particularly rock fishes, grouper, rock cod, and we have the conspicuous forms which make up the summer catch in the Santa Catalina, Santa Barbara and San Clemente channels, and from Santa Barbara to Ensenada and beyond down the Mexican coast.

The chief points of interest are the islands of Santa Catalina and San Clemente; the haunts, par excellence, of these forms which constitute the chief fisheries and fish supply of Los Angeles. Of this large and interesting series, to which I have but briefly referred, many are migrants. They move with regularity south, and down, and out. The yellowtail (*Seriola*) is theoretically a semi-migrant. It disappears with the first heavy storm of winter, but winters when the rainfall has been low, and storms few, I have taken them every month in the year in Avalon Bay, and a few remain here the year round under all conditions; the majority going by December or January. Later they are found in numbers down the Mexican coast, also in deep water in the San Clemente channel. Such fish are often filled with sardines, hence it is evident that they have followed this food to some off-shore plateau. Doubtless their movements are governed by the schools of sardines and anchovies, which constitute their food.

The white sea bass appears at Santa Catalina in April and May, and is at its best in June, lying in the kelp beds in vast schools, passing from south to north and disappearing in August and September.

The swordfish (*Xiphias*) is found in a general way from May until October; rarely, if ever, in winter. *Tetrapturus*, the so-called "Marlin fish," comes north, often in vast schools, in late August and September, and disappears in October. Schools of thousands have been seen, but in September "pairs" are generally seen, often close in-shore at Santa Catalina or San Clemente.

The bonito appears in June, and is taken until October; is at its best in midsummer, none appearing in winter. The oceanic bonito is taken as early as April. The tunas are variable, uncertain migrants. The blue or leaping tuna, before it was driven away by the insatiate netter, came in June or about July 15, with some regularity, and took bait until the middle of August, feeding on flying fishes, hunting them in vast schools. After August 15 they were often found filled with squid and rarely took bait. Of late years, very few over 100 pounds in weight have been seen, the series of fence-like nets having driven them off. The albacore—the tuna of the can-

neries—is an off-shore fish, rarely coming in-shore, being taken in midchannel. I have taken it every month in the year off Avalon, yet in stormy winters it will disappear in the fall and not return in numbers until spring, earlier or later as the case may be. The spawning habits of this fish should be made a special study. I am convinced a school of fish, averaging about thirty pounds, will often spawn in these waters, as I have taken such fish in July and found them in ripe spawn. Then, when striking a school of fish averaging 15 pounds, or possibly 20, no spawn will be found. From this it might be inferred that mature fish came north to spawn, and did spawn, in and about the Islands.

I think most of these fishes spawn on the surface. Dr. David Starr Jordan, the eminent authority on fishes, believes that practically all of these fishes spawn at Santa Catalina or in its immediate waters, at times, and that the region should be recognized as a *spawning ground* and protected as such. This is referred to in the following letter:

STANFORD UNIVERSITY, December 5, 1912.

DR. CHAS. F. HOLDER,

*Throop College of Technology,
Pasadena, California.*

DEAR DOCTOR HOLDER: I trust that you will be successful in having Santa Catalina and San Clemente Islands set aside as fish preserves. These two islands and the smooth waters off their shores are the spawning grounds, above all others, for the greatest game fish of the country. The white sea bass, the great jewfish, the spearfish, swordfish, tuna, bonito, albacore, the Japanese tuna (yellow-fin tuna), all spawn on the rocky and other places about these islands, as well as a multitude of smaller fishes valuable to the angler or to the markets.

Many of these fish spawn in the kelp which surrounds these islands. The netting carried on inshore disturbs these fishes at spawning time, and it is said that there has been a very marked falling off of these species. As Avalon, on Santa Catalina, is the great center of big game fishing, the disappearance of any of these species makes a great loss to the people who have investments there as well as to the visitors who come there for fishing purposes.

It is desired to prohibit the use of seines and all nets for market purposes within three miles of the shores of these islands. This allows the professional fishermen the entire Santa Barbara channel, Santa Rosa, San Miguel, and the rest comprising the Santa Barbara group.

I trust that you and our friends will be successful in getting the statute* passed which will protect these islands and set them apart as spawning grounds for the great game fishes of southern California.

Yours very truly,

(Signed) DAVID STARR JORDAN.

*The writer procured the passage of such a bill twice.

There are few questions so puzzling as those referring to the breeding or spawning habits of fishes. Southern California is a new region and has received but little attention, hence little or nothing is known of the breeding habits of its common fishes. I have been more or less familiar with conditions at the Santa Catalina group for thirty years, but I have never seen the very young or newly hatched of the black sea bass, white sea bass, or any other fishes except sardines, mackerel, sheepshead, garibaldi, anchovies, etc. The very young disappear in a marvelous manner. I have seen the young of the flying fish, about the size of a grasshopper, "flying" or soaring a few inches in Avalon Bay. All this is not new to the distinguished members of this Society, who will recall the mystery of the years, relating to the breeding habits of eels, *Xiphias*, the tarpon and many other fishes.

One of the common summer sights of Avalon is a two or four hundred pound black sea bass (*Stercorolepis gigas*) swollen with pounds of spawn, but I have never found a fisherman who has seen a young fish of this species; by this I mean a fish an inch or two in length.

In the little embryonic zoölogical station at Avalon, due to the courtesy of the Banning Company, I have made some interesting observations. I have watched the birth, alive, tail first, of the surf fish, first noticed on this coast by Agassiz. I have observed here the beautiful mimitic kelp fish build its nest by winding a long viscid cord about the weed, forming a ball four or five inches across, the cord containing the eggs. After the female worked a while at this, she sank to the bottom exhausted, while the smaller male, brilliant in nuptial garb, would hover over the nest, impregnate the eggs, and in turn give way to the female. At this time the splendidly garbed male was a jealous, indeed ferocious, caretaker, driving off all suspicious enemies.

Here I have watched the living argonaut or paper nautilus, the rare living band fish (*Regalecus*), luvarus, opah, and many more, dreams and memories to the majority of zoölogists, and suggestive of the need at this point of a well equipped zoölogical station. For many years it has been my habit to report

the new fishes here to Dr. Jordan and the notes have been published in the Proceedings of the National Museum.

The big tuna (*Thunnus*) makes mysterious visits inshore when *not* feeding. I have seen them swimming up and down the shores, suggestive of spawning, and containing ripe spawn. The black sea bass is a migrant, though not entirely so, as I have seen individuals in Avalon Bay about the dock in February, but in October the fishing ends and few are seen. They appear inshore, in the kelp, or near sandy places, in May, increase in numbers in June, when the females often bear enormous masses of eggs. Millions of black sea bass must be hatched about Santa Catalina, but, as previously stated, I have never seen the very young, the smallest specimen observed being about seven pounds.

The barracuda appears in early spring—April, May, June—and disappears in the fall. Schools so vast have been seen, in June, that Santa Monica Bay appeared to be filled with them, while schools of thousands of swordfish (*Tetrapturus*) have been seen in August. By this it will be seen that the majority of fishes of this semi-tropic region are migratory, the constant ones being the sheepshead, rock fishes, rock bass, “halibut,” white fish, rock cod and many others.

The Southern California fisheries have just begun to attract attention, on account of their economic value, and, as with other sections, they will in time be exhausted, or seriously depleted, if the rules of conservation (a synonym for common sense) are not observed. In 1910 Santa Catalina Island was set apart as a Fish Reservation, on the ground that it was a spawning ground. This lasted a year or two, with marked results, the law being thrown out on the ground that it was “class legislation.” I have been watching this region—the waters of the islands of Santa Catalina and San Clemente—for 28 or 30 years, and the indiscriminate netting to which the former has been subjected has resulted in a falling off of from 50 to 75 per cent. In 1914-15, I took up the matter of Santa Catalina under the regular conservation propaganda of the Wild Life Protective League, of which I had the honor to be President, and urged the re-passage of the bill prohibiting all netting at Santa Catalina, said by Jordan and others to be a

spawning ground, in the letter previously referred to. This proposition was systematically, if not violently, opposed by the San Pedro marketmen, the Avalon boatmen, the 13 or 14 companies of tuna or albacore canners, and the San Francisco seiners.

The Legislature of 1915 passed a law stopping *all* netting at Santa Catalina Island and the waters three miles off its shores, practically repassing the old bill, which would now hold, as the Island had been constituted a fish district by itself by the Commission. This Island, which represents an investment of several millions of dollars, has a permanent town with a population of from four to seven thousand persons in summer, shops, hotels, homes of all kinds, all more or less dependent upon the angling conducted in its waters, and its variants; in a word, the Island is in a class by itself, and one of the best reasons why it should be protected is given in the following decision of the United States Fish Commission:

DEPARTMENT OF COMMERCE AND LABOR,

Bureau of Fisheries.

WASHINGTON, D. C., December 26, 1912.

PROFESSOR CHAS. F. HOLDER,
Throop College of Technology,
Pasadena, California.

SIR: In reply to your letter of December 11th, you are informed that in the opinion of the bureau it is a proper policy to preserve for angling any waters in which fish for sport greatly predominates over the commercial fisheries, as the prosperity of the adjacent communities is more affected by the expenditures of sportsmen than by the revenue derived from the capture of a comparatively small quantity of fishes for food purposes only. It is also highly important to both the angling and commercial fishery interests that the fishes should not be disturbed on their spawning grounds.

Although the bureau has no recent knowledge of the conditions obtaining on Santa Catalina and San Clemente islands, it appears from the statements of Dr. Jordan that these two considerations would be subserved by the proposed measure to establish a fish refuge within territorial waters adjacent to the two islands, and with that understanding the bureau gives the proposition its endorsement.

Respectfully,

(Signed) H. M. SMITH,
Commissioner.

If netting of any kind had been permitted at Santa Catalina, a new and valuable industry would have been aided by the practical destruction of one of the great assets of the State of California, the building up of which during 25 years having only been accomplished by the expenditure of vast sums running into the millions.

It is the custom among the thoughtless, and generally made a war cry by labor agitators, that mere "angling" is a "millionaire's sport" that should be brushed aside and eliminated when confronted by a "legitimate industry," say, like the canning of albacore, or tuna. The truth is, that while the product of the fish canneries is of value to State and Nation, and every patriotic citizen rejoices in its successful establishment, the business is no more legitimate than that of the citizens of California who subsist upon the proceeds of legitimate sport, as sea angling, glass bottom boats and the scores of variants of this sport found at the town of Avalon, Santa Catalina, and other coast towns of California. The income from sea angling is large and important, is the support of hundreds, and in importance and dignity ranks with any other economic proposition in the State of California; and it would seem to those knowing the circumstances, that no new industry should be allowed to climb to success over its ruins, which would have been the result had not the legislature intervened, and for the second time saved this great fishery of California from absolute destruction.

The financial importance and dignity of "sport" and its true economic value is not appreciated, or even suspected, in America by the people at large. The working man discriminates between \$100,000 made in a brickyard and \$100,000 expended in a year, or in the same time, in the city of Los Angeles for fishing tackle. Thousands of men and women in every state in the Union are supported directly by the so-called "sports" and pastimes, and it should not be forgotten that the despised so-called "millionaire sportsman" brings into the State of California every year, directly or indirectly, five or six millions of dollars and that the economic value of sports ranks side by side with the greatest and most dignified of California assets.

The State of Maine is a shining example of a community where sport is honored, valued, appreciated, conserved and looked after with jealous care. Why? Because it means millions to its people, its railroads, its hotels, its thousands of guides, its fly-makers, its rod-makers, and manufacturers of sporting goods, taxidermists, etc., etc. There are in Southern

California, south of Santa Barbara, thirteen or fourteen tuna canning companies, represented by 250 or 300 large launches, all of which require large quantities of sardines daily to enable them to catch the albacore which is canned under the name of tuna, a new and most commendable business, promising to rank with that of the salmon in the north in the not distant future. If, as proposed by the canners, these boats had been allowed to haul their bait seines at Santa Catalina Island, or along its shores, they would, in a very short time, have looted it of the sardines and anchovies which constitute the food of the fishes of this region, a systematic cleaning out which has been in operation during the summer of 1915 by netters of all kinds anticipating the closing of the operations by the law on August 8. The result of this netting is that the spawning or resting fish are continually disturbed, but worse! It would have been impossible for even a small army of deputies to have guarded this Island Fish Reserve and prevented the attacks or inroads of the San Pedro and San Francisco market fishermen, whose big purse nets would have been hauled under the guise of "taking bait," and the looting of the Island waters kept up to the bitter end. No better illustration of an indiscriminate looting of a fishery could be seen than at Santa Catalina during the present year up to August 8. Large fishing boats came down from San Francisco with purse nets said to be two miles or more in length. They absolutely devastated the region day and night, while the two hundred or more boatmen, many permanent residents of the town of Avalon, each owning boats representing an investment of from \$1,500 to \$5,000, faced the depletion and practical ruin of their lifework, unable to raise a hand or to protest. Every foot of water along shore was hauled and re-hauled by nets of various kinds, and tons of spawning and other fish taken, constituting a menace to the entire fishery of the region.

A few years ago, one could sit upon the piazza of the Tuna Club or the Hotel Metropole on the water front of Avalon Bay and watch vast schools of tuna, white sea bass and yellowtails rippling the waters in every direction. The tuna in particular, and I refer to the great tuna, the "tunny" of Italy, has been almost entirely driven away. In Italy this fish constitutes a

national asset, in reality a gold mine, and its approach is watched with the greatest interest by the people at large. I have seen hundreds of acres within the three mile limit of Santa Catalina lashed into foam by thousands of these fishes, during the past decades, and among the crimes of the century, their disappearance should be included, a crime due wholly to ignorance, mendacity and stupidity. They were driven away from these waters so completely that not half a dozen fish of over 100 pounds in weight have been taken in ten years, and but one or two so far in 1914-15. They have been driven away by the hurdle-like nets arranged along the shores of San Clemente and Santa Catalina Islands, 150 of which have been counted in less than a mile and a half, a system of obstructions so deadly that it might well seem that it had been devised by some clever mind who desired not only to ruin the fisheries in Southern California but to exterminate the fishermen. I venture to say that if I should go before any labor organization today and claim that the great leaping tuna was a valuable asset to the State of California, I should be laughed at or hissed; yet there is not a conservationist within the sound of my voice who does not know that this is an actual fact, and that this one fish fifteen years ago brought thousands of dollars to this State annually and people from all over the world, who distributed their money not alone in Southern California but from San Diego to the Canadian border, all classes being benefited alike, railroads, hotels, fishing tackle manufacturers, guides, boatmen, in fact, business of all kinds was aided by the men who came from all over the world to angle for the great leaping tuna at Santa Catalina, which we have permitted to be driven away by ignorant and mendacious net haulers, without conscience or the slightest idea what the word conservation means. If the laws are not rigorously observed and enforced, the yellowtail, white sea bass and other valuable food and game fishes of Los Angeles and San Diego Counties will also disappear and it behooves the friends of conservation to stand for reason, scientific discrimination and common sense. It is you, gentlemen of the Fisheries Society, who must do these things and set an example to our own ignorant countrymen, not to speak of the hords of aliens, Chinese, Japanese, Portuguese,

Italians and others, who seem to control the fisheries of the Pacific Coast. If we leave it to the ignorant and uneducated, without protest, our game, our market fisheries, our forests, will be wiped from the face of the earth! It is a lamentable fact and a truism that our fisheries are mainly in the hands of the aliens referred to, men who are convinced that every conservationist is an enemy, and that the protective theories so carefully worked out by men of intelligence in every state in the Union are the vagaries of irresponsible cranks. I need but call your attention to the struggles of conservationists, men and women, in the various conservation societies in every state in the Union, from the Audubon Society, The National Conservation Society, organized under Mr. Gifford Pinchot, the Permanent Wild Life Fund of Dr. Hornaday, to the numerous societies in our own State, to show that if it were not for the incessant labors of the members of these associations, and the State Fish and Game Commissions, animal life would cease to exist. *Extinction* seems to be the battle cry of ignorance and assinnity. We of California may rejoice in this Year of Our Lord 1915 in a Legislature that stands for the best in sane conservation, and that we have in Governor Johnson an official who has stood loyally behind the sane work of our conservationists, and who has made California largely what it is, and what it stands for in the protection of animal life and game. I need not refer to our distinguished President, Mr. Carl Westfeld, an honored member of the State Fish and Game Commission, who has done yeoman's service, with his confreres, along the lines of conservation, often a most thankless task in California, where the defender of wild life seems unfortunately to be selected for the abuse which emanates from the ignorant and mendacious, and it gives me pleasure to extend to the Fish and Game Commission of California the hearty thanks of the conservationists for the good work which they have done. We are all in a fight, a veritable battle royal, where the foes are mendacity and ignorance; we are often almost beaten and more than embarrassed by our insidious foes, but I believe, Mr. President, that it is our duty and that of every citizen to aid in the dissemination of knowledge relating to the requirements for the protection of animal life.

Every citizen, man or woman, should take a personal interest in the selection of the men in state and nation who constitute our Fish and Game Commissioners and, once selected, we should give them our hearty support and aid. As citizens, we should never forget our duties as conservationists. We should see that the business man, the canner or packer, whether of salmon or tuna or sardine, has fair play and we should demand fair play from them in return. Personally, I am proud of the economic successes of the business men engaged in the fisheries of the Pacific Coast, but I believe that all classes and all interests should stand together and work for the greatest good of the Wild Life of state and nation and aid in the sane utilization of our national products. The laws of conservation are the laws of common sense of the man of intelligence. If you cut down a tree and never encourage another tree to grow, your grandchildren are going to suffer. Posterity has its rights, despite the old ward politician—said to be a Californian—who retorted to the plea of an Audubon Society member the following philosophical truism, "What has posterity done for Casey?"

The Hon. Mr. Linthicum of Maryland, who has done such important work for the fisheries of the Atlantic Coast, told me that the season's catch of shad in the Chesapeake Bay in 1914 did not equal the catch of *one day* in 1900. In a word, gentlemen, the valuable shad industry of the Atlantic Coast appears to have been almost wiped out in a single decade, a luminous answer to those who protest that the fishes of the sea exist in such vast numbers that they cannot be exhausted. The futility of argument, and the necessity of fighting, was never better shown than in Mr. Linthicum's report to the government. He begged the netters at the mouth of the Potomac, which was almost shut in by nets, to allow but 10 per cent. of the spawning shad to ascend the river, assuring the netters that this would save the day and insure them work for the following year. Would they agree to it? Not for a moment! And the shame of it was that they were not aliens, representing the ignorance of oriental nations, but Americans, whose ancestors were among those who aided in the evolution of the great states of Maryland and Virginia.

The moral of all this, Mr. President, is, that the time has gone by for pleading, discussing and debating these questions. The intelligent men and women of California know the menace with which they are confronted, and they propose to fight, knowing that they are saving these ruthless and ignorant destroyers of fish and game from themselves.

The utilization of fish products has just begun on the Pacific Coast. The Mexican government has given a concession to parties to utilize the products of the west coast of Mexico. Another concession from the Villistas concedes the entire rights to fish the Gulf of California region, and a few years from now this virgin field will be drawn upon by California; in fact, to-day, Mexico is supplying certain products of the sea which ten years ago were common and unprotected.

THE CLOSE RELATION OF THE UNITED STATES COAST
AND GEODETIC SURVEY TO THE GREAT FISHING
INTERESTS OF THE PACIFIC COAST
AND ALASKA

By E. LESTER JONES

*Superintendent of the United States Coast and
Geodetic Survey*

I dare say there is no more fitting time and place than at this second annual meeting of the Pacific Fisheries Society to speak briefly of the close relations of the United States Coast and Geodetic Survey to the great fishing interests of the Pacific Coast and Alaska. As one who has in a modest way studied this enormous industry of the west coast, the urgent necessity for guarding the past neglected waters—more especially in Alaska—looms up to me in the strongest and most urgent manner possible.

When I made my trip of investigation to Alaska last year, I did so as United States Deputy Commissioner of Fisheries, and naturally my efforts were directed largely along the lines connected with the functions of my office. But before I had fairly started on my trip there was a serious question, yes, an *obligation*, of the Federal Government, which loomed up to me as a most important factor in the future development of Alaska's great industry, namely, its unsafe and unprotected waters, and the very little work which was being done to remedy this discrepancy in the territory's present condition and development; also the fact that so many had failed to recognize its significance, and that on the whole little preparation was being made to correct this evil by the provision of proper funds for safe vessels in which to conduct the surveys of waters, and with the vessels more men to carry on the work whenever it is possible to do so.

In 1914 the various fishing fleets operating in Alaska waters approximated 2,300 vessels, with a total net tonnage of almost 147,000, and valued at nearly eight and one-quarter millions of dollars. The home ports of these vessels are in Alaska, or the seaports of Washington, Oregon and California.

Alaska has been owned by this country for 48 years, and today all vessels, both fishing and commercial (as well as government vessels), still ply through largely unprotected waters, endangering both life and property. It is interesting to note that the failure to safeguard the seas, the bays, etc., has exacted a heavy annual toll from the fishing interests of the Pacific Coast and Alaska. During the last 15 years there have been over 70 sizable vessels, valued at over two and one-half millions of dollars, lost in the waters of Alaska. In addition to this, and of more serious importance by far, has been the loss of life. It is no wonder that the people who have invested their money in vessels to carry on a large and legitimate business should hesitate to enter these waters, of which there are not only no correct surveys, or no survey at all, but which are generally without lighthouses, buoys and other aids to navigation.

I am fully aware that in many instances these fishing companies have found it necessary to make their own surveys of the channels, which has been done at considerable expense and loss of valuable time.

This may seem to reflect on the U. S. Coast and Geodetic Survey. But the blame does not lie there. The survey is doing and *has* been doing everything possible with the means at hand—indeed it has almost accomplished *more* than possible, for it goes without saying that boats like the *Gedney* and *McArthur*, 41 and 40 years old respectively (ready to sink at almost any time), are not only *unfit to accomplish efficient work for a government like ours, but endanger the lives of the men in our service*. In addition to these vessels, the steamship *Patterson*, used in more unprotected places, and the *Taku*, used in carrying on inshore soundings, are not the kind of vessels which should now be used or be kept in commission for doing the most efficient work of this sort. I am glad to say that Congress, last year, appropriated money, a part of which was for a new vessel to be known as the *Surveyor*, which will be used exclusively in carrying on surveys in Alaskan waters.

This, I hope, marks a new era, not only in furnishing a high type of vessel, peculiarly and properly adapted for this work, but which will mean the beginning of an expansion

whereby we will have given us, regularly, necessary funds for carrying on such operations.

It is beyond my comprehension that a Federal Government which has laws that make it a criminal offense to provide unsafe and improperly equipped *privately* owned vessels, would permit Federal officials to man and operate these unsafe and otherwise inefficient crafts that should be, in some instances, consigned to the scrap heap. It is asking too much of our officers and men, who have already established a high standard of loyalty and efficiency, to jeopardize their lives on these vessels. They are a brave set of men, having no superiors in the world. They act as navigators, engineers, paymasters and surveyors, and I protest against the injustice of asking these men, who are themselves looking for dangers with the idea of protecting the lives of thousands of people and millions of dollars in property, to live on vessels that are unfit for any service, and which endanger their own lives.

I can assure you that one of my biggest efforts will be not only the literal carrying out, as far as our own vessels are concerned, of all the provisions of the Federal laws; but I want the standard so high that we will be fully complying with all the provisions of the Steamboat Inspection regulations, so that our boats will be a little safer and more efficient than those belonging to the merchant marine.

When I was in Alaska in 1914, and noted the excitement in reference to the plans for the new Federal railroad for which Congress appropriated thirty-five million dollars (and which no doubt is a great step toward bringing stability and permanency of commerce, and a class of people that are desirable as citizens of that great territory), I could not help seeing equally, if not with greater force, that the real success of the territory was dependent upon the safety of her waters. Alaska can never fully develop until her waterways, which are her real gateways to commerce, are safe to human life and property.

I hope that a large majority are awakening to this fact and I am constrained to believe that Congress, with the facts more clearly placed before it, is going to provide a sufficient sum to give the Coast and Geodetic Survey the necessary funds to put this work on the broad basis it deserves.

So much importance did the President attach to this question, and to the past neglect of such an important obligation of the government, that he referred to it in no uncertain terms in his annual message at the last session of Congress; the Secretary of Commerce has fought for more than two years to have a proper recognition given this need of his Department, and I am glad to say that his untiring efforts are beginning to bear fruit.

I know from experience that your Senators and Congressmen on the Pacific Coast are with you heart and soul in furthering this great work for Alaska; and I feel it incumbent upon me to use my every effort toward furnishing not only these members of Congress, who are so naturally and vitally interested in helping to solve this problem, with all necessary information; but I hope that a proper, quiet, thoughtful, and sane appeal to other members of Congress will make them ready and willing to lend their support.

And, in addition, this Society can lend a helping hand, and its efforts are bound to meet with satisfactory results in helping to bring about better conditions.

It is pertinently asked what our needs for carrying on the work are. This is easily answered. First, *more vessels specially constructed for the work; and more men*, not only to man the new vessels, but enough of them to carry on the work every day of the year, weather permitting. In addition to this, to insure absolute thoroughness and safety in the waters of Alaska, and in the harbors and bays of the Pacific Coast, the wire drag is the only adequate method to employ. This requires many men and small boats of the type necessary to make the carrying on of the work feasible and practicable. This is not a cheap method of getting exact results; but, may I ask, isn't it necessary from the human as well as the commercial standpoint? And is it economy for the government to save a small first cost and in a few years to lose nearly a million dollars in vessels thereby, not to mention a much greater amount lost to the fishing interests?

I hope the day is at hand when we can see these things in a broader light, and in no light of false economy.

Finally let me say that I am glad to have had these few minutes in which to address this Society on the relations of the work of the Bureau which I have the honor of heading to the future safety of the large fishing interests of the west coast. It gratifies me more than I can tell you to be affiliated so closely with two Federal bureaus whose work is so closely interlocked, and I assure you that my untiring efforts will be used in doing all I can towards furthering the work of protection for human life and property on the waters of the Pacific Coast and Alaska.

OYSTER CULTURE IN WASHINGTON

BY TREVOR KINCAID

University of Washington

The history of oyster culture in the northwest section of the United States has followed the same general lines as in other parts of the world where the molluscs exist in sufficient quantities to establish a fishery. A period of discovery and local use of natural beds was followed by active exploitation and extensive shipment of the product into more and more distant regions, as centers of population developed and means of transportation multiplied. No thought was given to the possible exhaustion of the beds till the end of the supply was in sight. The first district in which exhaustion of the fishery became apparent was in Willapa Harbor in the southwestern portion of the state. Here the extensive natural beds were easily reached, several considerable centers of population furnished a heavy demand and the other conditions favoring rapid exploitation were at hand. The depletion of the beds were rapid, and was pushed to an extreme, so that the native oyster has ceased to be an important item in the oyster production of the Willapa district. The growth of the industry based upon the transplantation of eastern oysters to this body of water, which is admirably adapted for this purpose, has tended to nullify the efforts that might otherwise have been made to re-establish the native oysters upon the basis of artificial tillage.

In the Puget Sound district a similar sequence of phenomena occurred, but here the conditions were more favorable for a recovery. The natural beds were more extensive and more scattered, the demand was not so exhausting, and the danger of depletion was observed before it had reached the acute stage. The transplanting of eastern oysters did not at first prove entirely successful, which tended to make the holders of oyster land view with great concern the possible extinction of a valuable source of production. The more intelligent and progressive of the oystermen cast about for methods of artificial control of oyster propagation, but they were at a

loss for a model, as the system of culture followed on the Atlantic coast was obviously ill-adapted to the native oyster, which occupies a different tidal zone from its relative of the eastern coast and which is otherwise different in its habits and method of reproduction. The methods employed on the coast of France seemed more likely to be satisfactory, so an effort was made, in the district adjacent to Shelton, to construct systems of artificial tide pools where the animals could be handled in an intensive manner. This plan proving reasonably successful the idea was followed up on a larger scale, and extensive areas were gradually developed through a process of leveling and diking.

The theory of diking was based upon the view that oysters protected in a diked area were at a great advantage over their relatives on the uneven and exposed areas outside. It was believed that the oysters were more readily protected from enemies, their supply of food was more abundant and more constant, the danger of freezing was lessened by a sheet of protecting water, while a corresponding protection was vouchsafed the young oyster during the heat of summer, when the delicate spat were subjected to baking upon areas exposed to the direct rays of the sun during the long runs of the tide. The earlier dikes were walled in with ridges of earth and gravel, but this method, which was wasteful of ground, was superseded by dikes built of a double wall of planks between which sand and gravel were deposited. A further advance came when concrete was substituted for the temporary wooden structures which had come into use.

At the present time reinforced concrete walls are in almost universal use in the oystering district at the southern section of Puget Sound, and many miles of such cement walls have been constructed. A tendency has been apparent in the case of the larger holdings to increase the size of the diked areas, thus lessening the cost of construction and minimizing the waste ground, as well as providing a more uniform distribution of water currents. The largest area now enclosed by a single dike is on the property of the Olympia Oyster Company at Oyster Bay and has a superficies of about thirteen acres.

The task of preparing such areas for intensive oyster farming involves considerable engineering skill, since careful studies must be made of levels, tidal movements, sedimentation and the relation of the piece of ground in hand to other areas already under tillage. Leveling is accomplished by means of floats made of cedar logs and decked over. At low tide the float grounds and the material to be shifted is loaded upon the deck, while at high tide it is poled to the proper place and dumped. For extensive work large dredging machines are being brought into use and seem likely to supersede the more primitive methods.

After a level has been established the wooden forms are constructed and the concrete is run in from mixers handled on floats. The diked area is next covered with cultch to form a nidus for the attachment of the larval oysters, the usual material being shells of oysters and clams, although various substances are utilized at times on account of a shortage of shells for this purpose. In case beds are located where they are subject to wave action, protection is afforded by driving a line of piles off shore and running a double string of booms calculated to break the crests of the waves.

Diking has been developed on a large scale in the southern section of Puget Sound, but in the northern district, about Bellingham and in Hoods Canal, very little has been done to improve the oyster ground, and considerable effort will be required to restore these beds to their full productive capacity. There is, however, some question whether certain of the oyster bearing areas can be handled by the diking method. This is notably the case in Willapa Harbor, where the bottom is largely sand, which tends to riffle and drift when the flow of the currents is interrupted.

It is estimated that a bed of native oysters will carry a maximum oyster population of three thousand sacks per acre, but it is obvious that this condition is reached but seldom under existing circumstances.

The spawning of the native oyster begins in April or May, depending upon the establishment of certain optimum conditions of temperature, the third week in May being the average time. After attaining a maximum, spawning gradually dimin-

ishes in volume, and finally tapers off to negligible quantities in August. The native oyster is hermaphrodite, and the eggs are fertilized while still within the mantle chamber of the mother animal. After fertilization the development of the larvæ from the embryonic phases requires approximately a week, after which the motile larvæ escape from the maternal shell and take their place in the midst of the swarming microscopic life of the surface waters. The duration of the swarming stage is apparently about a month, and during this time the larvæ pursues a very active and adventurous career, the most notable fact being a migratory movement in response to light, which brings them to the surface at night and causes them to seek lower levels during the daytime. Finally, the larval shell increases in size and weight and the animals become more sluggish, and where a suitable substratum is at hand the larva attaches itself and forms a minute oyster or spat.

Experiments designed to determine the length of the larval stage of the native oyster were conducted by the writer, and as a result of these, larvæ confined in receptacles in the laboratory were kept alive for a period of twenty days, during all of which time they continued to be exceedingly active. It is quite probable that the free stages of the animal are much longer than has been supposed, as it is rather surprising to find the animals enduring under these circumstances conditions which would tend to shorten, rather than prolong, their tenure of existence.

The oyster is relatively free from enemies in the waters of Puget Sound. In some localities starfishes appear but rarely, and when they do become numerous in the diked areas they are readily seen and easily controlled. No boring gastropods are present, the only injurious member of this group being the sea-snail, *Polynices lewisii*, which ploughs its way through the beds in search of clams on which they feed. Burrowing crustaceans, *Upogebia* and *Callianassa* cause trouble by bringing up the debris from lower strata and thus burying the oysters. Ducks of several species also destroy the young oysters and a special permit has been given the oystermen to destroy these birds upon the beds. The writer has also observed that one of the common jellyfishes, *Plcurobrachia*, de-

vours the larval oysters during their period of swarming in the plankton.

In addition to the native oyster, the eastern species has been the object of careful tillage through the development of an industry based upon the transplantation of the young oysters from the Atlantic to the Pacific. Large areas are now utilized for this purpose in Puget Sound, Grays Harbor, and Willapa Harbor. Young oysters from one to two years old are brought out from the eastern coast and planted out in areas where they will grow to a marketable size. As a rule the beds prepared for this purpose are between tides, as the difficulty of recovering the animals in deeper water is too great. In the Olympia district the eastern oyster is usually planted out on comparatively narrow beaches, somewhat removed from the great flats at the heads of bays where the native oyster is tilled. This industry has been carried on for a considerable time, and has proven profitable, notwithstanding great losses through the death of considerable numbers of the young oysters, and of mature ones as well, through causes that are not clearly understood.

All efforts to establish the eastern oyster locally through the process of reproduction failed of effect through causes which are not clear, although the lower temperature of our waters has been the usual explanation offered. Nature, however, has provided a solution for the difficulty through a combination of circumstances which could hardly have been foretold. In the southern section of Willapa Harbor, at the mouth of the Nasel river, a most fortunate set of conditions prevail, particularly as to the conditions of temperature and salinity of the water, and in this favored district the eastern species carried out its spawning operations unheralded, and the result has been a strong set of native born *Oystrea virginica*, which bids fair to establish this species on a commercial scale in the near future. This western spawned species will presumably possess hardy qualities which will enable it to survive in other sections of the Northwest, and efforts are already under way to introduce it into Puget Sound, a small plantation having been established in Oyster Bay, near Olympia, in the summer of 1914.

The possibilities involved in the culture of these two species of oyster side by side has given rise to speculations as to the likelihood of the animals interbreeding, and thus forming hybrids, which might give rise to new varieties of oyster, having some of the qualities of each. This is highly improbable, as it has been found by experiment that the two forms will not cross, since the eggs of the native oyster, when fertilized by the sperm of the eastern species, fail to initiate those changes that lead to the formation of an embryo. This fact is also true of the reciprocal cross, using the eggs of the eastern oyster.

A third species of oyster has recently been brought into prominence through the attempt of oystermen to introduce the Japanese oyster into our waters. This species seems to be much hardier than the transplanted eastern oyster and makes a very rapid growth in local waters. Since it is almost as large as the eastern oyster and is of an excellent flavor, the preliminary experiments proving successful, plantations are now being established at several points on an extensive scale. Since seed oysters can be secured from Japan more cheaply than from the Atlantic coast, and as the death rate appears to be less, this new industry may assume considerable dimensions. It has not been determined whether the Japanese species will propagate in our waters, but they will certainly mature their sexual products, since experiments in artificial fertilization proved successful when performed at Oyster Bay in the summer of 1915. Embryos were kept alive for several days and seemed hardier than those of the eastern oyster observed under like conditions.

The Japanese oyster crosses freely with the eastern species and gives rise to very vigorous larvæ. A large number of these hybrid larvæ were liberated in Oyster Bay in 1915, but whether any of them formed spat remains to be seen. The Japanese species will not cross with the native oyster if our experiments have been correctly interpreted.

With excellent laws to safeguard the industry, with a great area of undeveloped tidelands awaiting exploitation, it would seem as if the oyster industry of the State of Washington bids fair to undergo a great expansion in the years to come and thus

keep pace with the increase in population, which will inevitably multiply the present demand for the products of the oyster fishery.

DISCUSSION.

DR. EDWARDS: May I ask how many acres or square miles there are of oyster beds?

PROF. KINCAID: Exact data are not available owing to the rather confusing method of classifying the tidelands of the state. Of the land originally classified by the state as natural oyster ground, about 14,000 acres are now reserved to serve as a base for the supply of seed oysters to those engaged in oyster farming. Much of this land has also passed into the hands of private individuals or is held on leases from the state. In addition to this, much ground classified as second class tideland has been utilized for the purpose of rearing oysters. When all of the tidelands available for oyster culture has been brought into actual use, the acreage involved will be very large.

The present production of oysters is about half a million dollars per annum. Under intensive tillage, an acre of first class oyster land will carry about three thousand sacks of the molluscs, but under existing conditions this maximum is seldom reached. Since oysters have been sold at times at prices exceeding ten dollars per sack, the profits in the business are considerable, notwithstanding the great cost of improving the ground and the initial cost of the land, which has sold for as much as \$4,000 per acre. With the progressive development of the beds many thousands of acres now unproductive will be brought under tillage.

DR. FRASER: I should like to ask Professor Kincaid if the conditions in which the swimming larvæ were kept for 20 days were similar to the conditions out in the open. I ask this on account of something that occurred while rearing some jelly-fish last winter. After the eggs were hatched out to form free swimming planulæ, if there was seaweed in the dishes, the planulæ became attached to this in about two days, but when they were put in a watch glass without any seaweed or other basis for attachment, they remained suspended for many days, finally disintegrating, since they could not become permanently attached to the smooth glass surface.

PROF. KINCAID: The conditions under which the larvæ were maintained in the laboratory were totally different from those that existed in the open bay. The rearing was conducted in plain rectangular jars filled with water which was not changed during the entire period.

Attempts to establish conditions corresponding approximately to those of the natural environment of the oyster embryos have never been entirely successful. Small cages made of bolting cloth and suspended in the oyster dikes seemed at first sight the natural procedure, but the larvæ lived for a relatively short time. The conclusion reached was that one of the vital factors in rearing the larvæ was to so place them as to make it possible for them to reach the surface of the water at times. The fact that the larvæ of the native oyster require approximately a month to complete their transition to the attached state is shown quite clearly by a study of the seasonal phenomena. The great flood of larvæ cast into the water by the mother animals at the first heavy spawning in the early summer does not result in the appearance of attached oysters till about a month later. The time interval varies according to the season, so that spells of cold weather cause a lengthening of the interval between spawning and setting. Evidence derived

from other lines of observation tends to confirm this conclusion so there seems to be little doubt of the correctness of this view.

MR. WESTERFELD: In San Francisco Bay we have had considerable trouble with the oyster beds on account of the pollution of oil and sewage. Have the same conditions prevailed in Puget Sound?

PROF. KINCAID: We have had no trouble from the causes mentioned, except in a few bays upon the shores of which towns of considerable size have been established. For instance, the oyster beds that formerly existed near Olympia were destroyed through the expansion of commerce and industry over the ground which they occupied. The embryos of the oyster require extremely pure water for their development and are very sensitive to floating impurities, since they come to the surface at night, and any contamination of the surface water is immediately fatal. Possibly this may explain the failure of the oyster to spawn properly in San Francisco bay, where the development of commerce in recent years has been very marked, more especially an immense increase in the number of vessels using petroleum products for the generation of power.

DR. EDWARDS: May I ask at what age oysters are marketed?

PROF. KINCAID: Oysters are ordinarily marketed at three years of age, but many do not mature sufficiently by that time and are left on the beds till the following season.

DR. EDWARDS: At what tidal stratum is the culture of the native oyster conducted?

PROF. KINCAID: The native oyster can maintain itself on bottom that is covered by thirty or forty feet of water at low tide, but as a matter of practice all of the activities of the oystermen are conducted on areas uncovered by the tide, the optimum level being at about mid-tide.

SANITARY FISH MARKETS

DR. EVERMANN: Mr. President, there is one matter we should consider. I believe this Society could do good in starting a campaign, the object of which would be to force the retail dealers to handle fish in their stores and stalls in a more careful and sanitary way. When one goes into a fish house and sees the way fish are handled, he is disposed to make up his mind not to eat fish.

San Francisco is particularly noticeable in this respect. I saw the conditions at Portland and at Seattle and I have made some little observation in San Francisco, and that is the way it has impressed me. One of the best ways to develop in the public the habit of eating fish is to make the fish stores and stalls clean and attractive.

MR. O'MALLEY: Would not that belong strictly to the State Food and Dairy Commission? Would it not be a delicate matter for us to step in there?

DR. EVERMANN: They should handle it, but pressure could be brought upon them to act by some representation from this society.

MR. COBB: I think that is one of the most important subjects we could take up. I have gathered data on it for quite awhile. I discussed it to a limited extent in a paper which I prepared for the U. S. Bureau of Fisheries, on the Cod Fisheries of the Pacific. The great trouble in disposing of cod is that there are but few places with proper cold storage for the holding and display of cod on sale. Some dealers let it lie in the open and it gets dried up with the heat, while other dealers put it down in their cellars from whence it is brought to the light only when some one asks for it.

There are only a few places in the United States where sanitary fish markets are maintained. Honolulu has the best fish market; they handle the fish there in a sanitary manner. I think without question it is the best fish market in the world. You cannot duplicate it in the United States proper and a campaign inaugurated by the Pacific Fisheries Society, even though it only covered the Pacific Coast, would doubtless help.

PRESIDENT: At the last session of the California Legislature, the Finn bill was introduced, which provided that the Fish and Game Commission should take over almost the entire fish industry of the coast, particularly that of retailing fish. The bill provided that the fish should be placed upon the market in a sanitary way.

The bill found much favor throughout the State. It was surprising to see how the newspapers took up the fight in favor of the bill, and the people generally were in hearty accord with its provisions. It passed both Houses, but was hastily prepared, and contained numerous defects. The Governor could not sign it. The appropriation was ridiculously small and there were numerous provisions which could not be carried out in practice. But I have no doubt but that, at the next session of the Legislature, a similar bill will be introduced and something will come of it.

In the meantime the Governor has asked that the commission make a full and detailed report on the fishing industry of the Coast, and Mr. Scofield and Mr. Nidever are now preparing one. In their report they will comment upon the unsanitary conditions of the markets.

DR. EDWARDS: I know of one fish market where the fish are all exposed in glass cases, and it is one of the most interesting sights I ever saw. The one I refer to is in the city of Los Angeles. The fish are right there in glass cases, and they take them out of the glass, and there is no dust or anything noticeable that could get on them.

LIST OF MEMBERS, 1915-1916

The President of the United States, Woodrow Wilson.

The Governors of certain States:

Washington, Ernest Lister.

California, Hiram Johnson.

Montana, S. V. Stewart.

Oregon, James Withycombe.

Idaho, Moses Alexander.

Nevada, Emmet D. Boyle.

Arizona, George W. P. Hunt.

Alaska, J. F. A. Strong.

Hawaii, L. E. Pinkham.

Dr. Hugh M. Smith, U. S. Commissioner of Fisheries, Washington,
D. C.

ACTIVE MEMBERS.

Life members indicated by (*).

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Baldrige, Henry, Fish and Game Commission, Palmer, Wash.

Baldwin, M. D., Member Game and Fish Com., Kalispell, Mont.

Barker, Fred, Astoria, Oregon.

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Blass, John, Olympia, Wash.

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Brady, Philip J., Globe Building, Seattle, Wash.

Brenner, Chas., Mud Bay, Olympia, Wash.

Brenner, J. J., care of J. J. Brenner Oyster Co., Olympia, Wash.

Buschmann, August, L. C. Smith Building, Seattle, Wash.

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Conn, C. G., Elkhart, Ind.

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Cryderman, J. J., Blanchard, Wash.

Culver, A. E., Dunsmuir, Cal.

Cunningham, Edward, Mgr. Pacific Net & Twine Co., Pier 8, Seattle,
Wash.

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Deer, L. H., Shelton, Wash.

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Doyle, Henry, Vancouver, British Columbia.

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Wold, H. P. A., University of Washington, Seattle, Wash.
Young, Jack, Fish and Game Commission, Deadwood, Ore.

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be the Pacific Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of one dollar, become a member of this Society. In case members do not pay their fees, which shall be one dollar per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States, and the Governors (by name) of the Pacific Coast States, Arizona, Nevada, Idaho, and Montana, and Alaska and Hawaii territories shall be honorary members of the Society.

Any person shall, upon a two-thirds vote and the payment of twenty-five dollars, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a president and a vice-president, who shall be ineligible for election to the same office until a year after the expiration of their term; a vice-president, a secretary, a treasurer, and an executive committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session—four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the council.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by president.
2. Roll call of members.

3. Applications for membership.
4. Reports of officers.
 - a. President.
 - b. Secretary.
 - c. Treasurer.
 - d. Standing committees.
5. Committees appointed by the president.
 - a. Committee of five on nomination of officers for ensuing year.
 - b. Committee of three on time and place of next meeting.
 - c. Auditing committee of three.
6. Reading of papers and discussions of same.

(*Note*.—*a*. In the reading of papers preference shall be given to the members present.

b. The president and secretary are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

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

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