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Fishery Bulletin.
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DEPARTMENT OF COMMERCE AND LABOR

BULLETIN

OF THE

BUREAU OF FISHERIES

VOL. XXVIII

1908

IN TWO PARTS—PART I

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PROCEEDINGS OF THE FOURTH INTERNATIONAL FISHERY CONGRESS: ORGANIZATION AND SESSIONAL BUSINESS, PAPERS AND DISCUSSIONS

HELD AT WASHINGTON, U. S. A. : : : SEPTEMBER 22 TO 26, 1908

IN TWO PARTS

PART 1

ISSUED AUGUST, 1910

ANNOUNCEMENT.

The proceedings of the Fourth International Fishery Congress are published herewith in accordance with the instructions of the Congress. By authority of the Secretary of Commerce and Labor and the Commissioner of Fisheries, the Bulletin of the Bureau of Fisheries for 1908 is devoted to this purpose. In thus providing a medium for publication, the Bureau of Fisheries assumes no responsibility for any of the statements or views of the individual members or the Congress as a whole.

HUGH M. SMITH,
Secretary-General.

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Hon. George C. Sturgiss, House of Representatives, Washington, D. C.
C. L. Topping, Charleston.
Col. Robert Williamson, Huntington.

WISCONSIN.

Jabe Alford, Commissioner of Fisheries, Madison.
Prof. E. A. Birge, Commissioner of Fisheries, Madison.
Neal Brown, Wausau.
James H. Jenkins, Oshkosh.
James Nevin, Superintendent Commission of Fisheries, Madison.
George F. Peabody, Appleton.
J. W. Stone, State Fish and Game Warden, Madison.

WYOMING.

C. W. Morgareidge, Superintendent of State Hatcheries, Wolf.
Theodore Tregoning, Laramie.

V. DELEGATES FROM AMERICAN SOCIETIES AND ORGANIZATIONS.

AMERICAN FISHERIES SOCIETY.

Seymour Bower, Superintendent Michigan Fish Commission, Detroit, Michigan.
James Cruickshank, New York City, New York.
Dr. James A. Henshall, Superintendent U. S. Fisheries Station, Bozeman, Montana.
H. F. Hurlbut, Fish Culturist, East Freetown, Massachusetts.
Edwin A. Newman, Washington, D. C.

AMERICAN MICROSCOPICAL SOCIETY.

Prof. Henry B. Ward, University of Nebraska, Lincoln, Nebraska.

BOARD OF TRADE OF GLOUCESTER, MASSACHUSETTS.

John J. Pew, Gloucester, Massachusetts.

BOARD OF TRADE OF WASHINGTON, D. C.

Henry L. West, Washington, D. C.
Charles J. Bell, Washington, D. C.
Scott C. Bone, Washington, D. C.
Clarence F. Norment, Washington, D. C.

CARNEGIE INSTITUTION OF WASHINGTON, DEPARTMENT OF EXPERIMENTAL EVOLUTION.

Dr. Charles B. Davenport, Director of the Laboratory, Cold Spring Harbor, New York.

CHAMBER OF COMMERCE, WASHINGTON, D. C.

Thomas W. Smith, Washington, D. C.
Julius Garfinkle, Washington, D. C.
D. S. Porter, Washington, D. C.
Thomas C. Noyes, Washington, D. C.
William F. Gude, Washington, D. C.

DISTRICT OF COLUMBIA FISH AND GAME PROTECTIVE ASSOCIATION.

Dr. William P. Young, Washington, D. C.
Dr. Theodore S. Palmer, Bureau of Biological Survey, Department of Agriculture, Washington, D. C.
Henry Talbott, Interstate Commerce Commission, Washington, D. C.
Dr. W. S. Harban, Washington, D. C.
Richard Sylvester, Washington, D. C.

FIELD MUSEUM OF NATURAL HISTORY.

Dr. Seth E. Meek, Chicago, Illinois.

LEAGUE OF AMERICAN SPORTSMEN.

Maj. R. R. Raymond, U. S. Army, Washington, D. C.

MARYLAND FISH AND GAME PROTECTIVE ASSOCIATION.

Oregon Milton Dennis, Baltimore, Maryland.

NATIONAL ASSOCIATION OF SCIENTIFIC ANGLING CLUBS.

Dr. R. Johnson Held, New York City, New York.
H. Wheeler Perce, President of the Association, Chicago, Illinois.

NATIONAL ASSOCIATION OF AUDUBON SOCIETIES FOR THE PROTECTION OF WILD BIRDS AND ANIMALS.

William Dutcher, President, New York City, New York.
T. Gilbert Pearson, Secretary, Greensboro, North Carolina.

NATIONAL ASSOCIATION OF GAME AND FISH WARDENS AND COMMISSIONERS.

Carlos Avery, Executive Agent Minnesota Game and Fish Commission, St. Paul, Minnesota.
W. F. Scott, President National Association of Game and Fish Wardens and Commissioners, Helena, Montana.
Charles A. Vogelsang, Chief Deputy California Game and Fish Commission, San Francisco, California.

NEW ENGLAND FOREST, FISH, AND GAME ASSOCIATION.

Richard E. Follett, Boston.
Bayard Thayer, Boston.
Hon. Herbert Parker, Boston.

NEW YORK ZOOLOGICAL SOCIETY.

Charles H. Townsend, Director of the New York Aquarium, New York City.

PENNSYLVANIA FISH PROTECTIVE ASSOCIATION.

Marion G. Sellers, Philadelphia.
William E. Meehan, Harrisburg.
E. D. Hemingway, Philadelphia.
Joseph Johnson, Philadelphia.

PHILADELPHIA AQUARIUM SOCIETY.

Dr. Herman Burgin, President of the Society Philadelphia, Pennsylvania.
Herman T. Wolf, Philadelphia, Pennsylvania.

TUNA CLUB, AVALON, CALIFORNIA.

Charles F. Holder, President, Pasadena, California.

UNIVERSITY OF NEBRASKA.

Prof. Henry B. Ward, Dean of the College of Medicine and Head Professor of Zoology, Lincoln, Nebraska.

WEST VIRGINIA FISH AND GAME PROTECTIVE ASSOCIATION.

L. C. Crile, Clarksburg.
Andrew Price, Marlinton.
E. M. McPeak, Fayetteville.
Anton Reymann, Wheeling.
George E. Stifel, Wheeling.

VI. OTHER MEMBERS.

Dr. Carl L. Alsberg, Associate Professor of Zoology, Harvard University, Cambridge, Massachusetts.
Dr. R. Anthony, Museum of Natural History, Paris, France.
L. F. Ayson, Chief Inspector of Fisheries, Wellington, New Zealand.
John P. Babcock, Deputy Commissioner of Fisheries of British Columbia, Victoria, British Columbia.
O. N. Baldwin, U. S. Fisheries Station, Leadville, Colorado.
Dr. S. P. Bartlett, Superintendent U. S. Fisheries Station, Quincy, Illinois.
Prof. Dr. Arthur Bellini, Commachio, Italy.
Dr. Marcus Benjamin, Editor, U. S. National Museum, Washington, D. C.
Guiseppe Besana, Lombardy Society of Fishing and Aquiculture, Milan, Italy.
Hayes Bigelow, Member American Fisheries Society, Brattleboro, Vermont.
H. C. Bliss, Alaska Packers' Association, San Francisco, California.
Nicholas Borodine lately Chief Specialist in Fish Culture, Department of Agriculture, St. Petersburg, Russia.
G. M. Brown, State Fish Commissioner, Detroit, Michigan.
W. O. Buck, U. S. Fisheries Station, Grand Lake Stream, Maine.
H. M. Buller, State Fish Hatchery, Bellefonte, Pennsylvania.
E. N. Carter, Superintendent U. S. Fisheries Station, St. Johnsbury, Vermont.
E. S. Casselman, Kamp Kill Kare, Raquette Lake, New York.
Eugene Catte, Langdon, Kansas.
John K. Cheyney, Member American Fisheries Society, Tarpon Springs, Florida.
Theodore M. Cogswell, U. S. Bureau of Fisheries, Washington, D. C.
R. J. Conway, Director of Belle Isle Aquarium, Detroit, Michigan.
Dr. Jules Cotte, Station of Marine Zoology, Endoume, France.
Prof. W. C. Curtis, University of Missouri, Columbia, Missouri.
Capt. G. M. Dannevig, Director Marine Fish-Hatching Station, Arendal, Norway.
H. D. Dean, U. S. Fisheries Station, Neosho, Missouri.
Dr. Frederick W. D'Evelyn, Alameda, California.
N. T. DePauw, Waverley Farms, Haymarket, Virginia.
A. H. Dinsmore, Superintendent U. S. Fisheries Station, Baker, Washington.
S. W. Downing, Superintendent U. S. Fisheries Station, Put-in Bay, Ohio.
Dr. Irving A. Field, Western Maryland College, Westminster, Maryland.
John D. Figgins, American Museum of Natural History, New York City.
Karl Flégel, Member Imperial and Royal Austrian Fisheries Society, Vienna, Austria.
Prof. Johann Franke, Laibach, Austria.
Dwight Franklin, American Museum of Natural History, New York City.
Charles E. Fryer, Secretary of Board of Agriculture and Fisheries, London, England.
Alfred E. Fuller, U. S. Fisheries Station, Northville, Michigan.
Dr. T. Wemyss Fulton, Aberdeen, Scotland.
J. J. Glennan, U. S. Bureau of Fisheries, Washington, D. C.
H. D. Goodwin, Milwaukee, Wisconsin.
Chester K. Green, Superintendent U. S. Fisheries Station, Cape Vincent, New York.
Prof. Frederic P. Gorham, Brown University, Providence, Rhode Island.
Dr. E. W. Gudger, State Normal and Industrial College, Greensboro, North Carolina.
L. G. Harron, Superintendent U. S. Fisheries Station, Washington, D. C.
Walter E. Hathaway, White Stone, Virginia.
Prof. Dr. Bruno Hofer, Royal Bavarian Biological Research Station for Fisheries, Munich, Germany.
Henry Holt, Publisher, New York City.
Dr. F. M. Johnson, Member American Fisheries Society, Boston, Massachusetts.
R. S. Johnson, Superintendent U. S. Fisheries Station, Manchester, Iowa.
A. G. Keesecker, Superintendent U. S. Fisheries Station, Erwin, Tennessee.
Dr. William C. Kendall, Scientific Assistant, U. S. Bureau of Fisheries, Washington, D. C.
Dr. George Frederick Kunz, with Tiffany & Co., New York City.
G. H. Lambson, Superintendent U. S. Fisheries Station, Baird, California.
Charles Lay, Sandusky, Ohio.
John L. Leary, Superintendent U. S. Fisheries Station, San Marcos, Texas.

Prof. George Lefevre, University of Missouri, Columbia, Missouri.
Prof. Edwin Linton, Washington and Jefferson College, Washington, Pennsylvania.
E. F. Locke, Superintendent U. S. Fisheries Station, Woods Hole, Massachusetts.
Samuel Lovejoy, U. S. Fisheries Station, Bullochville, Georgia.
Frederic A. Lucas, Curator in Chief of the Museum, Brooklyn Institute of Arts and Sciences, Brooklyn, New York.
M. C. Marsh, Agent at the Alaska Salmon Fisheries, Bureau of Fisheries, Washington, D. C.
Prof. S. Matsubara, Director of the Imperial Fisheries Institute, Tokyo, Japan.
W. L. May, Denver Convention League, Denver, Colorado.
Frank Miller, Put-in Bay, Ohio.
Roy W. Miner, Assistant Curator, American Museum of Natural History, New York City.
Henry O'Malley, Superintendent U. S. Fisheries Station, Clackamas, Oregon.
William Palmer, U. S. National Museum, Washington, D. C.
Prof. George H. Parker, Harvard University, Cambridge, Massachusetts.
Edward E. Race, Superintendent U. S. Fisheries Station, Green Lake, Maine.
Casimir Raveret-Wattel, rue des Acacias, 20, Paris, France.
Dr. Jacob Reighard, Professor of Zoology, University of Michigan, Ann Arbor, Michigan.
Paul Reighard, University of Michigan, Ann Arbor, Michigan.
Robert K. Robinson, Superintendent U. S. Fisheries Station, White Sulphur Springs, West Virginia.
Al. Rosenberg, Spring Brook Trout Company, Kalamazoo, Michigan.
W. H. Safford, Conneaut Lake, Pennsylvania.
Dr. George G. Scott, College of the City of New York, New York City.
George A. Seagle, Superintendent U. S. Fisheries Station, Wytheville, Virginia.
William P. Seal, Aquarist, Delair, New Jersey.
Hon. George Shiras 3d, Stoneleigh Court, Washington, D. C.
G. E. Simms, 61 Lamb's Conduit, London, W. C., England.
A. Sölling, Commissioner of Danish Fisheries Department, London, England.
John I. Solomon, Civil Engineer, 51 West Eighty-first street, New York City.
L. B. Spencer, New York Aquarium, New York City.
M. F. Stapleton, Superintendent U. S. Fisheries Station, Mammoth Springs, Arkansas.
Charles H. Stevenson, U. S. Bureau of Fisheries, Washington, D. C.
W. T. Thompson, Superintendent U. S. Fisheries Station, Leadville, Colorado.
E. A. Tulian, Chief of Fish-cultural Section, Ministry of Agriculture, Buenos Aires, Argentina.
Dr. Antoine Valle, Secretary-General of Austrian Society of Marine Fishing and Fish Culture, Trieste, Austria.
Eugene Vincent, Fish Culturist, Trocadero Aquarium, Paris, France.
Claudius Wallich, Field Superintendent, U. S. Bureau of Fisheries, Washington, D. C.
B. O. Webster, Bellefonte, Pennsylvania.
Andrew R. Whitaker, Phoenixville, Pennsylvania.
R. Tyson White, Brooklyn, New York.
E. C. Whitman, Board of Trade, Canso, Nova Scotia.
Dr. H. V. Wilson, Professor of Zoology, University of North Carolina, Chapel Hill, North Carolina.
S. G. Worth, Superintendent U. S. Fisheries Station, Edenton, North Carolina.
Paul Zirzow, Oderbergerstrasse 56, Berlin, Germany.

REGULATIONS.

1. Object of the Congress.

The congress will deliberate on all important affairs concerning fishing and fish culture, and will submit propositions and memorials to governments and to provincial and local authorities.

2. Members of the Congress.

The membership of the congress will consist of government, state, and provincial representatives, delegates from home and foreign societies, corporations, and personages invited by the management of the congress, and persons at home and abroad who are deemed to have an interest in the purposes of the congress and express a wish to take part in it.

3. Rights to Members.

All the members of the congress have the right to vote, to participate in the discussions, and to make independent propositions. In case a corporation should be represented by several delegates, the members of this delegation have the right to only one vote, which shall be cast by the delegate designated to the presiding officer. The delivery of the card of admission gives to members the right to take part in all the enterprises and excursions projected by the congress, to receive all the publications, and to wear the insignia of the congress. The members of the congress are required to conform to its regulations and decisions.

4. Organization of the Congress.

The congress will follow officially the preceding international fishery congresses, and will conform to the decisions for the regulation of the international fishery congresses decreed at Paris in 1900. The president and the secretary-general of the congress will be nominated by the United States Bureau of Fisheries; the vice-presidents will be elected by the congress from among its members.

5. Elections and Resolutions of the Congress.

All the resolutions of the congress are adopted by an absolute majority of the members present having the right to vote. (See sec. 3.) In case of division the president's vote will decide. Elections take place by ballot. Formal propositions and resolutions intended for the consideration of the congress should be in the hands of the local committee by August 1, 1908. The committee will decide on the admission of such propositions; but in case of rejection it is required to make known to the congress the reasons therefor.

6. Resources of the Congress.

The resources of the congress consist of a special appropriation by the Congress of the United States, of voluntary contributions from interested persons, and of membership fees fixed at $2 for each person. In the case of official representatives of governments the membership fee is remitted.

7. Method of Debate.

All the debates of the congress take place in full assembly. The official language is English, but in presenting papers and in debates members have the right to use also the French, German, or Italian language.

The meetings will be presided over by the president or vice-president, who will conduct the debates according to the established order. The president, on yielding the chair, may himself take part in the debates. The duration of the discussion of a subject will be regulated by the extent of the programme and will be communicated to the assembly before the commencement of the debate. Members desiring to speak will inscribe their names and subjects during or after the reading of papers, and the president will call on them to speak in the order of their inscription.

A member may speak only twice on the same subject in the same meeting, personal remarks and corrections excepted. The motion for the close of a debate must immediately be put to a vote; this motion once accepted, only the members who have previously asked recognition may speak. The author of a proposition or paper shall at the end of the debate be recognized for a final résumé.

8. Minutes and Publications.

Minutes will be prepared on all the proceedings of the congress and will contain the reports and debates in brief and in extenso. The full transactions of the congress will be published as soon as practicable after the final adjournment.

9. Additional Regulations.

The local committee of organization will make such further regulations as may be necessary for the proper conduct of the work of the congress.

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FOURTH INTERNATIONAL FISHERY CONGRESS.

WASHINGTON, U. S. A., 1908.

SESSIONAL BUSINESS.

PRELIMINARY MEETING, TUESDAY, SEPTEMBER 22.

DEPARTMENT OF STATE.

The foreign delegates and others convened in the Diplomatic Room of the Department of State at 9.30 a. m. and were received by the Assistant Secretary of State, Hon. Alvey A. Adee.

Secretary ADEE. Gentlemen, I have much pleasure in greeting you. It would have been Secretary Root's privilege to meet you, but he is detained at his summer home, in northern New York, and has asked me to welcome you in his name. Falling on me at the last moment, this agreeable duty finds me unprepared to make a formal address. With your kindly indulgence, I venture to offer a few desultory remarks.

Your mission is beneficent. It deals with a phase of the world-old yearning for the conquest of the sea. From Salamis to Trafalgar, from Trafalgar to our own day, the peoples have been rivals for its mastery. Not alone have their mighty fleets striven for supremacy, but their traders have sought to acquire its commercial control for their own advantage. But this keen contest has been for domination upon the face of the waters. Beneath the surface lie other and nobler prizes to be won. We seek those prizes not as embittered antagonists, but as associates in the interest of the great solidarity of mankind.

Above the problem of naval and commercial supremacy is the greater problem of the sustenance and maintenance of the peoples. Without the farmer, the stock raiser, the miner, and the fisherman, there could be no wide-reaching empires, no armies, no navies, no marvelous progress in civilization, no development of culture or science, for the producers supply the means by which all these things are done. It is through the producers, the men who wring from the earth and the seas the means of supporting existence itself, that national life is begotten and developed. It is by the abundance of the producers' returns that the world's prosperity may be measured.

It was said long ago, by a philosopher of the mythical Commonwealth of Brobdingnag, that whoever could make two ears of corn or two blades of grass

to grow where one grew before would be a benefactor of mankind. How many fold greater would be he who, leaving the fertile land for the yet more fertile ocean, should develop the life-sustaining harvest of the waters in ever increasing abundance, for the benefit of all the world in generous equality.

Your purpose is a great one, and in the effort to accomplish it you meet as fellow-workers toward the general welfare. I wish you godspeed in your work.

OPENING SESSION, TUESDAY, SEPTEMBER 22.

NATIONAL GEOGRAPHIC SOCIETY HALL.

The congress was opened at 10.30 a. m. by Hon. George M. Bowers, chairman of the local committee of organization and Commissioner of Fisheries of the United States.

Commissioner BOWERS. Ladies and gentlemen, as Commissioner of Fisheries and chief of the Bureau primarily responsible for the assembly of the Fourth International Fishery Congress in the city of Washington, I do now call this meeting to order.

It gives me great pleasure to present to this meeting the Hon. Oscar S. Straus, Secretary of Commerce and Labor, who will deliver an address of welcome to the congress in behalf of the Government of the United States.

Secretary STRAUS. Mr. Commissioner, ladies, and gentlemen, it is a great pleasure and a high privilege, as head of the Department of Commerce and Labor, of which the Bureau of Fisheries forms an important part, to welcome you heartily to this the Fourth International Fishery Congress.

The subject of fish as an article of food and as an industry, and I might say amusement, is one of the oldest and dates back to the earliest history of mankind. Even in Isaiah we read, when foretelling or forecasting the dissolution of Egypt, "The fishers also shall mourn, and all they that cast angle into the brooks shall lament, and they that spread nets upon the waters shall languish," showing that even in those early times the fish and fishers were held to be one of the important considerations of mankind.

The question of food, and of fish as an important article of food for mankind, was perhaps even more important in the dawn of history than it is to-day, in that the articles of food, the contributions to what made up the sustenance of mankind, were not so extensive as they are, and as they became, as nations became more enlightened and their needs became greater.

Last spring the President of the United States, who as a historian is one of the greatest that this country has known, and whose horizon is therefore that of a historian, called together in conference the governors of our states for the purpose of considering the conservation of our natural resources—the forests, the lands, the waters, the minerals—recognizing, as all students

of these important subjects must, that we are drawing heavily upon that valuable capital, the natural resources of the land and of water, and that, looking forward to the generations that are to follow us, it becomes not only our duty, but a necessity of safe policy, to see that these great blessings that have come to us shall be handed down to those generations not exhausted in selfishness or wasted in ignorance, but as little impaired as human science and human ingenuity can provide for. In full accord with that wise and statesmanlike policy is the meeting of a congress such as this, for one of the great natural resources is fish, one of the important articles of food and one of the healthiest.

There is perhaps no more significant sign of the unity of the enlightened people of the world, of the brotherhood of mankind, than these international congresses for the purpose of promoting the welfare and happiness of the people of all nations. Here in this city now are two such international congresses meeting. Not far from here are gathered many of the scientists of the world, the great healers, the physicians, who have come together in order to compare notes, to study, to advance the knowledge that will eliminate the greatest enemy of mankind, popularly known as the "great white plague." And here are assembled men from every State, delegates from foreign countries, in order to compare notes, to exchange ideas, to discuss the various phases of the science with which they are connected, for the purpose of promoting the culture and the propagation of one of the great articles of food upon which mankind subsists. The purpose and object are worthy of your consideration.

To us in this country fish and fisheries have been of the highest importance since the earliest period of colonization. Our Pilgrim Fathers, of whom we are very proud—so proud that the whole United States might be divided into two classes, those who are descended from them and those who claim to be descended from them [laughter and applause]—for the first two years they subsisted almost entirely on fish; and I leave it to you, gentlemen of science, that perhaps that is the reason why their descendants have shown such wonderful mental powers [laughter], such aggressiveness, are so rich in brains—because their original progenitors lived for two years on fish. [Applause and laughter.]

Another point: The earliest commerce of the settlers on the New England coast was fish and lumber. Now, fish is dried, salted, and cured, and I am told that fish eaten in that way stimulates thirst very much. [Laughter.] Was it, perhaps, on that account that the early commerce with the West Indies—the exportation of cured fish—resulted in the bringing back from the West Indies of rum [laughter], sugar, and molasses? They go well together. [Laughter and applause.] A very fair exchange. Bismarck says that "the logic of the historian is as exacting as Prussia's accounting office." Let us see. One of the

great political questions that is sweeping over New England to-day is prohibition, and I suppose the reason it finds so much favor in New England is because of this, for the New Englanders are nothing if they are not historical. Historically speaking, having in mind the enormous amount of rum that they imported from the West Indies, they can say, "O, Lord, we have had our fill." [Laughter and applause.]

I need not point out to you that the quest for fish has inspired, has brought up, some of the most intrepid navigators, who, in search of fish, have become the great discoverers. It is said, with historical accuracy that I neither admit nor deny, that the continent was first discovered, or at least the northern portion of it, by the Norse fishermen. You know that the Cabots, in their discoveries, came back and placed great emphasis upon the fact of the Newfoundland cod. The cod is almost a national emblem for a part of this country, and well it may be.

Gentlemen, I know you are scientific, and you do not want to hear from me on questions of history; but one of my chief objects in talking to you, who know so much about fish from its scientific side, is to conceal from you my ignorance of the subject [laughter], and if I have succeeded in doing that I have largely accomplished what I came for.

I wish, in conclusion, to say that we welcome you most heartily, especially you who have come to us from foreign shores. We know that you have much to teach us, and perhaps we may have a little something to teach you in return. Be that as it may, whatever we have is yours. We are united with you in this great and noble work, in uniting our experience, our scientific knowledge, for the purpose not only of conserving this very important and great item of food for mankind, but of increasing it, propagating it; and no more important subject can engage the attention of scientific and practical men of all nations. [Applause.]

The CHAIRMAN. We have with us one of the Commissioners of the District of Columbia and city of Washington—one of our governors—and it gives me great pleasure to present the Hon. Henry L. West, who will extend a welcome to the congress on behalf of the city of Washington.

Commissioner WEST. Mr. Commissioner, members of the congress, ladies, and gentlemen, the citizens of the District of Columbia add, through me as their representative, to the very warm and sincere words of welcome just eloquently uttered by the Secretary Commerce and Labor.

Your meetings hitherto, I believe, have been held on shores foreign to us, and it is peculiarly appropriate that here in the United States you should hold your session in the capital of this great American Republic. We may be, as the Secretary has said, ignorant of the scientific terms and other technical knowledge regarding fish, and yet we are not unaware of the great results which are already a part of the enviable history of this congress nor of the high aims which stimulate you to still further accomplishment. And we believe and hope

that your deliberations here will add still more to the splendid record you have already attained.

The work of this congress appeals with peculiar force to the popular mind. The propagation and culture of the food fishes, as well as the preservation of the important species which would become extinct but for the care, zeal, and knowledge which you exercise, offers to every man a most attractive field and brings its large reward in the consciousness of doing good for all mankind. It is, therefore, with especial pleasure that we welcome you to Washington, in the continued and increasing development of your practical work.

We have not here, in a new country and a new city, the traditions and the histories which invest foreign capitals with so much charm; and yet you will find here in Washington many things that we hope will be of real interest to you. Yonder white-domed Capitol must dwell forever in your memories as an impressive and inspiring picture; the White House is the embodiment of our democratic life; and the tomb at Mount Vernon, when you stand beside it, whether you be an American or a foreigner, must compel your respect, if you admire in the human race the characteristics of patriotic courage and devotion. And, above all, in the laboratories and museums here you will have ample opportunity for the facilitation of that study in which you are engaged and which has earned for you the commendation of the world.

I can not, I assure you, talk either as eloquently, as confidently, or with as much experience regarding "rum and molasses" as my friend Secretary Straus [laughter], but I can join with him, and do join with him, in welcoming you to this beautiful capital, which has grown in hardly a century—in fact, the new Washington is but twenty or twenty-five years old. We can join together in welcoming you here, in expressing the hope that your deliberations may be of such advantage to you, that your experiences here may be so pleasant, that the hospitality which we will try to extend to you may leave so warm a spot in your hearts and thought, that when you leave you will have had awakened a desire to reassemble as soon as possible in the capital of the United States. [Applause.]

The CHAIRMAN. The president of the American Fisheries Society is with us, and will now extend a welcome in behalf of that society. I take pleasure in presenting Dr. Hugh M. Smith.

Doctor SMITH. Mr. Chairman, ladies, and gentlemen, it is not inappropriate that on this occasion an opportunity should be afforded the American Fisheries Society to join with the United States Government and the city of Washington in extending a welcome to those who have come from afar to participate in this gathering of the fishermen of all nations; for the society feels that its objects, its accomplishments, and its affiliations entitle it to a voice in these proceedings.

Forty years ago fish culture was a very absorbing theme among a small band of American pioneers by whom the creation of a fishery bureau under

government control was strongly advocated. A few years later, when these fish lovers had banded themselves together in a society, they continued their agitation and exerted a decided influence in inducing Congress to establish the national bureau of fisheries. A little later, when it was seen that the law incorporating the bureau contained no provision for the artificial propagation of food fishes, this same society on whose behalf I have the honor to speak persuaded Congress to authorize and make special appropriation for fish culture, which has since been conducted on a yearly increasing scale and has become the most important branch of the fishery work of the government.

This society was thus intimately concerned in inaugurating and shaping the course of the public fishery service of the United States, and it has continued to exert a potent influence in federal and state fishery affairs. It is the representative fishery organization of the Western Hemisphere, and has just held its thirty-seventh annual meeting. Its 400 active members include nearly all national and state fishery officials, as well as men engaged in private fish culture for pleasure or pecuniary profit; hardy fishermen of our seas, lakes, and rivers; managers and employees of fishing and fish-preserving companies; university professors whose biological studies deal with the inhabitants of the water; enthusiastic disciples of Izaak Walton; ultra-fastidious scientific anglers who would rather tie an artificial fly properly and cast a line gracefully than catch the largest trout—in short, all sorts and conditions of that widely distributed variety of the human species which we may call *piscatorius*.

The society has been pleased to include in its honorary and corresponding membership many who have attained prominence in various branches of fishery work in Europe, Asia, and America. A number of these members are here to-day with our other colleagues; and perhaps the greatest benefit that will accrue to our people from this congress will come not from the formal papers and discussions, important as they may be, but from the opportunity thus afforded to meet personally and informally exchange experiences with our colaborers from other lands.

Therefore, the American Fisheries Society wishes to express its great pleasure that you have come among us, and to extend to you a cordial greeting from every state and territory of this vast country; but we prefer to regard you not as representatives of great sovereign powers and influential foreign societies and organizations, but as fellow-citizens of that cosmopolitan domain where fish is king and where, as loyal subjects, we labor together for the good of the royal family and all of its aquatic relatives.

The CHAIRMAN. I have to announce that in pursuance of the established custom, those extending the invitation to meet in Washington have selected as president of the Fourth International Fishery Congress Dr. Hermon C. Bumpus, Director of the American Museum of Natural History, in New York. A motion to ratify this selection is now in order.

Dr. HEINRICH VON KADICH. I move that the nomination be ratified.

[The motion was duly seconded.]

The CHAIRMAN. You have heard the motion. As many as are in favor of the ratification say "Aye;" the contrary, "No." The motion prevails.

I have to announce further that Dr. Hugh M. Smith, Deputy Commissioner of the United States Bureau of Fisheries, has been nominated for secretary-general. A motion to ratify this selection is in order.

Lieut. RADLER DE AQUINO. I move that the nomination be ratified.

The CHAIRMAN. As many as are in favor of the ratification of this selection say "Aye;" the contrary, "No." The "ayes" have it, and Doctor Smith is duly elected secretary-general.

The permanent officers have now been selected, and I surrender the chair, with expression of the hope that the deliberations of this congress will be pleasurable and profitable, and that when you go hence, at the conclusion of the meeting, you will carry with you the feeling that the long journey many of you have made has not been made in vain. I wish you happiness and success. Doctor Bumpus, will you come forward? [Applause.]

Doctor BUMPUS. On assuming the chair, I will ask if any one is prepared to acknowledge the courtesies that have been extended to us by the Honorable Secretary of Commerce and Labor, by the Honorable Commissioner of Fisheries, and by the Honorable Commissioner of the District of Columbia?

Dr. P. P. C. HOEK (Holland). You will please excuse my poor English, gentlemen. I might address you in another language as well, yet I believe that though my English is not quite pure, still most of you might understand me better than if I addressed you, say, in Dutch.

Gentlemen, I have been asked, and I have accepted the invitation with great pleasure, to address, first, to the United States Government, and especially the Bureau of Fisheries of the Department of Commerce and Labor; in the second place, to the District of Columbia; and in the third place, to the American Fisheries Society, the hearty thanks of the congress for this splendid and extremely agreeable reception here in Washington. But it is not only for that reception—it is especially for the excellent way in which this congress has been prepared—that we are extremely grateful to the secretary-general, of course, in the first place, and to the president, and to all the gentlemen who have given themselves the trouble to assist these other gentlemen in this matter.

Ladies and gentlemen, may I use this opportunity to tell you that a few days ago I came across an American book, a book published, I think, about thirty-five years ago and then studied by me with great pleasure on the other side, a book which I have not seen since? It was a book by Draper, and the title of that book was "The History of the Struggle between Religion and Science." It is not for the question of that struggle that I quote that book, but it is because the

formulation brought me to think about another struggle, a struggle between—let me see—human industry on one side and nature on the other side. When I say "human industry" I mean the whole of what man does—the building of great cities, the river pollution, the erection of large manufactories, navigation, all kinds of industry, mining, and much more—I mean that altogether. How does that human industry compete with nature? We soon find out that to a large extent human industry has been extremely disadvantageous—I might use a stronger word—to nature. It is true that human activity did what it could, in some cases more, in others less, to make good again what was spoiled by man on the other side. A German poet said, "Die Erde ist schön überall, wo der Mensch nicht hinkommt mit seiner Qual." You might say that in English, "Beautiful is the earth everywhere where man does not come to spoil it."

You understand, now, what I mean; I intended to say that it will be very nice to have another book written, another Draper writing a book on that struggle between industry and nature; and when such a book ever will be written I am perfectly sure beforehand that you will find in that book pages—no, whole chapters—telling of the excellent and most efficacious way in which that struggle has been taken up here in your country. And when we were honored with the invitation to come to your United States, and were glad to receive that invitation, it was, in the first place, because we enjoyed beforehand, and were sure to enjoy making acquaintance with, your excellent methods of ameliorating the fisheries in your waters.

This is nearly all I have to say to you, but when I repeat my thanks for this reception, and for the invitation, I lay stress upon the fact that it is especially because we so extremely admire the excellent way in which you have tried to propagate and to protect the fisheries, to do what you could by artificial and natural culture to promote the great industry in which we all here are so highly interested.

The PRESIDENT. Those having the arrangement of the affairs of the congress in hand have asked me to make certain announcements, particularly in regard to the appointment of officers and committees, and with your kind permission I will make them at this time. First, I have the honor to propose the following list of vice-presidents:

As the first vice-president, and representing the Netherlands, Dr. P. P. C. Hoek, Scientific Fishery Adviser of the Dutch Government, Harlem.

Austria, Dr. Heinrich von Kadich, Councillor of Administration, Department of Forestry and Domain, Vienna.

Brazil, Lieut. Radler de Aquino, Naval Attaché of the Brazilian Embassy, Washington, D. C.

Canada, Prof. Edward E. Prince, Dominion Commissioner of Fisheries, Ottawa.

China, Dr. Wei-ching W. Yen, Second Secretary Imperial Chinese Legation at Washington, D. C.

Guatemala, Dr. Ramon Bengoechea, Consul-General of Guatemala, New York City.

Italy, Prof. Decio Vinciguerra, Director of the Royal Fish-cultural Station, Rome.

Japan, Dr. Tasaku Kitahara, Imperial Fisheries Bureau, Department of Agriculture and Commerce, Tokyo.

Mexico, Hon. José F. Godoy, Chargé d'Affaires ad interim, Mexican Embassy, Washington, D. C.

Peru, Dr. Robert E. Coker, Fishery Expert of Peruvian Government, Lima.

Roumania, Dr. Gregoire Antipa, Inspector-General of Fisheries, Bucharest.

Sweden, Dr. Oscar Fritiof Nordqvist, Superintendent of Fisheries, Lund.

German Fisheries Society, Dr. Walther Naumann, Lipsa, near Ruhland, Germany.

Royal Geographical Society, England, Mr. O. T. Olsen, Grimsby, England.

United States, Dr. Richard Rathbun, Assistant Secretary Smithsonian Institution and member of Permanent Commission of International Fishery Congresses, Washington, D. C.

[Moved and duly seconded that the nominations for vice-presidents be ratified.]

The PRESIDENT. Those in favor will signify by saying "Aye;" those opposed, "No." It is carried. The ratification will be duly recorded by the secretary.

I announce certain committees, and particularly a committee that will attend to the arrangement of the programme. There are about 100 papers that have been submitted, and naturally there is not sufficient time for the presenting of all these papers in extenso. The adoption of some scheme that will be satisfactory to the largest number, and an arrangement of the programme from session to session, has been found essential. This, it was thought, might well be delegated to a representative committee, which might consist of the following: Mr. Charles E. Fryer, Dr. Leonhard Stejneger, and the secretary-general. If these gentlemen will then kindly convene in this room at the time of the adjournment this morning, the first meeting of that committee can be held, provided the appointment meets with your approval.

Another committee—a committee on awards—will have a great deal of work to do. It was thought wise to have the committee on awards practically a number of small committees. The subjects for which awards have been arranged group themselves under five headings, and there will be announced at the session this afternoon those gentlemen whom we would like to have serve on the international committee on awards. At that time there will also be

given a full statement of the conditions under which these awards have been given and a list of the competitors.

For a committee on resolutions, these names are suggested: Prof. Edward E. Prince, Dr. Tarleton H. Bean, and the secretary-general.

Is there miscellaneous business to come before this meeting?

Dr. HENRY F. MOORE. There appears to be no other business to be presented. I therefore move that we adjourn, Mr. President, until 2 o'clock this afternoon, when the meeting will be held at the New Willard Hotel.

The PRESIDENT. Doubtless all understand that our regular place of meeting will be in the large banquet hall, on the top floor of the New Willard Hotel. Our headquarters will be there. At the anteroom you will find notice of the places at which you may receive your mail, in case it has been sent in care of the local committee. You will also find there some one who will act as interpreter and general adviser, and some one who will have charge of the local bureau of information. The meetings will be held promptly at the times announced. At 2 o'clock this afternoon the meeting will be called to order. We will now adjourn to meet at that hour.

Thereupon, at 12.05 p. m., the congress adjourned.

AFTERNOON SESSION, TUESDAY, SEPTEMBER 22.

NEW WILLARD HOTEL.

The congress was called to order by the president at 2 o'clock.

The PRESIDENT. The chair would make the following announcements:

With reference to the committee on awards, you will remember that the list of prizes has been printed and circulated, and there are some 18 prizes. The committee on awards will consist of the following subcommittees:

For prizes numbered 3, 7, and 8, Dr. Oscar Nordqvist, Dr. T. S. Palmer, Maj. Richard Sylvester, Dr. B. W. Evermann, and Dr. W. S. Harban.

For prizes numbered 1, 5, 6, 11, 14, and 15, Dr. Decio Vinciguerra, Dr. E. A. Birge, Dr. F. B. Sumner, and Dr. T. Kitahara.

For prize numbered 17, Dr. H. von Kadich, Dr. H. B. Ward, and Dr. R. E. Coker.

For prizes numbered 9, 10, 12, 13, and 16, Dr. P. P. C. Hoek, Mr. W. E. Meehan, and Mr. J. W. Titcomb.

For prizes numbered 2, 4, and 18, Dr. Gregoire Antipa, Dr. S. E. Meek, and Dr. F. W. True.

And I would request the chairmen of these respective committees kindly to apply to the secretary-general of the congress, Doctor Smith, by whom you will be given a list of the papers and the papers themselves that have been submitted to the congress in competition for these awards.

The committee on programme found themselves somewhat in doubt in regard to the wisest way in which to arrange the programme. It seems that we have two kinds of papers—some that are submitted in competition and some that are not submitted in competition. The committee on programme have felt that it was to the best interests of the congress to have the papers presented here irrespective of whether they were or were not offered in competition; and, feeling that they had the confidence of the members of the congress to the effect that they would be quite impartial in selecting papers for presentation, have decided, so far as their work is concerned, to arrange the programme for the successive sessions without respect to the question of competition. The question of competition is left to an entirely different committee or committees.

The committee on programme, moreover, have felt that it would be fair to all that the time limit for papers presented should be fifteen minutes, unless voted an extension by the congress. It was also felt that discussion would be stimulated if the time for those discussing the papers presented should, in the initial case, be limited to three minutes. Therefore, the chair will follow the instructions of the committee, unless it is instructed by the congress to the contrary.

The chair has been asked to make certain announcements.

All members of the congress who have not received invitations, cards, et cetera, to the President's reception, Secretary Straus's reception, the lecture at the National Geographic Society, and all other functions connected with the congress, should call at room 1001, the anteroom in the New Willard, to secure these cards of invitation; and I beg of you to keep in touch with room 1001. It is practically our headquarters between sessions.

The members of the International Fishery Congress and ladies are invited to be the guests of the American Fisheries Society at an informal lunch to-morrow at the Arlington Hotel, at 12 o'clock sharp. This is a lunch given by the American Fisheries Society, the society that adjourned yesterday in order that it might merge its meetings with yours.

The programme that has been submitted for the meeting this afternoon has been roughly outlined upon the blackboard. Mr. Olsen has consented to open the congress with his paper, "International Regulations of the Fisheries on the High Seas." Mr. Olsen, will you kindly come forward to the platform?

Mr. O. T. OLSEN (England). Ladies and gentlemen, I rather regret that I should be called upon so early to read the paper which I had prepared but not quite finished; and should it be disjointed I hope you will forgive me and let me down gently, for I have come a long way on short notice, and therefore have not been able to finish what I intended to do.

The paper relates to a very extensive subject, and to do justice to it here would take up considerably more time than we shall be able to afford, as there

are many speakers to come after me. I think the best plan will be to begin with the territorial waters or sea-fishery limits.

[Mr. Olsen's paper appears on pages 77–82.]

The PRESIDENT. Mr. Fryer has consented to open the discussion on this paper—the initial paper of the congress.

[Mr. Fryer's remarks appear on page 83.]

The PRESIDENT. I am sure all Americans feel with me the great sense of gratification that it is to be permitted to listen to and to meet those with whose work we are so familiar, but with whom we have not heretofore had the privilege of personal acquaintance. I feel like thanking personally both of the gentlemen that have opened the discussion, and I am sure that we all feel the same way about it.

The paper that has been presented is now open for general discussion. Are there any contributions from the floor?

[Dr. B. W. Evermann thereupon addressed the congress in continuation of the discussion. His remarks appear on page 85. Mr. A. Kelly Evans followed, and his remarks appear on page 87.]

The PRESIDENT. Are there others who will contribute to this discussion?

[Mr. John J. Pew then spoke on the regulation of beam trawling, and his remarks will be found on page 88. The discussion of the same subject was continued by the president, Doctor Hoek, Mr. North, and Mr. Fryer, whose remarks appear on page 89.]

The PRESIDENT. We are still discussing the first paper on the programme. Are there others who will contribute to the discussion?

Mr. C. H. WILSON (New York). Mr. President, I would like to get into this discussion for just a minute.

[The remarks of Mr. Wilson on the condition of the fisheries of the Great Lakes are given on page 89. He was followed by Mr. Henry Hinrichs, who spoke on the same subject and whose statements may be found on page 90.]

The PRESIDENT. Are you now ready to proceed with the second paper? Is Professor Prince here, please? Will Professor Prince rise? [No response.] Then the next paper is one to be submitted by Mr. Hathaway. The paper is entitled "Effects of Menhaden Fishing upon the Supply of Menhaden and of the Fishes that Prey upon Them," by Walter E. Hathaway, of Whitestone, Virginia.

[Mr. Hathaway's paper is printed on pages 269–277, and was briefly discussed by the president and Dr. Hugh M. Smith. See page 277.]

The PRESIDENT. The secretary has one or two announcements to make.

The SECRETARY-GENERAL. I desire to call attention to a typographical error in the invitation card to the moving pictures which will be displayed by courtesy of the New England Forest, Fish, and Game Association. The card reads "September 26th," but is intended to read "September 22d." The function is this evening.

These very beautiful bouquets that decorate our desks have been presented by the exceedingly efficient chairman of our local entertainment committee, and are sent to this meeting with the compliments of the White House, with the further request that they be given to the ladies in attendance when we adjourn. [Applause.]

I have great pleasure in reading this cablegram from Prof. Dr. Franz Steindachner, the president of the Third International Fishery Congress, dated Vienna, September 22:

"An old lover of fishes regrets his absence and sends best wishes." [Applause.]

[The congress took a recess of five minutes, after which the discussion of Mr. Hathaway's paper on the menhaden was resumed, and Mr. Cooper and Mr. George P. Squires spoke. Their remarks appear on page 278.]

The PRESIDENT. Is Doctor Coker here? [No response.] Then is Dr. I. A. Field here? [No response.] Then Dr. George W. Field, of the Massachusetts Commission, who has spent a great deal of time on the various problems connected with the lobster.

[Doctor Field spoke on "Lobsters and the Lobster Problem in Massachusetts." His remarks are given in full on pages 209–212. The discussion which followed (see p. 213–217) was participated in by the president, Mr. H. T. Root, Mr. W. H. Boardman, Mr. James Donahue, Mr. Fryer, and Dr. George W. Field.]

The PRESIDENT (at the conclusion of the discussion on lobsters). Are there other contributions? If not, I will read a communication that has been received by the Rhode Island Commission of Fisheries from Robert Aldrich & Co., fish trappers and trawlers, of Wickford, Rhode Island. The letter is dated September 18, 1908, and is as follows:

It is our belief that the continual firing for a week of the heavy guns at Fort Greble has a serious effect on the squeteague fishing in West Bay. Last June the squeteague were entering the bay just before the militia went to the forts, and for some few days we had good fishing. As soon, however, as the firing commenced at Fort Greble the catches became very much smaller and by the end of the week we got very little. We can not prove, of course, that the firing was the cause of this, but we believe that it had a good deal to do with it. We do know that a school of menhaden in the vicinity of Dutch Island will "shower" every time a big gun is fired. Squeteague enter the bay in large schools and they must pass close to Dutch Island. The militia go to the forts every year just as the squeteague are at the height of their run, and we think the steady firing has a tendency to drive them back and out of the bay. After the fish have got by the forts and are well distributed in the bay the firing would probably have little effect—that is, about August 1. We have it on pretty good authority that in one of the large bays in Ireland the fishing has been very poor for a number of years since the battle ships have had their target practice there, while in the other bays the fishing has been normal. We write this hoping that perhaps the question may be discussed and more facts discovered at the coming fishery congress.

The PRESIDENT. Perhaps some of the members present have information in regard to the effect of heavy firing upon fish.

Mr. HATHAWAY (Virginia). Mr. President, I would like to make a statement in regard to that. A year or two ago our fleet came up into the Chesapeake Bay and made their headquarters off Tangier Island, about the center of our menhaden fishing. This we believe to be a positive fact, indicated by what we saw and experienced. They were practicing, and our fishing was around within 10 miles; and every day the fishermen would find a school of fish—as the menhaden are a surface fish—and away would go one of those guns and down the fish would go, and not a fish for the poor fisherman. And many of our friends know what kind of oaths our fishermen utter under those circumstances. [Laughter.] We believe, judging from our fleet, according to the estimated catch of the fish by the number of vessels we had at work, that by that fleet coming and practicing for a few weeks, $4,000,000 loss was sustained in our state. It is a fact that the fleet drove every fish away as fast as every gun would go. The fish had just come up there and the fishermen had just got among them, and they absolutely drove away every fish from us; so much so that we petitioned through our Representative in Congress that they withdraw the fleet from our grounds, and I am very proud to say that they did.

The PRESIDENT. May I ask some one in the Bureau of Fisheries whether the government is now making any observations with reference to the effect of gun practice?

Dr. FRANCIS B. SUMNER (Woods Hole Laboratory, Massachusetts). We have some data on that subject—unfortunately not nearly as much as we could have wished for. Nearly all that I shall say is on the authority of Prof. G. H. Parker, who, as many of you know, is a well-known student of animal physiology, and especially a student of the physiology of the sense organs and of reactions to stimuli. Professor Parker several years ago made some investigations in the endeavor to answer the question, Do fishes hear? As many of you may know, there has been a good deal of difference of opinion as to whether fishes hear at all. It was claimed at one time that fishes could hear even such sounds as the shouting of persons on shore, or in a boat, or even the ringing of a bell. There is that classical story, which perhaps some of you have heard, of the monastery in Europe, where a bell was rung periodically and the fishes came up to get their food. A scientist—I do not recall his name—took the trouble to investigate the report and found it to be quite correct. He looked a little further, however, than the ordinary observer, and he found that what the fish really did was to respond to the sight of the approaching person, and not at all to the sound of the bell. The bell had nothing to do with it.

Professor Lee, of Columbia University, also made some experiments upon the hearing of fishes more than ten years ago, and his conclusion was entirely negative. While he granted, of course, that the obvious auditory organ or organs which exist in the ear region of a fish are there for a purpose—in other words, that they have a function—this function he did not believe to be hearing.

Professor Lee came to the conclusion that his fishes did not hear, so far, at least, as he could get any responses from them. Professor Parker, however, working a few years ago in the employ of the Bureau of Fisheries at our laboratory at Woods Hole, proved pretty definitely that certain fishes, at least, did respond to sound stimuli. He put fishes into a moderately small tank in the laboratory and had an apparatus contrived by which he could transmit sound vibrations which would shake the tank and thus the water. By this means he could virtually eliminate mechanical stimuli, and yet allow the fishes to be affected by stimuli which were rapid enough to produce in ourselves auditory sensations. Professor Parker's results led him to believe that fishes could hear to a limited degree. He worked chiefly on a certain small noncommercial fish known as the "killifish" or "mummichog" (*Fundulus heteroclitus*); also on the squeteague, or weakfish.

Now, when this question came up recently as to whether the battleships actually did disturb the fishes on our coast, as has been alleged pretty vociferously in certain quarters, and also whether the motor boats disturb these fishes, naturally the man to whom the Bureau of Fisheries turned for information was Professor Parker. The original intention was that Professor Parker should carry out some experiments with the cooperation of the Navy Department—that is, the Bureau had correspondence with the Navy Department, and an arrangement was made, which, however, unfortunately miscarried. We sent a boat down to the vicinity of No Mans Land, off Marthas Vineyard, where this firing was to take place, but the battleship was not there at the time. Since then other propositions have been made by the Navy Department, and we might perhaps have made an arrangement with them, but the thing was otherwise not practicable at the time. We are in possession, however, of the following data: We had in Woods Hole Harbor this summer one of the large revenue cutters, the *Gresham*. Those cutters, as you know, are, of course, provided with nothing like such heavy guns as are the naval vessels, but still with good big guns, which, at short range, make a concussion unpleasant to people in the neighborhood of them, and, of course, a very loud sound. Professor Parker went across Woods Hole Harbor with his fishes. The gun was pointed at him, firing, of course, a blank charge, and he made observations. The fishes were placed in a little pen of netting, which was floated on the surface of the water. Doctor Parker is so accustomed to observing the reactions of these fishes to stimuli that he would naturally detect even very slight effects, which might not be noticed by a less skilled observer. He took out several kinds of fishes for this experiment. He tried them, first, at a distance of perhaps 300 or 400 yards; next somewhat closer than that, and, finally, almost directly underneath the guns of the vessel. There were absolutely no responses noted on the part of any of these fishes. That, of course, does not prove what a naval

vessel might do; but what a revenue cutter could not do in that line at a distance of 50 feet it is not likely a naval vessel could do a mile or even a quarter of a mile away.

As to the motor boats, Professor Parker got exactly the same results. He used some surface-living fishes, the mackerel among others. This is one of the fishes which, it was alleged, were disturbed most by these noises. So he had fishermen go around with a motor boat, with the discharge out of the water, and also with it turned under the water. In the latter case the sound is "muffled" to our own ears, and yet, of course, strong vibrations must pass into the water and would presumably affect the fish more under those conditions if there was any effect at all. In these experiments, also, there was no response whatever. If the motor boats came near enough and the mackerel saw them, why, "down they went," as the gentleman here has described; but if the motor boats did not come within sight of the fish, but merely made the sound under the water, there was no response whatever.

Of course, these results are not conclusive. It is desired to try these experiments with large guns; but so far this has not been practicable. In the meantime, however, I thought that these conclusions might be of some interest.

The PRESIDENT. What are your wishes in regard to this communication from Messrs. Aldrich & Co.?

Mr. HENRY T. ROOT (Rhode Island). I do not know what has been the experience of the members of this congress generally, but in our section we are having a considerable number of complaints about the firing of the great naval guns, and I am glad the subject has come up. I move that this whole matter be referred to a committee to be appointed by the chair.

The PRESIDENT. You have heard the motion. Is the motion seconded?

Mr. L. L. MOWBRAY (Bermuda). In the Bermudas we have made some experiments with that, and we think it is really due to explosive shells exploding very close to the surface of the water. They found many dead fish. It is a well-known fact that such explosions greatly disturb fish.

The PRESIDENT. The motion has been made and seconded that this matter be referred to a committee. Those in favor of such reference will please signify by saying "Aye;" contrary minded, "No." The motion is carried. I appoint Messrs. Root, Smith, and Sumner.

I am asked by the secretary to make the announcement that the several committees on award, by referring to the secretary at the conclusion of this session, will be given certain papers that have been submitted in competition.

Shall we continue with other papers—it is now 5 o'clock—or shall we adjourn for this afternoon? If the chair hears no motion to adjourn, he will continue.

Adjournment was taken, with announcement of an informal meeting at the National Geographical Society building at 8 o'clock in the evening.

At 8 o'clock p. m., at the invitation of Mr. Richard E. Follett, vice-president and manager of the New England Forest, Fish, and Game Association, the members proceeded to the hall of the National Geographic Society and witnessed an exhibition of motion pictures of fishing, hunting, and logging scenes, some of which had never before been displayed.

MORNING SESSION, WEDNESDAY, SEPTEMBER 23.

NEW WILLARD HOTEL.

The congress was called to order by the president at 9.45 o'clock.

[After calling for Prof. E. E. Prince and Dr. I. A. Field, who did not respond, the chair recognized Chevalier Guido Rossati, who spoke on "Economic Conditions of the Fisheries in Italy." Mr. Rossati's remarks appear in full on pages 323–332.

Dr. Tasaku Kitahara then read a paper entitled "The Fisheries of Japan, Considered from the Geographical Standpoint." This paper will be found on pages 375–379.]

The PRESIDENT. The paper of Doctor Kitahara is open for discussion. Are there questions to be asked in regard to the fisheries in Japan? Are there experiments that have been made that we can profit by? If the paper is not discussed, I will then ask for the next, a paper by Mr. Charles H. Stevenson; and in introducing Mr. Stevenson I would like to present to the congress a book that has recently appeared, of which Dr. George F. Kunz and Mr. Stevenson are joint authors. This book will be placed on the table here for inspection. It is entitled "The Book of the Pearl," and it is bound in form appropriate to the contents. It is a most beautiful volume.

[Mr. Stevenson dealt with "Preservation of fisheries on the high seas," reading extracts on this subject from his paper on "International Regulations of the Fisheries of the High Seas," which appears in full on pages 103–178.]

The PRESIDENT. The paper that you have listened to is now open to discussion.

[The paper was thereupon discussed by Mr. Olsen and Mr. Fryer, for whose remarks see pages 179 and 180.]

The PRESIDENT. Are there others who will speak on this most interesting topic? I imagine that we have discovered this morning an authority for a forthcoming work on piscicultural jurisprudence. If there are no others to speak on this matter, I will call for another paper that bears upon the subject, by Mr. Dennis.

Mr. OREGON MILTON DENNIS (Baltimore, Maryland). Possibly a word of explanation, Mr. President and ladies and gentlemen, is due at this time, in view of the fact that the paper which I have prepared was intended to be delivered before the American Fisheries Society. When I arrived in Washington yesterday I found that for the time being, at least, the American Fisheries Society had been absorbed by this congress; and I therefore thank you, gentlemen, for this opportunity, in view of those facts.

Another word: The views which I shall express are not those as a representative from my association, nor from my state, nor from the fact that I have been the state warden of Maryland. They are views gathered from experience in filling those various offices. I make that explanation because I want to stand personally responsible.

[Mr. Dennis's paper appears on pages 187–192.]

The PRESIDENT. Are there comments upon this paper? Is Doctor Sumner present? [No response.]

The remaining papers for this morning are papers that will be illustrated by the lantern. Doctor Sumner will deliver the first paper and Mr. Townsend the second paper—the first upon certain biological survey work that is being carried on at the station at Woods Hole under Doctor Sumner's direction, and the second paper, a most interesting one, giving illustrations that were taken in the field by Mr. Townsend, showing the appearance of the seal islands off the Alaskan coast, the behavior of the seals, the methods of capture, and so on. I am sure all members of the congress will wish to stay this morning until 12 o'clock to listen to these two papers. While we are waiting for Doctor Sumner, however, there are certain announcements I have been requested to make.

The chairmen of the respective committees on awards are asked to meet immediately after luncheon to-day at the Arlington at such place as may be indicated by Professor Birge. Professor Birge will be at the Arlington, and will arrange with the various chairmen for a joint session—not any other committees, but the committees on awards. I beg that the chairmen of these committees will confer with Professor Birge during the luncheon hour at the Arlington.

Of course, you understand that members of the International Fishery Congress and ladies are invited to be the guests of the American Fisheries Society at an informal luncheon at the Arlington at 12 o'clock sharp.

I have received a request through room 1001 to the effect that the members and those regularly attending these meetings will please register. It is very important that those who are identifying themselves with this congress should leave their names and addresses; otherwise it is impossible for the local committee to reach you with invitations and with announcements. At the conclusion of this session will you tarry long enough to register at room 1001?

I have also been requested to announce that the only members who are exempt from the payment of dues in this congress are those officially appointed from the foreign governments and the United States Government. A list of these officially appointed members appears on the programme. By some error it was suggested that those connected with the Bureau of Fisheries and not officially appointed by the United States Government were exempt from dues. I am asked to state that those who are employees of the Bureau of Fisheries will have the privilege of paying their dues. [Laughter and applause.]

To regulate the various congresses, of which this is the fourth, it is necessary that an international commission shall be convened. This commission will meet this afternoon at 1.30, after luncheon, in the Arlington Hotel, where the luncheon is served; and Doctor Smith will kindly read the names of those who are members of this international commission that will provide for the next meeting of the congress.

The SECRETARY-GENERAL. I will explain, Mr. President and gentlemen, that this Permanent Commission of the International Fishery Congresses has been appointed for the purpose of looking after the affairs of those congresses in the interim between the regular meetings; and it has as regular members persons selected from countries which have regularly participated in previous International Fishery Congresses. However, owing to the absence of a number of those members, representatives of countries not officially represented here have been invited to act with this permanent commission, and this is the list as decided on: Austria, Dr. Heinrich von Kadich; Brazil, Lieut. Radler de Aquino; Canada, Prof. E. E. Prince; China, Mr. Chang Po Ling; Great Britain, Mr. O. T. Olsen; Germany, Dr. Walther Naumann; Holland, Dr. P. P. C. Hoek; Italy, Dr. D. Vinciguerra and Chevalier Guido Rossati; Japan, Dr. T. Kitahara; Mexico, Mr. José F. Godoy; New Zealand, Mr. H. Stephenson Smith; Peru, Dr. Robert E. Coker; Roumania, Dr. Gregoire Antipa; Sweden, Dr. Oscar Nordqvist; United States of America, Dr. Hermon C. Bumpus, Dr. Richard Rathbun, and Dr. Hugh M. Smith.

The PRESIDENT. I have been requested to suggest that brief abstracts of papers—that is, abstracts that will indicate the contents of the papers—be prepared and handed to Doctor Moore. A great many requests have been received from the press and from individuals asking for the substance of the papers, somewhat more extensive than is given by the title alone. What is requested is a brief statement, in writing, of the substance of the papers that are to be presented, those abstracts to be left, if you please, on the secretary's desk or given directly to Doctor Moore. Is Director Townsend present?

A MEMBER. He is in the audience, Mr. President.

The PRESIDENT. With Doctor Sumner's consent, as it is a little late now, we will call for Doctor Sumner's paper at another session, and ask Director Townsend to present his paper, which is fully illustrated with lantern slides,

and on the conclusion of Director Townsend's paper we will proceed to the Arlington Hotel for luncheon.

Mr. Follett states that in view of there having been a large number of applications, or, perhaps, regrets, on the part of members of this congress that they were not fortunate enough to see the extraordinary exhibition of moving pictures last evening at the Geographical Society building, those pictures will again be put on the screen this afternoon at 5 o'clock at the same place, so that if you or your friends wish to come at 5 o'clock this afternoon you will be quite welcome.

The chair has been asked the duration of the touring trip this afternoon. It will consume practically two hours, the party leaving at 3 and returning about 5 o'clock.

The only other item on the programme this morning is the paper by Director Townsend, and I will ask Mr. Townsend to come to the platform.

Mr. CHARLES H. TOWNSEND (Director New York Aquarium). Mr. President and members of the congress, I shall take up only a few minutes of your time with this old story of the fur-seal fisheries; it is an old story to a great many of the officers of the Bureau of Fisheries in Washington. I suppose I can give you a very condensed account of it in about fifteen minutes, and then it will take about ten or fifteen minutes more to show you a few lantern slides I have brought along.

[For this paper see pages 315–322.]

On the conclusion of Mr. Townsend's paper, at 12 o'clock, the congress adjourned, and the members proceeded to the Arlington Hotel, where a complimentary luncheon was tendered by the American Fisheries Society.

WEDNESDAY AFTERNOON, SEPTEMBER 23.

RECEPTION BY THE PRESIDENT OF THE UNITED STATES, AT THE WHITE HOUSE.

The members of the congress and accompanying ladies assembled at the White House, and at 2.30 o'clock were received by President Roosevelt in the East Room. The President greeted the members as follows:

LADIES AND GENTLEMEN: I shall not try to make you any address, because I am to have the pleasure of shaking hands with each of you. I shall simply say what a pleasure it is to me to greet you here. I have grown to feel more and more that the problem of the conservation of natural resources is the great material problem before modern nations. Savages, barbarians, semicivilized people, and a good many civilized people do nothing but waste natural resources, and it is our business as we become more civilized to try to conserve them. That applies exactly as much to fisheries as it does to forests. One of the problems that will come up in connection with our treaties with foreign nations hereafter must be the arrangement of a method of preserving international fisheries—such fisheries as those in Lake Erie and Puget Sound. It is an outrage

to leave them to be squandered so that our children shall lose all benefit from them, and some method must be devised by international agreement for preserving them.

I am glad to have the opportunity of seeing you.

Each of the members was then presented to President Roosevelt by the secretary-general.

Following the President's reception a group photograph of the delegation was taken on the west portico of the Treasury Department building.

The remainder of the afternoon was spent in an automobile tour of the city for sight-seeing.

At 7.30 o'clock p. m., the members visited the Library of Congress in special cars, and were received by officials of the Library.

MORNING SESSION, THURSDAY, SEPTEMBER 24.

NEW WILLARD HOTEL.

The congress was duly called to order by the president at 9.50 o'clock.

The PRESIDENT. There are here on exhibition a few specimens that were submitted in competition for one of the prizes. These three specimens are submitted by one competitor. Here [indicating] is another specimen that is submitted by another competitor. I hope at your convenience you will examine them.

Are there matters of business to come before the congress? Upon the blackboard are listed the papers that will be presented to-day, and as far as possible they will be called for in that order. Of course, there are some gentlemen who have been unable to get their papers back from the committee on awards. We will now call for the first paper, as announced on the board. Dr. W. W. Yen is to present a paper on "The Fisheries of China." Doctor Yen, will you please come to the platform?

[This paper will be found on pages 367–373.]

The PRESIDENT. I think if we had come here merely to listen to this one paper we would have been repaid. As an indication of the progress in China, not only have we listened to this paper—this astonishing paper—but China has also delegated six persons to attend this congress, four of whom you must have noted are in constant attendance. The discussion of this paper and the presentation of other matter bearing upon the progressive attitude that China is taking in regard to the fisheries will be undertaken by Mr. Chang Po Ling, who is the special commissioner from Tientsin.

[Mr. Chang, however, asked to be excused, as having had little experience in public speaking.]

The PRESIDENT. At this hour, with your permission, I would ask to be relieved of occupying the chair, and will Doctor Hoek kindly take it?

[Whereupon Vice-President P. P. C. Hoek took the chair.]

Dr. HERMON C. BUMPUS. Mr. President, on behalf of Doctor Mead, who has been working for a number of years upon the problems connected with the propagation of the lobster, I would like to present informally to this congress reports upon his work, which are submitted in this substantial manner [showing manuscript and illustrations], and which I trust certain members who are interested in this work will examine.

[Doctor Bumpus then gave an abstract of the two papers by Dr. A. D. Mead, "A Method of Lobster Culture" and "A New Principle of Aquiculture," which are given in full on pages 219–240 and 759–780.]

Vice-President HOEK. Gentlemen, in the absence of Doctor Mead, I think we owe great thanks to Professor Bumpus for the excellent way in which he has given us a summary of these most interesting papers. I may say it, because they belong to a group of papers submitted to a committee of which I have the pleasure and honor to be chairman—the committee on awards. Of course, it would be entirely indiscreet to tell you about the conclusion to which that committee will come; at the same time, I am perfectly at liberty to say that we have at the present moment a very high regard for these excellent papers, not only for the contents but also for the excellent way in which these papers have been prepared, and the most excellent photographs and illustrations which are added to them. So, gentlemen, perhaps it will be of use to have them circulated among you, and, by all means, if the gentlemen wish to review them it will give me great pleasure to hand them over.

Before proceeding, the secretary-general is to give you a short announcement.

The SECRETARY-GENERAL. The office of the congress has received through our State Department communications from practically all of the governments of the earth in regard to their participation in this congress. Among the absentees which we particularly regret is Russia, a country which has such important fisheries and fishery resources. We have received only this morning through our State Department a communication from the American ambassador at St. Petersburg, in which he states that the foreign office has just advised him that they can not be represented at this congress, since they have but two fishery experts, Doctor von Grimm, who is an old man and can not get ready in time, and Mr. Borodine, who has just completed a term in prison for signing the Viborg manifesto, and whom they are unwilling to send on such a mission at this time. [Laughter.]

Vice-President HOEK. We next come, gentlemen, to a paper by Mr. Charles G. Atkins, Superintendent of the Fisheries Station at East Orland, Maine, entitled "Foods for Young Salmonoid Fishes." Is Mr. Atkins present?

Mr. CHARLES G. ATKINS. Mr. President and members of the Fishery Congress, I have a paper here on food for young salmonoid fishes. I much regret that the time at the disposal of the congress does not allow me to read this in full, as in the abstract that I shall give you I shall be obliged to omit a great

many statements that appear to be important and which I think might be interesting to you, but I shall endeavor to give you the gist of it and the most important points.

[Mr. Atkins then presented his paper, which appears on pages 839–851.]

Vice-President HOEK. I now open the discussion on the beautiful lecture we have had from Mr. Atkins. Does anyone wish to ask questions of Mr. Atkins, or to communicate something in relation to the subject? If not, then it only remains as my duty to extend to Mr. Atkins thanks for his excellent paper.

I think we now come to the paper of Mr. L. F. Ayson, of New Zealand, which will be read by Mr. H. Stephenson Smith.

Mr. H. STEPHENSON SMITH (New Zealand). I very much regret that we are unable to hear the gentleman who is the author of this paper, Mr. L. F. Ayson, Superintendent of Fisheries at Wellington, New Zealand. I think a great many of the members know him, and know him to be a very able man. I regret that he is not here to read it.

[Thereupon Mr. Ayson's paper on "The Introduction of American Fishes into New Zealand" was read. This paper is printed on pages 967–973, and is followed by remarks of Mr. H. Stephenson Smith on geographical features of New Zealand.]

Vice-President HOEK. Ladies and gentlemen, you all heard the interesting paper of Mr. Ayson, as it was read by Mr. Smith, and now perhaps Mr. Smith is willing to give further information, if some of the members desire to ask questions.

Mr. SMITH. I will have much pleasure in giving any information I can.

Vice-President HOEK. Should any of you wish to ask Mr. Smith questions regarding this paper of Mr. Ayson, he will gladly respond. You heard from him that it is not his paper, but that of the Superintendent of Fisheries for New Zealand.

[Mr. John W. Titcomb and Prof. Edward E. Prince discussed the paper. See page 974.]

Dr. T. KITAHARA (Japan). The Congress may be interested in the results of the transplanting of American fishes into the waters of Japan. For this we owe much to the kindness of the American authorities. First of all in 1877, 10,000 eggs of the rainbow trout were transported to the Bureau of Agriculture, Tokyo, through the kindness of the fish commissioner of California. It is believed that this was the first transplanting to another country ever tried with that species. About half the number of the eggs sent died on the way, the remainder were taken to Mr. Sekizawa's home, and hatched in the water of the well near his house. The resulting fry were liberated in a small pond in the suburb of Tokyo. As the fish grew larger the pond became too restricted, so the fish were again transferred to another larger pond. In 1879, 20,000 eggs were procured from 5 fish, hatched, and distributed to the lakes at Nikko and Wakamatsu (Aiza). Ten years afterwards

(1887), 4,000 fry of the same species were liberated in the lake at Nikko, and recently, in 1907, 200,000 fry brought from America in the form of eggs were put into the same lake.

Vice-President HOEK. We had better go on at once to the next paper. If I am reliably informed, we shall have considerable discussion on the whitefish production of the Great Lakes. May I ask whether Mr. Frank N. Clark, Superintendent of the Fisheries Station at Northville, Michigan, is present? Will you now give us the pleasure of hearing your paper, sir?

Mr. FRANK N. CLARK. Mr. President, ladies, and gentlemen, having received a communication from the secretary-general of this congress requesting me to prepare something upon a subject which comprises the study and labor of the past forty years of my life, and realizing that the papers which would be submitted at this meeting for your thought and consideration would be innumerable, I have concluded that a mere outline of my plan for the promotion of the whitefish industry of the Great Lakes is the most that would be proper for me to submit to you on this occasion. In preparing the following paper I was not unmindful of the desirability of eliminating, in so far as possible, complicated and tiresome matter.

[Mr. Clark then read his paper, "A Plan for Promoting the Whitefish Production of the Great Lakes," which appears on pages 635–642.]

A MEMBER. There are two more papers on this subject. Each one advocates an open season during the spawning season of the whitefish, and each one proposes remedies very similar to those of Mr. Clark. I therefore move, sir, that before having any discussion on this paper the other papers be read.

[The motion was duly seconded and carried.]

Vice-President HOEK. I have the pleasure now to say that the paper of Mr. S. W. Downing, superintendent of the United States Fisheries Station at Put-in-Bay, Ohio, will be read by Mr. Titcomb.

[Mr. Downing's paper appears on pages 627–633.]

Vice-President HOEK. Professor Ward, will you be so kind as to read for us the paper of Mr. Paul Reighard of the University of Michigan, Ann Arbor, Mich., on this same subject?

Prof. HENRY B. WARD. I have, Mr. President and gentlemen, been requested to read the paper by Mr. Reighard on a plan to promote the whitefish production of the Great Lakes. It is my intention, even at the risk of doing the paper injustice, to present merely a few words of the introduction and the conclusions.

[The paper of Mr. Reighard was then read in abstract, and appears in full on pages 643–684.]

Vice-President HOEK. Gentlemen, we have had three papers on that interesting question, the promotion of the whitefish production of the Great Lakes, and it is understood that the discussion of the question shall take place in the afternoon; and I have now the pleasure of calling on Mr. J. W. Titcomb, the

chief of the division of fish culture, United States Bureau of Fisheries, to give us his lecture on American fish-cultural methods.

A MEMBER. While the lantern is being made ready, I would make the announcement that the chairmen and secretaries of the several committees on award are requested to meet on this side of the room immediately following the lecture.

[The lecture of Mr. Titcomb was then delivered. It will be found on pages 697–757.]

Vice-President HOEK. Three cheers for the Bureau of Fisheries, and our thanks to Mr. Titcomb for his very interesting exhibit and explanation.

Thereupon, at 12.45 p. m., the congress adjourned to meet at 2.30 p. m., and the members were tendered a complimentary luncheon at the New Willard Hotel by the Blue Ridge Rod and Gun Club.

AFTERNOON SESSION, THURSDAY, SEPTEMBER 24.

NEW WILLARD HOTEL.

The congress was called to order by the president at 2.30 o'clock.

The PRESIDENT. The time has come for our afternoon session. I shall first call for the report of the international commission which is in charge of the affairs of the congress. Doctor Smith, secretary-general, will present the report.

Doctor SMITH. Mr. President, ladies, and gentlemen, a meeting of the Permanent Commission of the International Fishery Congresses was held yesterday, the 23d of September. The members of this commission in attendance were Messrs. Bumpus (chairman), von Kadich, Vinciguerra, Rossati, Antipa, Nordqvist, de Aquino, Olsen, Naumann, Godoy, Bengoechea, and H. M. Smith (secretary).

Doctor Vinciguerra presented an invitation from the Italian Fisheries Society to meet in Rome in 1911, on the occasion of the fiftieth anniversary of the Italian Federation. An invitation was likewise received from the mayor of Rome. The commission unanimously accepted the invitation and agreed to report the same to the congress for final ratification.

Dr. Walther Naumann, representing the German Fisheries Society, announced that at the next congress an invitation to meet in Germany would be formally presented.

The proposition of Mr. Nicholas Borodine for an international dictionary of fishing and fish-cultural terms was indorsed, and the secretary was instructed to bring the matter to the attention of the congress, with a favorable recommendation to the committee on resolutions.

After some further business that need not come before the general congress, the commission adjourned.

The PRESIDENT. You have heard the report of the secretary of this commission. A motion to adopt the report is in order.

A MEMBER. I move, sir, that the report be adopted.

The PRESIDENT. The motion has been made favoring the adoption. Is this motion seconded?

[The motion was duly seconded.]

The PRESIDENT. The matter is now open to discussion. Are there those who wish to discuss this report? If not, the motion will be put.

[The motion was duly carried.]

The PRESIDENT. Are there other matters to come before the congress?

Doctor VINCIGUERRA. I am sorry that I can not well explain in English my deep gratification and that of my country in realizing that the congress has agreed to accept the invitation of the Italian Fisheries Society; and I am sure that the members of the congress in Italy will be found in accord in a reception, if not so great as in America, as kind and as friendly as that we have had here. [Applause.]

The PRESIDENT. I am asked to convene the committee on resolutions. The committee on resolutions will meet immediately after this afternoon session, and the members of that committee I shall again announce, so that there may be no misunderstanding. They are Prof. Edward E. Prince, Dr. Tarleton H. Bean, and the secretary-general.

Is there other matter for consideration, Mr. Secretary?

The SECRETARY-GENERAL. The office is in receipt of a cablegram from the Uruguay Lobos Fishing Company, involving a matter which had probably better be referred to the committee on resolutions, but which it might not be out of order to read:

LONDON, *September 24, 1908.*

SECRETARY INTERNATIONAL FISHERY CONGRESS,
Washington.

Considering the terrible slaughter of seals due to poaching, would the congress see their way to include the question of pelagic sealing in their deliberations, as, if seals are not protected by international agreement, the species will disappear within very few years.

URUGUAY LOBOS FISHING COMPANY.

The PRESIDENT. A second communication has been received.

The SECRETARY-GENERAL. This is from Mr. Edward Hatch, jr., and reads as follows:

NEW YORK, *September 23, 1908.*

INTERNATIONAL FISHERY CONGRESS,
Washington, D. C.

Please do not fail in your deliberations to call attention to the great damage done the fish industry by sewage and manufacturing wastes.

EDWARD HATCH, Jr.

The PRESIDENT. What is your wish in regard to these two important communications that have come to us by wire? Ordinarily they would be referred to the committee on resolutions.

[A motion to this effect was made, seconded, and carried.]

The PRESIDENT. Is there anything more, Mr. Secretary? If not, the next item on the programme is the discussion of the whitefish question. I have been informed that this is a rather important matter everywhere; and the chair, in view of the large number who will probably speak upon the question, will apply rather severely the instructions which he has received in regard to the limitation of the time taken by various disputants. We want a large number to speak, but the time is three minutes, unless the chair is otherwise instructed.

It is also suggested that this discussion may be a rather long one, and it might be wise to place a limit upon the total amount of time that we shall give to the first item on the programme. Is anyone prepared to make a motion that the time assigned to this question, namely, the whitefish production of the Great Lakes, shall be limited?

A MEMBER. I move that a limitation of forty minutes be placed on the entire discussion.

The PRESIDENT. The motion is made that the time for the entire discussion be limited to forty minutes. Are there any who approve? Are there any who object to this limitation?

A MEMBER. I hope that this motion will not prevail. It is one of the most important questions to come before this congress, and I think three minutes given each speaker ought to be sufficient limitation without any further restriction.

The PRESIDENT. The chair hears no second to the original motion. If the motion has not been seconded, there is no need of our taking action thereupon. We will proceed to the discussion of the whitefish question.

[The subject was discussed at length by Prof. Edward E. Prince, Mr. C. H. Wilson, Hon. Paul North, Mr. A. Kelly Evans, Dr. Barton W. Evermann, Dr. Tarleton H. Bean, Mr. Charles E. Fryer, Mr. Frank N. Clark, Mr. John W. Titcomb, Mr. William E. Meehan, Mr. Seymour Bower, Prof. E. A. Birge, Mr. W. T. Thompson, Mr. J. J. Stranahan, Mr. Samuel F. Fullerton, and Mr. Dwight Lydell. The remarks of these members will be found in the order given, the discussion beginning on page 685.]

The PRESIDENT. Are there others who wish to contribute? If not, the discussion will be closed. Unless there is objection to closing, we shall call for the paper by Dr. P. P. C. Hoek, upon the Rhine salmon. [Applause.] Professor Prince, will you kindly take the chair as vice-president? [Applause.]

[Thereupon Prof. Edward E. Prince took the chair.

Doctor Hoek then read his paper entitled, "Propagation and Protection of the Rhine Salmon," which appears on pages 817–829.]

Vice-President PRINCE. I am sure you will bear out the policy of the chair in not rigidly limiting Doctor Hoek, but giving him as much time as we could reasonably allow, because this paper, like every memoir with which

Doctor Hoek has favored the piscicultural world, is so full of real worth that it would have been a pity to omit any part of it.

I have no doubt there are some present who have some questions to ask. Now will be the opportunity for any comments or questions, but I must warn the congress that the observations must be very brief.

[The paper was briefly discussed by Prof. E. E. Prince and Doctor Hoek, whose remarks appear on page 829.]

Vice-President PRINCE. Gentlemen, as the time is passing rapidly and there seem to be no questions on this paper of Doctor Hoek, although we appreciate it very much as a valuable paper and record of personal observations, we shall proceed to the next, by Mr. W. S. Kincaid, who is to read a paper on "New Methods of Transporting Eggs and Fish." Is Mr. Kincaid present? [No response.] In the absence of Mr. Kincaid, we shall have to proceed to the next paper. The secretary-general will read a paper by Professor Matsubara.

The SECRETARY-GENERAL. Mr. President and gentlemen, this paper by Prof. S. Matsubara, on "Goldfish and Their Culture in Japan," is of great interest to many people, but I do not know that we have the time or opportunity to read it in extenso. I should certainly like to call attention to the contents of the paper and exhibit some of the admirable colored paintings which accompany it. Professor Matsubara is the Director of the Imperial Fisheries Institute at Tokyo, Japan, and, as we know, the goldfish receives more attention in Japan than in any other country.

[The paper was then read in abstract, and will be found in full on pages 381–397.

President Bumpus at this point resumed the chair.]

The PRESIDENT. This paper is open for discussion. We have an interesting paper by Professor Prince on the "Training and Qualifications of the Modern Fish Culturist."

I am sure no one has been more surprised than I, during this afternoon's session in particular, at the amount of accurate information that seems to be on hand among the men who are connected with the various fish hatcheries of the country. I wonder where it is possible to find such men. I sat here wondering that the United States Government can succeed in getting these perfectly splendid men—men who are specialists, that do this work so well and know it in all its branches and ramifications. Now, I imagine, although I have not seen the paper that is about to be presented, that there is a plan for the direct training of such individuals.

Prof. EDWARD E. PRINCE. Mr. President and gentlemen, I fully agree with the words which you have just expressed in regard to the gentlemen who have appeared before us to-day, who are the practical fish culturists. What I have to bring before you will occupy only five or six minutes, because I

intend merely giving the main points of my paper, which is rather in the way of suggestion than of a set treatise or essay.

[This paper was then read in abstract.]

The PRESIDENT. Members of the congress, this interesting paper is open for discussion. I think that we all feel that the ground has been pretty well covered by Professor Prince. The fact that the paper is not being discussed does not indicate that we have not been very much interested in and instructed by listening to it.

May I ask if the secretary-general has the paper by Mr. Franz von Pirko, "The Naturalization of American Fishes in Austrian Waters?"

The SECRETARY-GENERAL. Mr. von Pirko has been obliged to leave the city, and I shall not read his paper, but shall simply state that he has gone to the trouble to write it in excellent English and to give us for distribution copies of it printed in German. These will be distributed to those who desire them, and the paper will simply be read by title and published in full in the proceedings. [See pages 977–982.]

The PRESIDENT. I am instructed to state that all of the papers that have been submitted to the conference and reports of the discussions taken by the stenographer will be published by the United States Government and distributed.

We now come to the last subject on the programme for this afternoon, the dogfish question, to be opened by Professor Field, and to be discussed by Messrs. Fryer, Nordqvist, Gill, Whitman, Prince, and others.

Prof. IRVING A. FIELD. Mr. President and gentlemen, I am asked to start the discussion this afternoon on the dogfish question. Before entering on that, I wish to say a few words on the mussel. The title of the paper which was called for yesterday and the day before is, "Sea Mussels and Dogfish as Food." I have here a few samples of preserved mussels and dogfish, which I shall pass around.

[Professor Field's paper appears on pages 241–248, and following it is the discussion, which was participated in by the president, Dr. Oscar Nordqvist, Dr. Theodore Gill, Mr. Charles E. Fryer, Mr. T. E. Libby, Mr. Charles G. Atkins, Mr. John J. Pew, Prof. E. E. Prince, Dr. George W. Field, Mr. Walter E. Hathaway, Mr. E. C. Whitman, and Prof. Irving A. Field.]

The PRESIDENT. If there are no more contributors to this discussion, a motion to adjourn will be put.

The SECRETARY-GENERAL. Before the motion is put, I would like to suggest that, in view of the lateness of the hour, the committee on resolutions do not meet this evening, but instead at 9 o'clock to-morrow forenoon, in this room.

Thereupon, at 6 o'clock p. m., the congress adjourned until 9.30 o'clock Friday morning.

MORNING SESSION, FRIDAY, SEPTEMBER 25.

NEW WILLARD HOTEL.

The congress was duly convened by the president at 9.45 o'clock.

The PRESIDENT. We will now begin our work. Are there any matters to be presented by the secretary?

The SECRETARY-GENERAL. Mr. President and gentlemen, many messages of good will and greeting have come to the congress from persons who are prevented from being with us. The cable message from the distinguished president of the Third International Fishery Congress has already been read. Among the other messages received have been the following:

Mr. Nicholas Borodine, Secretary-General of the Second International Fishery Congress and late Chief Specialist in Fish Culture in the Russian Department of Agriculture, asks that his best wishes be given to the members of the congress, and to those members who remember him he sends his special regards and his assurance that though unavoidably absent he is with them in spirit.

Dr. David Starr Jordan, United States International Fishery Commissioner, writes:

> Will you kindly present my compliments to the Fishery Congress and express to them my interest in their work? It is a matter of sincere regret to me that I can not be present at this auspicious meeting. The affairs of the university, combined with the work of the International Commission of Fisheries, occupy all my available time, and I must forego the honor and the pleasure of being associated with this convention.

Mr. H. Wheeler Perce, president of the National Association of Scientific Angling Clubs, has written a very interesting letter, which will be published among the papers of the congress. [See pages 193–198.]

Greetings have come from—

Dr. E. L. Mark, of the Zoological Laboratory of Harvard University, at Cambridge, Mass., and Director of the Biological Station at Hamilton, Bermuda.

Prof. Dr. Bruno Hofer, of the Royal Bavarian Research Station for Fisheries, Munich, Germany.

Dr. Ernst Ehrenbaum, of the Royal Biological Experiment Station at Helgoland, Germany.

Dr. H. Henking, of the German Fishery Society, Berlin, Germany.

Prof. Jules Cotte, of the Marine Zoological Station of the University of Marseille, France.

I would also like to bring to the attention of the congress at this time some recently published or manuscript works which have been presented by their respective authors for the information of the congress.

[The secretary-general read a list of the works that had been submitted, which list, with later additions, appears on page 74.]

The PRESIDENT. Mr. Fullerton has just spoken to me about a matter of general misunderstanding in regard to the whitefish question, and it seems to

me to be of sufficient importance to be brought again before the attention of the congress. I will ask him kindly to make that statement made to me a moment ago.

[Mr. Fullerton's statement appears on page 695.]

The PRESIDENT. Unless there is some other business to be transacted before we proceed to the reading of the papers, the chair will now call for the papers as listed on the blackboard.

Doctor Meek, will you give the initial paper this morning?

Dr. S. E. MEEK (Field Museum, Chicago). I have some lantern slides.

The PRESIDENT. Is the operator not here? Then, in view of Doctor Smith's return, I will ask the secretary-general to present the paper of Mr. N. Borodine.

The SECRETARY-GENERAL. It will probably be desirable, Mr. President, to refer this communication to the committee on resolutions. Mr. Borodine writes as follows:

PROPOSAL FOR AN INTERNATIONAL CONDENSED DICTIONARY OF THE TERMINI TECHNICI USED IN THE FISHERIES AND FISH CULTURE.

One of the most important tasks of the International Fishery Congress is to make as easy as possible the study of the state of the fisheries and fish culture in all countries and to unite efforts of the specialists for the advancement of applied science concerning fishery matters and of the fishery industries themselves. A great obstacle to this, however, as to all other branches of science, is the difference of the languages in which the works on ichthyology, fish culture, and the fisheries are printed, and in the difficulty, well known to every body of colleagues, when they try to understand even only the most important points, such as conclusions, statistical tables, explanation of figures, etc., of a work written in an unfamiliar language. It is impossible to overcome this difficulty with an ordinary dictionary, because termini technici are not to be found there, and they are often very different even in the same language.

Having had, in the character of editor of the Revue Internationale de Pêche et de la Pisciculture, much to do with the periodicals and books on fisheries and fish culture written in all European languages, I know very well, by my own experience, how difficult it is, for instance, to make any use of the works written in Danish, Dutch, Hungarian, and other seldom-learned languages. Though the Latin saves us the difficulty, so far as concerns the names of fishes, it can not help us to understand all the other things in the book, sometimes the most interesting. Therefore I have always thought it would be very useful if the specialists of all countries would draw up a kind of little information book or dictionary in which should be found (1) names of all commercial fishes and other fishes and animals that are of some interest to the fishing industries, to sportsmen, and in fish culture; (2) denominations of the most important fishing appliances used by professional fishermen and sportsmen; (3) denominations of fishery vessels, boats, and the principal vessel implements; (4) denominations of the principal fishery products; (5) measures, weights, utensils, etc., used in fishery business, also the different moneys; (6) list of the principal termini technici used in fish culture. All of these denominations ought to be given in the following languages: French, English, German, Italian, Spanish, Norwegian, Swedish, Dutch, Russian (with Latin and Russian letters), Hungarian, Roumanian, and Japanese (with Latin and Japanese letters). Moreover, names of fishes should also be given, it should be understood, in Latin.

To accomplish such a work is not possible but in a collective way, with collaboration of the specialists of each country upon the six categories mentioned above. Naturally the book should first of all be written, as full as possible, in one of the languages, and then

the proper parallel termini technici should be given in other languages, and the list should be completed by adding the new ones, which may not exist at all in other languages, simply because there are no such objects. To avoid misunderstanding, it is to be desired that the original list of termini technici should be accompanied by some explanation of the kind used in the condensed dictionaries (Larausse, Webster, and others). The original list should be reproduced in several copies for distribution among the specialists of all countries where the above-mentioned languages are in use, and every specialist, or many of them, should give a parallel list of the names and of the termini technici used in fisheries in his own country. It is necessary, further, that all these papers should be under direction of one and the same hand in order to give them one system and similar editorial lines. In such a state the work may then be presented to the next congress, by which it should be, if found good, approved, such approbation by the congress being desired in order to fix the terminology, to unify it, and thus to facilitate the use of different books and papers in future.

Such is a general plan for drawing up an international book of information, or dictionary of fisheries and fish culture. I should say in addition that the charge of writing the original list we should beg our German colleagues to take on themselves, for these reasons: First of all, the German terminology in fisheries and fish culture is more elaborated and detailed; besides which, in the German "Handbuch der Fischzucht und Fischerei," by Professors Benecke, Dallmer, and M. von dem Borne, we find already the primitiæ of what should be included in the proposed dictionary.

There is another question: What institution, or what persons, should be engaged to see that the work is completed at the proper time? It would be natural to give this in charge to the "Conseil permanent de la pêche," an executive organ of the International Fishery Congresses. But this institution, as is well known, gives no sign of existence. Or, it would be possible to give this task to the organizing committee of the next congress. But experience shows us that this committee can scarcely accomplish such a task, because it as a rule is not itself organized until a short time before the opening of the congress and has too much work to do at that time. It remains to propose that this work be intrusted to another permanent institution having direct relations with the fisheries, it being better, of course, if such institution be of international character. The only institution of this kind, so far as I know, is the "Conseil international (and bureau of it) pour l'exploration des mers du Nord." If the honorable and highly esteemed secretary of that institution and the members thereof assisting in this congress find my proposal practicable and will be kind enough to render their assistance in the matter, it will be certain that the work will be done.

It will be understood that if my proposal is accepted this congress shall appoint persons from each country to write the respective parts of the whole work. As to the printing of the book, it would be more practicable for each country to have a separate edition, because the alphabets naturally should be the national ones. Then the question of expense for the printing, etc., would be each country's own business.

I have, then, the honor to submit to the Fourth International Fishery Congress at Washington the following proposal for a resolution:

1. That it be recognized as desirable and useful to draw up an international dictionary on fisheries and fish culture in twelve languages, according to the plan outlined above.

2. That the writing of the original text of this dictionary (in German) be intrusted to ....., and the writing of the parallel texts in other languages, or the responsibility therefor, be given to .....

3. That the relations with collaborators for the compiling of this information book be intrusted to the bureau of the "Conseil international pour l'exploration des mers du Nord," which institution will have the right to fix the time for delivering the papers by collaborators in each country, and will provide for unity of form for the whole, bearing in mind, however, that the manuscript of the book, quite ready for printing, shall be presented to the next congress for approval.

The PRESIDENT. Ordinarily communications of this kind, that involve recommendation for indorsement, are referred to the committee on resolutions. The paper, however, may be discussed, if you wish, or the chair will entertain a motion to refer to the committee on resolutions.

Lieutenant DE AQUINO (Brazil). I think we should put in the Portuguese language, which I believe is being spoken by more than 30,000,000 people, and therefore ought not to be left out, although putting in another language would raise the number to thirteen, which may not prove very lucky. I would like to present the suggestion that to the twelve languages be added the Portuguese language.

The PRESIDENT. Will it serve the purpose if the secretary-general of the congress is instructed to so communicate with the editor of the dictionary?

Lieutenant DE AQUINO. Yes, sir.

The PRESIDENT. That will be sufficient?

Lieutenant DE AQUINO. Yes, sir.

Mr. O. T. OLSEN. This subject is a matter to which I have given a great deal of thought and at which I am working. The unification of fish names, I think, is a very desirable thing, and we ought to have done it at this congress. To do it here is impossible, for when we disperse to-morrow what work we have done is finished, and there is nobody to carry it on for the next three years.

I may say with regard to the different languages suggested for the dictionary, to my way of thinking it would not be desirable to have all those languages in one book, inasmuch as if I read the book in English, the Spanish or the Japanese language is no use to me, and there would be so many sections of the book simply lying dead, not being used. Now, I have a different scheme, and that is to have one book in one language, say in English, and when compiled to have it translated into the different languages. I would have a number for each sentence or for each subject, which could be referred to; this number should correspond in all the languages, so that if, we may say, a Russian wishes to get the same meaning in Russian as in English he would simply have communicated to him the number and the reference number, and then he can read in his own language. Then there would be no necessity of having so much matter within the covers of the book used. That is one thing.

The next, Mr. President, is that I am at present compiling a work for the fishermen—that is, the deep-sea fishermen. The subjects to be treated are navigation, the rule of the road, oceanography, fish culture at sea, a little natural history, just sufficient for the fishermen in their calling; and there will also be a chapter on steam, sufficient for them in case of breakdown to repair their engines and get to port, and a few matters like this which I have compiled and I am compiling. And I should be very glad if anyone present who hears me and who feels inclined would supply me, for insertion in that book, any kind

of information respecting any of those subjects that I have mentioned. This book is called for. It has been called for for several years. I have issued two editions of The Fishermen's Practical Navigator, of which this will be the third, brought up to date; and it includes steam fishing vessels, with all the modern improvements and gear. I should be very pleased to hear from anyone who is for progress in the same direction.

The PRESIDENT. A motion to refer to the committee on resolutions is in order, unless there is further discussion.

[The motion was made and duly seconded.]

The PRESIDENT. The motion has been made and seconded, and if there are no objections the chair will so refer.

The paper by Mr. William P. Seal, namely, "Fishes in their Relation to the Mosquito Problem," is a paper that the chair has received several requests for, and if Mr. Seal is here, or if there is some one here who will present the paper for him, that paper will be the one now called for on the programme. [After a pause.] Mr. Seal is in attendance, I am informed, but he seems to be out at the present moment. [For this paper see pages 831–838.]

Then the paper by Professor Wilson, which is "On the Development of Sponges from Tissue Cells Outside the Body of the Parent," will be called for, and I shall ask Doctor Moore if he will kindly introduce the discussion on this paper when the reading is finished.

[Prof. H. V. Wilson presented his paper, which appears on pages 1265–1271.]

The PRESIDENT. Are you willing to leave these specimens on the table, Professor Wilson, for a little opportunity to examine them? Perhaps Professor Wilson will be willing to meet you at the close of this session for a few moments, and explain the preparations to those who care for a special explanation.

Doctor Moore has asked me to state that he has a number of things to attend to just now, and that he would prefer not to undertake to discuss the paper of Professor Wilson. Nevertheless, he would like me to state that in the basement of the building of the Bureau of Fisheries there is an exhibit that shows the process of budding and growth of commercial sponges. You will find an exhibit made there which represents the work that the United States Bureau of Fisheries has done during the experiments for some years past in this most important matter.

Are there other questions to be asked of Professor Wilson from the floor? If not, I shall ask Doctor Evermann to present in abstract the paper, "Experiments in the Artificial Propagation of Freshwater Mussels," by Prof. George Lefevre and Prof. W. C. Curtis.

Dr. B. W. EVERMANN (U. S. Bureau of Fisheries). Mr. President and gentlemen, I regret very much that neither Doctor Lefevre nor Professor Curtis has found it possible to be present at this congress. We all felt, however, that something should be said regarding certain experiments which they have been carrying on. I shall not present the formal paper which they prepared, but

shall give you a more or less rambling talk concerning some of the questions, at least, which are dealt with in their formal paper.

[The paper by Professors Lefevre and Curtis will be found on pages 615–626.]

Mr. PAUL NORTH (Ohio). Will you kindly explain in reference to the colored buttons?

The PRESIDENT. Mr. North asks a question. I learn that those which are discolored—are not uniform in color—are smoked by putting into nitrate of silver, and made into what is called the "smoky pearl." There is a small demand for buttons of other colors, and those are produced by using aniline dyes, by which they can be made red, blue, and the different colors obtainable in the aniline dyes.

The members may have noted the various exhibits that have been brought to the congress, with certain papers submitted in competition for prizes, and material that has been presented here by those who have been good enough to contribute to the programme. This material has been arranged in front of the desk, and those who are interested in discussing it will kindly come to the desk at the conclusion of the sessions. And I shall ask those who have contributed the material to please install themselves as demonstrators of the respective exhibits.

Will the honorable Mexican minister, Mr. José F. Godoy, please come to the platform? [Applause.]

Mr. GODOY. Mr. President and members of the Fourth International Fishery Congress, it is with great pleasure that I address you these few words to inform you that the Government I have the honor to represent here has felt great interest in, and attaches great importance to, the meeting of this congress. The discussions held at these sessions and the conclusions to be determined upon will no doubt greatly aid the Mexican Government in framing ampler regulations on the subject of fisheries, and I hope will also serve to establish measures looking to the preservation and increase of our fish industry.

Permit me, in the name of President Porfirio Diaz, whose progressive and enlightened administration of affairs is well known to most of you, to present you his greetings and his best wishes for the success of your important labors. Permit me also to inform you that the Department of Promotion, which has the subject of fisheries under its charge in my country, and which at present is directed by Minister Olegario Molina, a most active and efficient cabinet officer, is looking to the results of the labors of this congress as a guide for its future work along the lines that may be pointed out in the deliberations of this international gathering.

To me, who have had the privilege of residing some time in Washington, the cordiality shown in the reception accorded to the members of this congress here has not been surprising. We all know the well-earned reputation for courtesy and hospitality which the inhabitants of Washington enjoy, and therefore it was

to be expected that the welcome extended in this city to the members of this congress would be, as it has been, most warm and cordial.

The well-chosen words with which the Acting Secretary of State, Mr. Adee, received the delegates, and the timely and thoughtful address of the Secretary of Commerce and Labor, as well as the hearty manner in which Commissioner West extended the city's welcome, were but a forerunner of the enthusiastic way in which this congress was to be treated. No less hearty was the reception accorded to its members by His Excellency President Roosevelt, the honored head of this nation, whose warm hand grasp and frank and eloquent utterances were indicative that he was in hearty approval of the labors of this congress. These indications, as well as the interest shown in the work of this convention by the enlightened press of this city, and the facilities and advantages afforded by the well-established libraries and museums of Washington, no doubt have contributed to spur on the investigation and resolution of the subjects here for discussion.

And let me not forget, among the advantages enjoyed by us, the timely election made of our president and secretary. I know full well that Mr. Bumpus and Mr. Smith are not fishing for compliments, but I can assure you that we gathered in our nets the best president and secretary that we could have selected.

Under such auspicious circumstances the work of this congress has gone on, and when such work shall be finished I think that all of you will say with me that we are proud to be members of the Fourth International Fishery Congress, and to have contributed, even if it is but by our close attention and hearty applause, to the far-reaching and important labors of those who organized this gathering and carried it on to a successful conclusion.

Thanking all of you for your kind attention, as also for the undeserved honor of having been selected as one of your vice-presidents, I again convey to you Mexico's greetings and good wishes.

The PRESIDENT. Secretary-General Smith has a communication from Ecuador.

The SECRETARY-GENERAL. I have had placed in my hand by Señor Don Esteban F. Carbo, who represents the Republic of Ecuador, a communication, which, with your permission, I will read:

HONORABLE DELEGATES: As delegate for Ecuador to the International Fisheries Congress, I have the honor to call your illustrious attention toward a new and hitherto unknown field of activity for the interesting, valuable, and productive industry of fisheries. I speak with reference to Ecuadorian waters, and especially of the Colon Archipelago (Galapagos Islands), which belongs to the Republic of Ecuador and is situated about 500 nautical miles from the coast of said country, and enjoys the old and well merited reputation for its magnificent geographical position, its splendid climate, smooth seas which surround it, and for the abundant and choice resources in turtles, grouper (known by the native name of mero), and infinite and rich varieties of other fish. The Government of Ecuador is ready to extend all facilities and its decided support to the enterprise or enterprises which will propose to dedicate themselves to the fisheries of the

archipelago, which could be converted into one of the most productive industries in the world.

The location of the islands of the Colon Archipelago, as I expressed before, could not be more advantageous to the fishing industry, on account of the facilities to ship their products to all markets. The opening of the Panama Canal will augment those facilities, providing at the same time the advantage of maritime commerce, because a large number of vessels will stop on their voyages to and from North America, South America, and Australia.

The circumstance that the ocean which surrounds these islands is tranquil all the year round, hurricanes and fogs being unknown, and the undisputed mildness of one of the best climates known give to the islands of the archipelago of Colon an exceptional opportunity for establishing important fisheries with indubitable benefit for the persons who will undertake it and for the whole world which will enjoy the excellence of those products. Well-known travelers have made careful studies of the Colon Archipelago and they are all consistent with the datum that I submit to the congress.

Small colonies can be established because the soil is rich, the ports are good, there is abundance of wild cattle, and the villages that will be erected by those interested in fishing may become important cities, there being all the facilities for living. Salt mines may be worked on the islands to salt the fish, and the nearby coast of Ecuador has numerous mines that are now in operation.

With the few undetailed facts that I give, gentlemen, I am sure that you will be convinced that the fishing industry has a new horizon and that the Archipelago of Colon is destined to be one of the most important centers of universal activity in such an important branch of the industries.

The eminent Dr. Teodoro Wolf in his "Geology and Geography of Ecuador" says:

"The islands of Galapagos lie 9°, or from 500 to 600 nautical miles, from the Ecuadorian coast and are traversed by the equinoctial line. The principal mass of the islands, including the 5 largest ones—that is to say, Albemarle, Indefatigable, Narborough, James, and Chatham—lies between said line and the first austral degree; only the 3 small ones—Abingdon, Bindloe, and Towers—are north of the line, and 2 not much larger—Charles (Floreana) and Hood—south of the first austral degree. There are commonly 13 islands, adding to the ones I have mentioned those of Barrington, Duncan, and Jervis. Furthermore, there are several smaller keys which surround the large islands. The longitudinal area of the archipelago, from Chatham to Narborough, measures 53 leagues, and the latitudinal from Floreana to Abingdon, 41 leagues, in a manner such that these islands are found scattered over an area on the Pacific Ocean of 2,000 square leagues, nevertheless reunited in one body they would have an area of 240 square leagues of solid ground. Albemarle, the largest, has 138 square leagues. In the inland region of the islands the ground is covered with a turf that is green the year round. The thickets offer a large variety of trees and shrubs of equal magnificence and verdure."

Doctor Wolf, in speaking of the colonization of the islands, calls attention to the fact that the fishing along the coast of the islands could be elevated to a plane of great importance, which would be a fountain of richness to the colonizers and which would give occupation to a numerous population. There would be in addition numerous subordinate industries, such as the taking of the oil from turtles and terrestrial iguanas.

On the question of harbors and anchorage, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding the United States Fish Commission's steamer *Albatross*, says: "There are no landlocked harbors in the Galapagos, but anchorages are found near most of the islands, where a vessel may lie usually with perfect safety. Indefatigable Island affords good anchorages from Conway Bay along its northern side to the Seymour Islands; there are places also along the northeast side where good protection may be found. Chatham Island has several good anchorages. Wreck Bay is the most important, as it is the seaport of the Hacienda del Progreso, a large sugar plantation. It is open to the westward, but particularly protected by Schiavoni reef; there is usually a small swell, but

landing or lightering is seldom interrupted. Stevens Bay is superior as a harbor, has more room, and has a snug cove which forms an excellent boat landing and harbor for small craft or lighters, its smooth beach affording excellent opportunity for hauling them out for repairs. Post-Office Bay, 4 miles to the north of Black Beach Road, is one of the best anchorages in the Archipelago. It is well protected, with moderate depth of water and good holding ground. Landing is practicable at all times." There are many other anchorages on these islands too numerous to be mentioned in this brief report.

Commander Tanner, commenting on the strategical value of the archipelago, goes on to say: "The strategical value of the islands is increasing with the advent of modern cruisers which are entirely dependent upon steam as a motive power. They are in direct route from San Francisco to Callao and Valparaiso, and, in the event of the completion of the Panama Canal, they would lie in the route to Australia and New Zealand and would become a regular port of call for steamers plying between those places. A glance at the map will show the location of the group with reference to the coasts of North, Central, and South America, and the value of a coaling station at that point, nearly midway between San Francisco and Lota, the southernmost coaling port in the Pacific, becomes at once apparent. A modern cruiser could make the run direct from San Francisco to the Galapagos, fill up with coal, procure fresh provisions from shore, and reach the South American coast with a good supply of fuel, avoiding the longer and more expensive route via Acapulco and Panama. The location of the islands in the region of the southeast trade winds is particularly favorable for the delivery of coal from Australia, Lota, or even from the Atlantic coast. It could be laid down there at much less cost than at Acapulco or Panama."

I ask, therefore, of the honorable delegates of the different countries here represented that they be so kind as to call the attention of their countrymen toward the fisheries of the Archipelago of Colon (Islands of Galapagos) in the certainty that they will reap great rewards.

The PRESIDENT. Professor Vinciguerra has a communication to present to the congress.

Prof. DECIO VINCIGUERRA. Before this congress adjourns I think it proper to call its attention to a subject which was discussed at the International Fishery Congresses of St. Petersburg and Vienna, namely, the timeliness of an international oceanographic exploration of the Mediterranean Sea in the interest of fisheries. The same question was debated at various international geographic congresses, and recently at the Geographic Congress of Geneva. I had the honor to report on this subject on behalf of the Italian Geographical Society. The importance of this proposition was recognized by the Geneva Congress, which has intrusted its consideration to a committee, whose presidency has been offered to the Prince of Monaco, whose valuable contributions to oceanography are well known. On this committee should be represented all nations of the Mediterranean shore, the Adriatic and Black seas included. I think it superfluous to tell this congress the reasons why the fishery interests of the Mediterranean make this exploration impellent, because it is generally known that whatever legislation there may be on the matter, and especially that having an international character, can be based only upon the knowledge of the life history of fishes and on that of the physical conditions of the waters where they live. I confine myself, therefore, to the proposition that this congress, reaffirming its former votes, shall approve the proposed exploration.

The PRESIDENT. You have heard this most interesting communication that brings to us business that was begun three years ago. What is your pleasure in regard to the communication that has been thus submitted?

A MEMBER. It is a matter of very great importance, and I move you, sir, that the communication be referred to the committee on resolutions.

The PRESIDENT. Is the motion seconded?

[The motion was duly seconded.]

The PRESIDENT. The motion has been made and seconded. The matter is now open to discussion, if you care for discussion. If the chair hears no request, then——

Mr. CHARLES E. FRYER. I would like to ask Professor Vinciguerra whether it is proposed that the explorations of the Mediterranean in regard to the interests of the fisheries should be limited to the powers which adjoin the Mediterranean, or whether other countries would participate. I raise the question for the reason that quite recently some English fishing vessels have actually been fishing in the Mediterranean, having been tempted to try their fortune on the eastern side of the Straits of Gibraltar, and if such practices were to extend it would undoubtedly enlarge the sphere of inquiry in which any such committee as is proposed would be concerned. All the powers that are likely to take up fishing operations in the Mediterranean should, it seems to me, have a share in such a scheme of investigations as is proposed.

Another point to which I should like to call attention would be the great desirability of especially directing any investigation to those problems which immediately affect the interests of the fisheries. This is a fishery congress, and although we all fully recognize that fisheries involve questions of interest in many different sciences, still our chief interest is that of fisheries, and I would suggest that, just as in the case of the North Sea investigations, the international council for which is now sitting in Copenhagen, the first and immediate points for consideration should be those which affect the future industrial welfare of fishermen and fisheries.

The PRESIDENT. The stenographer has taken down the remarks of Mr. Fryer, and these remarks will become a part of the published reports of this congress. If there is definite action on the part of the congress required by Mr. Fryer, the chair will be very glad to entertain any motion to that effect; and will Professor Vinciguerra kindly reply to the queries that were put to him?

Professor VINCIGUERRA. It is the intention of the committee which was proposed to invite all nations that have interests on the Mediterranean to take a part in these explorations, and three or four members have already been indicated, because their countries were well represented at the Geneva congress. All the other nations, not only of the Mediterranean, but also in the Adriatic and Black seas, will have a representative—Roumania, Russia, and also Germany, because Germany has a station on the Adriatic Sea; and the representative of Germany at the congress in Geneva made the proposition that also Germany

must have a member in this committee. And I suppose, for instance, England has great interests in the Mediterranean, and without doubt England will be entitled to take a part in this enterprise.

Our thought is to promote the exploration of the Mediterranean in the interest of the fisheries. Then it is clear that the fisheries interests may be the main influence that may be regarded in these explorations.

I hope that Mr. Fryer now fully understands.

[The motion before the congress was carried, and the communication of Professor Vinciguerra was referred to the committee on resolutions.]

The PRESIDENT. I have been requested to read the following communication from those who have in charge the luncheon that is to be served to-day by the Alaskan Packers' Association, as a compliment to the congress. [Communication read.]

Now, one other matter: There are still some who, because of their interest in the programme as rendered in this room, have forgotten to register, and you are again asked to kindly register and become organically connected with the congress.

Then there are some who have signified their intention, by handing in their names, to attend the subscription banquet this evening, and who have not yet received the cards of admission. It would be too bad if any member of the congress should come to the Hotel Raleigh this evening, after having prepared himself for the banquet, and find that although he had on a "wedding garment," nevertheless "he could not enter in." [Laughter.]

Is there other incidental matter to come up before we proceed with the reading of papers? There are a few of these [indicating] badges here for those members who care for them.

Doctor Field, will you kindly give an abstract—the substance—of the paper submitted by H. C. Rowe? Mr. H. C. Rowe is at the head of one of the largest oyster concerns in America, and he entertains the members of the congress on our arrival in Fall River on Tuesday morning next. One of Mr. Rowe's steamers (he has a large fleet of these steamers, of course) will meet us there at 8 o'clock on Tuesday morning and will take us to one of the large oyster beds, and that steamer will then show the method of steam dredging and oyster culture that is carried on in Narragansett Bay, a method which is used throughout Long Island Sound and in the extensive beds still farther south. Doctor Field is quite well acquainted with this work in Narragansett Bay. The paper is rather long, and Doctor Field will give it to us in abstract.

Dr. GEORGE W. FIELD. We must all regret the absence of Mr. Rowe, who would be able to present this to you in a better shape than I can.

[The paper by Mr. H. C. Rowe was then presented in abstract; the full paper appears on pages 259-267.]

The PRESIDENT. There is some probability that the various committees on award will be prepared to make their reports in time to be read at the conclusion

of the luncheon this noon. We hope that these committees' announcements may be made at that time—at the conclusion of the luncheon in the banquet hall.

The next paper is one that has been prepared by Professor Reighard, and Doctor Ward has consented to give it to us in abstract. Is Doctor Ward here? If Doctor Ward is not here, I shall ask for the paper by Mr. Seal. Is Mr. Seal here? [No response. This paper is printed on pages 831–838.]

[At this point Professor Vinciguerra was invited to the chair.]

Vice-President VINCIGUERRA. We will, then, now hear the paper by Dr. S. E. Meek, of the Field Museum of Natural History, Chicago, entitled "A Study of Lakes Amatitlan and Atitlan, Guatemala, with Especial Reference to Fish Culture."

[Dr. Meek's paper was then read.]

Vice-President VINCIGUERRA. I now have pleasure in introducing Hon. Gifford Pinchot, Chief Forester of the United States Department of Agriculture. [Applause.]

Mr. GIFFORD PINCHOT. Mr. President, ladies, and gentlemen, it is a real pleasure for me to foregather with a body of people interested in fishing. I should like to assure you that the old proverbial question, "What would you rather do or go fishing" has but one answer with me: I would always rather fish; and I have accumulated in the course of my life a certain number of fish stories, which I shall not inflict upon you here. I know that this is an economic congress, and in what I have to say I want mainly to take the economic point of view.

The Forest Service is fortunate in having a very direct relation to the fisheries question. It has charge of the area which includes the headwaters of the streams which water about two-thirds of the United States; and through the 2,500 or 2,600 men who compose its force the opportunity is afforded of helping in the preservation of food and game fishes, an opportunity, I should like to add, its officers very greatly prize.

You are well aware that questions of game and fish are reserved to the states, and national officers have little to do with them, outside the national game reserves and national parks, except as they may be also state officers. A majority of the rangers in the national forests have in fact become state officers, for the purpose of protecting the fish and game, and we are doing what we can to enforce state laws and prevent the indiscriminate slaughter of both fish and game; and, I think I may venture to say, with some success.

I suppose there are few questions which more completely show the interrelation of the different natural resources of a country than does the fisheries question; and that in its relation not to the forests, but to other resources as well. I suppose the majority of the types of fresh-water fish depend directly on the conservation of the forests, if not for the very existence of the species, at least for its plentiful distribution. That is why the Forest Service has so direct a relation to the fisheries question; and in various parts of the country,

especially in the national forests in the West, at least a good beginning has been made to protect the streams upon which fresh-water game fish depend.

But it is not by any means enough to protect the forests; other things must come in also. Where we have protected the headwaters of a stream with forest cover and are maintaining it, even then there are very serious dangers connected with other uses of the land and water which appeal directly, as I should imagine, to a congress such as this. For example, where water is used for power a great many fish may be killed by the physical arrangement of the apparatus. In the same manner, enormous numbers of game fish perish from time to time because of the use of the water in which they live for irrigation, and the lack of a proper system of protective headgates to keep the fish from getting into the irrigation ditches.

I believe that few things will have a more beneficial influence, in the end, on the fisheries of the country than the demand for clear water in our streams for city and town supply. The fishery question is thus immediately connected with one of the great fundamental problems of conservation in the United States, which is to prevent soil wash and so to maintain the fertility of the soil on the farms.

As an illustration of the unity of this great conservation problem, which has taken so firm a hold on the people of the United States since it was first propounded by the President, I think the fisheries question is one of the best.

It is a little difficult to connect sea fisheries with forest preservation, and yet even in places that connection exists. The condition of the harbors and the lower salt reaches of the great rivers is directly affected by the condition of the forest cover at the head waters; and thus even here, while the relation is by no means so direct, it still exists.

Therefore—and this is the substance of what I wanted to say to you to-day—it seems to me that every single one of the interests that are concerned with any phase of this great conservation problem is also concerned with the rest of it. You are intimately concerned with forests, water power, irrigation, soil conservation, and a number of others. All of these interests in their turn are concerned with the preservation and protection of the food and game fish.

Many of us have been seeking for definite results on definite lines, with a good deal of lack of success, and for a good many years we have been working too much alone. If the great question of conservation is a single question, then it seems to me the natural remedy in this age of combination lies in the combination of the interests of all of us who need to get the same things done.

I have been asking and getting for the National Conservation Commission the heartiest and most vigorous support and cooperation for the one central object of conservation on the part of a very large number of associations that are interested in specific and individual parts of the great whole. Your help is greatly needed. You are concerned with the business and common-sense use of foresight in providing for things which you foresee the need of, as well

as in preventing or repairing losses which may happen or have happened. The same spirit of looking ahead, the use of the same kind of prudence and good sense that a man employs in dealing with his own business affairs, is the key to the solution of your problem. So it is of the forest problem, the water-power problem, the soil-erosion problem, the navigation problem, which affects, of course, your work most intimately; and all the other great individual problems concerned in this greatest of all movements.

So I have wanted to bespeak for the conservation movement the sympathy and good will of the fisheries men just exactly as the fisheries men should have and do have the sympathy and good will and cooperation of the forest men; and I should be very glad indeed if in any way whatever the Forest Service can more efficiently promote the work you have in hand. I should welcome any assistance or advice you may be willing to give for that purpose.

Thank you very much for your attention.

Mr. S. G. WORTH (Superintendent U. S. Fisheries Station, Edenton, North Carolina). I have listened attentively to the papers and discussions in the sessions of this congress, and there is nothing I have heard in these meetings that has interested me more, or that has seemed to be a broader-gauged question, than the one alluded to by the last speaker. I have been in fish-cultural work for something like thirty-one years, and acquainted with the Piedmont section of North Carolina during that time. It has been painful to me for many years to see the ruin that has taken place in the streams of that section; and when I recently rode through the State from Cape Lookout to Asheville, it occurred to me that I ought then to sit down and write a newspaper article, encouraging the people connected with the state government to take some steps against the washing away of the lands. This last speaker has asked for some suggestion by which the Forest Service could aid us, and I may make this suggestion to him, that in Wake County, N. C., which is the site of the state capitol, there is a species of hillside ditching carried on by the cotton and corn farmers of that country which obviates almost entirely the washing away of those lands. It is a perfected system, which has been in existence there for years. I lived for a year on the farm of the late Jesse F. Taylor, where I saw that great land improvement which he had effected, and where he had stopped all the land wash; and I became acquainted with the principles of that hillside ditching; and I recommend to the Forest Service the study and extension of the system of hillside ditching referred to, as a universal benefit to fish culture in the United States. I would close my remarks by saying that it is one of the simplest and cheapest operations that I have ever seen, and may be done entirely with a 1-horse turn plow and a long-handled shovel.

The PRESIDENT. Are there others who will make suggestions or remarks? If not, the session will adjourn until 2.30 this afternoon.

Thereupon, at 12.30 p. m., the congress adjourned.

At 1 o'clock the members of the congress were tendered a complimentary salmon luncheon by the Alaska Packers' Association in the banquet hall of the New Willard Hotel. Mr. C. W. Dorr, vice-president of the association, presided at this function, and remarks were made by Commissioner George M. Bowers, Hon. John M. Allen, Hon. William R. Wheeler, Mr. Charles E. Fryer, Mr. H. C. Bliss, Mr. John H. Wallace, jr., Prof. Edward E. Prince, and Dr. P. P. C. Hoek. At the conclusion of the luncheon Prof. E. A. Birge submitted the report of the committee on competitive awards (for which see page 69).

AFTERNOON SESSION, FRIDAY, SEPTEMBER 25.

NEW WILLARD HOTEL.

The congress was called to order by the president at 3.15 o'clock.

The PRESIDENT. Will the committee on resolutions kindly submit resolutions for the general adoption of the congress? We shall now listen to the illustrated paper by Prof. E. A. Birge on "The Gases Dissolved in the Waters of Wisconsin Lakes."

[Professor Birge's paper, followed by discussion by Mr. J. J. Stranahan, Dr. Oscar Nordqvist, and Professor Birge, appears on pages 1273–1294.]

Mr. M. G. SELLERS (Pennsylvania). Mr. President and gentlemen of the congress, it is not my purpose to in any way discuss the scientific feature of Professor Birge's paper, but its presentation brings up a very serious question, which I thought it might be advisable to express to you to-day. I appear before you only in the character of an angler. It is the function of the fish commissions to populate inland lakes of the various states. Inland lakes, I take it, concern the angler more than they do the commercial fisherman.

Has it ever occurred to you that outside of a philanthropic effort on the part of the owners of the land bordering such lakes, the general public have to either pay toll or request the privilege of going in and angling for what the state has planted in those waters? I consider that this is a question largely concerning the anglers; but, nevertheless, it has a great deal to do with the question of food and angling, in so far as it represents the great bulk of the money distributed through a state by the sportsmen who seek that kind of pleasure. In my own State of Pennsylvania we have not solved that problem. I know of no state yet, in the whole United States or in foreign countries, which has solved satisfactorily the problem of providing means of ingress and egress for the angling public to inland lakes, for the great privilege of enjoying fishing. I had intended to bring this subject before you in the shape of a paper, because I think it is a burning subject, in that when the state through its departments of a public nature propagates fish, to plant them in the waters of the inland lakes, as I have described, the general public should, I feel, have some means of ingress and egress that they may partake of what the state has done primarily for their benefit.

I do not feel that I ought to take up more time in discussing a problem on which I might tire you, but it is a very serious question not only to the State of Pennsylvania, as I say, but to all states—the free right of trespass to partake of what is hatched in the hatcheries for the benefit of the general public of the several states.

Mr. JOHN J. PEW (Massachusetts). Mr. Chairman, in our state you can not exclude the public from fishing in a pond of, I think, 10 acres.

Mr. SELLERS. It is 20 acres.

Mr. PEW. In New Hampshire, I think, a man owned a lake and tried to keep the public out of it. The inhabitants were very angry, and they went through the fields and entered that lake; and they carried the matter to the superior court, which decided that by that law the inhabitants had the right to fish in that lake, and it could not be shut up to the people—that was either in Maine or New Hampshire.

Mr. SELLERS. I would suggest that in Pennsylvania, as an angler, my first duty, about twenty years ago, was to bring about a free right for the public to fish streams in which brook trout were planted by the state. Those streams in their original nature were created navigable by acts of the assembly, and the right of fishing was never mentioned in those acts, which start away back in 1814 and continue up to the year 1870. After many years of hard effort, I finally succeeded, in 1901, in the State of Pennsylvania, in getting through the legislature a bill which accorded to the general public the right to fish those navigable streams.

It may be of great interest to you to know why this is a burning question to the State of Pennsylvania. I shall describe a case that has been decided against the Commonwealth, in so far as it refers to the public fishing in those waters. We have always assumed—in fact, case after case, not getting further than the local magistrate, has been decided always in favor of the angler. Usually when a stream is well stocked by the state and the fishing becomes good in our thickly populated eastern sections, it is a misfortune that about the first thing to happen is that someone, or a combination of persons having good success, think it a very wise thing to lease the water and have it all to themselves. That occurs frequently, with the result that one stream in particular, in a section of Pennsylvania, which was declared navigable by act of assembly in the year 1814, was subjected to a test. An angler went into that creek. In order to insure that he would not trespass on the riparian right of the owner, he walked down the country road and got into the creek from the bridge, and was careful to keep in that creek to the point of the highway mark. He was arrested, brought before the magistrate, and was fined for trespass. Representing the Pennsylvania Fish Protective Association, we appealed that case and took it to the superior court; and without taking any more of your time on a question which is not quite scientific, we were absolutely beaten, because the constitution of Pennsylvania

is declared to be greater than the acts of the legislature, in that there was no compensation given to the owner of the land, hence he had a free right to the positive control of that creek, not only along its highway, but along the bed of the creek.

Gentlemen, I can not begin to tell you what I feel for the angler of Pennsylvania. I fear that public trout fishing in the State of Pennsylvania will some day become a very, very expensive luxury, due to the fact that at the present time, unless we go to the Supreme Court of the United States, we do not know what that decision might be. We do not know whether we have any public fishing waters for trout in the State of Pennsylvania; and my heart goes out to the anglers who formerly fished those waters and who may in the future find it very expensive to get a little trout fishing.

Dr. TARLETON H. BEAN (New York). I do not know whether I exactly understood the gentleman in his remarks about the State of Pennsylvania in regard to providing for the public fishing, but I ought to say that in New York, which appropriates, I think, about as much money for fish culture as any other State of the Union, no streams except public streams are provided with fish. It is not possible for a private owner to secure fish from the state; and when a stream has been stocked with fish by the state it becomes public water. There were 2,000 streams stocked during the last year with brook trout alone, and every one of those streams becomes a stream open to the public for fishing.

Mr. A. KELLY EVANS (Canada). As some reference has been made to the State of Maine, and I do not know that the state representative is here, I might point out that in that state, which undoubtedly has proved the most successful in turning angling and sport into an asset of great wealth to the state, amounting last year undoubtedly, from its statistics, to twenty-five millions of money brought into the state, its system provided this: That in any lake called a big pond, of a greater area than 10 acres, anyone can go and fish, even if an individual owns the land completely surrounding it, unless that land is cultivated. If it is not cultivated and is, comparatively speaking, wild land, the only action the owner can take is to bring the man who comes in and fishes on the lake before the courts; and the owner must prove damage in his passing through that land; but he has no right to prevent that man from fishing in that lake. And so universal has that custom become in the State of Maine that no attempt is made by private owners to control either lakes or streams. Where this works out to the advantage of the state and to the fish culturist is this, that the sympathy of the public is entirely with the fish culturist and with the whole system, in so far as no private ownership is allowed. I may say, Mr. Chairman, that it has been because of the wonderful success of Maine—the money that Maine has shown to exist in this system—that I myself have been successful in arousing an agitation in the Province of Ontario, and on account of always speaking and voting for holding the waters open to the public I have thereby received the

sympathy and support of the general public. And we find in Canada this, gentlemen, and I shall only take one moment to tell you so, that the greatest difficulty in the world exists in protecting the rights to the salmon river owners, because when we attempt to carry out the laws of the country as to the placing and lifting of nets and so on in the mouths of the rivers, we feel that after all the public is against those actions by the state, on account of the streams being owned by private individuals. And I take it that on a broad principle, as far as game fishes go, it is undoubtedly best for the whole body politic, for the fish culturist, and for everybody concerned to keep the waters absolutely open to the public.

The PRESIDENT. This has been a congress of young men. There is one young man here who is twice the age of some of us in years, but who has been identified with the subject of practical fish culture in America from its inception. He has been a friend of every ichthyologist and every ichthyologist in America has to-day a feeling of intense devotion for him. The chair therefore feels that the concluding session of this congress should properly be turned over to Dr. Theodore N. Gill. [Great applause.]

Dr. THEODORE N. GILL (Washington, D. C., assuming the chair). Mr. President and gentlemen, in order to insure conciseness and to avoid digressiveness, I have put my thoughts in writing, and without further preface I will read a paper I have prepared embodying "A Plea for Observation of the habits of fishes and Against Undue Generalization."

[This paper, with discussion by Prof. E. E. Prince, Dr. Tarleton H. Bean, Dr. Hugh M. Smith, and the author, will be found on pages 1059–1069.]

The ACTING CHAIRMAN. If there is no further discussion, the report of the committee on resolutions is now in order. Professor Prince is the chairman of that committee. Will Professor Prince give us the report?

Professor PRINCE. It is unnecessary to say anything about the work of this committee. I shall just read the resolutions; that is all that is necessary. The first resolution we had before us and which we now present to the congress is one which would express the views of the congress upon three important matters, and I shall just read word for word the resolutions, as we present them. I presume it is not necessary to have separate action on each resolution.

The ACTING CHAIRMAN. The chair presumes that it is not necessary to act upon each of these resolutions separately. If there is no objection we shall consider them all together and act upon them at the end.

Professor PRINCE. I shall proceed to read them all, Mr. Chairman.

[The resolutions were here read. See page 67.]

The ACTING CHAIRMAN. You have heard the resolutions with respect to the different matters. Have you anything to say? Have you any motion to make or any further remarks? The resolutions as you have heard, gentlemen, are before you now for ratification. All in favor of these various resolutions will

please signify by the usual manner, "Aye;" all opposed, "No." No objection being offered, the resolutions that you have heard have all been accepted.

Professor PRINCE. I should say that there is still one addendum, and that is in regard to the international condensed dictionary of technical terms, which Mr. Borodine, of Russia, has proposed. The congress has had this matter before it, and I need not read the somewhat lengthy resolutions which Doctor Borodine suggested to the congress, but the committee on resolutions were disposed to favor this proposal; and perhaps, Mr. Chairman, it might still be left to the congress to decide what to do with it.

The ACTING CHAIRMAN. You have heard the proposition of the gentleman, and the question is what shall be done with this—that is, whether, for example, it should be referred to the permanent commission or whether it should be acted upon immediately. A motion to that end is now in order. What is your pleasure, gentlemen?

Doctor HOEK. I suggest the wisdom of laying the resolution in the hands of the permanent commission and not undertaking to reach a decision on it at present.

[The motion was duly seconded.]

The ACTING CHAIRMAN. You have heard the motion by Doctor Hoek. It is proposed that this resolution should be referred to the permanent commission and that no action be taken by the congress for the present. All in favor of this motion will please signify by the affirmative sign; all opposed, "No." It is carried, and the resolution is so referred.

It is suggested by the secretary that Professor Ward will present the paper by Professor Reighard, for which a prize has been awarded.

Professor PRINCE. One moment. There is another resolution.

The ACTING CHAIRMAN. Doctor Prince will offer another resolution.

Professor PRINCE. Doctor Vinciguerra has just brought before the congress a resolution which had been referred to the committee—a resolution on the matter which was discussed at the international fishery congresses at St. Petersburg and Vienna, namely, an international commission on oceanography and exploration of the Mediterranean in the interest of fisheries. The scope of the resolution has been given by Doctor Vinciguerra, and the committee are favorable to that resolution.

The ACTING CHAIRMAN. If there is no demand for the reading of this resolution, it will be considered as it has been enunciated. There apparently being no demand, the question is before the congress. All in favor of adopting this resolution will please signify in the affirmative; all opposed, "No." It is carried. We shall now proceed to the regular business.

Prof. HENRY B. WARD. I find myself in the agreeable position of being called upon to read a paper by my friend and colleague, Doctor Reighard. It would seem like cruelty to fishermen, if not to other animals, to inflict on you a long

paper; consequently, although this is one that has been awarded a prize by the committee on awards, I shall take the liberty of cutting it in such fashion as to present the essential features and leave out the other matter which is not necessary to your comprehension at the present moment. I consequently pass over the introduction, which deals with the work of all previous investigators, including our chairman, Doctor Gill, and shall proceed at once to the second section of the paper, the general principles involved in the field study of fishes. Possibly I neglected to mention the exact title, "Methods of Studying the Habits and Recording the Life Histories of Fishes."

[This paper, read in abstract, is printed in full on pages 1111–1136.]

The ACTING CHAIRMAN. The chair thanks Doctor Ward for the distinct and excellent rendition that he has made of Doctor Reighard's paper. The donor of the prize, assuming that the entire memoir is of the same character as the part read, thinks that the award was amply justified, and is very much gratified that such an excellent paper has been produced. In respect to the species whose life history has been recorded it would, however, be well, I think, if Professor Reighard would add that the same characteristics of nest building are manifest in the other species of the genus *Semotilus;* that is, in *Semotilus bullaris.* It has been denied that *Semotilus bullaris* exercised this function of parental supervision. Doctor Abbott many years ago denied it in the most explicit manner, but recently a member of the Bureau of Fisheries, Doctor Kendall, has observed the habits, and has well illustrated it in a recent report published by the Bureau of Fisheries, giving the details of his work in New Hampshire and Maine.

The chair congratulates the congress upon the happy results of its meeting here, upon the excellent papers that have been presented, the harmonious relations that have been established; and the meeting will now stand adjourned sine die.

Thereupon, at 5.50 o'clock p. m., the congress took final adjournment.

During the week following the adjournment of the congress a party of foreign and local delegates visited points of special interest in New York and New England in accordance with a prearranged programme.

On September 28 Mr. Charles H. Townsend, director of the New York Aquarium, tendered a reception followed by a private view of the aquarium; Prof. H. Fairfield Osborn, president of the American Museum of Natural History, gave a reception and luncheon at the museum.

The party was met at Fall River, Mass., on September 29 by Mr. Henry C. Rowe, president of the Connecticut Oyster Growers' Association, and taken in a steam oyster vessel to his private oyster grounds in Narragansett Bay, where there was given a demonstration of oyster dredging, gathering of starfish from

the oyster beds, etc. The delegates then proceeded to Wickford, R. I., and were received by the governor of Rhode Island and the members of the Rhode Island Commission of Inland Fisheries on the latter's houseboat *Biophore*, where luncheon was served. The inspection of the lobster-rearing plant of the Rhode Island Commission, the main object of the visit, followed, after which the party proceeded to Newport for the night.

On September 30 the United States fisheries steamer *Fish Hawk* took the delegates from Newport to Woods Hole, Mass., where the government marine fish hatchery and laboratory were inspected.

In Boston on October 1 the delegates were the guests of the T Wharf Association and the Boston Fish Bureau, being escorted in automobiles to the fish wharves, fish-packing establishments, Quincy Market cold storage plant, and other points of interest. Hon. Curtis Guild, governor of Massachusetts, received and addressed the delegates at the statehouse. A complimentary luncheon was tendered by the fish merchants of Boston, and the delegates were there welcomed by the mayor of the city. At Harvard University President Eliot gave an informal reception and address, and the Museum of Comparative Zoology and other buildings were visited. In the evening the party were the guests of honor at a banquet provided by the fishery interests of Boston.

October 2 and 3 were spent in Gloucester, Mass., where a committee of the board of trade and the Master Mariners' Association escorted the visitors to the fish wharves, fish-curing and fish-packing plants, and fish-glue works, and the marine hatchery of the United States Bureau of Fisheries in Gloucester Harbor was inspected. The excursion terminated with a cruise on a mackerel schooner and a demonstration of purse-seine fishing, the boats being manned and the seine operated by the masters of mackerel vessels.

VIEWS AND RESOLUTIONS ADOPTED BY THE CONGRESS.

GENERAL VIEWS.

1. The congress learns with pleasure that the long standing fishery dispute between Great Britain and the United States affecting waters on the northeast coast of North America is likely to be submitted to settlement by arbitration at an early date.

2. We heartily commend the stand of the President of the United States in behalf of the conservation of natural resources, and congratulate him on the beneficial effects of his example and influence at home and abroad.

3. The congress advocates the establishment, in all countries having important fisheries, of national schools of fisheries and fish culture under government auspices.

4. The congress strongly urges the necessity of simplifying fishery laws by the elimination of qualifying clauses which so often provide loopholes through which offenders escape penalties and waters continue without protection.

5. In view of the injury to the fishing communities and the menace to the prosperity of important fishing industries on the Atlantic coast of the United States and Canada arising from the depredations of dogfish, especially of the spiny and smooth dogfishes, this congress favors uniform measures for the extermination or utilization of these injurious fishes in the contiguous waters referred to.

VIEWS OF UNITED STATES DELEGATES.

1. The condition at this time of the shad fishery in east coast streams forbodes ill for its future and demand energetic action on the part of the United States and Canadian provinces. We urge prompt action, especially with regard to interstate waters, that will so regulate fishing as definitely to insure the passage of a fair proportion of the run to the spawning grounds each season. A 10 per cent reduction in the catch at this time may prevent the ultimate destruction of a fishery worth $1,500,000 yearly.

2. We heartily indorse the movement instituted by President Roosevelt for the conservation of our natural resources, and we pledge our official and personal support to measures for insuring the protection of our fishes and other aquatic creatures.

3. Believing that the welfare of all of our most valuable river fisheries demands the preservation of natural conditions at the headwaters of streams, we favor and urge the formation of the Appalachian Forest Reserve and other similar reserves which embrace the watersheds of important streams.

4. The convention between Great Britain and the United States under which the regulation and administration of the fisheries of the boundary waters of the United States and Canada will be undertaken by the respective federal governments marks an epoch in the history of our fisheries. We pledge our support to all measures that, after proper investigation, are found to be necessary for the preservation of the fisheries of the waters in question.

RESOLUTIONS.

1. That the thanks of the congress are due and are hereby tendered to the President of the United States, the Secretary of Commerce and Labor, and the authorities and citizens of the city of Washington for their cordial and effective support.

2. That the thanks of the congress are offered to the Italian Fisheries Society for its cordial invitation to hold the next session in Rome in 1911.

3. That the congress reaffirms the action of previous International Fishery Congresses in recommending an international exploration of the Mediterranean Sea in the interests of the fisheries.

4. That the congress records its sincere appreciation of the inestimable services of Dr. H. C. Bumpus as president and of Dr. Hugh M. Smith as secretary general of the congress, their untiring devotion and constant courtesy as principal officers of the congress having contributed so much to its success.

5. That thanks are freely extended to the following institutions for their generous entertainment and their contributions to the exhibits: The American Fisheries Society, the Blue Ridge Rod and Gun Club, the Alaska Packers' Association, the New England Forest, Fish, and Game Association, the National Geographic Society, the United States National Museum, and the United States Bureau of Fisheries.

6. That the thanks of the congress be, and are hereby, extended to the donors of the various competitive awards.

7. That the efficient and painstaking work of the international committee of awards merits special recognition, and is heartily appreciated by the congress.

8. That the proceedings of the congress be edited and published by the secretary general, who is authorized to incorporate in the volume of proceedings such papers as may have been received but which for lack of time or other reason may not have been formally brought before the congress.

9. That the secretary general be, and he is hereby, authorized and requested to bring the various views and resolutions adopted by the congress to the attention of all persons concerned or interested therein.

COMPETITIVE AWARDS.

In connection with the Fourth International Fishery Congress, arrangements were made for the award of money prizes for the best or most important investigations, discoveries, inventions, etc., relative to fisheries, aquiculture, ichthyology, fish pathology, and related subjects during the years 1906, 1907, and 1908. It was felt by the local management that, while the amounts of the individual prizes were not large, the conferring of the awards by so representative a body as the International Fishery Congress would induce many persons to compete and would result in much benefit to the fisheries and fish culture. In June, 1906, circulars announcing the subjects and conditions of the competition were issued in the English, French, and German languages and were extensively distributed. Several other circulars relating to the matter were sent out in 1907 and 1908.

LIST OF AWARDS.

1. By the AMERICAN FISHERIES SOCIETY: For a paper embodying the most important original observations and investigations regarding the cause, treatment, and prevention of a disease affecting a species of fish under cultivation, $100.

2. By the AMERICAN MUSEUM OF NATURAL HISTORY, New York City: For an original paper describing and illustrating by specimens the best method of preparing fishes for museum and exhibition purposes, $100.

3. By "FOREST AND STREAM," New York City (Mr. George Bird Grinnell, editor): For the best paper giving description, history, and methods of administration of a water, or waters, stocked and preserved as a commercial enterprise, in which angling is open to the public on payment of a fee, $50.

4. By the MUSEUM OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. (Mr. F. A. Lucas, curator in chief): For the best paper setting forth a plan for an educational exhibit of fishes, the species and specimens that should be shown, the method of arrangement, and suggestions for making such an exhibit instructive and attractive, $100.

5. By the NEW YORK AQUARIUM, under the management of the New York Zoological Society, New York City (Mr. Charles H. Townsend, director): For an exposition of the best methods of combating fungus disease in fishes in captivity, $150.

6. By the NEW YORK BOTANICAL GARDEN, New York City (Dr. N. L. Britton, director): For the best essay on any interrelation between marine plants and animals, $100.

7. By the SMITHSONIAN INSTITUTION, Washington, D. C.: For the best essay or treatise on "International regulations of the fisheries on the high seas, their history, objects, and results," $200.

8. By THE FISHERIES COMPANY, Philadelphia, Pa. (Mr. Joseph Wharton, president): For the best essay treating of the effects of fishing on the abundance and movements of surface-swimming fishes which go in schools, particularly the menhaden

and similar species, and the influence of such fishing on the fishes which may prey on such species, $250.

9. By the UNITED STATES BUREAU OF FISHERIES, Washington, D. C.: For a report describing the most useful, new, and original principle, method, or apparatus to be employed in fish culture or in transporting live fishes (competition not open to employees of the Bureau), $200.

10. By the WOLVERINE FISH COMPANY, Detroit, Mich.: For the best plan to promote the whitefish production of the Great Lakes, $100.

11. By MR. HAYES BIGELOW, Brattleboro, Vt., member of the American Fisheries Society: For the best demonstration, based on original investigations and experiments, of the commercial possibilities of growing sponges from eggs or cuttings, $100.

12. By HON. GEORGE M. BOWERS, United States Commissioner of Fisheries, Washington, D. C.: For the best demonstration of the efficacy of artificial propagation as applied to marine fishes, $100.

13. By DR. H. C. BUMPUS, director of the American Museum of Natural History, New York City: For an original and practical method of lobster culture, $100.

14. By MR. JOHN K. CHEYNEY, Tarpon Springs, Fla., member of the American Fisheries Society: For the best presentation treating of the methods of the world's sponge fisheries, the influence of such methods on the supply of sponges, and the most effective means of conserving the sponges.

15. By PROF. THEODORE GILL, honorary associate in zoology, Smithsonian Institution, Washington, D. C.: For the best methods of observing the habits and recording the life histories of fishes, with an illustrative example, $100.

16. By DR. F. M. JOHNSON, Boston, Mass., member of the American Fisheries Society: For the best demonstration of the comparative value of different kinds of foods for use in rearing young salmonoids, taking into consideration cheapness, availability, and potentiality, $150.

17. By the NEW YORK ACADEMY OF SCIENCES, New York City (Dr. N. L. Britton, president): For the contribution, not entered in competition for any other award, which shall be judged to have the greatest practical value to the fisheries or fish culture.

18. By MESSRS. HENRY HOLT & CO., publishers, New York City: For the best series of photographs, with brief descriptions, illustrating the capture of food or game fishes, $100.

CONDITIONS GOVERNING COMPETITION.

1. Any person, association, or company may compete for any of the awards.

2. Each competitor shall, before July 15, 1908, notify the secretary-general of the congress as to the particular award for which he competes; and he shall duly qualify himself as a member of the congress.

3. Each paper or exhibit offered in competition shall be in the custody of the secretary-general on the day of opening of the congress.

4. Papers may be written in English, French, German, or Italian.

5. Each device, apparatus, process, or method for which an award is asked shall be represented by a sample, a model, or an illustrated description; and each shall be accompanied by a complete statement of the points for which an award is asked.

6. The congress reserves the right to publish, prior to their publication elsewhere, any papers or photographs submitted in competition, whether or not such papers or photographs receive awards: *Provided, however*, That in the event of the congress having failed to publish within six months after the session, an author will be at liberty to publish when and where he may elect.

7. The papers, appliances, exhibits, etc., submitted in competition for awards will be examined by an international committee to be designated by the president of the International Fishery Congress.

8. The committee will determine the competitors who are entitled to awards, and the decisions of the committee will be final.

9. The committee may call before it, in order to obtain additional information when desirable, persons who may have entered the competition and also other persons.

10. The committee may, at its discretion, withhold the award in any case if in its judgment no sufficiently worthy competition is presented; and it may divide an award if there are two competitions that it deems of equal merit.

11. The committee will make its report to the congress not later than the day preceding final adjournment.

12. The awards will be announced at a session of the congress, and each award will be accompanied by a special certificate or diploma suitably inscribed and bearing the signatures of the officers of the congress.

INTERNATIONAL COMMITTEE ON AWARDS.

At the opening session of the congress, the president appointed an international committee on awards, consisting of eighteen members who were not competitors. The committee, divided into five subcommittees to deal with the various groups of awards, consisted of the following, of whom Dr. E. A. Birge was chosen as general chairman:

For prizes numbered 3, 7, and 8—Dr. Oscar Nordqvist, chairman; Dr. Theo. S. Palmer, Maj. Richard Sylvester, Dr. Barton W. Evermann, Dr. W. S. Harban.

For prizes numbered 1, 5, 6, 11, 14, and 15—Dr. Decio Vinciguerra, chairman; Dr. E. A. Birge, Dr. F. B. Sumner, Dr. T. Kitahara.

For prize numbered 17—Dr. H. von Kadich, chairman; Dr. Henry B. Ward, Dr. Robert E. Coker.

For prizes numbered 9, 10, 12, 13, and 16—Dr. P. C. C. Hoek, chairman, Mr. W. E. Meehan, Mr. J. W. Titcomb.

For prizes numbered 2, 4, and 18—Dr. Gregoire Antipa, chairman; Dr. S. E. Meek, Dr. F. W. True.

THE AWARDS CONFERRED.

About 50 papers and exhibits were submitted in competition, many of which were of high value and embodied the results of painstaking research and experiment. The committee adopted the following rules for their guidance:

1. No prize shall be awarded except for a paper of exceptional value. Such paper should contain the results of an unusually thorough and complete investigation, or should announce an important new discovery or method.

2. It is not expedient to award less than a full prize to a single paper, although, following the general rules, a prize may be divided between papers of equal merit.

3. In case no award of a prize be given, the committee recommend that the donor be requested to allow the prize to remain open for competition at the next International Fishery Congress.

The committee reported their findings on September 25, and unanimously made the following awards:

No. 2: To Mr. Dwight Franklin, New York City.

No. 4: To Mr. Frederic A. Lucas, Museum of the Brooklyn Institute of Arts and Sciences, New York City, and Mr. Roy W. Miner, American Museum of Natural History, New York City (division of prize).

No. 7: To Mr. Charles H. Stevenson, U. S. Bureau of Fisheries, Washington, D. C.

No. 9: To Dr. A. D. Mead, Brown University, Providence, R. I.

No. 10: To Mr. Paul Reighard, University of Michigan, Ann Arbor, Mich.

No. 11: To Dr. Henry F. Moore, U. S. Bureau of Fisheries, Washington, D. C.

No. 13: To Dr. A. D. Mead, Brown University, Providence, R. I.

No. 14: To Dr. Henry F. Moore, U. S. Bureau of Fisheries, Washington, D. C.

No. 15: To Prof. Jacob Reighard, University of Michigan, Ann Arbor, Mich.
No. 16: To Mr. Charles G. Atkins, U. S. Fisheries Station, Craig Brook, Me.
No. 17: To Mr. John I. Solomon, New York City.

The committee recommended that no awards be made in the case of prizes numbered 1, 3, 5, 6, 8, 12, and 18. For one of these there was no competition and for the others the papers or exhibits were regarded either as not of sufficient merit or as not strictly within the terms of the award.

In recognition of his papers on the sponge fisheries, and his most praiseworthy efforts on behalf of the sponge fishermen, Mr. Charles Flegel, member of the Imperial Austrian Fishery Society, was awarded a special cash prize of $50 by the officers of the congress.

PERMANENT COMMISSION OF THE INTERNATIONAL FISHERY CONGRESSES.

A meeting of the Permanent Commission of the International Fishery Congresses was held at Washington, D. C., on September 23, 1908, in connection with the Fourth International Fishery Congress. The meeting was called to order by the ex-officio chairman, Dr. Hermon C. Bumpus, president of the congress; and the following members were in attendance: Dr. Heinrich von Kadich, representing Austria; Prof. Decio Vinciguerra, representing Italy; Prof. Gregoire Antipa, representing Roumania; Dr. Oscar Fritiof Nordqvist, representing Sweden; Dr. Hugh M. Smith, representing the United States of America.

With the approval of the meeting, the representatives from various other countries were invited to be present, and the following were in attendance: Lieut. Radler de Aquino, representing Brazil; Mr. O. T. Olsen, representing Great Britain; Dr. Walther Naumann, representing Germany; Dr. Ramon Bengoechea, representing Guatemala; Chevalier Guido Rossati, representing Italy; Hon. José F. Godoy, representing Mexico.

Prof. Decio Vinciguerra presented a letter from the president of the Italian Fishery Society, extending on behalf of the society a very cordial invitation to hold the next congress at Rome in 1911, on the occasion of the fiftieth anniversary of Italian unity. An invitation having the same purport was likewise received from the mayor of Rome. After Professor Vinciguerra had seconded the invitation, the commission voted unanimously to accept it, and agreed to report their action to the congress for ratification.

Dr. Walther Naumann announced that at the next congress an invitation to hold the Sixth Congress in Germany would be formally presented.

A proposition from Mr. Nicholas Borodine, of Russia, for an international dictionary of fishing and fish-cultural terms in twelve languages was indorsed, and the secretary was directed to bring the matter to the attention of the congress with a favorable recommendation to the committee on resolutions.

Professor Vinciguerra proposed that at the next congress a scheme should be submitted for imposing more important duties and responsibilities on the Permanent Commission of International Fishery Congresses than have heretofore been assumed. On motion, duly seconded, a committee of three was appointed to consider this matter and report at the next congress, the committee consisting of Professor Vinciguerra (chairman), Dr. P. P. C. Hoek, of Holland, and Prof. Bruno Hofer, of Germany.

The meeting then adjourned.

HUGH M. SMITH, *Secretary.*

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INTERNATIONAL REGULATIONS OF THE FISHERIES ON THE HIGH SEAS

By O. T. Olsen, D. Sc., F. L. S.

WITH DISCUSSION

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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INTERNATIONAL REGULATIONS OF THE FISHERIES ON THE HIGH SEAS.

By O. T. OLSEN, D. Sc., F. L. S.

To attempt a history of the fisheries on the high seas would be like attempting to bail out the ocean or to name all the inhabitants in the vast deep. It is well known to all here that there are no greater flow and ebb in any industry or commerce than in that of the fisheries. Many fortunes have been made and as many have been lost.

God, the great Creator, has very bountifully provided for his creatures, both on land and sea, and given to man the cunning of entrapping the denizens of the seas as food. As populations increased so the demand for fish food increased, accordingly markets were established and both catchers and venders reaped great harvests. It was soon found that to keep markets supplied larger vessels had to be built to go farther afield for fish, and indeed the fishermen did not confine themselves to their own coasts, but they invaded the shores of other nations, which led to dispute and legislation.

Many acts were passed by the various governments to regulate the fisheries of their own coasts, but nothing of an international character has ever been attempted which has worked more satisfactorily than the international convention of 1882 in the North Sea, although there are improvements to be made even in this.

Territorial waters or sea fishery limits have for many centuries occupied the minds of maritime nations. As far back as 1200 King John claimed dominion over the British seas, so did Edward I and Edward II. The sovereignty included many rights and privileges, of which fishing was one, but foreigners were allowed to fish along the British coasts. In 1295 King Edward I commanded the authorities at Yarmouth to treat foreign fishermen in a friendly and kind spirit while fishing off Yarmouth, and freedom of fishing in the seas was embodied in various treaties between England, France, Spain, Portugal, and Flanders. In 1493 the Pope issued a bull dividing the seas between Spain and Portugal. Spain became ruler over the Pacific and the Gulf of Mexico, while Portugal reigned over the Atlantic south of Morocco and over the Indian Ocean.

During the reign of Elizabeth most of the seas were claimed by one nation or another. Denmark claimed the seas between Norway and Iceland, as well as the Sound, the Belts, and the Baltic. England claimed the English Channel, Bay of Biscay, and the seas westward of Ireland and north of Scotland; also the whole North Sea. These claims included the rights of fishing, and led to

frequent international disputes. The British fisheries declined, and the Dutch increased, and eventually the British assailed the Dutch for fishing off the British coast, and proclaimed the exclusive fishing rights in the British seas. In 1609 King James issued a proclamation forbidding foreigners from fishing on any British coasts unless they had first obtained licenses to do so. This proclamation was renewed by Charles I in 1636. Time and space will not permit of any further reference to the history of territorial limits. The North Sea convention of 1882 decided the present 3-mile limit. This international law has worked well, although a 4-mile limit would have given greater satisfaction to some nations. It has to be remembered that the English mile is not a standard in all countries. For instance, 4 English miles are equal to a Norwegian mile, to a Danish mile, and to a Swedish mile, so that at present the restricted waters are a portion of a mile in each of those countries, and in their case the distance is taken as one minute of a degree. Both Norway and Sweden would have become parties to the convention had the 4-mile limit been accepted, and there are other reasons favorable to that distance. In the first place such a limit would have been as easily ascertainable as the 3-mile limit; it would have given an additional mile round the land for the development of the fry, which are generally found in shallow water, and it would secure to the local fisherman another mile of fishing water. This 4-mile limit would also have served the purpose of customs limitations for contraband, for boarding by cruisers, etc. A governing power on the high seas is absolutely essential, and such a tribunal should be international. The North Sea convention will serve as a criterion.

If the limits could be extended so as to apply to all nations the result would be very beneficial. The lettering and numbering of fishing vessels which is insisted upon has proved a very wise precaution, and fishing vessels are given their due exemption from pilotage, and the rules of the road regarding them are defined. The letters and numbers served the purpose with the sailing vessels, when they were painted on the sails as well as on the hull of the vessel. Now that the steam trawler predominates, the numbers and letters are placed on the bows, and in some cases on the funnels.

The number of steam trawlers to the end of 1907, published by the Board of Agriculture and Fisheries, July, 1908, is as follows:

Belgium	23
Denmark	5
France	224
Germany	239
Netherlands	81
Norway	20
Portugal	13
Spain	18
Sweden	11
England and Wales	1,317
Scotland	292
Ireland	6
Total	2,249

Besides these steamers there are in Norway, Sweden, Denmark, and Iceland a multitude of motor boats for fishing along the shore.

The police or superintendence and protection of fisheries by cruisers has been more or less successful, and it would be well to reconsider carefully the duties and the administration of the power invested in the commanders and officers of the cruisers, as well as the magistrates who have to mete out penalties for infractions of the law. This also is a matter for an international fisheries society to deliberate on. "Regulations for Maintaining Good Order Among the Fisheries at Sea," April 6, 1889, has had only a limited effect, as it is practically embodied in the sea fisheries acts of 1882, but, on the other hand, the North Sea fisheries act, 1893, respecting the liquor traffic in the North Sea, has been a great blessing and a boon both to the owners of fishing vessels and to the fishermen themselves. It has practically annihilated the "cooper," with spirituous liquors and tobacco, and the tobacco has been transferred to the mission ships belonging to the Royal National Mission to Deep Sea Fishermen, from which tobacco can be bought for 1 shilling per pound, equally as cheap as from the "cooper."

The one unfortunate result which has arisen in contravention to the international convention of 1882 came from a desire to close the Moray Firth against all steam trawling, the plea being that this piece of water was the spawning ground for flatfish. In reality there was another feeling emanating from the fishermen who carried on long-line fishing in the Firth of Forth, and those fishermen made representations to the Fishery Board for Scotland to stop this trawling in the Firth. This board accordingly passed a by-law prohibiting trawling. Power was sought and obtained from the British Government and it became a statute. The English trawlers were seized in the Firth, skippers arrested, fish confiscated, and trawling gear removed from the vessels. The owners were heavily fined, but the foreign trawlers insisted upon their rights to fish when outside the 3-mile limit and inside the imaginary line drawn from point to point, a distance of over 70 miles, instead of the 10-mile bay. When it became known that the foreign trawlers could carry on their operations under the protection of the international agreement or convention, the English began to register their ships under foreign flags. There are to-day 35 steam trawlers sailing under the Norwegian flag out of Grimsby, practically owned by Englishmen and worked by them for the sole purpose of trawling in the Moray Firth. This action has caused much enmity between the Scotch fishermen, as well as the Fishery Board for Scotland, and the English trawlers under the Norwegian flag. Of course, English trawlers should observe the fishing rights of the long-line fishermen and also those of the drifters as well as the preserved ground or waters for scientific purposes; but, on the other hand, the Fishery Board for Scotland had no legal right to encroach upon the North Sea outside of the teritorial limits, which is under the common jurisdiction of the high contracting parties and this tribunal

was not consulted. This matter is not settled yet. This is also a case for an international society to settle by arbitration free from political bias.

At the International Fisheries Exhibition, London, in 1883, a statement was made by our much esteemed and lamented friend, Prof. Brown Goode, of the United States Fisheries Bureau. He said: "As long ago as the year 1600, within forty years of the settlement in New England, there were records of the colonists seining the mackerel off Cape Cod by moonlight; and it was somewhat remarkable that on this fishery was founded the system of public schools in the United States, for within ten or twenty years of that time the first public school was founded on a tax upon the fishery." It is not my intention to touch upon the American fisheries; it would be presumptuous to do more than eulogize the rapid progress and the enormous success accruing from the excellent management and regulations in the vast territory of that part of our globe. Such men as my friends Capt. J. W. Collins and Prof. Brown Goode, whom I have already named, have done much for the American fisheries and have enriched all other nations by their original research and publications. Their names will live when many of us have finished our careers.

NOTE.—Appended to Mr. Olsen's remarks were reprints of the following documents as published in his Fishermen's Nautical Almanac:

Digest of the Merchant Shipping Act, 1894 (57 and 58 Vict., ch. 60).
North Sea Fisheries Act, 1893.
Extract from the Sea Fisheries Act, 1883.

DISCUSSION.

Mr. CHARLES E. FRYER. Mr. President, ladies, and gentlemen, I am sure we are much obliged to Mr. Olsen for the paper he has read. It has occurred to me, in the course of the reading of it, that it might possibly be a little local in its character, and refer too much to matters in which we on the other side of the Atlantic are more interested than you who are separated from us by so many miles of deep and, as I know to the full within the last few days, tempestuous water.

The question of the international regulation of the fisheries on the high seas involves, I need hardly say, many very wide considerations. The first point to determine, no doubt, is whether it is the fish and the methods of catching them that you wish to take into account, or whether it is the more immediate interests of those who go in pursuit of the fish, namely, the fishermen.

Where the fisheries are conducted over such enormous areas as the ocean, and not merely in the limited waters of rivers and estuaries, it almost follows that any steps that may be suggested for the protection of the fish must be both less necessary and more difficult to put into operation than any steps that may be taken for the protection of the fishermen; and I submit that so far as the high seas are concerned—and the title of the paper rather limits us to the high seas—the possibility of any international regulation is very much greater when we come to deal with such questions as the protection of life, and the maintenance of law and order among the fishermen, than when we come to consider the possibility of protecting the fish themselves.

The fisheries carried on in the high seas are to a large extent concerned with fish of whose habits we know very little. Notwithstanding all that has been done here in this great country—probably more than in the rest of the world put together—we still find that we are exceedingly ignorant of the minutiæ of the habits and of the habitat of the fish which constitute the great harvest of the sea. The more we know, the more I think we find we need to know, and there is an enormous field of research to be exploited before we can decide whether any protective measures should be adopted for the furtherance of the fisheries carried on in the high seas, more particularly with reference to those fish which are classed as pelagic rather than those which are more local in their habits. The first consideration, therefore, would be to decide upon a method of investigation; and, if I may take a leaf out of Mr. Olsen's book and refer somewhat to what is taking place in western Europe, I may perhaps find a wider illustration of what is sought than can be found on this side of the Atlantic. You here in the United States are in the happy position of having very few neighbors—so far, at any rate, as the flag goes—to deal with. On the other side of the Atlantic we have a large number of nations—separate nations—each under its own separate government, interested in the fisheries in a relatively small portion of the sea, and it has become a much more important question with us to consider whether anything can be done for the protection and development of the fisheries—the fish themselves—than can be the case, or, at any rate, than has hitherto been found to be the case, in this country. For I am afraid to say how many centuries the British statute book alone has been filled with enactments, first for the promotion of the fisheries, and then for the protection of them; and the protection of them in the double sense of the word, with a big "P"—the protection of them against the foreigner; and with a small "p"—the protection of them against the depredations of what are held to be detrimental modes of fishing. For centuries we have been putting laws on the statute book, and we have been equally ready to wipe them out. We have found that we have made regulations in many cases—

in most cases—without sufficient information; and then, having made regulations, we have had to set to work to a very much larger extent to find out whether they are justified by the facts before us. But in recent years we have been somewhat altering our methods, and there is now established, as regards the principal powers of western Europe who are interested in the fisheries of the North Sea, the German Ocean, an international council for the study of the sea. That council started with a very large programme of research, involving many matters, which those who are interested in fisheries know are concerned with fishery development, and which influence the movements of fish, such as temperatures, currents, depths, salinity, and generally what is summed up in the word "oceanography." But, while all these matters are necessarily involved in the great question of fishing and fisheries, they are not necessarily essential to the study of some of the more important problems that we have to deal with, and the international council which has been established with regard to the North Sea is finding that it has to limit its programme and to take up some of the more pressing and urgent questions, rather than to deal with the study of fish and fisheries of the ocean at large. And I should like very much if, in what I am saying, I could lead some gentleman on this side to tell us how far individual cases of urgent necessity have arisen where particular fisheries seem to require protection as contrasted with the wider study of the general questions of biology and of the metabolism of the sea generally.

Having decided whether it is the fish or the fishermen that most require protection, it is for the states concerned in any fisheries which are common to them, as they necessarily are on the high seas beyond the territorial limits, to make up their minds as to the extent to which any regulations are needed and as to the direction which they should take.

It may possibly be of interest to you here if I point out that, so far as any international regulations on the other side of the Atlantic are concerned, in which England—the United Kingdom—at any rate, is interested, there is none which deals directly with the protection of the fish. The regulations deal with the protection of the fishermen; sometimes protection of the fishermen against themselves; sometimes the protection of the fishermen against the elements; sometimes against undue competition, competition carried to the extent of what are commonly, or have in the past, been known as "outrages" committed on the persons and on the property of competing fishermen. Our international regulations have been directed to putting down abuses of that kind and to establishing a system of international marine police which, on the one hand, should protect the territorial limits, but which is mainly established for the purpose of protecting the fishermen and preventing such "lewd outrages" as Mr. Olsen referred to, such undesirable practices as took place when the class of men known as the "coopers," of whom you have heard, practically had the high seas to themselves and carried on a most undesirable traffic in intoxicating liquors, leading to very serious outrages, and, in many cases, to disaster. That has been entirely put down. The moment that these practices were recognized, the several nations interested agreed at once, without any demur, to establish a system of police and a method of license by which the traffic in intoxicating liquors among fishermen on the high seas, at any rate in that part of the sea which was particularly infested by these men, should be controlled.

Then, as another instance of undesirable practices, is what you, I believe, on the United States coast know as the trawler, here practically unknown—that is to say, the trawler who fishes with a net drawn along the bottom of the sea. I believe I am right in assuming that by the trawl on this side is commonly meant the long line?

The PRESIDENT. Yes.

Mr. FRYER. But on the other side of the Atlantic the practice of trawling by nets whose mouths are held open by one or two very ingenious devices and which are drawn along the bottom—at or near the bottom—of the sea, is a practice which is extending enormously. I am told that one or two experiments have been made on the Nova Scotian coast, and I hear that it is proposed to send over some of these vessels to the banks on this side—the Newfoundland banks in particular—with a view to seeing

whether that industry can be established on this side. Thus you may possibly have in a very short time to deal with difficulties such as we have had to deal with, namely, the interference caused by a method of fishing, such as the trawl, with older-established methods, such as the long line, or what you know as the "bultow" or with the "drift net."

When steam was introduced as a means of propulsion of trawling vessels, it became very much more easy for the trawler to force its way through the drift nets, or to sweep up the long lines, than when a vessel was propelled merely by sail. And a very reprehensible practice was adopted by a certain number of fishermen who actually carried with them to sea cutting grapnels, which enabled them to cut into the nets with which they came in contact, and very great damage was done by one class of fishermen to another class in this way. This is an illustration of the protection of fishermen against their colleagues. Now, as soon as this practice was brought to the notice of the powers interested, in the North Sea fisheries especially, they again entered into an international agreement to put this practice down, and heavy penalties were imposed upon the possession of the instrument in question, which was known by the somewhat significant title of "devil." The devil has been abolished, in that shape at any event, from the North Sea.

I do not know whether I am passing the time limit or not.

The PRESIDENT. Just a minute or two more.

Mr. FRYER. One other matter in which it is possible to protect the fishermen is with respect to the outfit of the vessels, and the prevention of collisions at sea, and in things of that sort, which also have become the subject of international regulation. In such questions as the carrying of lights for particular purposes, not only the nations of western Europe but practically all the nations of the world have agreed to an international code, which I think I may refer to fairly as an illustration of the link which exists among all nations in the waters of the high seas in which the great fisheries are prosecuted.

I should like to enlarge upon the idea which suggests itself as soon as we begin to speak of the ocean as a link. We speak of it commonly as a means of division between nations, but I think that the suggestion may be maintained that the water is rather a connecting link. It is much more a connecting link than it is a means of dividing of the nations. In this room we have an illustration of the fact that the subject of fish, and the element in which the fisheries are conducted, has led to the bringing together of a large body of gentlemen from all parts of the world; and if the question of the international regulation for fisheries on the high seas can lead, as I hope it may in the future, to more harmonious and fraternal relations among the nations of the earth, we shall be entering upon quite a different era from that of the past, when the question of fisheries was a question sometimes nearly, if not actually, of war, and led at any rate to anything but fraternal relations. But I think the longer we study and the more we know of these matters, the more we regard them from the point of view not of our own local interests, but as interests uniting nation to nation, the better it will be, not only for the fishers themselves, but for the general welfare of those nations who are so largely interested in them in common. [Applause.]

Dr. B. W. EVERMANN (U. S. Bureau of Fisheries). Ladies and gentlemen of the congress, this matter of the international control of the fisheries on the high seas suggests to me that it might be worth while for a word to be said regarding a step which the Governments of Great Britain and the United States have recently taken looking to the control of the fisheries in international waters. As you are doubtless aware, the fisheries in the international waters between the United States and Canada are of great importance. There are a number of important lakes—four of the Great Lakes, and smaller lakes connected with them—the St. Lawrence River and those other waters to the eastward; and then of equal or even greater importance are the fisheries on the west coast, those in the Puget Sound and Fraser River region. The fisheries in those international waters

have been administered by the respective States on this side of the line and by the Provinces on the other side, in some cases jointly by the Provinces and the Dominion Government.

Lake Erie may be taken as an illustration. On the American side are the States of New York, Pennsylvania, Ohio, and Michigan; on the other side the Province of Ontario. Each of those governments has exercised control over a certain portion of Lake Erie. The laws or statutes in no two of those States or provinces have been uniform. As a result, interminable and very irritating conflicts arise every year. Because of that situation, recently the United States and Great Britain entered into a treaty, the terms of which provided for the appointment of an international fisheries commission to look over the ground, to find out what the local conditions are, and to recommend to the respective governments proper statutes which would regulate in a proper way the fisheries of these international waters. The treaty named specifically the waters which were to be considered by this joint commission. The treaty also provided that this international fisheries commission should write the statutes, define what should be the terms under which fishing may be carried on in these various waters, and that they should submit their report to the respective governments not later than the 31st of December next. Then it is understood that the statutes written by that commission will be promulgated by the respective governments and the necessary steps taken for the enforcement of the regulations agreed upon.

The short time that was allowed the commission to consider these matters was embarrassing, of course. To allow them only until the 31st of December seemed a very short time; at first blush it seemed that it was almost useless to attempt to do anything, but the commission entered upon its investigations at Eastport, Me., the 7th of July. After a few days the situation cleared up very materially. I may say that the commission took as the basis from which to work the most admirable report made by the Rathbun-Wakeham commission of 1892–1896. Those two gentlemen, as high joint commissioners, representing the two governments, Canada and the United States, went over the ground during each of four years and made a very thorough and very sane report as to the conditions, and then closed their consideration of each of the international waters with a statement embodying what they thought were the proper recommendations necessary to be carried out for the proper regulation of the fisheries of that particular body of water. Using that as a basis, the present international commission was able to make much more rapid progress and to understand the situation much more readily and much more thoroughly than at first seemed possible. After interviewing a few hundred fishermen it was easy to tell what the next fisherman would say, so that the matter became simple. I may say, simply, that this international commission, consisting of David Starr Jordan, of Stanford University, California, and Samuel T. Bastedo, of Canada, with myself as associate, went over the entire boundary, visiting all of the important fisheries, and the commission is now writing its statutes and will have its report ready for the respective governments by the end of December.

What I want to call to your attention particularly is this: Practically all of the difficult problems which came to the attention of this commission were biological problems. They are problems which can not be settled or solved offhand. They are problems which can be settled or which can be understood only through a series of careful observations; the time of the spawning of the different species of fishes, the food of the different species of food fishes, and I may say, and strangely, just what are the species of food fishes in the Great Lakes. They are not what they are said to be in the books. There is a discrepancy; there are several discrepancies, in fact. So that the problems which must be studied from now on, which will need to be studied in order to revise and revamp the statutes from time to time, as the international commission has authority to do, are problems of that character; and they will have to be taken up from year to year to keep the statutes up with the ever-changing conditions.

This, it seems to me, the taking over of the control of the fisheries on the Great Lakes by the federal governments—by the United States Government on our side, and the Dominion Government on the other side—is a great step, the greatest step that has ever been taken, I think, looking toward the proper conservation and the building up of the fisheries.

The terms of the treaty are numerous, and if they are carried out—and the governments are sure to do it, I think—we feel that the outlook for the fisheries in these international waters is more encouraging than it has ever been. Thank you. [Applause].

Mr. A. KELLY EVANS (Canada). I would like to amplify something that Doctor Evermann alluded to.

In speaking for the Province of Ontario, which virtually controls the major Canadian portion of the great inland fisheries, I should like to explain one point that Doctor Evermann has left out, as showing the great advantage accruing through this new treaty, and the matter being left in the hands of the commission.

Unfortunately, it has been the practice in the past that persons at certain local points, governed by certain local political conditions, were able to place regulations upon the statute book which undoubtedly were very much against the conservation of the fisheries of the inland lakes. Having now placed the power in the hands of a commission, it will be impossible, for instance, for the local representative of one constituency to have his own way as has unfortunately often occurred. As an illustration, take a small body of water which it so happens occupies the position of the most favorable spawning ground for the fish of a very large body of water—for example, in Lake Ontario we have the Bay of Quinte, a small, narrow, land-locked bay in which most of the white fish of the entire lake spawn. At present some 300 or 400 net fishermen practically determine a member for a constituency there and have been able to dictate terms to that member. Now that this matter is placed in the hands of a commission, you will see that the member representing that one constituency will have but little or no power over the regulations governing the fisheries, etc., and consequently the net fishermen, for their own temporary, selfish interests, will not be able to dictate the policy governing the fisheries of the Great Lakes.

Unfortunately, the map that is exposed on the wall is rather broken off here [indicating] and it does not show a large portion of our Canadian fisheries to the right, and also owing to the coloration you hardly catch the immense coast line of these Great Lakes; but the coast line of the Great Lakes on our side in Ontario alone is much greater than your American coast on the New England seaboard. And these waters, which but a few years ago teemed with fish in masses that are almost unbelievable, at the present time have reached a point nearing depletion. In this smallest of the Great Lakes here, Ontario, but a few years ago as many as 90,000 whitefish have been taken in one haul with a net. To-day the whitefish fishery in this lake has practically ceased to exist; and I may say that the depletion of the whitefish of Lake Ontario is due very largely to the political influence of some 300 net fishermen in the little constituency of Prince Edward County.

The same thing applies to other of our waters. That peninsula up there [indicating] in North Bruce is also the governing point of important breeding grounds for fish, and the net fishermen there can exercise direct political influence upon their member in parliament. The consequence is that in our country we have this anomaly, that to suit these local political exigencies actually we had an open season there [indicating] different from the open season here [indicating] and different from the open season there [indicating]. In other words, those net fishermen who could bring sufficient political weight to bear upon their member in parliament were enabled to have the fishing season extended into the dangerous breeding zone and otherwise influence the fishery regulations. Now, fortunately, these men, when they come to Ottawa asking for certain favors for their own particular constituency, will be swamped; and we do feel—and I take great pleasure in amplifying what Professor Evermann has said—we

do feel that for the future we may expect that, largely through this treaty and through the work of this commission, the fisheries of the Great Lakes will be saved to posterity. [Applause.]

Mr. JOHN J. PEW (Massachusetts). Mr. President and fellow-delegates, having been interested in the fisheries from boyhood and having had many generations of my ancestors engaged in the same business, as a delegate from the largest fishing port in the United States I feel compelled to bring before this body the matter of beam trawling.

It is the question of beam trawling as now pursued. Several trawlers equipped with beam trawls have already been operating on the banks off the coast of New England, Nova Scotia, and Newfoundland. This method of fishing is looked upon with great alarm and anxiety by all the experienced fishermen of New England and Canada, as far as I am informed; not, as I believe, on account of any spirit of jealousy or on account of any temporary success that any of the beam trawlers may have achieved in the above-mentioned waters, but on account of the catching of so many small fish, which after being taken are found too small for use and are then thrown back in the sea, thus destroying many millions of fish which in a few years if left alone would grow larger and assist in keeping up a continual supply of a catchable and profitable fish for commercial use.

Allow me here to cite an interview with a captain of a Gloucester vessel by a reporter of one of our Gloucester papers. Knowing the captain as I do, I can speak for his reliability and experience in regard to the deep-sea fisheries.

Captain Geel says the greatest menace to the fishery on the banks is the fleet of steam trawlers which have been sweeping over it this season. No one is more qualified to speak than this captain. He says that the damage these crafts are doing may not be apparent right away, but if continued will surely play out the banks as places for the usual method of fishing. Said he:

> Why, you just imagine it! They sweep over the shoal spots steadily, dragging and hauling and setting, dragging, hauling, and setting that great trawl day and night, working two gangs. Now, they do not save any fish under 22 inches in length. They dump the contents of the trawl on deck, pick out the fish over this length, then open the big ports in the bulwarks and dump all the rest of the catch, dead, of course, back into the sea. I do not know what we can do about it; but you take my word for it, it means the beginning of the end of our valuable fisheries if something is not done soon.

Also allow me to cite an extract from a Boston paper of September 11 in regard to steam trawlers:

> HALIFAX, NOVA SCOTIA, *September 11.*
>
> Fishing by means of steam trawlers within the bays and harbors or within the 3-mile limit of Canada has been prohibited by an order in council passed by the Canadian government. The fishermen of Nova Scotia made strong protests to the government against the operation of trawlers, one of which, the *Wren*, recently arrived from Scotland and was fishing out of Canso, Nova Scotia, manned by a crew of North Sea fishermen. This means of fishing is largely used in the North Sea, and as a beginning had been made to introduce it in the waters of Canada the government has taken prompt action to stop it. It is so effective that the above order had to be made to prevent the extermination or serious diminution of the fish supply.

In New England there is only one steam trawler engaged in the beam-trawl fishing, and I am informed it is the opinion of those interested in this vessel that this method is considered destructive to small fish and harmful to the best interests of the New England fisheries for the future.

I do not feel like going into a long argument about this method of fishing, but wish to call your attention to this matter and appeal to you whether it is not time for you to consider it in all of its bearings and take some action which will result in a speedy investigation of the whole matter, that will tend to some regulation or restriction by your respective governments, and be the means of saving millions of small fish from extermination, the loss of which would diminish the catch in the coming years and result in serious losses to all persons engaged in the fisheries.

The PRESIDENT. This opens up a very important matter that is new to America and old to Europe. Are there some who are well acquainted with the situation in the North Sea who will contribute? Doctor Hoek, is it well for us to attempt to secure any preventive methods at present?

Doctor HOEK. I hardly believe that.

The PRESIDENT. You hardly believe that? Must we wait until it gets a little more serious?

Doctor HOEK. Mr. President, in the North Sea they have been trawling now for such a long time, have they not? And the same complaints that just now have been brought forward have been put forth on twenty-five different occasions—on two hundred and fifty occasions. In several instances investigations have been made, and we have at the present moment an immense bulk of information, but hardly one of us dares to come forward with a conclusion, so difficult is the matter. It is so easy to say when a little fish is killed, "Oh, it is a pity," and when a large quantity of young fish is killed to say it should not be permitted; yet it is a very curious thing that taken as a whole the quantity of flatfish taken from the North Sea of late years, while it is diminished, is by no means (so far as statistical information goes) so greatly diminished as you would expect from the alarming communications we have had for several years already on that point. I hardly believe we are sufficiently prepared here to discuss this difficult problem, and so I should prefer not to go into the details of the question, Mr. President.

The PRESIDENT. We are very much obliged.

Mr. PAUL NORTH. Would it be possible to prevent the deep-sea trawling on the open seas—on the bank would it be a possibility?

The PRESIDENT. You have heard the question of Mr. North. Is anyone here prepared to answer him?

Mr. FRYER. Mr. President, I must congratulate you upon your skill as an angler. I never saw a fly more adroitly thrown over any fish than the fly you threw over Doctor Hoek; and I must equally congratulate Doctor Hoek upon having disposed in five sentences of so vast a question as that of the use and the alleged abuse of the trawl. I would only add to what he said that you should not only throw your fly over Doctor Hoek, but that you should keep your eye upon the work that he and his colleagues in Europe have been doing in investigating this question of trawling, more particularly in the North Sea.

Of all the fisheries problems, so far as the high seas are concerned, the problem which is attracting the attention of the great fishing powers on the other side of the Atlantic is with regard to the question of the trawl. I think the answer to the question, "Whether it is possible to pass laws prohibiting trawling?" is undoubtedly in the affirmative. It is perfectly possible to pass laws prohibiting trawling, and it is perfectly possible to enforce those laws within the territorial limits, provided you have got (I hope I am not treading on dangerous ground) a navy big enough to do it [laughter]; but to prohibit trawling in the extraterritorial waters, the waters in which international regulations are necessary, is quite another matter; and there, again, I would suggest that you watch very carefully the results of the investigations that have been conducted for the last seven years—investigations which some of the originators thought might have been brought to an end in less than half that period, but which they are recognizing must be carried on for a considerable period yet before even the answer to a single question can be given, namely, whether trawling is or is not detrimental.

Mr. C. H. WILSON (New York). I wanted to say that our Canadian friends have made a confession here, through their able advocate, Mr. Evans, of Ontario. I think it decidedly un-American that we of the United States should not come halfway in admitting the fact that the fisheries of the Great Lakes on the United States side show quite the same percentage of depletion as those of the Dominion of Canada. I speak by the book. Take the catch of whitefish alone on the Great Lakes, including St.

Clair. The report of 1880 shows a catch of 21,463,900 pounds. In 1903 the catch had dwindled to 3,813,259 pounds. In the State of Michigan the reports of its fisheries are as follows: The whitefish catch in 1891 was 8,110,000 pounds; in 1904 the catch was 4,197,000 pounds, and other varieties of food fish suffered a like loss during that period.

The question of international control of the waters contiguous to the United States and Canada is a question that has disturbed the heart and soul of the average American citizen in a painful manner. We have seen year by year the reduction of the catch of the various varieties of food fish in those lakes. Worse than that, we have seen the continuous rise in the price of food-fish products, menacing the poor.

The settlement of this question is a consummation devoutly to be wished, not any more so by anyone than by the citizens of the State of New York. [Applause.]

Mr. HENRY HINRICHS (Pennsylvania). Regarding the decrease in the catches of fish on the Great Lakes, I regret very much that the gentleman who preceded me failed to take into consideration that last year (1907) and this year there was a phenomenal increase in the catches of whitefish. My home is Erie, Pa. I am interested in the fishing there. Whitefish were considered practically extinct. We did not deem it advisable, from a pecuniary point of view, to invest any money in fitting out nets for the purpose of catching whitefish. Last year and this spring, however, exceptional catches of whitefish have been made. The blue pike, another of the common-food fishes, were decidedly on the increase last year. Extremely heavy catches were made all along the south shore of Lake Erie. This year the herring, the most common fish that swims in the waters of the Great Lakes, have been found more abundant than ever in the history of fishing. There seems to be no end to them; and as far as the price to consumers is concerned, to which the distinguished gentleman referred, I wish to say that the scarcity of fish naturally affects the price. Owing to the heavy catches that have been made this year, at least on Lake Erie, the prices have been lower by from 50 to 75 per cent in some instances than in a great number of years.

Whether this phenomenal increase in the catch of food fishes on the Great Lakes is to be attributed to artificial propagation, or to the exceedingly warm weather of this summer, I am not sure. However, I believe that artificial propagation is perfectly justified in laying claim to the phenomenal increase.

INTERNATIONAL REGULATIONS OF THE FISHERIES ON THE HIGH SEAS

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Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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PRIVILEGES AND CLAIMS OF THE FLAG.

The same principle by which the protection of the flag of its proper nationality is afforded to a vessel on the high seas beyond the territorial limits of its country requires that vessel to comply with all the laws of its country, whether applicable within or beyond territorial limits, and it is as much within the competence of any power to impose restrictions on fishing operations carried on by vessels flying its flag in any part of the world, outside of the territorial waters of other nations, as it is to regulate the fisheries within its own rivers and elsewhere within its domain. But however admirable or necessary such restrictions might be, they would necessarily apply only to the subjects or citizens of the particular State that enacted them, and could not be enforced against aliens except by consent. In cases, therefore, where the fisheries prosecuted in extraterritorial waters were shared in by fishermen of other states, great hardship would result unless by international agreement the same regulations were made applicable to all fishermen alike, of whatever nationality.

NECESSITY FOR COMBINED ACTION.

The hardship thus involved recently received curious illustration in the effects of a self-denying ordinance which the herring and mackerel fishermen of the county of Cornwall (England) imposed upon themselves in the matter of Sunday fishing. For various reasons, partly religious, partly social, partly economic, the Cornishmen agreed to regard Sunday as a day of rest from fishing and to discountenance not only fishing operations, but also the task of departure for or return to the fishing grounds on the Sabbath day.

This understanding was loyally adhered to until the advent of large numbers of competitors from east-coast ports, who, making Cornish harbors their temporary headquarters, sought to gather in the harvest of the sea as quickly as possible. Not being actuated by the same scruples as the west-country folk, and not being in any way parties to the understanding, the newcomers did not feel

themselves called upon to abstain from Sunday fishing; and, notwithstanding all appeals, they declined to discontinue their labors on the Sabbath. So much resentment was engendered among the Cornishmen that, not being inclined to surrender their principles, but having no lawful means of imposing them on their visitors, they had recourse to acts of violence, and considerable rioting was the consequence. In the absence of laws to the contrary the east-country boats were, of course, as much entitled to fish on Sunday as the west-country boats were to abstain; and, short of mutual agreement, the only way of settling the dispute would have been to pass a law making Sunday fishing illegal on the part of all British subjects, at any rate in the particular portions of the sea in respect to which the trouble had arisen. But while this would, so far, have ended the controversy as between British subjects, it would have resulted in a possibly greater grievance and a certainly greater anomaly, since the waters in question are frequented by both British and foreign fishermen. It was one thing for the Cornishman voluntarily to abstain from fishing on Sunday and to leave the ground free to such of his foreign rivals as chose to fish there in his absence—especially seeing that the fish so caught were not brought into the Cornish markets, but it would have been quite another thing to compel the east-country fisherman to desist from catching fish which he was anxious to catch, while the foreigner was under no such disability—especially seeing that it was not pretended that the prohibition of Sunday fishing would have benefited the fisheries as a whole. Without in any way going into the merits of the dispute, it is obvious that no form of compulsion in this case would have been tolerable, if effective, which was not of universal application, and this could be brought about only by the common consent of all the States whose fishermen frequented the grounds in question.

MAIN OBJECTS OF INTERNATIONAL REGULATIONS.

It seems obvious that, in waters in which the fishermen of any considerable number of different nationalities are largely concerned in fishing at the same time, not only will there be the greatest necessity for international agreement and regulation, but there must exist the greatest diversity of interest, and the greatest difficulty will be encountered in devising rules that will be mutually acceptable. It is therefore, perhaps, not out of place to consider what have been the history, objects, and results of such international regulations as have been framed for waters which answer most fully to the above description.

In none of the seas of the world are such extensive and diverse fishing operations carried on at the same time by so large a number of fishermen, of so many various nationalities as in the extraterritorial waters of the English Channel and the North Sea or German Ocean. Prolific of fish in great variety and of the finest quality, and easily accessible to vessels of all sizes belonging to at least eight different powers of western Europe whose shores it washes,

the North Sea in particular has for centuries been the resort of an ever-increasing number of fishing craft of different nationalities; and, with an ever-growing demand for the product of their industry, and with the increasing power and size of their vessels, especially since the introduction of steam, not only have the fishermen been brought into closer and more frequent contact with each other, over wider areas, but the opportunities, if not the need, for interchange of commodities between them have also been enlarged. It is natural, therefore, that we should find in the case of the North Sea fisheries a greater diversity than elsewhere of purposes for which international regulations have been called for in relation to the better government, more orderly conduct, and greater prosperity of those engaged in their prosecution.

The main objects toward which the regulations of this character have been directed have been fourfold: (1) The protection or further development of the fishing industry, as such; (2) the protection of the gear of the fishermen against injury; (3) the maintenance of law and order among fishermen; (4) the greater security of the lives and persons of the fishermen. These objects are, almost of necessity, the same as those which are aimed at in all fishery legislation, whether in inland waters or elsewhere, but their relative importance is practically reversed in the case of fisheries on the high seas as contrasted with what may be called the "domestic" or "national" fisheries. In the latter case, and more particularly in regard to river fisheries, not only are the effects of overfishing more readily made manifest, and the necessity for protection recognized, but the national laws, whether for the development of the particular industry or for the security of the property involved, are more easily enforced against all persons alike than in extraterritorial waters where differences of custom, of methods, of laws, and of language—to say nothing of interests—bring about unavoidable complications. Two nations whose fishermen practice different methods of fishing for the same kind of fish will not always admit that the same necessity exists for its protection or that the same remedy is the appropriate one. Each class of fishermen will probably attribute mischief to the method of fishing adopted by the others, and the mutual jealousies which exist between, for example, the seiners and the drifters, or the trawlers and the line fishermen, of the same nation—each attributing to the acts of the other any falling off in the productiveness of the fisheries—are intensified when to difference of method is added difference of race. Hence the cases are rare in which international agreement has been arrived at with respect to regulations aimed directly at the protection of fish against overfishing, alleged or real, on the high seas.

The instances of the conventions between the United States and Canada for the preservation of the fisheries of the Great Lakes, or of the agreements between Germany, Holland, and Switzerland with respect to the salmon fisheries of the Rhine, are not appropriate to the present essay, since they relate to inland waters in which no extraterritorial rights are admitted, and not to the high

seas.[a] Perhaps the most prominent instance of the kind in which international regulations were directed to the protection from threatened extermination of a marine animal is that of the treaty dealing with the seal fisheries of Bering Sea.

SEAL FISHERIES.

It may be objected that, although the pursuit of the seal is popularly classed under the head of "fisheries," the seal itself is not a "fish" and does not therefore properly come within the purview of this essay. But a reference to the case is at least admissible on the ground that it serves to bring into prominence the fact already alluded to that international agreements for the protection of fish from overfishing are conspicuously rare in the case of the high seas.

The difficulty of proving the existence and effect of overfishing in the case of fisheries on the high seas is generally recognized; the movements of the fish are not easily traced, the causes of those movements are often unknown, and the direct effect of man's operations, either in influencing those movements or in reducing the available supply of fish, is generally a matter of inference from insufficient data and incapable of proof. But in the case of the seal we are dealing with an animal whose movements at the most critical periods of its career are open to view and easily observed; whose numbers are capable of ascertainment by means of a census sufficiently accurate for all practical purposes; and on whose destruction a definite limit could be set without serious difficulty. It was therefore comparatively easy in this case to bring home to all the powers interested the necessity for measures of protection and then to induce them to agree on the most obvious restrictions. Whether those restrictions will prove in all respects sufficient for their purpose is a question which only further experience can finally answer, but their promise of success is sufficient to encourage the hope that the end in view will be achieved, and furthermore that the increase of knowledge as to the habits of fish and as to man's influence upon them will be made the basis of any analogous steps that may be proposed for international action toward the prevention of overfishing in the case of fish properly so-called.

It may be interesting to note, in this connection, that thirty years ago, by agreement between the United Kingdom and the Scandinavian powers interested in the seal fisheries of Greenland, the killing of seals on and near the coasts of that country was prohibited in any season until a date at which it was estimated that the young cubs would be able to provide for themselves, and it is believed that the supply of seals in the waters in question has considerably increased in consequence.

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[a] The omission from this essay of any reference to the international regulations relating to the fisheries carried on in common by the fishermen of the United States, Canada, and Newfoundland is justified on the ground that some of the questions involved are the subject of pending diplomatic negotiations between the powers concerned.

OYSTER FISHERIES OF THE ENGLISH CHANNEL.

The earliest instance of an international agreement for the enforcement of a regulation directed toward the protection of seafish from overfishing occurs in connection with a convention entered into between the United Kingdom and France in 1839, under which regulations were mutually agreed upon for the better ordering of the fisheries carried on by the subjects of those two states in the English Channel. Here, again, the object of the solicitude of the two powers was not a "fish" in the true sense of the word, but a mollusk, namely, the oyster. Here, also, the condition precedent existed that it was comparatively easy to secure adequate evidence of the necessity for some protection against overfishing. This protection took the form of a regulation forbidding the removal of oysters measuring less than 2½ inches across the shell, and of a close season of four months, during which oyster-dredging was forbidden in the extraterritorial waters of the English Channel, while, later on, it was provided that oyster dredges should not be carried on board the fishing boats of either country during the prohibited period, unless kept duly secured by seals affixed by a competent official. The dates fixed for the close season, however, were not altogether the most appropriate, and, by a later convention arranged in 1867 between the two countries, it was agreed that the period should be altered. This latter convention was never ratified by France, and, although England took the necessary steps to give effect to it, it has never been fully put into operation, but the close season for oysters as then determined is maintained by special agreement renewed from year to year.

OTHER ANGLO-FRENCH CONVENTIONS.

By far the greater part of both these Anglo-French conventions, as well as the whole of the more recent conventions relating to the fisheries of the North Sea, deals with the several points included under the heads—other than the protection of fish—into which the objects in view have been divided; and, although international regulations with respect to overfishing are rare, there are numerous instances in which the regulations have dealt with the protection of the fishermen themselves in either their persons, their morals, or their property.

Both the Anglo-French conventions above referred to made provision for identification marks being affixed to fishing boats operating within the English Channel, for keeping certain classes of fishermen as far as practicable apart, so as to minimize the risk of damage or conflict, and for establishing a system of international sea-police for the proper enforcement of the regulations. The great development of fishing operations in the last few years has, apart from other considerations into which it is unnecessary to enter here, rendered obsolete the greater part of the regulations thus agreed upon, and negotiations are now in progress between the two countries for a new convention on wider and more modern lines and more fitted to existing conditions.

NORTH SEA REGULATIONS.

In the meantime a separate series of enactments applicable to the North Sea has been put in force, dealing with a wider range of subjects than were contemplated either in 1839 or in 1867. None of these enactments, however, affects the question of overfishing. They deal with the human aspects of the question only. And, curiously enough, one of the earliest of them was brought about, not by overintensity of rivalry between competing fishermen, leading to acts of hostility, but by undue familiarity based on mistaken notions of friendship and resulting in abuses of a social and moral nature which called for interference.

Out of a system of exchange and barter, at sea, of fish, clothing, and other commodities, there had grown up a practice of sending among the fishing fleets in the North Sea a number of vessels, known as "coopers," specially fitted for the supply of intoxicating liquors, which found a market among certain of the fishermen, being sold for money where cash was available, or exchanged for fish or other articles. Such opportunities were especially frequent in the case of the trawling vessels fishing on what is known as the "fleeting" system. Instead of returning to port after each fishing trip the boats of certain companies fish together on a given ground, where they are visited day by day by specially fitted "carriers" or "cutters" which go the round of the fleet, collect the whole catch, and straightway steam back to deliver it in the fish market, returning again to the fleet and repeating these operations as long as fish remain sufficiently plentiful on the ground. In this way a fleet of trawlers may remain at sea for considerable periods, and in these and other circumstances, due to the development of the industry, the facilities for surreptitious traffic in drink not only led to the fishermen being exposed to great temptation to dishonesty, but conduced to scenes of drunkenness, to acts of violence, to neglect of duty, to insubordination, and to danger and disaster in which other and innocent persons were frequently involved.

The result of all this was a convention between the United Kingdom and certain neighboring powers known as the North Sea Liquor Traffic Convention of 1889, whereby heavy penalties were imposed on any persons supplying intoxicants or tobacco to fishing vessels, except under license from the duly constituted authorities. In practice the issue of these licenses is limited to a few vessels employed as "mission" or "hospital" ships in connection with the trawling fleets, whose visits afford sufficient opportunity for the supply of such liquors as are needed for medicinal and other legitimate purposes. The consequence has been the entire disappearance of the "coopers" and the almost total abolition of the evils which followed in the train of their misdirected enterprise.

Equally satisfactory results have followed on the adoption of other international regulations, for the repression of acts of unprovoked injury to fishing

gear on the high seas, under a convention in which the powers bordering on the North Sea are again concerned jointly, so far as regards that part of the ocean.

In or about the year 1882, very serious complaints were made by British drift-net fishermen in the North Sea that it was the practice of certain foreign trawlers, chiefly Belgian, deliberately to cut through any drift nets that they might encounter and so clear a way for their trawl, continuing on their course without waiting to haul their gear and disentangle the net which they had fouled. For this purpose they carried a specially constructed iron implement, which got to be known as the "Belgian devil," shaped like a three or four pronged grapnel of considerable size, the inner sides of whose prongs or arms were furnished with cutting edges, and which they carried suspended in the water at such a depth that it automatically caught the footrope of the drift net, gathered the net in a loop, and severed it by the mere action of the trawl boat sailing, or steaming, on its course. A committee of inquiry found these complaints to be well founded and the result was an international convention forbidding the use or possession of any such engine for any such purpose under heavy penalties, and the "Belgian devil" has now entirely disappeared from the North Sea.

Abuses of such kinds as either of those just alluded to will, it may be hoped, be rare, but whenever they occur it may be expected that public opinion, in all countries, will readily support decisive and prompt conjoint action for their suppression. It will, however, be always more necessary and more difficult to deal with those other and constantly recurring cases of unavoidable collision, more or less serious, between the boats and the gear of men lawfully and peacefully pursuing their various avocations, with different kinds of engines, in the same waters.

Wherever fishermen are attracted in large numbers to the same fishing grounds, there is always risk of damage from such a cause. In the North Sea alone, such diverse methods of fishing as trawling, seining in various forms, drifting and lining—not to mention other and less important modes—are employed at the same time within a comparatively narrow area, and often for the same kind of fish; and it may easily happen that, with the best intentions in the world, and with every desire to avoid all cause of conflict or dispute, the trawler may foul the nets of the drifter or the lines of the line-fisherman, or the drifter and trawler alike may disturb the seiner.

To minimize such possibilities the International Code of Navigation Laws and of regulations for the lights at sea to be carried by fishing boats at night has done something, and so long as those regulations are observed it is comparatively easy for one boat to avoid collision with another or with its gear. But, even so, occasional collisions are inevitable unless specified areas are set apart on which only one mode of fishing is permitted at one time. Even such a remedy as this would not remove all possibility of collision between boats of

the same kind, and there is the further objection that the reservation of particular areas to particular classes of vessels would involve great difficulty and expense in watching. It is clear, therefore, that after minimizing as far as possible the opportunities of collision by a well-considered system of signals, the next step is to minimize the damage resulting from inevitable casualties and to provide for the restoration of the damaged gear to the owners and for payment of compensation for the injuries inflicted.

With these objects in view the several powers bordering on the North Sea have entered into a series of conventions under which a fairly comprehensive code of regulations has been adopted, providing for the following matters:

(1) The clear delimitation of the areas within which the joint regulations were to apply.

(2) The adoption of easily recognizable marks of identification for both boats and gear.

(3) The protection of a vessel already engaged in fishing from undue interference by another boat arriving on the fishing grounds later.

(4) Provision for the restoration to the owner of gear accidentally carried away or picked up at sea.

(5) Provision for the prosecution of claims for compensation for damage in default of agreement.

(6) The assessment and recovery of damages duly adjudged.

(7) The prohibition of willful damage and enforcement of due diligence and care in releasing gear accidentally fouled.

(8) The enforcement of the regulations by the national vessels of all the contracting powers, with right of arrest in case of necessity.

RESULTS ACHIEVED.

A quarter of a century's experience of the working of this convention—while showing that it is incomplete in many details and is capable of improvement in order to fit it to deal adequately with the changing conditions of the fishing industry—has demonstrated that, given a frank recognition of equal rights, it is possible so to harmonize the apparently conflicting interests of different classes of fishermen, belonging to different nationalities that a spirit of mutual forbearance will take the place of jealousy, ill feeling, and suspicion, and law and order will supplant violence and outrage. In this connection, two conclusions present themselves: (1) That these results can only be obtained by the assertion of the superior force of authority and (2) that a very slight display of the resources of duly constituted government power is sufficient to secure the observance of the regulations. In the absence of such show of authority, however, there will always be men, who, however familiar with the law, and however much accustomed to its observance wherever there is provision for its enforcement, will seize

any opportunity of breaking it with impunity. The spirit underlying the conventions between Great Britain and France as regards the English Channel on the one hand, and between Great Britain and other powers as regards the North Sea on the other, is precisely the same, namely, a desire to secure to the subjects of each separate state the same protection from injury on the high seas that they would expect within the territorial domain of their respective governments. But the machinery for giving effect to this spirit is less complete in the case of the earlier conventions, and the result is that the same men who in the North Sea are careful to observe the law are apt to disregard its principles as soon as they cross the line which divides the North Sea from the English Channel, and as long as they are outside the line which separates territorial from nonterritorial waters.

The moral of this appears to be that, once the authorities are agreed that good cause for interference exists, it is easy to take and to enforce the necessary measures provided they are based on the generally accepted principles of law, order, and morality, and as long as they are founded on sufficient evidence as to the habits of fish and the effect of man's operations. Differences in legal procedure and practice involve a certain amount of difficulty, but in the cases above quoted this has been practically overcome by providing that a person charged with an offense shall be tried in the courts of the country to which he belongs, whatever the nationality of the officer arresting him. In this way mutual confidence in the sincerity of the authorities of the various contracting powers has been inspired; and with increasing evidence of a determination to maintain the ordinary principles of justice and right there have been displayed on the part of the fishermen themselves both a more general appreciation of the value of international regulations and also a sense of the greater security with which they can carry on their industry further and further afield—and this, after all, is only one indication of the increasing prosperity of the industry, which it is the ultimate aim and object of all such regulations to secure.

INCREASING NEED FOR INTERNATIONAL AGREEMENT.

Nevertheless, the greater the success of such regulations in this direction the greater is the variety of other interests involved. The further afield the fishermen of any State go, the more certainly will they be brought into closer relations with the fishermen of fresh nationalities, and the longer will be the list of States which find that they have interests in common—interests which will, sooner or later, call for combined action in the direction of international regulation of the fisheries on the high seas. Whether such regulations should aim at the protection of the fishermen—either in their lives, their property, or their morals—or at the protection of the fisheries against overfishing must depend on circumstances. So far as experience goes, the first object is the one most likely both

to claim attention and to make good its claim. It is far easier to prove that the lives or property of fishermen are in danger than it is to establish any connection between the fishing operations of the fishing fleets and the fluctuations in the yield of the fisheries, especially in the deep seas; and, as a preliminary to any effective steps for the protection of the fisheries on the high seas by way of international regulations, it will be found necessary to provide for international agreement as to the nature and extent of the statistical records to be kept and as to the method and scope of research into those natural phenomena which affect the productiveness of such fisheries more extensively than the combined operations of all the fishing fleets.

INTERNATIONAL REGULATIONS OF THE FISHERIES ON THE HIGH SEAS

By Charles Hugh Stevenson

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Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908, and awarded the prize of two hundred dollars in gold offered by the Smithsonian Institution for the best treatise on international regulations of the fisheries on the high seas, their history, objects, and results

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DISCRIMINATION BETWEEN HIGH SEAS AND TERRITORIAL WATERS.

As used in defining the jurisdiction of admiralty courts, the term high seas implies all the waters of the ocean, and all connecting arms and bays, "exterior to low-water mark;" but in international law and in the sense employed in this paper, the term is not so broad, and it signifies only so much of the ocean as is outside the territorial jurisdiction of maritime states, and is what might be called the extraterritorial seas. It is now well established that the exclusive jurisdiction of a maritime nation covers only a narrow belt or margin of the littoral waters; beyond is the open ocean, the high seas, free to all for purposes of navigation and fishery, incapable of being monopolized by any state or people.

This principle in law is of relatively modern recognition. In the middle ages strong maritime powers made claims to sovereignty over considerable portions of the seas, which to some extent may have been justified by their maintenance of protection against piracy in those waters. At the height of her power the Republic of Venice was recognized as sovereign over the Adriatic Sea, and likewise Genoa over the Ligurian. France arrogated to herself a considerable stretch of the seas adjacent to her coasts. By his celebrated decision of arbitration on May 14, 1493, and by his approval of the treaty of Tordesilhas in the following year, Pope Alexander VI apportioned the Indian seas and the Pacific Ocean between Spain and Portugal. For three centuries Denmark claimed jurisdiction over the fisheries in the seas between Norway and Iceland; by treaties made in 1500 and 1523 this claim was acquiesced in by England, and English fishermen and traders in those waters were required to obtain licenses from the King of Denmark. With development in maritime strength, Great Britain claimed sovereignty over all the seas in communication with those surrounding her coasts, and in the seventeenth century fishermen of Holland and other countries were obliged to secure licenses from that Government, the Dutch in 1636 paying £30,000 for this purpose. Immediately previous to the Revolutionary war considerable portions of the Newfoundland banks and of the St. Lawrence Gulf were monopolized by Great Britain and her colonies, and at the conclusion of that war only the determined protest of the United States prevented the British Government from exercising jurisdiction thereover.

Although surrendered slowly and reluctantly, these extravagant claims of the great powers have given way to a just consideration of the rights of weaker nations. With development of commerce, the modern conception of the freedom of the seas, first formally set forth in 1609 by Grotius, that master builder in the science of international jurisprudence, was gradually established, and the limit of territoriality of a maritime state became restricted to a narrow margin surrounding her external seacoast. Within this limit the authority of a nation is paramount and exclusive, except as it may be affected by treaty rights and subject to peaceable passage by ships of other nations. Grotius, however, although restricting the authority of a maritime state to a limited distance seaward, gave only an indefinite idea as to the extent of this marginal belt, stating that it must be a reasonable area and bear a proper relation to the adjacent land.[a] Difference of opinion as to the precise limit has been great. Claims have been made now and again and by various authorities for 100 miles,[b] for 60 miles,[c] for two days' sail,[d] as far as the bottom can be found with the lead line,[e] and for as much as can be seen from the shore on a clear day.[f] Nearly one hundred years after the publication of Grotius's "Mare liberum," the learned yet practical Bynkershoek made the first statement of the present rule which defines the marginal waters as extending as far as the riparian state is able to exercise jurisdiction from the shore, the maxim in which this doctrine is tersely expressed being "Terræ finitur potestas ubi finitur armorum vis."[g] This seemed a just and practical solution of the controversy, and succeeding publicists adopted the attractive formula.

The modern conception of international law and the just relations and jurisdictions of nations had its birth and made its greatest progress in the seventeenth and eighteenth centuries, after the introduction of firearms and before the great development in modern artillery. Since authority over the marginal waters was exercised by means of cannon, it was natural to assume the distance of a cannon shot as the limit of jurisdiction. The extreme limit of cannon range being then about 3 marine or geographical miles, this distance from low-water mark became recognized as the extent of the marginal belt

[a] De Jure Belli ac Pacis, II, ch. 3, sec. 3.

[b] Cœpolla, De servitutibus prœdiorum urbanorum, ch. XXVI, no. 14.

[c] Bodin, De Republicâ, lib. I, ch. X.

[d] Locenius, De Jure Maritimo, ch. IV, sec. 6.

[e] Valin, Commentaire sur l'Ordonnance de la Marine du mois d'aout 1681. Paris, 1761, ch. V, p. 687.

[f] Rayneval, Institution du Droit de la Nature et des Gens, lib. II, ch. IX, ch. X.

An old Scottish law recognized the jurisdiction of that country as extending seaward to the visible distance from the shore. Mackenzie calls attention to the grim sense of humor entertained by James V of Scotland (1513–1542): "In the time of K. James the 5th, the Hollanders having only a verbal licence to fish at 28 miles distance cam neere the shore into the mouth of the Furth of Edenborough, and ther fished in despight of the Kings comand. Then the King sent out men of warre and took so manie of them that he sent a barilful of their heads into Holland with their names fixed to their foreheads uppon cards." (MS. in Public Records Office. State Papers, vol. CLII, no. 63; quoted in Mackenzie's History of the Outer Hebrides, p. 304. Paisley, 1903.)

[g] Bynkerskoek, De Domino Maris, ch. II; Quæstionum Juris Publici, 1737, lib. I, ch. 8.

among those who preferred a distinct and uniform distance to a general and somewhat indefinite one. It was specifically acknowledged in the maritime regulations adopted by Tuscany in 1778, and in those of Genoa and of Venice in 1779; it was affirmed by Russia in 1787, by the United States in 1794, by Austria in 1803, and by various other nations at different dates. It was recognized in the convention of 1818 between Great Britain and the United States, in the fishery conventions between France and Great Britain of 1839 and 1867, in the convention of 1882 between Belgium, France, Denmark, Germany, Great Britain, and the Netherlands for the police of the fisheries in the North Sea, and in various other conventions, treaties, and arbitrations. Indeed, for many years the terms "maritime belt" and "the marine league" have been used interchangeably.

Objection to a universal recognition of the rule that territorial jurisdiction extends only 3 miles from land is made chiefly by Norway and Sweden. These states have never recognized the 3-mile limit as the confines of their territorial waters, and have never concluded nor acceded to any treaty setting forth that rule. By their municipal or national laws the limit has generally been fixed at 4 geographical miles. This was established in Norway by royal rescript of June 18, 1745, and has been affirmed repeatedly since then, especially in the early part of the last century.[a]

The Government of Spain has from time to time claimed exclusive jurisdiction within 6 nautical miles of her coasts and of those of her colonies. This claim was expressed in a royal cedula of December 17, 1774, which was supported by a royal decree of May 1, 1775, and by another of May 3, 1850, and was asserted as recently as August 4, 1874. But both Great Britain and the United States refused to accede to this pretension or to concede the extension of Spanish sovereignty beyond 3 littoral miles.[b]

Since harbors and small bays have more of the characteristics of territoriality than the open seas along the coast, it has been customary to recognize jurisdiction as extending over these within reasonable limits, even though they be not wholly within the 3-mile belt. But there is not at present any generally recognized standard as to what can be justly regarded as territorial bays when the width exceeds 2 marine leagues. Some authorities claim that the limit of exclusive jurisdiction is 3 miles from a line drawn from headland to headland,

[a] See p. 109 and 137.

[b] See letter of Lord Derby to Mr. Watson, December 25, 1874, Foreign Relations of the United States, 1875, p. 641, 649. In the language of Mr. Seward, it can not be admitted "that the mere assertion of a sovereign, by an act of legislation, however solemn, can have the effect to establish and fix its external maritime jurisdiction. This right to a jurisdiction of 3 miles is derived not from his own decree but from the law of nations, and exists even though he may never have proclaimed or asserted it by any decree or declaration whatsoever. He can not, by a mere decree, extend the limit and fix it at 6 miles because if he could, he could in the same manner, and upon motives of interest, ambition, or even upon caprice, fix it at 10, or 20, or 50 miles, without the consent or acquiescence of other powers which have a common right with himself in the freedom of all the oceans." (Letter to Mr. Tassara, Spanish minister, August 10, 1863.)

instead of a marine league from the shore following its sinuosities. The present tendency is to consider all bays less than 10 miles in width at the mouth as within the jurisdiction of the riparian state.

In the convention of 1839 between France and Great Britain, applicable to the seas lying between the coasts of the two countries, it was agreed that "the limits within which the general right of fishery is exclusively reserved to the subjects of the two kingdoms respectively are fixed (with the exception of those in Granville Bay) at three miles distance from low-water mark. With respect to bays the mouths of which do not exceed 10 miles in width, the 3-mile distance is measured from a straight line drawn from headland to headland." By a municipal law of June 7, 1832, Belgium had already adopted this rule.

The convention of 1882 signed by Belgium, Denmark, France, Germany, Great Britain, and the Netherlands, respecting the fisheries of the North Sea, recognized territorial waters as those "within the distance of 3 miles (geographical) from low-water mark along the whole extent of the coasts of their respective countries, as well as of the dependent islands and banks. As regards bays, the distance of 3 miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed 10 miles." And precisely the same language was used in the Anglo-Denmark convention of 1901 for regulating the fisheries in nonterritorial waters surrounding Iceland and the Faroe Islands.

The unratified Anglo-American fishery treaty of 1888 provided that the territorial jurisdiction of 3 marine miles "shall be measured seaward from low-water mark;" and after designating certain bays which should be considered as territorial waters, it set forth: "But at every bay, creek, or harbour not otherwise provided for in this treaty, such marine miles shall be measured seaward from a straight line drawn across the bay, creek, or harbour in the part nearest the entrance at the first point where the width does not exceed 10 marine miles."

While the tendency of international law is to restrict jurisdiction over large coastal indentations, there is no absolute rule in this respect. Chesapeake Bay and likewise Delaware Bay are recognized as parts of the territory of the United States.[a] Great Britain claims territorial jurisdiction over Conception Bay in Newfoundland,[b] which is of an average width of 15 miles; also over Bristol Channel,[c] an arm of the sea about 80 miles long and from 5 to 45 miles wide.[d] France claims the Bay of Cancale, which is 17 miles wide, and also a large portion of Granville Bay. Other territorial bays in Europe are: White Sea in Russia, Zuider Zee in Holland, and the Frisches Haff, the Kurisches Haff, Bay of Stettin,

[a] Wharton, Digest of International Law, 2d ed., sec. 27 and 28.

[b] Direct United States Cable Company *v.* Anglo-American Telegraph Company (1877), L. R. 11 App. Cases, 394.

[c] Queen *v.* Cunningham (1859), Bell's Crown Cases, 86.

[d] See also page 136, with reference to her claim of jurisdiction over Moray Firth, which is about 85 miles across at the mouth.

and Jade Bay in Germany. Norway claims as territorial waters many of her great fiords or gulfs, which are very wide at the mouth and extend far inland; and she especially reserves to her fishermen the very important cod fishery prosecuted by 30,000 men each spring in West Fiord and about the Lofoten Islands, this exclusive right being founded in immemorial usage.

The situation was well expressed by Lord Blackburn in 1877 in the case involving jurisdiction in Conception Bay: "It does not appear that jurists and text writers are agreed what are the rules as to dimensions and configurations which, apart from other considerations, would lead to the conclusion that a bay is or is not a part of the territory of the state possessing the adjoining coasts; and it has never been made the ground of any judicial determination." The question has to be considered in each case with regard to international laws and usages affecting that particular body of water; but nations are inclined to view with jealousy this extension of territoriality, and the burden of establishing the usage is upon the nation claiming under it.

While the Supreme Court of the United States has held [a] that the waters of the Great Lakes are "high seas" within the meaning of a certain section of the criminal laws,[b] yet those waters are not high seas as the term is used in international law and in this paper. The Great Lakes are wholly territorial, and the waters on either side of the international boundary line are under the exclusive jurisdiction of the respective countries.

RESTRICTION OF FISHERIES ON THE HIGH SEAS.

Although it is customary to speak of the "freedom of the seas," we must not understand that this signifies lawlessness. The freedom of the seas simply implies perfect freedom of navigation and fishery for vessels of all nations without restriction from any foreign government. As regards the vessels flying its flag, each sovereign state has as much authority on the high seas as within its territorial waters, and may enforce among them any regulations or restrictions it may deem advisable. Consequently the municipal law of a power is sufficient for regulating those fisheries on the high seas prosecuted only by subjects of that nation. Prominent instances of the exercise of this authority are found in the old herring regulations of England and of Scotland, in the Newfoundland seal-fishery laws of 1879 and 1892, the American mackerel law of 1887, the Australian pearl-shell regulations of 1888 and 1889,[c] and in regulations established by many of the continental countries. Although these municipal laws are operative on the high seas, they are not international regulations, which signifies something more than the independent legislation of an individual state, affecting its subjects only.

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[a] United States *v.* Rogers (1893), United States Reports, vol. 150, p. 249.

[b] Section 5346 of the Revised Statutes, giving the federal courts jurisdiction over certain crimes committed upon American vessels "on the high seas and out of the jurisdiction of any particular state."

[c] The municipal regulations for the pearl fisheries of the colony of Western Australia extend over an area of the high seas estimated at 700,000 square miles.

In relation to the subjects of another sovereign power the situation is quite different, for no single nation is allowed to interfere on the high seas with the vessels of another nation without previous agreement. Indeed, so liberally does international law guard the coast fishermen that even in war they are humanely exempted from capture while engaged in their legitimate pursuit. And a municipal law has no effect on the high seas except on the vessels flying the flag of that particular nation.

Where vessels of several powers are concerned, it is a hardship and exceedingly unjust for one government to enforce restrictive regulations among its own fishermen without concurrent action by other governments, for this makes a hurtful monopoly in favor of foreigners. The principal effect of such action is usually to transfer the nationality of the operations from the government enforcing the restriction to one under which greater freedom is enjoyed. Striking instances of this may be found in the transfer of pelagic fur-sealing vessels from the American to the British flag when the United States interdicted pelagic fur sealing in 1886, and also in their transfer to the Japanese flag after both America and England agreed upon the Bering Sea regulations in 1893. By united action of all the nations interested in a particular fishery, however, regulations may be established and enforced on the high seas as effectively as though that fishery were prosecuted within territorial waters. Hence arises the importance of concurrent action among the powers interested when such regulations are found necessary, and such action is obtained through international conventions and agreements. These conventions recognize the right of all nations to fish in the seas beyond the territorial waters, but for their mutual benefit each one agrees to restrict its own subjects by regulations to be observed by all alike. Such regulations do not apply to the subjects of nations which are not parties to the agreement and do not restrict their fishing in any place or in any manner.

The number of instances in which nations have united or even concurred in regulating fisheries on the high seas is not large. Fortunately for the length of our paper, the much discussed "fisheries question," respecting the rights and privileges of the British provinces and of the United States on the northeastern coast of America, does not relate to the high seas, although it bears materially on the limit of maritime jurisdiction.

The first prominent attempt at international regulation of the fisheries was the Anglo-French convention of 1839, applicable to the English Channel and adjacent seas, which set forth the limits of exclusive jurisdiction in marginal waters and established regulations for preserving the oyster and other fisheries and for maintaining order among the fishermen. The regulations prepared in 1843 in accordance with the provisions of this convention were never satisfactory and have been of little effect. In 1867 an effort was made to revise them, and a convention was signed to this effect by representatives of the two nations; but this failed, owing to lack of confirmation by the French Government.

The North Sea convention of 1882, among Belgium, Denmark, France, Germany, Great Britain, and the Netherlands, was strictly for the police of the

fisheries and to prevent the destruction of property. As determined by the results accomplished, this is doubtless the most important of all international fishery regulations. In 1901 Denmark and Great Britain applied the provisions of this convention to their fisheries in the waters surrounding Iceland and the Faroe Islands.

The submarine cable convention of 1884 interdicted fishing in the vicinity of cables and cable ships. Strictly speaking, this has never interfered materially with fishery operations, but the convention is important in that the restriction on the fisheries has been agreed to by nearly every important nation.

The convention of 1899 between Sweden and Denmark authorized the subjects of each of these nations to fish in certain territorial waters of the other and also provided against the destruction of fishing gear operated in the waters between the two countries. In 1907 this convention was supplemented by a declaration that plaice under a designated length should not be caught or landed from the waters of the Cattegat or The Sound.

In all of the conventions noted the interests of the signatory powers were fairly mutual and the restrictions bore evenly on the subjects of the several nationalities. But in 1893 an international agreement occurred which was unique in that the interests of the powers were in absolute conflict. This was the Bering Sea arbitration between Great Britain and the United States, which was intended to restrict the scope of the pelagic fur-seal fishery, prosecuted almost exclusively by subjects of Great Britain, with a consequent and corresponding advantage in the yield on the Pribilof Islands, under the exclusive jurisdiction of the United States. Although the practical results of the regulations established by that tribunal of arbitration have been far short of what was expected, from the standpoint of international law this is the most important of all fishery agreements applicable on the high seas, owing to the numerous and lengthy arguments presented in the tribunal and the influence of their decision.

From the foregoing it appears then that the international fishery regulations operative on the high seas have been of two general classes, the one for preserving the resources and the other for the maintenance of good order among the fishermen and for preventing the destruction of property. To the former class belong the Bering Sea fur-seal regulations, and in some particulars the Anglo-French regulations of 1843, and the declaration of 1907 between Sweden and Denmark. All the remaining conventions and regulations are of the second class.

Aside from the submarine cable convention of 1884, which was confirmed by nearly every important nation, it appears that as regards the number of sovereign powers adhering to it, the North Sea convention of 1882 was the most general of all these international regulations, having received confirmation from Great Britain, France, Germany, Belgium, Denmark, and the Netherlands. Each of the remaining conventions and regulations applied to the subjects of

two governments only, of which in four instances Great Britain was one of the parties. Thus it appears that in the six important instances of international regulation or restriction of the fisheries on the high seas, Great Britain has been actively concerned in five; Denmark in four; France in three; Germany, Belgium, the Netherlands, and the United States each in two; and Sweden in one of them. The Greenland seal fishery restrictions of 1875–1877, enacted by Denmark, Great Britain, the Netherlands, Norway, and Sweden, differ from international regulations in that they were not the result of a formal convention or agreement, but were based on analogous municipal enactments by these powers acting in concert. These restrictions were for the purpose of preventing the exhaustion of the seal herds in the waters about Jan Mayen Island and off the eastern coast of Greenland, a purpose which they have failed signally in accomplishing. Each of these conventions, agreements, and regulations will be considered separately.[a]

[a] In addition to the international agreements respecting the fisheries on the high seas, there have been very many treaties, conventions, declarations, etc., for regulating those prosecuted in territorial waters on the frontiers of bordering states, of which the following is only a partial list:

1839, April 19. Belgium and the Netherlands (article 9).
1840, April 5. France and the Grand Duchy of Baden.
1843, May 20. Belgium and the Netherlands, for the enforcement of article 9 of the convention of April 19, 1839.
1849, February 9. Prussia and the Grand Duchy of Luxemburg.
1856, December 2. France and Spain, respecting the fisheries in the Bidassoa River (abrogated).
1866, May 26. France and Spain, respecting the fisheries in the frontier rivers (Nive, Garonne, Signe, etc.).
1880, December 28. France and Switzerland, respecting the fisheries in the frontier waters.
1882, April 19. Belgium and the Grand Duchy of Luxemburg.
1882, May 6. Belgium and the Netherlands.
1882, November 8. Italy and Switzerland, on the fisheries in the bordering waters.
1883, August 9. Austria-Hungary and Italy, regulating the fishery in Lake Garda.
1884, April 3. Belgium and the Netherlands, modifying the regulations of May 20, 1843.
1885, June 30. Germany, Switzerland, and the Netherlands, for regulating the salmon fishery in the Rhine.
1886, February 18. France and Spain, respecting the fishery in Bidassoa River (modified January 19, 1886; September 20, 1888; October 4, 1894; and December 17, 1898).
1887, May 18. Switzerland, the Grand Duchy of Baden, and Alsace-Lorraine, respecting fisheries in the Rhine and its tributaries, including Lake Constance.
1891, March 12. France and Switzerland, concerning fisheries in the frontier waters.
1891, July 30. France and Switzerland, supplementary to the convention of December 28, 1880, respecting fisheries in the frontier waters.
1892, November 5. Prussia and the Grand Duchy of Luxemburg.
1893, July 5. Switzerland and the Grand Duchy of Baden, respecting the fisheries in Lake Constance.
1894, September 25. Switzerland and Baden, supplementary to the convention of July 5, 1893, respecting the fisheries in Lake Constance.
1897, July 3. Switzerland and Baden, concerning the fisheries in lower Lake Constance.
1898, July 8. Italy and Switzerland, concerning uniform regulations for the fisheries in the bordering waters.
1899, December 27. France and Switzerland, regulating the fisheries in the frontier waters.
1900, June 23. Russia and Roumania, respecting the fisheries in the River Pruth and in the lower Danube.

ANGLO-FRENCH CONVENTION OF 1839.

The first successful attempt at international concert in regulating the fisheries on any part of the high seas resulted in the convention of August 2, 1839, between France and Great Britain, which applied to "the seas lying between the coasts of the two countries." This convention had its origin in the many disputes which had arisen with respect to the limits in which the subjects of each of the two kingdoms were permitted to fish, and especially in contentions which arose in 1837 and 1838 between French fishermen and those of the channel islands. The principal objects of this convention were stated to be: (1) To define the limits of territorial jurisdiction and exclusive fishery over the marginal waters of the two countries; (2) to provide regulations for preventing collisions among fishermen in the seas lying between the coasts of Great Britain and France; and (3) to settle the limits of the oyster fisheries lying between the Channel Islands and France.

By the ninth article of this convention, the right of fishing within 3 miles from low-water mark along the coasts of each country, respectively, was exclusively reserved to the subjects of that country; and in bays not more than 10 miles in width, the distance of 3 miles was measured from a straight line connecting the two headlands. The first of these provisions was in strict accordance with international law as then recognized. The second provision was novel, but a practical reason suggested it. It was considered that as 3 miles on each side of a bay less than 10 miles in width were unquestionably territorial, the interests of the proprietary nation within the bay were sufficient to determine its territoriality. This is by far the most important and lasting of all the provisions of the convention.

The eleventh article provided that with a view to preventing collisions which had occurred so frequently between the fishermen of France and those of Great Britain on the seas lying between the two countries, and to carry out other purposes of the convention, a commission should be appointed to prepare a set of regulations for guidance of those fishermen in the seas above noted.

In pursuance of the provisions of this article and of the convention generally, a code of regulations was prepared and confirmed by the respective Governments in June, 1843. The 89 articles agreed upon embrace many other subjects than those contemplated by the convention, and they constitute by far the most elaborate and complicated of all fishery laws applied to any part of the high seas. They are given in full in Appendix A (page 151 of this paper), and in this place we have room for only a brief résumé.

Articles 1 to 5 of the regulations define the limits within which the right of fishery is exclusively reserved to the subjects of the two countries, respectively. Articles 6 to 15 provide for the numbering, lettering, and licensing of all British and French fishing boats, and for the numbering and lettering of all buoys, floats, nets, and other implements of fishery. Articles 16 to 26 regulate

trawl fishing, defining the size of mesh, the length of beam, the weights of head-pieces and of ground rope, and the distance trawlers may fish from boats engaged in drift netting for herring or mackerel. Articles 27 to 35 regulate the herring fishery, defining the size of mesh in nets, the manner of shooting the nets by decked and undecked boats, respectively, and the distance at which these boats should remain apart when fishing. Articles 36 to 40 regulate the mackerel fishery in a manner somewhat similar to the preceding articles. Articles 41 to 44 regulate the fishing with bratt nets, trammel nets, and other set or anchored nets. Articles 45 to 49 regulate oyster fishing, establishing close time from May 1 to August 31, and from sunset to sunrise in the remaining months, and requiring the fishermen to throw back on the reefs all oysters measuring less than 2½ inches in length, and also all gravel, shell fragments, etc. Articles 50 to 54 define the flags, lights, and signals to be displayed by fishing boats. Articles 55 to 60 supplement several of the foregoing provisions respecting size of mesh in nets and noninterference with nets belonging to other fishermen. Articles 61 and 62 relate to the salvage of fishing boats, nets, gear, etc. Articles 63 to 75 provide means for enforcing these regulations by the cruisers and agents of the two countries, the summary proceedings before magistrates, and the fines and penalties that may be imposed. Articles 76 to 86 define the conditions and circumstances under which the fishing boats of either of the two countries are at liberty to come within the territorial limits of the other country. Article 87 forbids the shooting of herring nets earlier than half an hour before sunset, except where it is customary to carry on this drift-net fishing by daylight. Article 88 deals with fishing on the Sabbath day "within the fishery limits of either country." Sunday fishing outside of these limits was not prohibited by these regulations, and as the fifth article interdicted the subjects of one country from fishing within the limits of another country at any time, the purpose of this article is not clear. Article 89 authorizes the commanders of the cruisers and also all fishery officers of each of the two countries to enforce the above regulations.

These regulations were enacted into law in Great Britain (6 and 7 Vict., ch. 79), dated August 22, 1843, and in France by royal ordinance of June 27, 1846.

It is generally admitted that the terms of the convention of 1839, of the pursuant regulations of 1843, and of the legislative enactments adopted in connection therewith were defective and ambiguous. Owing to difference of opinion as to the limits in which they were applicable, as well as to their severe conflict with the fishery laws then operative in British territorial waters (Geo. I, ch. 18), the convention regulations were never enforced. It was claimed by some authorities that the words "the seas lying between the coasts of Great Britain and of France" should be construed strictly, and referred only to the English Channel; but it was held by others—and probably with greater reason—that this phrase comprised all the seas about the British coasts, including those off the eastern and even the northern coast of Scotland. And many of the

provisions respecting the modes and the times of shooting the drift nets, and the construction details of trawls, etc., would have been either futile or mischievous had they been enforced.

Some attempt was made to enforce the provisions relating to the numbering of fishing boats, and cruisers were occasionally sent among them to preserve order; but there was no serious attempt to enforce such regulations of the fisheries themselves as did not meet with the wishes and conveniences of the fishermen, except with respect to territorial limits and to the close season in the English Channel oyster fishery, the regulations of which were enforced for several years following 1852, at the instance of the French Government.

In 1866 the commissioners appointed to inquire into the sea fisheries of the United Kingdom reported respecting the convention act of 1843:

> It is obvious that the majority of its regulations, so far as they affect methods of fishery and not matters of police, are either superfluous or impracticable or injurious, their evil tendencies being only neutralized by the circumstance that they are disregarded. And even were the provisions of the act requisite or expedient, the highest legal authorities are so completely at variance concerning the interpretation and the limits of the application of the act, that it must be regarded as an extremely defective piece of legislation.[a]

For the purpose of revising the convention of 1839 and the regulations of 1843, a new convention was signed at Paris on November 11, 1867. It applied beyond the territorial waters of both countries, "to the seas surrounding and adjoining Great Britain and Ireland, and adjoining the coast of France between the frontiers of Belgium and Spain."

The details of this convention were more definite and much less complicated than the regulations prepared in accordance with the convention of 1839. Instead of 89 articles there were only 42. The principal changes were removal of all restriction on the size of mesh and on the forms and construction of beam trawls, etc., and an extension in the termination of the oyster season from April 30 to June 15. Also an improvement was attempted in general supervision and in methods of enforcing the regulations governing the conduct of the fishermen. The articles of this convention are given in full in Appendix B (page 158 of this paper).

To carry into effect the provisions of the convention of 1867 was the principal intention of the British sea fisheries act of 1868 (31 and 32 Vict., ch. 45), which repealed the convention act of 1843. Reciprocal action in France failed, however, and the provisions of the new convention were never made applicable to French boats and fishermen. And the convention act of 1843 having been repealed by the sea fisheries act of 1868 (sec. 71), there was an absence of mutual regulations until 1877, when the provisions of the convention act of 1843 were revived by the fisheries act of 1877 (40 and 41 Vict., ch. 42, sec. 15) so far as regards French fishermen, "until the day when the convention of 1867 might be brought into operation by action of the French Government."

[a] Report of the commissioners, p. LXXIV.

As a result of this legislative condition, while the provisions of the convention of 1867 were enforceable against British subjects by virtue of the act of 1868, it was necessary, when dealing with the offenses of French fishermen, to have recourse to the regulations drawn up in 1843 under the convention of 1839. Naturally this caused much confusion, and the British sea fisheries act of 1883 (46 and 47 Vict., ch. 22) repealed the convention act of 1868, so far as the same had come into force, with the exception of certain specified sections and articles, especially those relating to the numbering and lettering of fishing boats.

Since 1883 the provisions of the North Sea convention of 1882 [a] have within the limits of the North Sea superseded the regulations of 1843; while outside the North Sea and the British exclusive limits, most of the regulations of 1843 are regarded as obsolete and are rarely enforced, and they have little effect on the fisheries at the present time. It was thought that the success of the North Sea convention of 1882 would speedily result in the application of its provisions to the Channel fisheries also, but nothing has yet been done in this direction.

The British "Manual for the Guidance of Officers Connected with the Sea Fisheries" states that while articles 24–26, 29, 33, 52, and 57–59 of the regulations of 1843 now apply to French boats outside the exclusive fishery limits in the seas between Great Britain and France, "it must be distinctly understood that none of the regulations of 1843 which relate to the size of the mesh of nets, the close time for fish other than oysters, or to matters which are repugnant to the spirit of the North Sea Fisheries Convention, are to be enforced." [b]

THE NORTH SEA CONVENTION OF 1882.

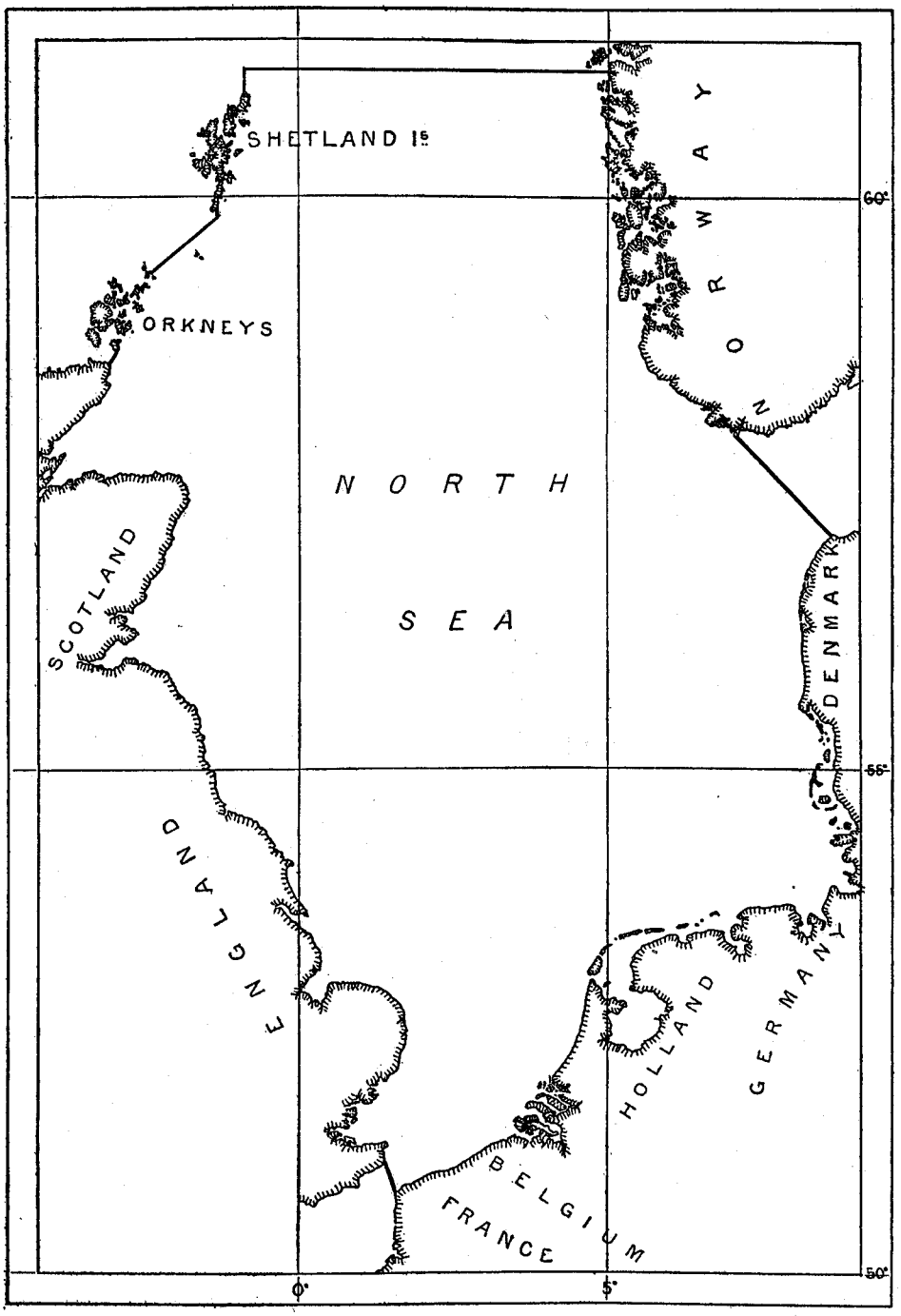
The most important fishery region of the world is the North Sea, situated east of England and Scotland, north of Belgium, the Netherlands and Germany, and west of Denmark and Norway. Within its waters, covering about 150,000 square miles and averaging less than 50 fathoms in depth, about 1,500,000,000 pounds of fish are taken annually, which is far more than the total weight of all the food fish taken on all the coasts and lakes and rivers of the United States. Upon these waters are employed thousands of fishermen from the adjoining countries.

During the latter half of the nineteenth century extremely unsatisfactory police conditions developed in the fisheries of the North Sea. With thousands of vessels fishing in relatively limited areas, much confusion arose, fishing gear was carelessly fouled, and in many instances nets were wantonly destroyed as the easiest method of freeing them, a special implement being provided for this purpose. [c] There was no uniformity in the display of lights and in marking

[a] See p. 116–121 of this paper.

[b] Edition of 1903, p. 9, sec. 23.

[c] An implement known as a "devil" had been employed for several years, especially, it is said, by the Belgian fishermen. Its manufacture, sale and use were interdicted by a municipal law of Belgium dated March 27, 1882.



Map showing area delimited by the North Sea Convention of 1882.

vessels for identification. And there was an absence of regulations for preventing collisions between vessels working in close proximity to each other.

For the purpose of remedying these unsatisfactory conditions and for policing the fisheries outside territorial waters, there was a conference of the interested Governments at The Hague in 1881 and again in 1882, to discuss provisions for joint regulations. This resulted in a convention signed on May 6, 1882, by delegates from Belgium, Denmark, France, Germany, Great Britain, and the Netherlands, power being reserved for adherence by Norway and Sweden. This is doubtless the most important document ever drawn up in connection with international police of the fisheries.

The principal stipulations of this convention are as follows:[a] Article 1 restricts the provisions of the convention to subjects of the contracting parties. Articles 2 to 4 define the limits of territorial jurisdiction and the limits of the North Sea for the purposes of the convention. Articles 5 to 13 provide rules for registering, numbering, and lettering vessels for identification, and the marking of small boats, nets, etc. All the fishing vessels must be registered and the registers are exchanged between the powers; every vessel bears in white oil color on black ground its name, number, and the initial of its harbor, and likewise carries an official voucher of its nationality. Articles 14 to 24 provide minute restrictions on fishermen in the conduct of their various operations so as to avoid collisions and to prevent injury to the nets and other apparatus. Article 25 refers to the salvage of fishing vessels, boats, nets, lines, etc. Articles 26 to 37 relate to the supervision of the fisheries by cruisers of the different nations and to the prosecution of offenses against the convention. The executing of regulations respecting documents, marking boats and equipment, and the use of interdicted implements was placed under the exclusive superintendence of the cruisers of the nation of each fishing boat; but cruisers of any one of the several nations were made competent to authenticate all infractions of the regulations other than these. For this purpose they have the right to visit, search, and arrest; but a seized vessel must be conveyed to a harbor of her flag state and turned over to the authorities there. All violations are to be tried by the courts of the state to which the contravening vessels belong; but cases of minor damage may be arbitrated at sea by the commanders of the cruisers should the parties concerned agree to it. This superintendence by cruisers is authorized only in respect to boats belonging to nations which are parties to the convention, and only when such boats are within the North Sea as defined by the convention. Articles 38 to 39 provide that the convention shall be ratified, and shall continue in operation until one of the powers gives notice of intention to terminate it; and in that event the convention shall be maintained among the other powers unless they give a similar notice.

[a] The articles are given in full in Appendix C (page 163 of this paper). The matter is treated in great detail by Hacke, Einige Opmerkingen over het Politietoezicht op Zee, in verband met de Zeevisscherij-Conventie van 6 Mei 1882, Amsterdam, 1885; and by Rykere, Le régime légal de la pêche maritime dans la Mer de Nord, Paris, 1901.

Each of the interested Governments enacted legislation for enforcing the provisions of this convention, the laws being promulgated by the respective states on the following dates: In Great Britain, August 2, 1883; in the Netherands, December 7, 1883; in Belgium, January 6 and 8, 1884; in France, January 15 and April 5, 1884; in Denmark, March 29, 1884, and in Germany, April 30, 1884. The regulations of the convention came into force on May 15, 1884.

Although an additional article made provision for adherence to the convention by Norway and Sweden, either jointly or separately, neither of these nations has assented, and they are not bound thereby. Nor has any one of the signatory powers withdrawn; so that the regulations of the convention are yet operative among them.

In 1891 the Governments of Great Britain and Belgium united in a declaration for the purpose of simplifying the procedure for the settlement of differences between British and Belgian fishermen in the North Sea outside territorial waters, and of reducing as much as possible the injuries they may sustain from the fouling of fishing gear. This declaration is given at length in Appendix D (page 167 of this paper). It was confirmed in Great Britain on July 21, 1891 (54 and 55 Vict., ch. 37), and in Belgium on August 19, 1891.

Difficulties among the fishermen in the North Sea decreased as a result of the convention of 1882, especially with the better understanding of that convention and of the laws founded upon it, although cases still occur in which avoidable injury is occasioned to the gear. The following summary shows for a series of years the number of complaints made against foreigners by British fishermen, with the amount of damages claimed and the amount of damages collected, and similar data relative to foreign complaints made against British fishermen. This probably represents fully three-fourths of the total number of complaints made during the years herein reported.

SUMMARY SHOWING FOR A SERIES OF YEARS THE NUMBER OF COMPLAINTS, AMOUNT OF DAMAGES CLAIMED AND THE AMOUNT OF DAMAGES COLLECTED, BY AND AGAINST BRITISH FISHERMEN UNDER THE NORTH SEA CONVENTION OF 1882.

Year.	Complaints against foreigners by British fishermen.			Complaints against British by foreign fishermen.		
	Number.	Damages claimed.	Damages collected.	Number.	Damages claimed.	Damages collected.
		£	£		£	£
1891	12	318	13	11	2,212	57
1892	9	280	143	16	310	53
1893	10	229	65	20	513	74
1894	12	115	102	24	330	40
1895	4	208	98	14	416	33
1896	4	41	6	9	162	----------
1897	5	212	95	12	159	54
1898	18	696	158	13	106	----------
1899	9	372	----------	8	273	169
1900	14	943	701	8	253	18
1901	10	304	93	10	727	5
1902	5	484	442	9	275	65

The greater size of steam trawlers, the improvements in the apparatus of capture, and the increased use of ice in preserving the catch, have resulted in extending trawling operations not only to all the available waters in western Europe, but to those of Iceland, northern Europe, and even to the coast of Africa. The increased receipts have been especially noticeable from Iceland, Faroe, and the Bay of Biscay. Throughout the whole of this region the area within a depth of 100 fathoms is now exploited, and the fishermen of several nationalities meet there on a common footing; but the regulations of the convention of 1882 apply to no other region than the North Sea.

Not a regulation of the fisheries themselves, but having an important bearing thereon, is the abolition of the liquor traffic among the fishing vessels in the North Sea. Trading boats from England, Germany, and the Netherlands were especially fitted out two or three decades ago for traffic among the fishing fleet, supplying the cheapest of liquors, tobacco, and obscene cards and literature. Dreadful evils resulted from this "bumboat" trade. The question of its regulation or abolishment was discussed at The Hague conference in 1881 which resulted in the North Sea convention of 1882, but without effect. After numerous unsuccessful attempts at regulation, an international convention was entered into on November 16, 1887, by representatives of the signatory powers of the 1882 convention, binding them to effect such legislation as would entirely prohibit the sale, exchange, or barter of spirituous liquors—that is, liquids "obtained by distillation and containing more than 5 per centum of alcohol"—and would establish a system of licensing bumboats for traffic with persons on board or belonging to fishing vessels of those nationalities in the North Sea outside territorial waters.

Failure on the part of France to ratify the convention nullified its conclusions.[a] However, on February 14, 1893, the other signatory powers, viz, Belgium, Denmark, Germany, Great Britain, and the Netherlands, entered into a protocol by which they agreed to bring the convention into force so far as their own boats and subjects were concerned, when such boats or subjects are outside territorial waters and within the limits of the North Sea, as defined by article 4 of the 1882 convention. Each licensed boat is required to exhibit, from the head of the principal mast, a white flag 2 meters square, bearing in the center the letter "S" in black, 1 meter high and 2 decimeters wide. Acts of legislature passed by each of these powers came into force on May 23, 1894. Since that date traffic in liquor by their subjects in the North Sea has been illegal, and in the same waters provisions and other articles for use by fishermen

[a] It is but just to add that this nonaction on the part of France was not due to sympathy with the traffic, for it has not been represented that boats of that nation have ever engaged therein. It was because of the opinion that the regulations were contrary to the fundamental principles of the freedom of commerce and the view that the municipal laws of the offending nations would suffice to end the traffic.

may be sold only by persons licensed by the respective Governments.[a] The enforcement of these regulations is referred to the same officials who are charged with the police of the fisheries in the North Sea, with the proviso that the regulations do not in any way affect French fishermen or concern French cruisers.

ANGLO-DENMARK CONVENTION OF 1901.

The success of the North Sea convention of 1882 resulted in similar action by Great Britain and Denmark for regulating the police of the fisheries prosecuted by their subjects outside territorial waters about Iceland and the Faroe Islands. A convention between these two powers was signed at London on June 24, 1901, and ratifications were exchanged on May 28 in the year following. This convention and the regulations established thereunder applied to about 230,000 square miles (geographical) of water area outside the territorial jurisdiction of Denmark about Iceland and the Faroe Islands, constituting the largest definite area in which an attempt has been made to police the fisheries by international convention.[b]

In detail the provisions of this convention were almost literally the same as those of the North Sea convention concluded at The Hague in 1882. Each article followed the older convention almost word for word, except in article 4, defining the geographical limits to which they applied, and in article 8, which contained the additional provision that steam fishing vessels should be appropriately marked on the funnel. Since the convention of 1882 there had been a very large increase in the number of steamers employed in the trawl fisheries, and most of the English vessels fishing about Iceland were of this type, hence the importance of this item. As in all other international fishery conventions, the courts of the flag state of the infringing vessel were made exclusively competent to deal with infractions of the regulations, but cruisers of either of the signatory powers were authorized to search and arrest. An additional article stipulated that any other Government, whose subjects fish in the seas surrounding Iceland and the Faroe Islands, may adhere to this convention; but no nation has yet availed itself of this privilege.[c]

The geographical limits for the application of this convention were fixed as follows: "On the south by a line commencing from where the meridian of North Unst light-house (Shetland Islands) meets the parallel of sixty-first degree of north latitude to a point where the ninth meridian of west longitude meets the parallel of 60° north latitude, and from thence westward

[a] For a more extended discussion of these regulations, see Guillaume in Revue de Droit International et de Législation Comparée, t. XXVI (1894), p. 488.

[b] The dominion of the North Sea convention of 1882 approximated 150,000 square miles. The concurrent municipal laws of 1875–1877 regulating the Jan Mayen seal fishery (see p. 135) applied to about 285,000 square miles.

[c] The articles of this convention are given in full in Appendix F (page 169 of this paper).

along that parallel to the meridian of 27° west longitude. On the west by the meridian of 27° west longitude. On the north by the parallel of 67° 30′ of north latitude. On the east by the meridian of the North Unst light-house." (Article IV.)

SUBMARINE CABLE CONVENTION OF 1884.

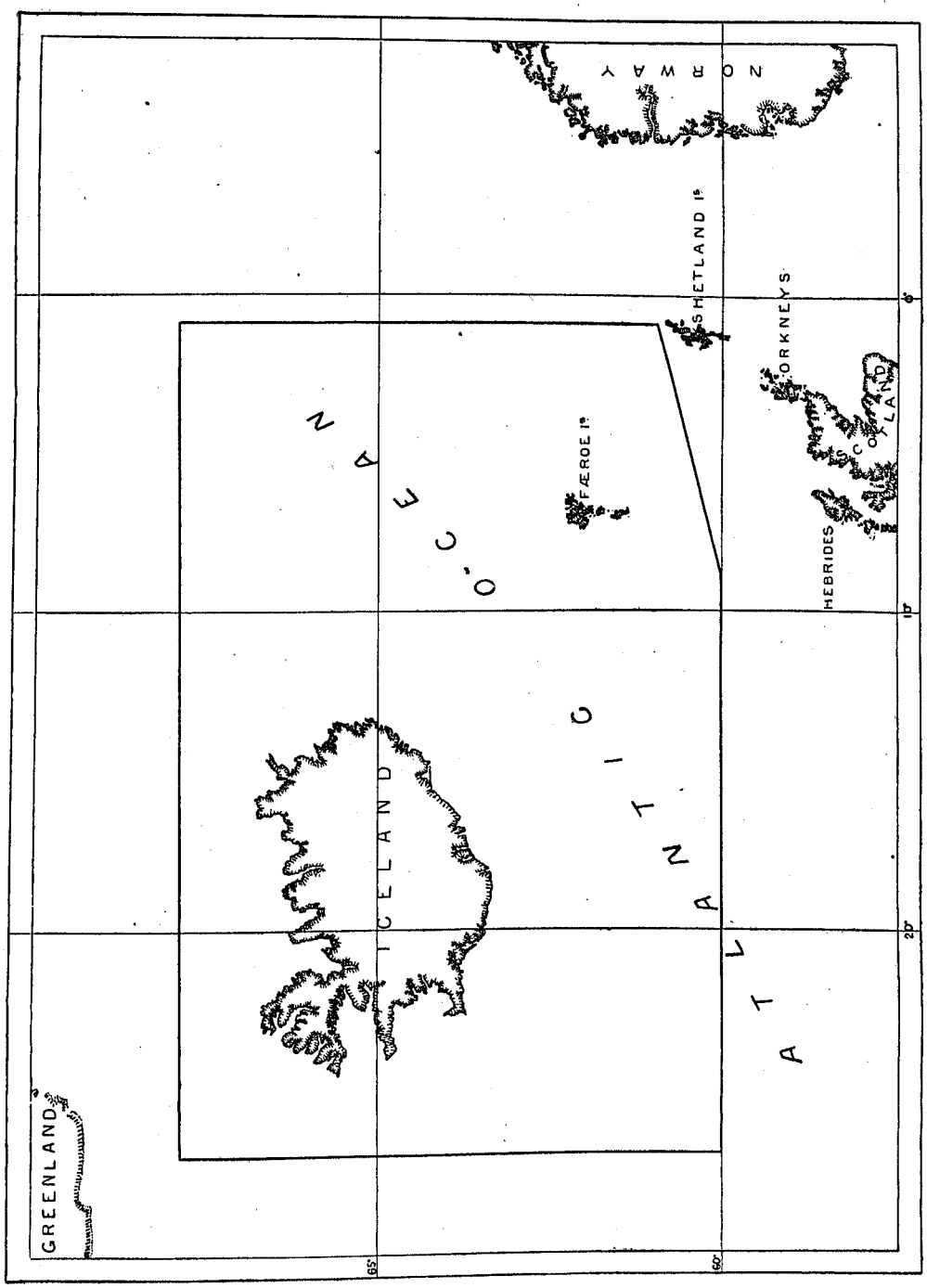
Another restriction of the fisheries on the high seas is a result of the convention for protecting submarine telegraph cables.

As early as 1869 the United States Government suggested a conference at Washington for consideration of this subject, but the Franco-Prussian war prevented the proposed convention. Various meetings were subsequently held at Rome, Brussels, and Paris, and an "International Convention for the Protection of Submarine Cables" was finally concluded and signed by the representatives of 25 sovereign powers at Paris, on March 14, 1884. The ratifications of 17 of these states were exchanged at Paris on April 16, 1885, and the convention was proclaimed on May 22 of the same year.

While the submarine cable regulations have not seriously interfered with fishing operations in any single region, the convention is noteworthy in this connection because of the very large number of sovereign states which adhered to it, including nearly every important nation in the world outside Asia, and even that continent was represented by Turkey, and Japan acceded to it some years later, so that the dominion of this convention now extends almost as far as civilization. Indeed, since those powers which have not signed the convention have not acted in opposition to it, one might safely maintain that these regulations have almost become universal international law through custom.

The terms of this convention are applicable outside the territorial waters, and they provide among other things that willful and unnecessary injury to a submarine cable shall be a punishable offense. Vessels, fishing gear, and nets shall be kept at the distance of at least 1 nautical mile from a vessel flying signals that she is engaged in laying or repairing a cable; "nevertheless, a period of twenty-four hours at most shall be allowed to fishing vessels that perceive or are able to perceive a telegraph ship carrying the said signals, in order that they may be enabled to obey the notice thus given, and no obstacle shall be placed in the way of their operations during such period." Vessels, nets, and gear must be kept at the distance of at least one-quarter of a nautical mile from buoys designed to show the position of cables when the latter are being laid, are out of order, or are broken. And owners of vessels who can prove the sacrifice of an anchor, a net, or any other implement used in fishing, in order to avoid injuring a cable, shall be indemnified by the owner of the cable, upon sufficient proof made promptly to the competent authorities.[a]

[a] The articles of this convention which relate to the fisheries are given in full in Appendix E (page 168 of this paper).



Map showing territory covered by the Anglo-Denmark Convention of 1901.

A final protocol, signed at Paris, July 7, 1887, fixed upon May 1, 1888, as the date upon which the instrument was to become finally operative. This was ratified by the United States on May 1, 1888, suitable provision for its enforcement having been already made by act of February 29, 1888 (25 Stat. L., p. 41). Practically all the other parties to the convention have enacted appropriate legislation for enforcing the regulations. And while these have safeguarded the property of the cable companies and the freedom of telegraphic communication, they have not imposed special hardship upon the fishermen or restricted their operations in any noteworthy degree.

REGULATIONS OF THE FUR-SEAL FISHERIES.

No attempt at regulating or restricting any branch of the fisheries on the high seas has caused more extended discussion or is more interesting from the point of view of this paper than the protection which the American and the Russian Governments have endeavored to give to the fur seals outside territorial jurisdiction in the North Pacific Ocean and tributary waters.

The well-known breeding habits of this animal, and its resort to the same shores year after year, render its capture on the rookeries an easy matter. This resulted in the slaughter of millions of them a century ago and nearly exterminated the species in the southern seas. But on the Pribilof Islands, the great breeding grounds of the northern fur-seal herd, the Russian Government about 1840 developed a system of management which tended to the greatest utilization with the least injury to the perpetuation of the resource. The keynote of this system was the absolute protection of the females, none whatever being intentionally slaughtered, and the killing was confined to the young males 2 or 3 years old, 95 per cent of which are superfluous for breeding purposes, owing to the polygamous habits of the animal. Grouped by themselves on the rookeries, the young males are surrounded, and those selected for slaughter are slowly driven off, precisely as one would drive a flock of sheep.

Under this wise system of management the herd prospered, and contained probably 3,000,000 or 4,000,000 animals when the Pribilof Islands came into the possession of the United States with the transfer of Alaska under the convention of March 30, 1867.

The act of July 27, 1868, by which the territory was erected into a customs district, made it the duty of the Secretary of the Treasury "to prevent the killing of any fur seal," except as it should be otherwise provided by law. By act of July 1, 1870, it was made "unlawful to kill any fur seal upon the islands of St. Paul and St. George, and in the waters adjacent thereto, except during the months of June, July, September, and October," or "to kill such seals at any time by the use of firearms, or use other means tending to drive the seals away from the said islands." And in August of the same year the Government leased the privilege of taking fur seals on the Pribilof Islands to a corporation

organized under the laws of California, the take being fixed at 100,000 young males annually, under the system of management developed by the Russian Government.

From time immemorial the Indians of the northwest coast had been accustomed to capture the fur seals in the open sea, as these animals passed along the coast en route to and from the breeding grounds, spearing males and females indiscriminately as they were found sleeping at the surface of the water. The extent of this slaughter was small, probably never exceeding 6,000 or 7,000 in any one year previous to 1879, and it is generally agreed that it had no serious effect in diminishing the herd.

But the high value of fur-seal pelts about thirty years ago induced persons to fit out vessels for conveying a number of Indians and their canoes to the main path of the migrating animals and there follow them day after day, so as to prosecute their capture with greater effect. About 1881 this pelagic fleet extended its operations to Bering Sea, where it met with so much success that the number of vessels quickly increased to 34 in 1886, to 68 in 1889, and to 115 in 1891, each with from 5 to 20 canoes. The number of fur seals taken by these vessels reached the total of 59,568 in 1891, valued at about $938,196, all of which were taken by Canadian fishermen, as the law of 1868 was enforced against American subjects. In the meantime the American lessees on the Pribilof Islands were obliged by reason of the decreased size of the herd to reduce their take from an annual average of 100,000 pelts previous to 1886 to 12,040 in 1891, valued at about $360,000. There was a large preponderance of females among the animals taken in the pelagic fishery, owing to the slaughter of surplus males on land, the proportion being about 4 females to 1 male. The capture of a female in the spring migration to the rookeries involved the death of her unborn offspring, and the killing of the mother in August or September resulted in the death of her dependent young on the islands.

Rather than witness the destruction of this valuable resource, the American authorities in 1886 construed the aforementioned acts of 1868 and 1870 as applicable to the entire water area within the limits of territory ceded by Russia in 1867—in other words that Bering Sea was mare clausum; and notice was given of this construction, with a view to preventing the pelagic fishery in those waters.

In August, 1886, an American revenue cutter seized 3 Canadian sealing vessels in Bering Sea about 60 miles from the nearest land. On October 4, these vessels were condemned for having been "found engaged in killing fur seal within the limits of Alaska Territory and in the waters thereof in violation of section 1956 of the Revised Statutes of the United States." After repeated protests on the part of the British Government, the President on January 26, 1887, without conclusion of any questions which might be found to be involved, directed "the discontinuance of all pending proceedings, the discharge of the

vessels referred to, and the release of all persons under arrest in connection therewith." Later in this same year other Canadian vessels were seized and occasioned a renewal of diplomatic controversy.

In a circular letter dated August 19, 1887, Mr. Bayard, the American Secretary of State, proposed international cooperation "for the better protection of the fur-seal fisheries in Bering Sea," sending the communication to the American ministers in France, Germany, Great Britain, Japan, Russia, and Norway and Sweden, for presentation to those respective Governments.[a] The preliminary steps seemed to be viewed favorably by the Governments of France, Great Britain, Japan, and Russia, and "the convention had been virtually agreed on verbally, except in its details;"[b] but in May, 1888, these were suspended by reason of opposition made by the government of Canada, without whose assent Great Britain would not act.

In 1888 no seizures were made of foreign vessels in Bering Sea. But in 1889 the American Government renewed its activity against the pelagic fishery and arrested a number of British Columbian vessels outside the 3-mile limit, claiming that "the Canadian vessels arrested and detained in the Bering Sea were engaged in a pursuit that was in itself contra bonos mores, a pursuit which of necessity involves a serious and permanent injury to the rights of the Government and people of the United States,"[c] the ownership of the fur seals resulting from ownership of the islands on which they breed and of the coast on which they live. Unfortunately, however, there was no exact precedent in international law for treating the fur seals as the subject of property on the high seas, and indeed no municipal law of the United States had ever so considered them.

Diplomatic correspondence continued between the two Governments, and pending negotiations for the reference of the controversy to a tribunal of arbitration, a modus vivendi was agreed to on June 15, 1891. By this agreement Great Britain undertook to prohibit, until the following May, the killing of fur seals by British subjects in that part of Bering Sea lying eastward of the line of demarcation described in the treaty of 1867 between the United States and Russia, and the United States to prohibit the like killing of seals by citizens of the United States in the same part of Bering Sea and on the islands thereof, in excess of 7,500 to be taken on the islands for the subsistence and care of the natives.

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[a] "Without raising any question," said Mr. Bayard, "as to the exceptional measures which the peculiar character of the property in question might justify this Government in taking, and without reference to any exceptional marine jurisdiction that might properly be claimed for that end, it is deemed advisable to attain the desired ends by international cooperation." (S. Ex. Doc. 106, 50th Cong., 2d sess., 84.)

[b] Letter from Mr. Phelps, American minister at London, dated September 12, 1888.

[c] Letter from Mr. Blaine, Secretary of State, to Lord Salisbury, January 22, 1890.

On April 18, 1892, a second modus vivendi was concluded embodying the provisions of the modus vivendi of 1891, with the added subject of compensation for damages to be paid "by the United States to Great Britain (for the use of her subjects) for abstaining from the exercise of that right during the pendency of the arbitration upon the bases of such a regulated and limited catch or catches as in the opinion of the arbitrators might have been taken without an undue diminution of the seal herds; and, on the other hand, if the result of the arbitration shall be to deny the right of British sealers to take the seals within said waters, then compensation shall be made by Great Britain to the United States (for itself, its citizens, and lessees) for this agreement to limit the island catch to seven thousand five hundred a season, upon the basis of the difference between this number and such larger catch as in the opinion of the arbitrators might have been taken without an undue diminution of the seal herds."

On February 29, 1892, the two Governments agreed to refer to a tribunal of seven jurists the question of jurisdiction over the fur seals in Bering Sea, and what concurrent regulations were desirable for their protection outside the jurisdictional limits of the respective Governments. The tribunal of arbitration met in Paris in 1893. The American claim of exclusive jurisdiction was not strongly pressed, and the principal issue was: "Has the United States any right, and if so, what right, of protection or property in the fur seals frequenting the islands of the United States in Bering Sea when such seals are found outside the ordinary three-mile limit."

On the question of property in the fur seals, the United States claimed that these are not entirely feræ naturæ, but are in part domesticated, as is the honey bee; that ownership in the islands upon which fur seals breed, that their habit in regularly resorting thereto and rearing their young thereon, that their going out in search of food and regularly returning thereto, and all the facts and incidents of their relation to the islands gave to the United States a property interest therein; and that this was such a property interest as entitled the Government to preserve the herd from destruction by employment of such reasonable force as may be necessary, even at considerable distance from the islands.

Irrespective of this distinctive right of property in the fur seals, the American Government claimed for itself and its people an interest and an industry in the proper use of the fur-seal herd on its territory, which it was entitled to protect against wanton destruction by individuals for the sake of the small and casual profits in that way to be gained; and that no part of the high seas is or ought to be used by individuals for the purpose of accomplishing the destruction of national interests of such a character and importance. Furthermore, the United States, alone possessing the power of preserving this valuable interest, was in a most just sense the trustee thereof for the benefit of mankind and should be permitted to discharge that trust without hindrance.

On the question of ownership in the migrating seals, the decision of the arbitrators in the tribunal, by a majority of five against two, was that "the United States has not any right of protection or property in the fur seals frequenting the islands of the United States in Bering Sea, when such seals are found outside the ordinary 3-mile limit." As provided for in this event, a system of regulations was formulated for the protection of the herd outside the jurisdictional limits, to be enforced jointly by the two nations, the cruisers of each of the two powers being authorized to visit, search, and arrest all violators,[a] but a seized vessel must be conveyed to a harbor of her home state and turned over to the authorities there for trial.

These regulations provided for a suspension of all pelagic sealing in Bering Sea in May, June, and July, which covers the breeding season; and they interdicted sealing at any time within a zone of 60 geographical miles around the Pribilof Islands, which was supposed to cover practically the feeding ground of the mother while her young is dependent on her for nourishment. Licensed sailing vessels only were permitted to engage in the fishery, and the use of nets, firearms, and explosives was interdicted. These regulations were to remain in force until abolished by mutual agreement, but were to be examined every five years with a view to modification.[b]

For executing these regulations, an act was approved in the United States on April 6, 1894,[c] and a similar act was passed by Parliament[d] on the 23d day of the same month. Other maritime powers were asked by the United States to submit voluntarily to the regulations made by the arbitrators, but only Italy has agreed to this[e] and all other nations remain free to engage in pelagic sealing at any time without regard to the closed season mentioned in the award.[f] But as the fishery was then practiced almost wholly by vessels flying either the Canadian or the American flag, it was virtually subject to the regulations of the Paris tribunal.

In 1894 these regulations were enforced by the two interested Governments among their respective subjects, the United States spending over $500,000 in maintaining its patrol. But notwithstanding this protection, the pelagic catch of fur seals exceeded that of any preceding year, amounting to 61,838, as com-

[a] This is one of the three instances in which the United States has consented to a departure from its stoutly maintained policy of freedom of its merchantmen from search by foreign cruisers in time of peace, the successful advocacy of which forms one of the most glorious records in American history.

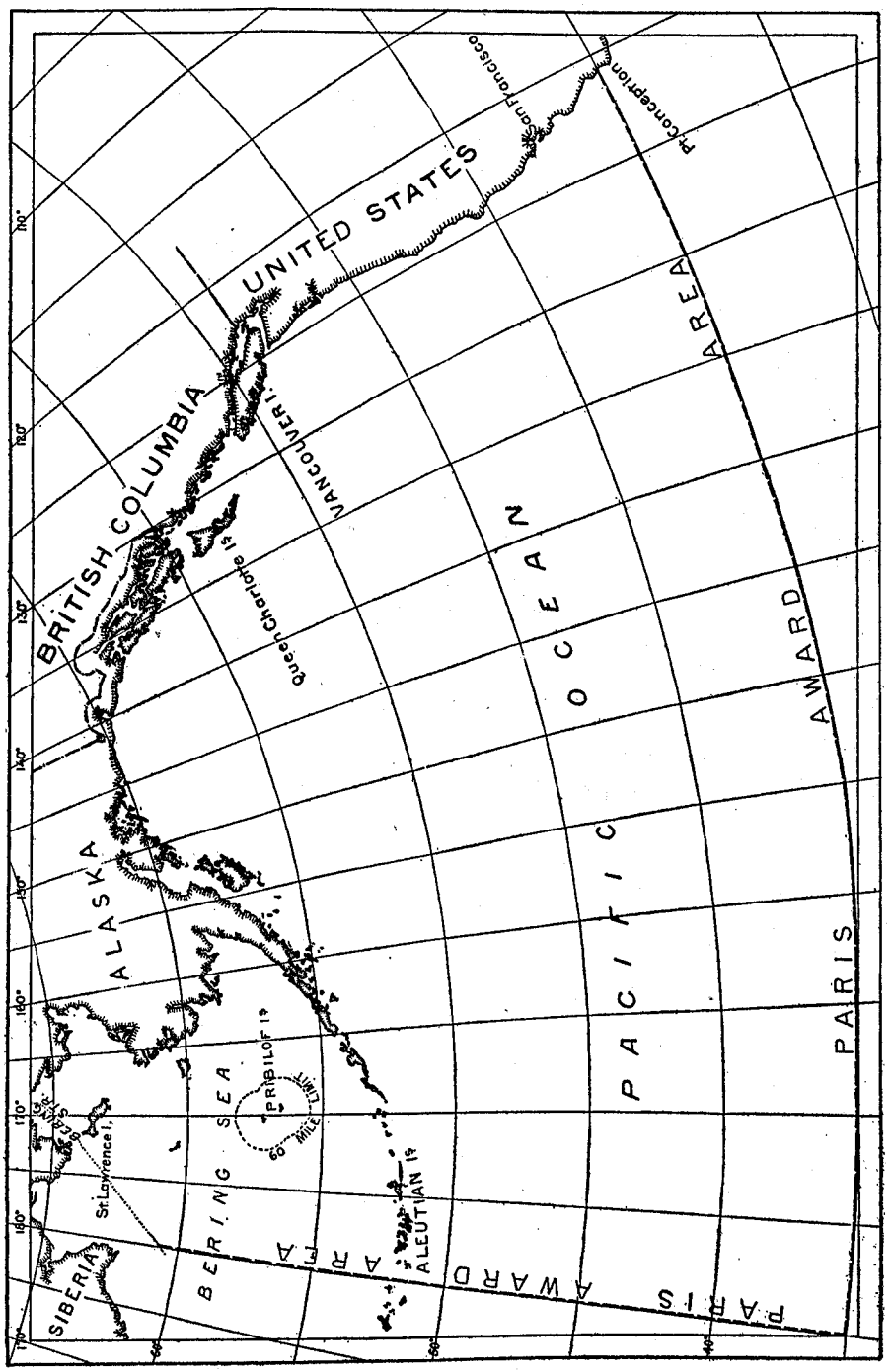
[b] These regulations are given in detail in Appendix G (page 173 of this paper).

[c] 28 Stat. L., 52.

[d] Foreign Relations, 1894, App. 1, p. 107–233.

[e] Martens, Nouveau Recueil General de Traites, 2d series, XXII, p. 565.

[f] France and Portugal signified their willingness but do not appear to have executed the regulations. The Government of Denmark declined to adopt them on the ground that no vessels of that nation were engaged in sealing in those waters. Japan declined to enforce them among its vessels unless similar protection should be given to the Japanese fur-seal fisheries. And Russia consented to adhere to the regulations only on condition that they be extended to the whole of the Pacific Ocean north of the thirty-fifth degree of latitude. (Moore, Digest of International Law, p. 922–923.)



Map showing area designated in the award of the Fur-seal Arbitration Tribunal.

pared with 30,812 in 1893, owing principally to the fact that the mother fur seals feed far outside of the protected zone. The vessels followed the herd as it moved along the coast in the spring and entered Bering Sea at the end of the close season in August, when under the ineffectual regulations they were free to use the spear outside the 60-mile zone. The pelagic catch in Bering Sea during 1894 numbered 31,585, of which over 80 per cent were taken by Canadian vessels.

The higher value and the greater abundance of fur seals in the Pribilof herd had resulted in attracting to it the attention of the pelagic sealers, so that previous to 1891 the herd resorting to the Russian islands was relatively free from their attention. But the prohibition of fur sealing within the limits agreed upon in the modus vivendi of 1891 and in that of 1892 resulted in diverting the fleet to the Russian coast, and caused such a destruction in that herd that measures of protection were imperative. In 1892 the Russian authorities arrested 6 vessels charged with fur sealing within the marine league about Copper Island.

On February 12 (24), 1893, in response to an inquiry from the British ambassador, made in behalf of Canadian sealers, as to the limits within which they would be permitted to take seals, the Russian minister of foreign affairs wrote that the insufficiency of the strict application of general rules of international law to this matter was conceded in the negotiations between Great Britain, the United States, and Russia in 1888, and that the necessity for exceptional measures had been confirmed by the Anglo-American modus vivendi of 1891, which had placed Russian interests in an abnormal and exceptional position. As a matter of self-defense, for the ensuing season and pending the adoption of international regulations, Russia would prohibit sealing within a zone of 10 miles on all her Pacific coasts, and within a zone of 30 miles around the Commander Islands and Robben Island. Although denying that Russia had a right to extend her jurisdiction beyond the usual territorial limits, in view of the existing conditions the British Government expressed willingness to enter into an agreement with Russia for the enforcement of these protective zones. Such an agreement was concluded in May, 1893,[a] and an order in council was issued on November 21, 1895, to give effect to this arrangement.

On May 4, 1894, a somewhat similar modus vivendi was concluded between the Governments of Russia and the United States. This provided, on the one hand, that the United States would prohibit its citizens from taking fur seals within a zone of 10 nautical miles along the Russian coasts of Bering Sea and of the North Pacific Ocean, as well as within a zone of 30 nautical miles around the Commander Islands and Robben Island; and, on the other hand, that the Russian Government would limit to 30,000 the number of fur seals to be taken during the year 1894 on the same islands. It was agreed that this provisional

[a] See Blue Book, "Russia, No. 1, 1893."

expedient might be terminated at will by either party upon giving notice to the other.

The fur seals in the Pacific continued to decline so rapidly in numbers that in 1896 Great Britain and the United States agreed to the appointment of a joint scientific commission to study the fur-seal life in Bering Sea with a view to greater protection. The investigations of this—the Jordan-Thompson—commission covered the seasons 1896 and 1897, and led to the conclusion that the cause of the decline was the killing of females at sea, and that the abolition of pelagic sealing was essential to the preservation of the herd. It was expected that the joint high commission called at Quebec in 1898 would act upon this finding, but unable to reach an agreement on the boundary dispute between Canada and the United States, that commission suspended without taking action, and the fishery has continued up to the present date under the very ineffective arbitration regulations of 1893.

So far as concerns the actual preservation of the fur seals from commercial ruin and extermination, it probably is not too much to say that virtually nothing has been accomplished by all the negotiations and arbitrations during the last thirty years. And while restriction of the pelagic fishery may have served to retard somewhat the exhaustion of this resource, it has been entirely out of proportion to the expense involved.

The official returns show that from 1890 to 1901 the American Government expended $3,357,097 for this purpose, as follows:

United States navy patrol	$1,003,048
Revenue-cutter patrol	1,299,735
Expenses of Paris tribunal	234,000
Award of damages, pelagic sealers' arrest	473,151
Cost of Jordan-Thompson Commission	30,000
Cost of treasury agents	317,163
Total	3,357,097

In view of the inefficiency of the regulations established by the Paris tribunal of 1893 and the great destruction of the herd, the American Government has made additional efforts to put a stop to the pelagic fishery. It has prohibited the fishery to its citizens; and, after ineffectual efforts to induce other governments to do likewise, has attempted to reduce the value of the pelts to the point where subjects of other governments would find no profit therein, employing such measures as branding all female seals on the islands, and interdicting the importation into this country of any fur-seal skins taken in the pelagic fishery. Probably the most extreme measure was introduced in the Fifty-fourth Congress. This bill, which passed the House unanimously, but failed in the Senate, required that in the event that the President failed to negotiate a satisfactory agreement with the Government of Great Britain for the preservation of the herd, the Secretary of the Treasury should cause to be

slaughtered every fur seal on the Pribilof Islands, without provision for the preservation of the species.

It is generally agreed that the preservation of the fur seals involves the complete elimination of the pelagic fishery. At present this is prosecuted only by vessels from Canada and Japan, the fleet of the latter having increased rapidly since 1893. The 15 vessels composing the Canadian fleet in 1907 secured 2,858 skins from Bering Sea, 448 from the vicinity of Copper Islands, and 1,934 from the British Columbia-Alaska coast, a total of 5,240 skins. In accordance with the provisions of the Paris award, these vessels are prohibited from killing seals in Bering Sea at any time with firearms or in any manner within a distance of 60 miles about the Pribilof Islands, and must observe a closed season between May 1 and July 31 of each year. The 36 vessels in the Japanese pelagic sealing fleet in 1907 secured about 9,000 skins in Bering Sea and the North Pacific Ocean, hunting in any manner and anywhere outside the marine league, as these vessels are not bound by the regulations of the Paris tribunal. During the greater part of the summer the Japanese vessels hovered about the Pribilof Islands, killing seals just outside the 3-mile territorial limit.

For years an effort has been made to induce the Canadian government to prohibit her fishermen from engaging in the pelagic fishery. But since this is a vested interest in which the right of her citizens was established by the decision of the Paris tribunal, and since such an interdiction would be almost exclusively for the financial advantage of America and Russia, the Canadian government has not seen fit to follow such a course. It has been suggested that for a definite sum of money the right of the Canadians to take seals on the high seas be sold to the American Government; but many practical and legal difficulties attach to this course, aside from any question as to whether it would meet with the approval of the nations interested. Since a termination of the pelagic fishery would promote the prosperity of the sealing on the rookeries, a more equitable plan would seem to be an exchange with the Canadian government of a share in the revenue from the rookeries for a prohibition of the pelagic fishery.

Some years ago the Japanese Government professed a willingness to concur in any agreement made between Great Britain and the United States for preserving the fur seals. However, that was before so many Japanese vessels were employed in the pelagic fishery, and possibly that Government might not now be so willing to abandon this vested interest without some equivalent. Any arrangement made with the Canadian government which is not concurred in by the Japanese Government would be wholly valueless, for experience of the last few years has shown how easy it is for a Canadian sealer to place his boats under the Japanese flag. Indeed, even should arrangements be made with both Canada and Japan, there would be no assurance that vessels of other nationalities might not engage in the pelagic fishery.

CONVENTION OF 1899 BETWEEN SWEDEN AND DENMARK.

In the narrow waters connecting the Baltic and the North Sea much confusion developed near the close of the last century between the fishermen of Sweden and Denmark, particularly as to the limits of territorial jurisdiction from which they were respectively excluded. This resulted in a convention, signed on July 14, 1899, which set forth the limits of territorial jurisdiction and extended to the subjects of each nation certain privileges within the territorial waters of the other; it also required that boats, fishing gear, etc., should be suitably marked and that avoidable injury thereto should be assessed against the person responsible.

This convention [a] was not so broad in its scope as the North Sea convention of 1882 or the Anglo-Denmark convention of 1901. For its purposes the waters between Sweden and Denmark were defined to be: (1) The Cattegat, limited by a line on the north extending from Skagen to Vinga light-house and thence to Hesingen Island, and on the south by lines extending from Hasenore to Gniben and from Kullen to Gilberghaven; (2) The Sound or Örasund, extending from the Kattegat on the north to a line drawn from Falsterbo to Stevns on the south, and (3) the navigable waters of the Baltic along the coast from Falsterbo to Simbrishamn and also around the Danish islands Bornholm and Kristiansö.

The area reserved to the subjects of each country extends seaward to the distance of 4 geographical miles (one-fifteenth of a degree of latitude) from the coast—that is, the outermost islands and the reefs not constantly covered by water. But in the Cattegat Swedish subjects are authorized to fish within a distance of 3 geographical miles of the shores of the Danish island Anhalt, and Danish subjects are authorized to fish at the same distance outside a straight line drawn from Hallands Wäderö light-house to Tylo light-house on the Swedish coast.

The convention made two other exceptions to the 4-mile rule, viz: (1) In The Sound the subjects of each country are authorized to fish everywhere without discrimination, with this limitation, that along the shores of each side within a depth of 7 meters the subjects of the other country are not permitted to catch any other fish than herring; and (2) in the Baltic along the shores of Bornholm and Kristiansö islands and on the Swedish coast from Falsterbo to Cimbrishamn fishing for herring with nets is permitted to the subjects of each country from May 1 to August 31.

The convention defined the manner in which the vessels and the various forms of fishing gear shall be marked. In accordance with its provisions, whenever a subject of either country occupies a fishing station with his gear duly marked he may not be ousted therefrom. If fishing gear is set or hauled over marked gear, or if a net is so hauled that duly marked gear is needlessly

[a] The original text and a translation of this convention are given in Appendix H (page 174 of this paper).

damaged, the owner thereof has the right to indemnity from the person causing the damage. This protection applies to salmon gear set around Bornholm and Kristiansö islands only from October 1 to April 1, inclusive.

Offenses against the convention are to be reported and tried in the country to which vessel of the guilty party belongs, and the punishment consists of fines ranging from 10 to 200 crowns.

A protocol to this convention set forth that the respective Governments would take the necessary measures for executing the provisions of the convention and especially those relating to police supervision; and furthermore that differences of opinion regarding the interpretation or application of the convention which could not be adjusted by diplomatic negotiations should be submitted to arbitration. The convention and protocol were ratified at Copenhagen on July 21 and at Marstrand on August 4, 1899, and the ratifications were exchanged at Stockholm on November 10, 1899.

On October 5, 1907, this convention was supplemented by a declaration, taking effect November 1, 1907, which specified that in The Sound fishing shall be permitted to the subjects of each country everywhere without restriction other than that along the shores of each side of the sound within a depth of 7 meters subjects of the other country shall not fish with nets for any other species than herring. And in the Baltic Sea along the coast of Bornholm and Kristiansö islands and on the Swedish coast from Falsterbo to Cimbrishamn the herring fishery with draft nets shall be common to the subjects of each country from May 1 to August 31.

The declaration also added this important provision: Plaice less than 25½ centimeters in length (21 centimeters from the point of the nose to the root of the tail) shall not be permitted on board any fishing vessel in the Cattegat, its bays or inlets, nor shall any such plaice be landed, sold, or shipped from one locality to another on the coasts of the Cattegat, but shall be returned to the water as quickly and as uninjured as possible. The same provisions apply to The Sound, excepting that in certain towns plaice 21 centimeters long (17 centimeters from the point of the nose to the root of the tail) may be used for consumption in the communes lying next to the coast.

GREENLAND SEAL FISHERY REGULATIONS OF 1875–1877.

Although they are not strictly international in the sense of binding the interested states in their relations with each other, yet it seems that reference should be made to the concurrent regulations enacted in 1875–1877 by Great Britain, Denmark, the Netherlands, Norway, and Sweden for protecting hair seals in the seas adjacent to the eastern coast of Greenland, and especially about the island of Jan Mayen.

Very rapid is the growth of the young seals born each March on the ice floes drifting down from the polar sea. The skin, with the attached fat, weighs only about 8 pounds at birth; but nourished by their mothers' milk on the icy

cradles the young animals increase rapidly in weight, so that at four weeks the pelt weighs about 40 or 50 pounds and the oil and the skin are in prime condition for commercial use. At this age the young seals are easily captured by vessels which penetrate among the ice floes, carrying men who descend upon the ice and club them to death in large numbers, single vessels sometimes slaughtering several thousand in a day.

There are two principal fisheries for seals in the northern Atlantic, the so-called Newfoundland fishery and the Jan Mayen or Greenland fishery. Although two or three of the vessels are owned in Scotland, the Newfoundland fishery is prosecuted entirely from St. Johns in that colony, so that colonial legislation has been found sufficient for its regulation and protection. The Greenland fishery is carried on between Greenland, Spitzbergen, and the island of Jan Mayen, but mostly within 400 miles of that island; and the vessels engaged therein have sailed from Scotland, Norway, Germany, and to a less extent from Denmark and Sweden.

Forty years ago this fishery was extensive, the annual take of pelts numbering about 200,000. Owing to the small area on which the seals breed and the large number of vessels employed, there was much competition among the fishermen in being the first on the ground, and very many young seals were slaughtered within a few days after birth, when they were wholly defenseless, making no effort to escape from the clubs of the hunters, and almost complete extermination of the herd was relatively easy. Furthermore, the pelts secured were very small, whereas had they been permitted to remain for two weeks longer the average value would have been several times as great.

There has never been an international convention, treaty, or arbitration for protecting these animals, but a close season has been established through analogous municipal enactments by each of the interested nations acting in concert. Norway and Sweden took the initiative in this matter and by informal concert were quickly followed by Great Britain, Denmark, and the Netherlands. Each power legislated independently for itself, and its legislation operated only on its own subjects. These regulations may be repealed, respectively, at the pleasure of the enacting state without notice to the other powers interested. Each nation acts with complete independence in the enforcement of its own regulations, no provision whatever being made for one government to arrest or otherwise interfere with foreign fishermen violating the regulations, which is probably the principal feature of the important conventions previously discussed in this paper.

In Great Britain legislation on this subject began with an act of Parliament passed on June 14, 1875 (38 Vict., ch. 18), which empowered the Queen in council, being satisfied that other powers concerned had made or would make the like regulations as to their ships and subjects, to prescribe a close time for the seal fishery in the area included between the parallels of 67° and 75° north latitude, and the meridians of 5° east and 17° west longitude from Greenwich,

covering an area of about 285,000 square miles. On November 28, 1876, an order in council was made bringing the act into operation and fixing the 3d of April in each year as the earliest day on which it should be lawful to take seals in that region. Concurrent action was taken by Denmark, the Netherlands, Norway, and Sweden; but, despite these regulations, the fishery has gradually declined, and since 1900 relatively few seals have been taken in these waters. So far as we are aware, this is the only instance in which Norway has acted in concert with other nations in regulating any branch of the fisheries on the high seas other than those designed for protecting submarine cables.

EXTENSION OF TERRITORIAL JURISDICTION.

As has been set forth in the first chapter of this paper, a nation can not independently establish any regulations over fisheries prosecuted by foreigners on the high seas. Each nation legislates for itself, and its regulations can operate on its subjects alone.

But has a state no power whatever to safeguard its marginal fishery resources by regulations applicable on the adjacent high seas to foreigners as well as to subjects? If the marginal resources are jeopardized by some very destructive procedure of foreign fishermen immediately outside territorial waters, would not international law sanction interference with those operations in order to preserve sustenance and livelihood to the coastal population? Even as nations now exercise jurisdiction over foreign vessels beyond the marine league for enforcing quarantine and revenue laws, may not authority somewhat analogous be exercised to preserve the fishery resources within the marine belt?

This principle of interference and protection, applied to a concrete case was the chief contention of the United States before the Bering Sea tribunal in 1893; and the assumption of such authority is greatly discredited by the decision in that case, which must be regarded as an authoritative declaration of international law. It is universally admitted that pelagic sealing is highly destructive and threatens the existence of the fur seals in the territorial waters and on the shores of the United States, to the great loss and injury of American subjects; and yet it was decided that the nation is powerless to prevent their destruction by foreign fishermen. Indeed, unless there be special agreement to the contrary, foreign fishermen may remain just outside the marine league and slaughter every seal that ventures that far from the shore, even to the last member of the herd, and the American Government is without authority to interfere. A similar condition exists about the Russian islands, and the Japanese fishermen endeavor to make the most of their rights in this respect, off the American as well as the Russian shores.

The recent action of the British Government in excluding foreign fishermen from trawling in the Firth of Moray, on the eastern coast of Scotland, seems at variance with the conclusions of the Bering Sea tribunal. In 1889 (52 and 53 Vict., ch. 23, July 26, 1889), Parliament authorized the Fishery Board for Scotland,

for the purpose of protecting the spawning grounds, to interdict trawling within a line drawn from Duncansby Head, in Caithness, to Rattray Point, in Aberdeenshire, a distance of 85 miles, inclosing an area of about 1,700 square miles outside the British maritime belt, all of which had been defined as a part of the high seas in the North Sea convention of 1882. Although neither the statute nor the by-law made, confirmed, and published thereunder was explicit on this point, it was generally understood—indeed, semiofficial expressions seemed to justify the construction—that this enactment applied solely to British subjects, and had no reference to the operations of foreign fishermen.

In November, 1905, Emmanuel Mortensen, captain of a Norwegian vessel, the *Niobe*, was arrested and charged with trawling in Moray Firth about 5 miles from land, contrary to this by-law. When found guilty in the lower court, the defendant appealed the case[a] on the ground of nonjurisdiction of the court, the alleged offense having been committed on the high seas 5 miles from land. After able argument on each side, the court dismissed the appeal on the ground that as Parliament had, apparently from the enactment, assumed jurisdiction over the water in question for the purpose of regulating the fisheries, the court was bound to give effect to its terms, and that it was not for the court to question whether the legislature had done what foreign powers might consider an usurpation.[b] Owing to her peculiar policy in regard to wide claims over marginal waters, no exception was taken to the action of the British Government by the Kingdom of Norway, to which country the arrested vessel belonged; and as no other nation was concerned in that particular case, the claim to jurisdiction has not been brought into international review, where possibly it would share the fate of several previous attempts to extend jurisdiction beyond the marine league.[c]

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[a] Mortensen *v.* Peters (High Court of Judiciary, full bench). Reported in The Scots Law Times, vol. XIV, p. 227, August 4, 1906.

[b] This decision is in accord with the rule in this country, where in a controversy between the United States and a foreign nation as to boundary, the courts follow the decision of those departments of the Government to which the assertion of its interests against foreign powers is confided, i. e., the legislative and executive. (Moore, Digest of International Law, sec. 154.)

[c] Indeed, the opinion has been expressed by eminent authorities that seizures beyond the marine league for revenue purposes can not be sustained as a right, and that revenue laws authorizing such action are enforceable at peril, and rest on the tacit permission of the states whose vessels may be seized. In his opinion given to the Sardinian Government in the case of the *Cagliari*, Sir Travers Twiss added: "In ordinary cases, indeed, where a merchant ship has been seized on the high seas, the sovereign whose flag has been violated waives his privilege, considering the offending ship to have acted with mala fides toward the other state with which he is in amity, and to have consequently forfeited any just claim to his protection." And Dana writes: "Doubtless states have made laws for revenue purposes touching acts done beyond territorial waters, but it will not be found that in later times the right to make seizures beyond such waters has been insisted upon against the remonstrance of foreign states, or that a clear and unequivocal judicial precedent now stands sustaining such seizures when the question of jurisdiction has been presented." And he adds, in the same connection: "It may be said that the principle is settled that municipal seizures can not be made for any purpose beyond territorial waters. It is also settled that the limit of these waters is, in the absence of treaty, the marine league or the cannon shot." (Dana, note 108, Wheaton's International Law, sec. 179, p. 258–260.)

The action of the British Government appears inconsistent with its attitude in the Bering Sea controversy, and seems to be a revival of the view taken a century ago by our own Chancellor Kent, who suggested that, considering the length and characteristics of the American coasts, the United States might claim control of the waters included within lines stretching from distant headlands, as, for instance, from Cape Ann to Cape Cod, from Nantucket to Montauk Point, from Montauk Point to the capes of Delaware, and from the South Cape of Florida to the Mississippi;[a] but which was said by Woolsey to be "out of character for a nation that has ever asserted the freedom of doubtful waters, as well as contrary to the spirit of more recent times,"[b] and has never been accepted as an expression of the policy of the American Government.

As a purely academic proposition, instances could be suggested in which it might seem that a nation would be warranted in interfering with some novel and highly destructive method of fishery employed contiguous to her marginal seas. For instance, it is not to be supposed that any of the countries bordering the North Sea would willingly tolerate the use of large quantities of poison or of dynamite in taking fish in those waters, or that similar destructive methods would be permitted on the Newfoundland banks, even though these vicious acts should be committed by foreigners operating more than 3 miles from land and with the approval of their Government. But in the light of the Bering Sea decision, very slight is the probability of an instance actually arising in which a nation would unquestionably be justified in interfering with a method of fishery prosecuted by foreigners on the high seas, for no single nation may arrogate to itself executive power for the enforcement of international law. The provocation would have to be so great as to threaten the very existence of its people, and it is scarcely presumable that a foreign government would permit its subjects thus to injure the resources of a friendly state, for the public opinion of the civilized world enforces submission from every nation. Obviously the exercise of this authority for a merely beneficial restriction or regulation would likely soon become the basis of complete jurisdiction over that particular area, and it would probably not be long before, through one pretext or another, the principal fishing grounds of the world would pass under control of individual powers. And, to quote the words of Dr. C. N. Gregory: "No right to regulate what belongs to all nations can be conceded to one nation, however large her interests or enlightened her councils."[c]

For the preservation of the coastal fisheries, as well as for the more important matters of national defense and safety, the opinion is growing that the present limit of the marginal belt is too narrow and that it should be extended considerably beyond the present distance of 3 miles. As already set forth

[a] Kent, Commentaries on American Law, vol. 1, sec. 29, 30.

[b] Woolsey, International Law, sec. 60.

[c] American Political Science Review, May, 1907, p. 436.

herein, the marine league had its origin in the range of cannon, which determines the distance over which a nation is able to exercise jurisdiction from the shore. As the efficiency of cannon has greatly increased, and is now considerably more than 3 miles, it is urged that the width of the maritime belt should increase correspondingly. In recent years most of the writers on international law have expressed views favorable to this extension.

As written by Oppenheim, one of the most recent and likewise interesting of all writers on international jurisprudence: "Although many states, in municipal laws and international treaties, still adhere to a breadth of one marine league, the time will come when by a common agreement of the states such breadth will be very much extended." [a]

The learned editor of the 1904 edition of Hall's International Law expresses the view that "it is desirable for a state to have control over a larger space of water for the purpose of regulating and preserving the fisheries, the productiveness of sea fisheries being seriously threatened by the destructive methods of fishing which are commonly employed." [b]

The extension of the marginal belt was discussed by the Institut de Droit International at its meeting in Paris in 1904. The general opinion was that such an extension was desirable, and it was agreed nemine contradicente to recommend an increase to 6 miles, after the proposal to extend it to 10 miles had been rejected by 25 votes against 10. [c]

In view, however, of the approval which the 3-mile margin has received in international conventions, legislative bodies, and judicial tribunals, the indefiniteness of centuries ago has become the vested rights of to-day, the once plastic cement which the workmen molded has now become so set and solidified with the passage of time that it is useless to discuss an extension of the distance of exclusive jurisdiction without absolute international agreement. It can not be denied that such an extension would be vigorously opposed by some influential interests. The trawl fishermen of Great Britain, for instance, would unquestionably object to it, and for very practical reasons. Exclusive of the White Sea and the Baltic, the trawling area outside the 3-mile limit of northern and western Europe approximates 450,000 square miles. An extension of the marginal belt 6 miles would place 81,000 square miles of this area within the territorial jurisdiction of continental countries, and an extension of 4 miles farther would exclude British fishermen from 135,000 square miles of the best trawling grounds, an area nearly equal to that of the North Sea. As the British trawling fleet greatly exceeds that of all the continental countries, the fishermen of Great Britain would have much to lose and nothing to gain by the extension. On this side of the Atlantic acceptance of the exten-

[a] Oppenheim, International Law, London, 1905, vol. I, sec. 186.

[b] Page 152.

[c] Institut de Droit International, Annuaire (1894–1895), t. XIII, p. 290, 328–331.

sion would depend very largely on how it would affect the rights and treaty privileges of the United States along the shores of the British Provinces, which possibly far more than any other factor has influenced the present firm position of this Government respecting a marginal belt of a marine league only.[a]

Probably more important from an economic point of view than several miles increase in the width of the marine belt is a clear and unquestioned international recognition of vested rights in attempts to exploit and develop definite areas of sea bottom under the high seas, as in the cultivation of sponges, corals, pearl oysters, etc. There is a distinction in law as well as in fact between such an industry and a fishery dependent on the pursuit of free-swimming fishes in the ocean. Oysters, sponges, and the like represent a peculiar kind of property. They are not feræ naturæ, as they do not stray, nor do they require taming, hence ownership may be acquired in them.

It can not be affirmed that this extension of territorial jurisdiction to sea bottoms which are devoted to the cultivation of sponges, mollusks, etc., has ever been made the basis of any treaty or agreement, or has even been the subject of diplomatic discussion. With the single exception of Vattel, the older writers on international law were silent on this matter, and even Vattel seems not to have clearly distinguished it from the exercise of jurisdiction over migratory fishes in the seas near the marginal belt,[b] a doctrine which has long since been discredited.

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[a] The attitude of the United States in this matter was well expressed by Mr. Olney, when Secretary of State: "This Government would not be indisposed, should a sufficient number of maritime powers concur in the proposition, to take part in an endeavor to reach an accord having the force and effect of international law as well as of conventional regulation, by which the territorial jurisdiction of a state, bounded by the high seas, should henceforth extend 6 nautical miles from low-water mark, and at the same time providing that this 6-mile limit shall also be that of the neutral maritime zone. I am unable, however, to express the views of this Government upon the subject more precisely at the present time, in view of the important consideration to be given to the question of the effect of such a modification of existing international and conventional law upon the jurisdictional boundaries of adjacent states and the application of existing treaties in respect to the doctrine of headlands and bays. I need scarcely observe to you that an extension of the headland doctrine, by making territorial all bays situated within promontories 12 miles apart instead of 6, would affect bodies of water now deemed to be high seas and whose use is the subject of existing conventional stipulations." (Letter to Mr. de Weckherlin, Dutch minister, February 15, 1896. And we may also refer in this connection to the letter of Mr. Secretary Seward to the Spanish minister, quoted on p. 107.)

[b] Said Vattel: "Who can doubt that the pearl fishery of Bahren and Ceylon may not lawfully be enjoyed as property? And though a fishery for food appears more inexhaustible, if a nation has a fishery on its coasts that is particularly advantageous, and of which it may become master, shall it not be permitted to appropriate this natural advantage to itself, as a dependence on the country it possesses; and, if there are a sufficient number of fish to furnish the neighboring nations, of reserving to itself the great advantage it may receive from them by commerce? But if, so far from taking possession of it, it has once acknowledged the common right of other nations to come and fish there, it can no longer exclude them from it; it has left that fishery in its primitive freedom, at least with respect to those who have been in possession of it. The English not having taken the advantage from the beginning of the herring fishery on their coast, it is become common to them with other nations." (Vattel, Le Droit des Gens, lib. 1, ch. 23, sec. 28.)

Very natural, however, was the silence of the older publicists on this subject, since there was no occasion for recognition of this view until a very recent period. The spirit of scientific investigation and of industrial development is everywhere, and in few directions have these made greater progress in the last score or two of years than in the possibilities of cultivating the sea bottoms. Millions of dollars worth of oysters are now grown on areas which thirty years ago were barren wastes. Biologists are obtaining excellent results in sponge culture in the Gulf of Mexico, and in coral growth in the Mediterranean. Careful observers are awakening to the possibilities of pearl culture, not simply to raise the mollusks which yield pearls fitfully and at rare intervals, but to insure and to increase the yield of pearls within these mollusks, and thus to obtain remunerative returns without the arduous toil and the element of hazard inseparable from pearling as now prosecuted. And must the work of these investigators, must the enterprises which they stimulate, be restricted to the bounds of the marine league, while the broad areas of shallow bays and gulfs remain barren? Must we plant and harvest but along the hedgerows of the maritime belt and leave the rich meadows of the sea bottoms to waste? Must the work be handicapped by the refusal of international law to concede to these enterprises the elements of private ownership, which must be wholly lacking unless territorial jurisdiction apply to the areas which they exploit?

Numerous instances exist in which fisheries for pearl oysters, etc., prosecuted beyond the marginal belt, are the subject of fostering care on the part of a government or its people. By careful supervision as to close seasons, size limits, etc., and in some cases special preparation of the bottom and even removal of predacious enemies, the output from these areas is conserved and increased. Instances of this kind under state authority or recognition may be regarded as an occupation of the bed of the sea, and territorial jurisdiction should rightly extend to them, even though they be carried on beyond the marginal belt ordinarily recognized by international law. Even Grotius' " Mare Liberum " is founded upon the old doctrine of Roman law that there can be no property in anything without occupation. And while the vagrant waters of the ocean can not be subjected and occupied, the sponge beds and pearl reefs can be, even as the hills and the mountains.

It is not difficult to find opinions and analogies among the authorities tending to the view that international law would extend protection to enterprises under state authority for cultivating the sea bottom without any question as to whether the strict territorial limits have been exceeded. Even as a nation, by building a light-house upon the bed of a rock or upon piles driven into the bed of the sea, acquires territorial jurisdiction over the space thus occupied, so it would seem that a portion of the bed of the sea might be exploited and occupied in like manner, and that ordinary territorial law would apply to it.

In the celebrated Franconia case,[a] Chief Justice Cockburn, of England, noted that a portion of the bed of the sea, where it could be physically, permanently occupied, might be subject to occupation in the same way as unoccupied territory. And as said by Vattel, the most popular and in many respects the most just of the writers on the law of nations: "Qui doutera que les pêcheries de Bahrein et de Ceylon ne puissent legitimement tomber en propriété?"[b]

This view is founded not only on justice but likewise on necessity. Man's eagerness has so nearly exhausted the easily exploited resources that fostering care is essential to the best development and use of the sea bottom. Left to the chance of nature and subject to despoilment by every one without hindrance, these areas would remain barren wastes. Law and government are for the benefit of humanity. The aim of international law is the welfare and happiness of the general society of mankind, and this would not be promoted by a policy which would keep the sea bottoms forever unproductive. The reason for the freedom of the high seas is the freedom of intercourse and commerce between the states, the seas being the common highway; and a recognition of the occupancy by an individual nation of so much of the sea bottom as it may actually improve and develop does not impair the perfect freedom of navigation by vessels of all nations, as this occupancy is subordinate to the right of navigation and can not be exercised in derogation thereof.

Necessarily in the recognition of this jurisdiction the interests of the various states should be carefully guarded, and especially of those near the areas to be exploited. Within general limits the right of exploitation and development must be reserved to the nation within whose sphere of influence the particular area is situated, for it would be manifestly unjust, indeed extremely unwise, to establish a principle by which a nation could appropriate to itself a resource off the shores of a less enterprising country. The privilege of exploiting the sea bottom in the whole of the Gulf of California, for instance, should undoubtedly rest with the Mexican people; Ceylon and British India should have control of that in the Gulf of Manar, and the riparian states should possess those in the Persian Gulf and the Red Sea.

PRESERVATION OF THE FISHERIES ON THE HIGH SEAS.

The fisheries prosecuted on the high seas are of vast economic importance; they furnish a livelihood to a large number of persons, and yield food products of great value in the sustenance of the human race. Unlike the mineral and the agricultural resources, this wealth can not be appropriated and conserved by individual enterprise, but must in a very large measure be maintained for the use of the people in common. Thus the governments of the world are in a just sense the trustees for the management of this great wealth, this common field where all reap and none sow, where all harvest and none plant.

[a] Queen *v.* Keyn, L. R. 2 Exchcq. Div., 63 (Nov. 11 and 13, 1876).
[b] Vattel, Le Droit des Gens, t. 1, ch. 23, sec. 28.

While at present the high seas yield about 1 per cent of the food of man, an examination of the conditions leads to the belief that there are potentialities of an enormous increase. All animal nutrition may be traced to a vegetable origin. Although marine vegetation does not grow in forest-like masses, yet owing to its distribution at different depths and to the extensive area of the seas, its production probably exceeds that on land. Practically all of it is available for animal nutrition, whereas a very considerable part of land vegetation is not available for food. Thus marine vegetation either directly or indirectly supports a great quantity of animal life, which in aggregate weight doubtless equals the continental animals. In consideration of these conditions, it seems that when the increase in population of the earth requires much more thorough utilization of our resources, the draft on the seas will be vastly increased and they will be far more important factors in the food problems of mankind.

It is to the common interest of all nations to prevent indiscriminate destruction and consequent extermination of resources which contribute so extensively to the commercial wealth and general use of mankind. Useless destruction is a crime against posterity. Doubtless a century hence no policy of our great President will add more largely to his credit than his efforts toward preserving the natural resources, and no branch of these resources calls for more thorough international consideration and action than the resources of the high seas.

Upon the subject of the preservation of these resources, so that their yield may continue undiminished, there is so much that is appropriate to be said that one is lost in the abundance of it. The animal and vegetable products of the seas differ almost as widely in their characteristics and needs as those on land, and equally diversified and complicated are the problems concerning the most favorable conditions of their production and development. But within the limits of this paper it is possible to discuss these questions only in the most general way.

Fortunately the problem of sewage pollution, doubtless the greatest destructive factor in the inland and the coastal fisheries, has little or no existence in a consideration of the resources of the high seas.

From the standpoint of protective needs, the fishery products of the high seas may be roughly divided into four general classes, viz: (1) The migratory species, such as herring, mackerel, bluefish, etc.; (2) the bottom or demersal species, such as cod, haddock, flounder, and flatfish, which are less migratory in their habits and remain in the same general locality; (3) the aquatic mammals; and (4) those products which are fixed to the bottom and are susceptible of ownership, as sponges, pearl oysters, etc.

As regards the migratory fishes, there is an increasing belief that serious impairment of these species is beyond our present demands on them, and that

the present destruction effected by man is but child's play compared with nature's work in that direction. Many states from time to time have enacted restrictive legislation with a view to preserving them, but estimation of the beneficial effect of these regulations is generally discredited, at least so far as concerns the present extent of the draft on these resources.

For the purpose of protecting the spawning mackerel in their spring migration the United States, in 1887, indirectly restricted their capture for a period of five years, beginning March 1, 1888. The enactment interdicted not the fishing itself, but the importation of the fish, and applied to those caught on the high seas by foreign fishermen as well as to the catch by American citizens. It provided that "for the period of five years from and after the first day of March, 1888, no mackerel, other than what is known as Spanish mackerel, caught between the first day of March and the first day of June, inclusive of each year, shall be imported into the United States or landed upon its shores: *Provided, however*, That nothing in this act shall be held to apply to mackerel caught with hook and line from boats, and landed in said boats, or in traps and weirs connected with the shore."

This enactment was intended especially to prohibit the capture of mackerel during the period noted by means of purse seins operated from American vessels. The following summary, from an able article on this subject by Dr. H. M. Smith,[a] shows the extent of this fishery during the three years immediately preceding the period to which this enactment applied and during the six years following:

STATEMENT SHOWING THE EXTENT OF THE AMERICAN PURSE-SEINE FISHERY FOR FRESH MACKEREL FROM MARCH 1 TO MAY 31, INCLUSIVE, DURING A SERIES OF YEARS.

Year.[a]	Vessels fishing.	Fresh mackerel landed.	
	Number.	*Number.*	*Value.*
1885	175	31,250,000	$273,500
1886	150	2,739,370	78,507
1887	105	3,500,000	86,805
1893	60	200,190	21,000
1894	50	160,550	10,919
1895	38	121,050	14,261
1896	39	317,000	41,790
1897	84	1,491,255	107,242
1898	44	102,545	19,764

[a] No fishing in 1888–1892, according to law.

From this summary it appears that practically no beneficial effect can be attributed to the enactment, the average annual yield in the three years preceding its enforcement being 12,496,457 fish, or 87,114 per vessel, while the average during the six years following the closed period was only 398,765 mack-

[a] The southern spring mackerel fishery, Bulletin United States Fish Commission, vol. XVIII, p. 270.

erel, or 7,596 per vessel employed. Those who favor restriction on the sea fisheries claim that the length of the closed season and the period of years which the restriction covered were too short for favorable results.

Other prominent enactments of a similar nature were the numerous herring restrictions in England, Scotland, and some of the continental countries, and especially the herring and mackerel protective regulations resulting from the Anglo-French convention of 1839. But it does not appear that these regulations had any effect whatever on the increase or the decrease of these migratory fishes, which seem to depend on such natural causes as fluctuations in food supply, the destruction of brood by storms, etc., and that the abundance of the fishes themselves can not be seriously affected by restrictive legislation so long as the present conditions of supply and demand exist.

Since this legislation interferes with the established uses and customs of the fishermen, the burden is upon those who advocate it to prove that the benefit will outweigh the inconvenience. Ever since the influential voice of Huxley was lifted in its defense,[a] the policy of unrestricted use of the migratory species has continued to grow. This view has been strongly supported by Prof. W. C. McIntosh in Great Britain, by Dr. Hjort and Dr. Dahl in Norway, by Prof. Baird, Dr. Goode, and Mr. Eugene Blackford[b] in America, and by many other eminent authorities.

So far as regards the demersal or bottom fishes—the cod, haddock, halibut, flatfish, etc.—our present knowledge of the remedial effects of fishery restriction is so slight as scarcely to furnish a satisfactory basis for even national legislation in territorial waters, much less for complicated international regulations. A review of these regulations already established shows that the arrangement of joint action is a tedious and difficult matter, and ratification of the convention is always uncertain. Indeed, except so far as concerns the police of the fisheries,

[a] "The best thing for governments to do in relation to the herring fisheries is to let them alone, except in so far as the police of the sea is concerned. With this proviso let people fish how they like, as they like, and when they like. There is not a particle of evidence that anything man does has an appreciable influence on the stock of herrings. It will be time to meddle when any satisfactory evidence that mischief is being done is produced." (Huxley, in Popular Science Monthly, August, 1881.)

And again: "Every legislative restriction means the creation of a new offense. In the case of fishery, it means that a simple man of the people, earning a scanty livelihood by hard toil, shall be liable to fine and imprisonment for doing that which he and his fathers before him have, up to that time, been free to do. If the general interest requires that this burden should be put upon the fishermen—well and good. But if it does not—if indeed there is any doubt about the matter, I think that the man who made the unnecessary law deserves a heavier punishment than the man who breaks it." (Huxley, "Inaugural Address," International Fisheries Exhibition (London), 1883.)

[b] In testifying before a United States Senate committee in 1886, the late Mr. Blackford, who was one of the best informed fish dealers this or any other country has produced, stated that formerly he had thought protection necessary for the mackerel and other ocean fishes, "but when I got my material all together, I found the facts were entirely opposite to the views which I had entertained, and the more I looked into the subject the more I became impressed that there was no necessity for legislation for the protection of any of the free-swimming open-sea fishes." (Bulletin United States Fish Commission, vol. XVIII, p. 212.)

it does not appear that great practical benefit has resulted from the regulations for preserving the fisheries on the high seas.

It is easy to exaggerate the evil effects of fishing on the bottom species. Nearly six centuries ago, in England under Edward III, there was an agitation against the use of beam trawls, and petitions in Parliament gave visions of the speedy and complete ruin of the fisheries unless the use of this form of apparatus was interdicted; and yet trawling has continued undiminished from that time; indeed, it has never been more extensive than in recent years, and the sea has continually repaired the loss.

In 1890 there was a conference of representatives of European nations to discuss the question of remedial measures for the preservation of the demersal fishes of the deep seas about Europe. This conference was held at London, under the auspices of the National Sea Fisheries Protective Association, and was attended by delegates from Belgium, Denmark, France, Germany, Great Britain, the Netherlands, and Spain. It was unofficial in the sense that the Governments were not bound by its conclusions, but the delegates were among the most prominent officials connected with the fishery service of their respective countries.

The conference had particular reference to some arrangement for saving the small or immature flatfish and especially those taken by means of beam or otter trawls.[a] The discussion related especially to the need for such action and to the particular species which required protection; also to the desirability for protecting the spawning fish and for reserving certain portions of the North Sea for breeding purposes, at least for a portion of the year.

There was a general consensus of opinion as to the desirability of restraint on the capture of undersized flatfish, but it was not found practicable to arrive at definite recommendation to the several Governments leading to an international agreement or arrangement. However, the following resolutions were adopted:

That this conference considers it desirable that an official international conference of European maritime powers should be held with the view of concluding a convention for the prohibition of the landing and sale of undersized flatfish within their respective jurisdictions.

This conference, moreover, considers it desirable that, before the official conference meets, the different nations interested in the sea fisheries of European waters will col-

[a] The chief proposals for dealing with the capture of immature fish were thus summarized by Sir Thomas Boyd, chairman of the Fishery Board for Scotland: (1) Simply to prevent the sale of fish under a fixed size, without in any way interfering with the mode of fishing or the place of fishing. The disadvantage is that such a measure would not prevent their capture and destruction, since they must be taken in the ordinary way of fishing; (2) besides prohibiting their sale, to make regulations with the object of preventing their capture or destruction, viz: (*a*) By closing certain areas where young fish are supposed to be especially abundant; (*b*) by enlarging the mesh of the nets and fixing by law a minimum size of mesh. This would be a useful measure, and would enable many immature fish to escape, but large numbers would still be retained; (*c*) by compelling trawlers and line fishermen to return undersized fish to the sea in such a condition that they would live.

lect, with as little delay as possible, sufficient information, scientific as well as statistical, with regard to the damage done by the capture of undersized fish by their fishermen.

That the National Sea Fisheries Protective Association be requested to formulate a set of questions with a view to obtaining scientific and statistical information in relation to undersized fish and forward it to each delegate, in order that he may submit it to his Government for adoption.

No international action has yet come of this conference, but several of the nations have acted independently in the matter and interdicted the sale of undersized fish.

The Belgian Government, by royal decree dated September 5, 1892, prohibited fish under certain sizes from being landed, transported, sold, or exposed for sale in Belgium, without distinction as to the place of capture (sans distinction de leur provenance) or as to the nationality of the boat which caught them. The sizes specified are 25 centimeters for turbot, brill, ray, halibut, cod, and haddock, and 18 centimeters for soles, dab, plaice, and whiting, these measurements covering the extreme length of the fish.

Somewhat similar provisions were enacted in Denmark by law of April 5, 1888.[a] The declaration of 1907, supplementary to the convention of 1899 between Sweden and Denmark, which restricted the capture and sale of plaice under a designated length, has already been noted at length in the discussion of that convention. Other states with undersize fish laws are France, Germany, Holland, Sweden, Norway with reference to lobsters, England with reference to lobsters and crabs, and many of the American states, especially with respect to crustaceans and mollusks.

The principal effect in Great Britain of the conference of 1890 was the appointment of a select committee in the House of Commons to consider the expediency of adopting measures for the preservation of the fisheries "in the seas around the British Islands, including the prohibition of the capture, landing, or sale of undersized sea fish, the prohibition of the sale or possession of certain sea fish during the periods when their capture is forbidden, the fixing of close seasons, the prohibition or regulation of certain methods of fishing, the protection of defined areas, and other like regulations, international or otherwise."

For the purpose of determining the best regulations for preserving the fishery resources with the maximum extent of their utilization, it is not easy to exaggerate the importance of systematic research in marine biology and the effect of fishing operations. Excellent work of this nature has been done and is yet in progress in many countries where the fisheries are of great extent.

[a] Section 15 of this law provided that no trade may be carried on in Bornholm salmon under 3 pounds, trout under one-half pound, cod under one-fourth pound, and turbot under one-half pound; and section 56 of the same law prohibited the purchase and sale of eels, pike, and salmon less than 12 inches; of cod, whiting, plaice, turbot, brill, bream, tench, trout, and gwiniad less than 8 inches; and of dab, flounder, perch, and bleak less than 6 inches measured from the point of the fore snout to the root of the caudal fin.

The sentiment favorable to this research has moreover surpassed the bounds of national jurisdiction and become international in its scope. Prominent among such investigations are those conducted by the Joint Commission—commonly known as the Rathbun-Wakeham Commission—appointed December 6, 1892, on behalf of the United States and Great Britain relative to the prevention of destructive methods of fishing and to the preservation of the fisheries in the waters contiguous to the United States and Canada. The interesting and valuable report of this commission, presented in 1896,[a] furnishes much practical data relative to the legislative needs of our border fisheries.

On April 11, 1909, a treaty was concluded between Great Britain and the United States for the purpose of arranging uniform regulations in these waters; and a thorough examination of the present condition and needs of these fisheries is now being made by Dr. David S. Jordan, assisted by Dr. Barton W. Evermann, on the part of the American Government, and by Prof. E. E. Prince, who succeeded Mr. S. T. Bastedo, on the part of the British Government. The report of these commissioners, to be made in June, 1909, is awaited with much interest, and it is hoped that favorable action thereon will result in great benefit to the fishery interests of both Canada and the United States.

Even more extensive are the joint investigations now in progress in the seas north of Europe. In 1899 the Government of Sweden extended to the nations prominently interested in those fisheries an invitation to attend a conference for the purpose of uniting on some plan of international research. This resulted in a gathering at Stockholm in June, 1899, of representatives from Great Britain, Germany, Russia, Denmark, the Netherlands, Norway, and Sweden. A second conference of representatives of the same powers was held in May, 1901, at Christiana on invitation of the Norwegian Government. The result of these conferences was the recommendation of a scheme of investigation to the attention of the states interested. This scheme was accepted by each of these nations, and the several legislatures appropriated a sum of money for inaugurating the work. At a conference in Copenhagen in July, 1902, representatives of the contributing states established the "International Council for the Exploration of the Sea." This international research is yet in progress, and the results already obtained fully justify its establishment.

However we may view the protective needs of the migratory and the demersal fishes, the situation is quite different with respect to the sea mammals—the seals, walrus, manatees, sea otters, and many species of whales. These animals are approaching practical exhaustion with great rapidity, and prompt action seems necessary if they are to be reserved from extinction. This is not the language of exaggeration. Under the influence of the bounty which industrial use offers of $40 for the life of a fur seal, $300 for a sea otter, and $5,000 for an arctic whale, these animals are passing away far more rapidly than is generally

[a] H. Doc. 315, 54th Cong., 2d sess.

realized, the entire annual product of sea otters throughout the world now approximating only 200 and of the arctic whales less than 100 each year. The timid whalebone whales have been swept from the navigable seas and are nowhere to be found except in the most remote ice fields of the frigid zones, the recent decrease having been in geometric ratio owing to modern inventions—to steam vessels, electric lights, and especially to the shot harpoon. The walrus are almost exterminated in the seas north of Europe, and in Bering Sea, where they were formerly so plentiful, they are to be found only in one small herd, which hauls out in the spring and falls on the islets off Port Heiden, on the Alaska peninsula.

It is shocking to contemplate the indifference with which the civilized world has witnessed, nay, not only witnessed but encouraged, the slaughter, almost to the point of extinction, of highly organized animals evidencing traits of affection and devotion which would do honor to human beings. Everywhere, in every sea, it is the same story, slaughter, slaughter, slaughter. What more pathetic sight in the whole range of man's ruthless destruction than the thousands of nursing fur seals starving and dead at the present moment on the shores of the Pacific islands as a result of the inhuman butchery of their nurture-seeking mothers in the waters of Bering Sea and the North Pacific. At the present rate of decrease the day is not far distant when these will have become as extinct as the buffalo of the American prairies.

Let it not be understood that our sympathy for the highly organized creatures of the sea would withhold them from industrial use. The slaughter of animals under proper conditions, whether they be in the seas or under domestic care, does not in itself constitute needless cruelty, for the end of every individual, beast or human, is pathetic, whether it be brought about by sudden accident or through the waste of years. When this slaughter is so conducted that it is conservative utilization, with due care for the welfare and perpetuation of the species as a whole, it is but the most intelligent application of nature's wisest law of the survival of the fittest. The preservation which we would extend to these animals is largely for the purpose of their greater slaughter. We would surround them with such protection and take them only under such conditions as would tend to increase their numbers and thus make them of far greater value to the hardy fishermen whose industry has won renown in all ages.

It is hoped that the wide public interest attracted to the preservation of our natural resources will result in preventing the now imminent extermination of these species, whose zoologic and philosophic worth far exceeds their economic value; and it seems that this Fishery Congress faces no more important duty than that of adding the weight of its great influence in staying the inhuman hand of destruction and extermination. Already this subject is attracting attention in America, and during the last twelve months resolutions favoring action for the preservation of these animals were adopted by a number of scientific

societies, including the New York Zoological Society, the American Society of Vertebrate Paleontologists, and the American Society for the Advancement of Science. These resolutions were closely similar. That of the last-named society was as follows:

Resolved, That the American Society for the Advancement of Science will aid in any way practicable those measures legislative, international and local, which will prevent the now imminent extermination of the great marine vertebrates, especially the cetaceans and manatees, seals, green and other turtles on the coasts of the United States, or on the high seas.

It is beyond the limits of this paper to outline the proper direction of the efforts to preserve these resources. But in view of the fact that the fisheries on the high seas represent the greatest economic resource which the nations of the world hold in common for their joint use, it seems that there might be wisdom in a general treaty or international union for their consideration. Already there are several treaties of this nature with special international offices for the purpose of satisfying economic and other nonpolitical interests, such as the Universal Postal Union, established in 1874, the Union for the Protection of Industrial Property in 1883, and the Union for the Protection of Works of Literature and Art in 1886. More closely allied to our subject is the convention in behalf of the preservation of wild animals, birds, and fish in Africa, which was signed in London on May 19, 1900,[a] by France, Germany, Great Britain, Italy, Portugal, Spain, and the Kongo Free State.

And in this gathering of representatives from so many powerful states, what subject more worthy of consideration than the economic conservation of the resources of the seas. A brotherhood of great nations arranging not the partition of nature's inheritance among themselves for speedy waste and despoilment, but the preservation of that inheritance for beneficial use in common by all the people of the earth; each to draw upon that storehouse of wealth only in accordance with the common welfare of all, for the sustenance of its citizens, for the comfort of its people, and for the advancement of civilization throughout the world.

[a] See Martens, Nouveau Recueil Général de Traités et autres Actes relatifs aux Rapports de Droit international. Deuxième série, t. xxx, p. 430.

APPENDIXES.

APPENDIX A.

Regulations for the Guidance of the fishermen of Great Britain and of France, in the seas lying between the coasts of the two countries; prepared in pursuance of the provisions of the eleventh Article of the Convention concluded at Paris on the 2d of August, 1839, between Her Majesty and the King of the French.

ARTICLE I. British and French subjects fishing in the seas lying between the coasts of the United Kingdom of Great Britain and Ireland and those of the Kingdom of France shall conform to the following Regulations.

ART. II. The limits within which the general right of fishery is exclusively reserved to the subjects of the two Kingdoms respectively are fixed (with the exception of those in Granville Bay) at three miles distance from low-water mark.

With respect to bays the mouths of which do not exceed ten miles in width, the three-mile distance is measured from a straight line drawn from headland to headland.

ART. III. The miles mentioned in the present Regulations are geographical miles, of which sixty make a degree of latitude.

ART. IV. The fishery limits of Granville Bay, established upon special principles, are defined in the first Article of the Convention of the second of August, one thousand eight hundred and thirty-nine, as follow:

The lines drawn between the points designated by the letters A, B, C, D, E, F, G, H, I, K, on the chart annexed to the Convention are acknowledged as defining the limits between which and the French shore the oyster fishery shall be reserved exclusively to French subjects; and these lines are as follow; that is to say:—

The first line runs from the point A, three miles from low-water mark (Point Meinga bearing south), to the point B, of which the landmarks are Agon Tower on with the clump of trees upon Mount Huchon, and the summit of Gros Mont in a line with the signal post on Grand Isle.

The second line runs from the said point B, towards Agon Tower and the clump of trees upon Mount Huchon in the direction north, sixty-four degrees east, until at the point C it brings the windmill of Lingreville to bear due east.

The third line runs from point C, due east towards Lingreville windmill until the Grand Huguenant is brought to bear on the Etat Rock at point D.

The fourth line runs from point D northward, and keeping the Grand Huguenant in one with the Etat Rock, until it intersects at E a line whose landmarks are Agon Tower on with Coustances cathedral.

The fifth line runs eastward from point E to point F, where the steeple of Pirou is brought to bear in a line with the Senequet Rock.

The sixth line runs from point F due north to point G, where the steeple of Blainville is brought in a line with the Senequet Rock.

The seventh line runs from point G (in the direction of Pirou steeple) to point H, where the light-house on Cape Carteret bears north, twenty-four degrees west.

The eighth line runs from point H to point I, nearly abreast of Port Bail; point I having for landmarks the fort of Port Bail in a line with the steeple of Port Bail.

And finally, the ninth line runs from point I to the Three Grunes at point K, where Cape Carteret bears east, ten degrees north, in a line with Barneville church.

All the bearings specified in the present Article are to be taken according to the true meridian and not according to the magnetic meridian.

ART. V. It is forbidden to British fishermen to set their nets or to fish in any manner whatever within the French limits; and it is equally forbidden to French fishermen to set their nets or to fish in any manner whatsoever within the British limits.

ART. VI. All British and French fishing boats shall be numbered.

There shall be a series of numbers for the fishing boats belonging to each Collectorship of Customs in the United Kingdom, and a series of numbers for the fishing boats belonging to each district of Maritime Registry in France; and to these numbers shall be prefixed the initial letters of the names of the respective collectorships or districts.

ART. VII. Whereas there are in the United Kingdom several Collectorships of Customs, and in France several districts of Maritime Registry, the names of which begin with the same letter, in which case the initial letter alone would not suffice; the distinguishing letter or letters for the boats of each collectorship or district shall be designated by the Board of Customs in the United Kingdom and by Ministry of Marine in France.

ART. VIII. The letters and numbers shall be placed on each bow of the boat, three or four inches (eight or ten centimètres French) below the gunnel, and they shall be painted in white oil colour, on a black ground.

For boats of fifteen tons burthen and upward the dimensions of these letters and numbers shall be eighteen inches (forty-five centimètres French) in height, and two and a half inches (six centimètres French) in breadth.

For boats of less than fifteen tons burthen, the dimensions shall be ten inches (twenty-five centimètres French) in height, and one and three-quarter inches (four centimètres French) in breadth.

The same letters and numbers shall also be painted on each side of the mainsail of the boat in black oil colour on white sails, and in white oil colour on tanned or black sails.

These letters and numbers on the sails shall be one-third larger in every way than those placed on the bows of the boat.

ART. IX. In order that the fishing boats of Jersey, Guernsey, and other islands of the same cluster may be distinguished from the fishing boats of the other British islands their numbers shall precede the initial letter of the name of the island to which such boats may belong.

Each of these islands shall have a separate series of numbers.

ART. X. All the buoys, barrels, and principal floats of each net, and all other implements of fishery shall be marked with the same letters and numbers as those of the boats to which they belong.

These letters and numbers shall be large enough to be easily distinguished. The owners of nets or other fishing implements may further distinguish them by any private marks they judge proper.

ART. XI. The letters and numbers of British fishing boats shall be inserted on the licenses of those boats, after having been entered in the Registry book kept at the Collectorship of Customs.

The letters and numbers of French fishing boats shall be inserted on the muster rolls of those boats, after being entered in the Registry book kept at the Maritime Registry office.

ART. XII. The licences of British fishing boats and the muster rolls of French fishing boats shall contain the description and tonnage of each boat, as well as the names of its owner and of its master.

ART. XIII. The fishermen of both countries shall, when required, exhibit their licences or muster rolls to the commanders of the fishing cruisers, and to all other persons of either country appointed to superintend the Fisheries.

ART. XIV. The name of each fishing boat and that of the port to which she belongs shall be painted in white oil colour on a black ground on the stern of the said boat, in letters which shall be at least three inches (eight centimètres French) in height and half an inch (twelve millimètres French) in breadth.

ART. XV. It is forbidden to efface, cover, or conceal, in any manner whatsoever, the letters, numbers, and names placed on the boats and on their sails.

ART. XVI. Trawl fishing may be carried on during all seasons in the seas lying between the fishery limits which have been fixed for the two countries.

ART. XVII. Trawls shall be made with nets, the meshes of which shall be at least one inch and three quarters (forty-five millimètres French) square, from knot to knot, along the line.

ART. XVIII. The length of the wooden yard or beam to which the upper part of the mouth of each trawl net shall be fastened shall not exceed thirty-eight feet (eleven mètres five hundred millimètres French).

ART. XIX. The underpart of the trawl net, to a length of ten feet (three mètres French) from its extremity, may be strengthened by rubbing pieces made of old nets; but these rubbing pieces shall be so fastened that they shall not cross or narrow the meshes of the trawl net, which must always remain at least one inch and three quarters (forty-five millimètres French) from knot to knot, along the line, open and unobstructed.

ART. XX. The size of the meshes of any supplementary nets which may be added to trawls shall be at least two inches (fifty millimètres French) square from knot to knot, along the line.

ART. XXI. Such supplementary nets shall be so fitted as not to cross or narrow the meshes of the trawl net, which must always remain at least one inch and three quarters (forty-five millimètres French) from knot to knot, along the line, open and unobstructed.

ART. XXII. The total weight of the two irons or headpieces of a trawl shall not exceed two hundred and eighty-seven pounds (one hundred and thirty kilograms French).

ART. XXIII. The total weight of iron chains or leads used for loading the ground rope of a traw shall not exceed one hundred and ten pounds (fifty kilograms French).

ART. XXIV. Trawl fishing is forbidden in all places where there are boats engaged in herring or mackerel drift-net fishing.

ART. XXV. Trawl boats shall always keep at a distance of at least three miles from all boats fishing for herring or mackerel with drift nets.

ART. XXVI. Whenever herring or mackerel boats shall commence drift-net fishing in any place whatever, the trawl boats which may be already fishing in such place shall depart therefrom, and shall keep at a distance of at least three miles from the said drift-net herring or mackerel boats.

ART. XXVII. Herring fishing is free all the year round.

ART. XXVIII. The meshes of all nets used for herring fishing shall not be less than one inch (twenty-five millimètres French) square from knot to knot, along the line.

ART. XXIX. Whenever decked herring boats and undecked herring boats shall commence shooting their nets at the same time, the undecked boats shall shoot their nets to windward of the decked boats, except they should prefer going to leeward, to a distance of at least half a mile, to shoot their nets.

ART. XXX. The decked boats on their part shall shoot their nets to leeward of the undecked boats, unless they prefer going to windward, to a distance of at least half a mile, to shoot their nets.

ART. XXXI. When decked boats shall arrive on grounds where fishing is already begun by other boats, among which shall be undecked boats, the decked boats so arriving shall shoot their nets to leeward of the undecked boats, except they should prefer going to windward, to a distance of at least half a mile, to shoot their nets.

ART. XXXII. When undecked boats shall arrive on grounds where fishing is already begun by other boats, among which shall be decked boats, the undecked boats so arriving shall shoot their nets to windward of the decked boats, except they prefer going to leeward, to a distance of at least half a mile, to shoot their nets.

ART. XXXIII. If, however, it should happen that the spot where fishing is going on, and consequently where the herrings are, should be so near to the fishery limits of one of the two countries, that the boats of the other country would, by observing the above mentioned Regulations, be prevented from taking part in the fishery, the said boats of the other country shall be at liberty to shoot their nets at a less distance than that prescribed in the preceding Articles for decked and undecked boats; but such fishermen as may take advantage of this permission shall be responsible for any damage or losses which their drifting may cause to the other boats.

ART. XXXIV. Fishermen of the one country shall not avail themselves of the circumstances mentioned in the preceding Article, nor of any other circumstances whatsoever, to shoot their nets within the fishery limits of the other country.

ART. XXXV. Whenever set nets are employed for the purpose of taking herrings, the boats engaged in this fishery shall always remain over their nets.

These boats shall, moreover, be bound to observe the prohibition contained in Article LVII in favor of drift-net fishing.

ART. XXXVI. Mackerel fishing is free all the year round.

ART. XXXVII. The meshes of all nets used for mackerel fishing shall not be less than one inch and one-sixth (thirty millimètres French) square, from knot to knot, along the line.

ART. XXXVIII. It is forbidden to all fishermen to load the lower parts of mackerel drift nets with leads or stones.

ART. XXXIX. Boats going to fish for mackerel with drift nets are required, when they shall arrive on the fishing ground, to lower all sails, to show that they have taken their berths.

ART. XL. The boats mentioned in the preceding article shall keep three-quarters of a mile at least apart from one another when they shoot their nets.

ART. XLI. The meshes of nets known by the name of bratt nets shall not be less than four inches and one-third (eleven centimètres French) square, from knot to knot, along the line.

ART. XLII. The meshes of the middle nets of trammels shall be at least two inches (five centimètres French) square, from knot to knot, along the line.

The meshes of both of the outer nets of trammels shall be at least six inches (fifteen centimètres French) square, from knot to knot, along the line.

ART. XLIII. Fishermen using bratt nets, trammels, and other set or anchored nets, shall place buoys on such nets, in order that vessels sailing in those places may avoid them.

ART. XLIV. Such bratt nets, trammels, or other set or anchored nets shall not, except in unavoidable cases, remain more than twenty-four hours in the sea without being taken up.

ART. XLV. Oyster fishing shall open on the first of September, and shall close on the thirtieth of April.

ART. XLVI. From the first of May to the thirty-first of August no boat shall have on board any dredge or other implement whatsoever for catching oysters.

ART. XLVII. It is forbidden to dredge for oysters between sunset and sunrise.

ART. XLVIII. The fishermen shall cull the oysters on the fishing ground, and shall immediately throw back into the sea all oysters less than two and a half inches (six centimetres French) in the greatest diameter of the shell, and also all sand, gravel, and fragments of shells.

ART. XLIX. It is forbidden to throw into the sea on oyster fishing grounds the ballast of boats, or any other thing whatsoever which might be detrimental to the oyster fishery.

ART. L. For the purpose of distinguishing by day drift-net fishing boats from trawl boats, both shall carry at the masthead vanes, which shall be at least eight inches (twenty centimètres French) in height and two feet (sixty-one centimètres) in length.

The colours of these vanes shall be, for—

British trawl boats, red.
French trawl boats, blue.
British drift boats, white and red.
French drift boats, white and blue.

It is understood that the vanes of drift boats shall be divided vertically into two equal parts, of which the white shall be nearest to the mast.

ART. LI. It is forbidden to all other fishing boats to carry vanes similar to those mentioned in the preceding Article.

ART. LII. It is forbidden to all boats to anchor between sunset and sunrise on grounds where herring or mackerel drift-net fishing is going on.

This prohibition does not apply to anchorages which may take place in consequence of accidents or any other compulsory circumstances, but in such case the master of the boat thus obliged to anchor shall hoist, so that they shall be seen from a distance, two lights placed horizontally about three feet (one mètre French) apart, and shall keep these lights up all the time the boat shall remain at anchor.

ART. LIII. In order that boats fishing with drift nets may be easily recognized at night, the masters of these boats shall hoist on one of their masts two lights, one over the other, three feet (one mètre French) apart.

These lights shall be kept up during all the time their nets shall be in the sea between sunset and sunrise.

ART. LIV. All fishermen are forbidden, except in cases of absolute necessity, to show lights under any other circumstances than those mentioned in the present Regulations.

ART. LV. The meshes of the various nets before mentioned shall be of the prescribed dimensions, measured when the net is wet.

ART. LVI. It is forbidden to use nets for any other kind of fishing than that for which each of those nets may be lawfully employed, with respect to the size of its meshes, or of its fittings.

ART. LVII. It is forbidden to set or anchor nets, or any other fishing implement, in any place where herring or mackerel drift-net fishing is going on.

ART. LVIII. No boat shall be made fast or held on to the nets, buoys, floats, or to any part of the fishing tackle belonging to another boat.

ART. LIX. It is forbidden to all persons to hook or lift up the nets, lines, or other fishing implements belonging to others, under any pretence whatsoever.

ART. LX. When nets of different boats get foul of each other, the masters of the said boats shall not cut them, except by mutual consent, unless it shall have been found impossible to clear them by other means.

ART. LXI. All fishing boats, all rigging, gear, or other appurtenances of fishing boats, all nets, buoys, floats, or other fishing implements whatsoever, found or picked up at sea, shall, as soon as possible, be delivered to the Collector of Customs, if the article saved be taken into England, and to the Commissary of Marine, if the article saved is taken into France.

ART. LXII. The Collector of Customs, or the Commissary of Marine, as the case may be, shall restore the articles saved to the owners thereof or to their representatives.

These functionaries may, when the circumstances are such as to call for it, award to the salvors a suitable compensation for their trouble and care. This compensation, which shall in no case exceed one-fourth of the actual value of the articles saved, shall be paid by the owners.

ART. LXIII. The execution of the regulations concerning the fittings of nets and the size of their meshes, the weight and dimensions of fishing instruments, and, in short, concerning every thing connected with the implements of fishing, is placed, with respect to the fishermen of each of the two nations, under the exclusive superintendence of the cruisers and agents of their own nation.

Nevertheless the Commanders of the cruisers of each nation shall mutually acquaint the Commanders of the other nation with any transgressions of the above-mentioned regulations, committed by the fishermen of the other nation, which may come to their knowledge.

ART. LXIV. Infractions of regulations concerning the placing of boats, the distances to be observed, the prohibition of certain fisheries by day or by night, or during certain periods of the year, and concerning every other operation connected with the act of fishing, and more particularly as to circumstances likely to cause damage, shall be taken cognizance of by the cruisers of both nations, whichever may be the nation to which the fishermen guilty of such infractions may belong.

ART. LXV. The commanders of cruisers of both countries shall exercise their judgment as to the causes of any transgressions committed by British or French fishing boats in the seas where the said boats have the right to fish in common; and when the said Commanders shall be satisfied of the fact of the transgression, they shall detain the boats having thus infringed the established Regulations, and may take them into the port nearest to the scene of the occurrence, in order that the offense may be duly established, as well by comparing the declarations and counter declarations of parties interested, as by the testimony of those who may have witnessed the facts.

ART. LXVI. When the offence shall not be such as to require exemplary punishment, but shall, nevertheless, have caused injury to any fisherman, the Commanders of cruisers shall be at liberty, should the circumstances admit of it, to arbitrate at sea between the parties concerned, and on refusal of the offenders to defer to their arbitration, the said Commanders shall take both them and their boats into the nearest port, to be dealt with as stated in the preceding Article.

ART. LXVII. Every fishing boat which shall have been taken into a foreign port, under either of the two preceding Articles, shall be sent back to her own country for trial as soon as the transgression for which she may have been detained shall have been duly established. Neither the boat nor her crew shall, however, be detained in the foreign port more than four days.

ART. LXVIII. The depositions, minutes of proceedings, and all other documents concerning the transgression, after being authenticated by the Collector of Customs, or by the Commissary of Marine according to the country into which the boat may have been taken, shall be transmitted by that functionary to the Consular Agent of his nation residing in the port where the trial is to take place.

This Consular Agent shall communicate these documents to the Collector of Customs, if in the United Kingdom, or to the Commissary of Marine, if in France; and if, after having conferred with that functionary, it shall be necessary for the interest of his countrymen, he shall proceed with the affair before the competent tribunal or magistrates.

ART. LXIX. All transgressions of these Regulations established for the protection of Fisheries in the seas lying between the coasts of the British islands and those of France shall, in both countries, be submitted to the exclusive jurisdiction of the tribunal or the magistrates which shall be designated by law.

This tribunal, or these magistrates, shall also settle all differences, and decide all contentions, whether arising between fishermen of the same country, or between fishermen of the two countries, and which can not have been settled by the Commanders of cruisers, or by the Consular Agents and the Collectors of Customs, or Commissaries of Marine, according to the country.

The above-mentioned jurisdiction shall not, however, be understood to apply to murder, felony, or any other grave crime; all such crimes remaining subject to the ordinary laws of each country, respectively.

ART. LXX. The trial and judgment of the transgressions mentioned in the preceding Article shall always take place in a summary manner, and at as little expense as possible.

ART. LXXI. In both countries the competent tribunal or magistrates shall be empowered to adjudge the following penalties for offenses against the Regulations committed by fishermen subject to their jurisdiction:

First. Forfeiture and destruction of nets or other fishing implements which are not conformable to the Regulations.

Secondly. Fines from eight shillings (ten francs) to ten pounds sterling (two hundred and fifty francs), or imprisonment for not less than two days, and not more than one month.

ART. LXXII. The use of nets or other fishing implements of which the fittings, size of meshes, dimensions, or weight shall not be conformable to the Regulations established for each kind of Fishery shall subject the said nets or implements to seizure and destruction, and the offenders to a fine of not less than eight shillings (ten francs) nor more than three pounds sterling (seventy-five francs), or to imprisonment from two to ten days.

In cases of repetition of the offence, the fine or imprisonment may be doubled.

ART. LXXIII. All persons shall be condemned to a fine of from eight shillings to five pounds sterling (ten francs to one hundred and twenty-five francs), or to imprisonment from five to fifteen days, who either by night or by day, conjointly or separately, shall offend against the measures established by the Regulations for the preservation of peace and good order, and specifically against those concerning—

First. The letters, numbers, and names to be placed on the boats and their sails, and on nets, buoys, etc.

Secondly. The vanes to be carried by the boats.

Thirdly. The distances to be observed between the boats.

Fourthly. The placing and anchoring of boats.

Fifthly. The placing or shooting of nets, and taking them up.

Sixthly. The clearing of nets.

Seventhly. The placing of buoys upon nets.

Eighthly. Lastly, the lights to be shown.

In cases of repetition of any of these offences, the fine or imprisonment may be doubled.

ART. LXXIV. In all cases of assault committed at sea by fishermen on other fishermen, or whenever they shall have intentionally caused damages or loss, the competent tribunal or magistrates may condemn the delinquents to a term of imprisonment not exceeding twenty days, or to a fine not exceeding five pounds sterling (one hundred and twenty-five francs).

Should there have been at the same time any infringement of the Regulations, the imprisonment or fine above mentioned may be awarded over and above the penalties to which the said infringement shall have given rise.

ART. LXXV. The competent tribunal or magistrates shall, when the circumstances are such as to call for it, award, over and above all penalties inflicted for offences against the Regulations, the payment of damages to the injured parties, and shall determine the amount of such damages.

ART. LXXVI. The conditions under which the fishing boats of either of the two countries shall be at liberty to come within the fishery limits of the other country are laid down in the following Articles, which also specify and regulate the penalties to be inflicted for infraction of the said Articles.

ART. LXXVII. The competent tribunal or magistrates shall exclusively take cognizance (in the same manner as stipulated in Article LXIX) of the infractions mentioned in Article LXXVI.

ART. LXXVIII. The putting into the Chausey Islands by British oyster fishing boats is regulated by the six following Articles.

ART. LXXIX. The putting into the Chausey Islands by British fishing boats, in consequence of damage, evident bad weather, or any other compulsory circumstance, is a right confirmed by Article VII of the convention of the second of August, one thousand eight hundred and thirty-nine.

ART. LXXX. The expediency of putting in, under any of the circumstances mentioned in the preceding Article, must naturally be determined by those fishermen who may find it necessary to avail themselves of this right.

Nevertheless, whenever the British fishing boats shall be able to communicate with the Commander of the British station, they shall not put in until they are authorised so to do by the said Commander's hoisting the following signal—a blue ensign at the masthead.

ART. LXXXI. The Commander of the English station may, when he shall consider this measure necessary, authorise the weaker boats, which are consequently the most exposed to the effects of bad weather, to put into the Chausey Islands whilst the other boats shall continue to fish.

This permission shall be made known by the following signal—a red ensign at the masthead.

ART. LXXXII. When the Commander of the English station shall have authorised the whole or part of the British boats to seek shelter in the Chausey Islands, in consequence of the above-mentioned causes, he shall give notice thereof immediately afterwards to the French cruisers by means of the following signals, viz:

For the anchorage of all the boats (provided for in Article LXXX), a blue peter placed under the blue ensign at the masthead.

For the anchorage of the weaker boats (provided for in Article LXXXI), a blue peter placed under the red ensign at the masthead.

ART. LXXXIII. Whenever the appearance of the weather, although it be not actually stormy at the time, yet shall be so threatening that boats could not gain shelter of the British Channel Islands before it comes on, the British Commander, taking on himself the responsibility of the measure, may authorize the said boats to anchor at Chausey, by hoisting a blue peter.

This permission shall, at the same time, be made known to the French cruisers by means of a French flag hoisted at the masthead over the said blue peter.

These flags shall not be hauled down until the French cruisers shall have understood the signal, and answered it by hoisting, also at the masthead, an English flag.

ART. LXXXIV. When British fishing boats put into Chausey, they shall keep together in the same part of the anchorage.

Should any compulsory circumstances prevent their doing so, the Commander of the English station shall inform the French station thereof by hoisting, in addition to the flags flying to announce the putting in of the boats, a Union Jack under the said flags.

ART. LXXXV. The fishing boats of the one country shall not approach nearer to any part of the coasts of the other country than the limit of three miles, specified in Article IX of the convention signed at Paris on the second day of August, one thousand eight hundred and thirty-nine, except under the following circumstances:

First. When driven by stress of weather or by evident damage to seek shelter in the harbours, or within the fishery limits of the other country.

Secondly. When carried within the limits established for the fishery of the other country by contrary winds, by strong tides, or by any other cause independent of the will of the master and crew.

Thirdly. When obliged by contrary winds or tide to beat up in order to reach their fishing ground; and when, from the same cause of contrary wind or tide, they could not, if they remained outside, be able to hold on their course to their fishing ground.

Fourthly. When during the herring fishing season, the herring fishing boats of one country shall find it expedient to anchor under shelter of the coasts of the other country, in order to await a favourable opportunity for proceeding to their lawful fishery outside of the limits defined by Article IX of the Convention of the second of August, one thousand eight hundred and thirty-nine.

ART. LXXXVI. Whenever, in any of the cases of exception specified in the preceding Article, the fishing boats of either nation shall have occasion to sail or anchor within the limits defined by the Convention of the second of August, one thousand eight hundred and thirty-nine, the masters of such boats shall immediately hoist a blue flag, two feet high and three feet long, and shall keep this flag flying at the masthead so long as they shall remain within the said limits; consequently this flag shall not be hauled down until the boats are actually outside of those limits.

These boats, when within the aforesaid limits, are not only prohibited from fishing themselves, but are also forbidden to send their small boats to fish, even outside of the limits in question. They must all (with the exception of herring boats, which may be waiting, as they have the privilege of doing, for a favourable opportunity to proceed to their lawful fishery) return outside the said limits so soon as the causes shall have ceased which obliged them to come in under the cases of exception specified.

It is further agreed, conformably to the tenor of the present Regulations, that the fishing boats of the one country shall not use the ports of the other country for the greater convenience of their fishery operations, either in proceeding from thence to their lawful fishery in the seas common to both, or in returning thereunto after fishing; it being understood, however, that this stipulation does not in any manner impair the right of putting into port in the cases of exception specified in Article LXXXV.

ART. LXXXVII. It is forbidden to herring drift-net fishing boats to shoot their nets earlier in the day than half an hour before sunset, except in places where it is customary to carry on this drift-net fishing by daylight.

ART. LXXXVIII. Herring fishermen, being within the fishery limits of either country, shall comply with the laws and regulations of the said country respecting the prohibition of fishing on the Sabbath day.

ART. LXXXIX. The Commanders of the cruisers of each of the two countries, and all officers or other agents whatsoever appointed to superintend the fisheries, shall exercise their judgment as to the causes of any transgressions committed by the fishing boats of the other country, and when they shall be satisfied of the fact of the transgression, they shall detain or cause to be detained the boats having thus transgressed the preceding Regulations (from Article LXXVI), and shall take them or cause them to be taken into port, where, upon clear proof of the transgression being brought by the detaining party before the competent tribunal or magistrates, the said boats so transgressing may be condemned to be kept for a period not exceeding three months, or to a fine not exceeding ten pounds sterling (two hundred and fifty francs).

In testimony whereof the respective Commissioners have signed the present Regulations, and have thereto affixed their seals.

Done in London the twenty-fourth day of May in the year of our Lord one thousand eight hundred and forty-three.

APPENDIX B.

Convention between Her Majesty and the Emperor of the French relative to fisheries in the seas between Great Britain and France.

ARTICLE I. British fishermen shall enjoy the exclusive right of fishery within the distance of three miles from low-water mark, along the whole extent of the coasts of the British islands; and French fishermen shall enjoy the exclusive right of fishery within the distance of three miles from low-water mark along the whole extent of the coast of France, the only exception to this rule being that part of the coast of France which lies between Cape Carteret and Point Meinga.

The distance of three miles fixed as the general limit for the exclusive right of fishery upon the coasts of the two countries shall, with respect to bays, the mouths of which do not exceed ten miles in width, be measured from a straight line drawn from headland to headland.

The miles mentioned in the present Convention are geographical miles, whereof sixty make a degree of latitude.

ART. II. It is agreed that the lines drawn between the points designated by the letters A, B, C, D, E, F, G, H, I, K, on the chart annexed to the present Convention, and signed by the respective Plenipotentiaries, shall be acknowledged by the high contracting parties as defining from Point Meinga

to Cape Carteret, the limits between which and the French shore the right of fishery shall be reserved exclusively to French fishermen, and these lines are as follows, that is to say:

The first line runs from the point A, three miles from low-water mark (Point Meinga bearing south) to the point B, of which the landmarks are Agon Tower on with the clump of trees upon Mount Huchon, and the summit of Gros Mont in a line with the semaphore on Grand Isle.

The second line runs from the said point B toward Agon Tower and the clump of trees upon Mount Huchon, in the direction north sixty-four degrees east, until, at the point C, it brings the windmill of Lingreville to bear due east.

The third line runs from point C due east toward Lingreville windmill, until the Grand Huguenant is brought to bear on the Etat Rock at point D.

The fourth line runs from point D northward (keeping the Grand Huguenant in one with the Etat Rock) until it intersects at E a line whose landmarks are Agon Tower on with Coustances Cathedral.

The fifth line runs eastward from point E to point F, where the steeple of Pirou is brought to bear in a line with the Senequet Light-house.

The sixth line runs from point F due north to point G, where the steeple of Blainville is brought in a line with the Senequet Light-house.

The seventh line runs from point G in the direction of Pirou Steeple to point H, where the light-house on Cape Carteret bears north twenty-four degrees west.

The eighth line runs from point H to point I nearly abreast of Port Bail; point I having for landmarks the fort of Port Bail in a line with the steeple of Port Bail.

And finally, the ninth line runs from point I to the Three Grunes at point K, where Cape Carteret bears east ten degrees north, in a line with Barneville Steeple.

It is further agreed that all the bearings specified in the present Article are to be taken according to the true meridian, and not according to the magnetic meridian.

ART. III. The arrangements of the present Convention shall apply beyond the fishery limits of both countries, as defined by the preceding Articles, to the seas surrounding and adjoining Great Britain and Ireland, and adjoining the coasts of France between the frontiers of Belgium and Spain. The rules respecting oyster fishery shall, however, be observed only in the seas comprised within the limits hereinafter described.

ART. IV. All British and French fishing boats shall be lettered and numbered. In the United Kingdom there shall be a series of numbers for the fishing boats belonging to each collectorship of Customs and in France a series of numbers for the fishing boats belonging to each district of Maritime Registry; and to these numbers shall be prefixed a letter (or letters) to be designated by the Board of Customs in the United Kingdom and by the Ministry of Marine in France.

ART. V. The letter (or letters) and numbers shall be placed on each bow of the boat, 3 or 4 inches (8 or 10 centimètres French) below the gunwale, and they shall be painted in white oil colour on a black ground.

For boats of 15 tons burthen and upwards the dimensions of the letters and numbers shall be 18 inches (45 centimètres French) in height and 2½ inches (6 centimètres French) in breadth.

For boats of less than 15 tons burthen the dimensions shall be 10 inches (25 centimètres French) in height and 1¾ inches (4 centimètres French) in breadth.

The same letter (or letters) and number shall also be painted on each side of the mainsail of the boat, in black oil colour on white sails, and in white oil colour on tanned or black sails. Such letter (or letters) and number on the sails shall be one-third larger in every way than those placed on the bows of the boat.

The name of each fishing boat and that of the port to which she belongs shall be painted in white oil colour on a black ground on the stern of the boat, in letters which shall be at least 3 inches (8 centimètres French) in height and one-half inch (12 millimètres French) in breadth.

The letters, numbers, and names placed on the boats and on their sails shall not be effaced, covered, or concealed in any manner whatsoever.

ART. VI. All the buoys, barrels, and principal floats of each net, and all other implements of fishery, shall be marked with the same letter (or letters) and number as those of the boats to which they belong.

These letters and numbers shall be large enough to be easily distinguished. The owners of the nets or other fishing implements may further distinguish them by any private marks they judge proper.

ART. VII. The letters and numbers of British fishing boats shall, after having been entered in the registry book kept at the collectorship of Customs, be inserted on the licences or other official papers of those boats.

The letters and numbers of French fishing boats shall, after having been entered in the registry book kept at the Maritime Registry Office, be inserted on the muster rolls of those boats.

ART. VIII. The licences or other official papers of British fishing boats, and the muster rolls of French fishing boats, shall contain the description and tonnage of each boat, as well as the names of its owner and of its master.

ART. IX. The fishermen of both countries shall, whenever required, exhibit their licences or other official papers, or their muster rolls, to the commanders of the fishery cruizers, and to all other persons of either country appointed to superintend the fisheries.

ART. X. Fishing of all kinds, by whatever means and at all seasons, may be carried on in the seas lying beyond the fishery limits which have been fixed for the two countries, with the exception of that for oysters, as hereinafter expressed.

ART. XI. From the 16th of June to the 31st of August, inclusive, fishing for oysters is prohibited outside the fishery limits which have been fixed for the two countries, between a line drawn from the North Foreland Light to Dunkirk, and a line drawn from the Land's End to Ushant.

During the same period and in the same part of the channel, no boat shall have on board any oyster dredge, unless the same be tied up and sealed by the Customs authorities of one of the two countries in such a manner as to prevent its being made use of.

ART. XII. No boat shall anchor between sunset and sunrise on grounds where drift-net fishing is actually going on.

This prohibition shall not apply to anchorings which may take place in consequence of accidents, or any other compulsory circumstances; but in such case the master of the boat thus obliged to anchor shall hoist, so that they shall be seen from a distance, two lights placed horizontally about three feet (1 mètre French) apart, and shall keep those lights up all the time the boat shall remain at anchor.

ART. XIII. Boats fishing with drift nets shall carry on one of their masts two lights, one over the other, three feet (1 mètre French) apart.

These lights shall be kept up during all the time their nets shall be in the sea between sunset and sunrise.

ART. XIV. Subject to the exceptions or additions mentioned in the two preceding Articles, the fishing boats of the two countries shall conform to the general rules respecting lights which have been adopted by the two countries.

ART. XV. Trawl boats shall not commence fishing at a less distance than three miles from any boat fishing with drift nets.

If trawl boats have already shot their nets, they must not come nearer to boats fishing with drift nets than the distance above mentioned.

ART. XVI. No boat fishing with drift nets shall shoot its nets so near to any other boat which has already shot its nets on the fishing ground as to interfere with its operations.

ART. XVII. No decked boat fishing with drift nets shall shoot its nets at a less distance than a quarter of a mile from any undecked boat which is already engaged in fishing.

ART. XVIII. If the spot where fishing is going on should be so near to the fishery limits of one of the two countries that the boats of the other country would, by observing the regulations prescribed by Articles XV, XVI, and XVII preceding, be prevented from taking part in the fishery, such boats shall be at liberty to shoot their nets at a less distance than that so described; but in such case the fishermen shall be responsible for any damage or losses which may be caused by the drifting of their boats.

ART. XIX. Nets shall not be set or anchored in any place where drift-net fishing is actually going on.

ART. XX. No one shall make fast or hold on his boat to the nets, buoys, floats, or any part of the fishing tackle belonging to another boat.

No person shall hook or lift up the nets, lines, or other fishing implements belonging to another person.

ART. XXI. When nets of different boats get foul of each other, the master of one boat shall not cut the nets of another boat except by mutual consent, and unless it be found impossible to clear them by other means.

ART. XXII. All fishing boats, all rigging gear or other appurtenances of fishing boats, all nets, buoys, floats, or other fishing implements whatsoever, found or picked up at sea, shall, as soon as possible, be delivered to the Receiver of Wreck if the article saved be taken into the United Kingdom, and to the Commissary of Marine if the article saved be taken into France.

The Receiver of Wreck or the Commissary of Marine, as the case may be, shall restore the articles saved to the owners thereof, or to their representatives.

These functionaries shall fix the amount which the owners shall pay to the salvors.

ART. XXIII. The execution of the regulations concerning lights and signals, licences, muster rolls, and official papers, the lettering and numbering of boats and implements of fishing, is placed, with respect to the fishermen of each of the two nations, under the exclusive superintendence of the cruizers and agents of their own nation.

Nevertheless, the commanders of the cruizers of one of the two nations shall acquaint the commanders of the cruizers of the other nation with any infractions of the above-mentioned regulations committed by the fishermen of such other nation which may come to their knowledge.

ART. XXIV. All infractions of the regulations concerning the placing of boats on the fishing ground, the distances to be observed between them, the prohibition of oyster fishing during a portion of the year, and concerning every other operation connected with the act of fishing, and more particularly concerning circumstances likely to cause damage, shall be taken cognizance of by the cruizers of either nation, whichever may be the nation to which the fishermen guilty of such infractions may belong.

ART. XXV. The commanders of cruizers of either country shall exercise their judgment as to the causes of any infractions brought to their knowledge, or as to damage arising from any cause whatever committed by British or French fishing boats in the seas beyond the fishery limits which have been fixed for the two countries; they may detain the offending boats and take them into the port nearest the scene of the occurrence, in order that the infraction or damage may be there duly established, as well by comparing the declarations and counter declarations of the parties interested as by the testimony of those who were present.

ART. XXVI. When the offense shall not be such as to require exemplary punishment, but shall nevertheless have caused damage to any fisherman, the commanders of the cruizers shall be at liberty, should the circumstances admit of it, to arbitrate at sea between the parties concerned. On refusal of the offenders to defer to their arbitration, the said commanders shall take both them and their boats into the nearest port, to be dealt with as stated in the preceding Article.

ART. XXVII. Every fishing boat which shall have been taken into a foreign port in conformity with the two preceding Articles shall be sent back to her own country for trial as soon as the infraction for which she may have been detained shall have been duly established. Neither the boat nor her crew shall, however, be detained in the foreign port more than three clear days.

ART. XXVIII. The depositions, minutes of proceedings, and all other documents concerning the infraction, after having been authenticated by the Collector of Customs in the United Kingdom, or by the Commissary of Marine in France, shall be transmitted by that functionary to the consular agent of his nation residing in the port where the trial is to take place.

Such Consular Agent shall communicate those documents to the Collector of Customs, or to the Commissary of Marine, as the case may be; and if, after having conferred with that functionary, it shall be necessary for the interest of his countrymen, he shall proceed with the affair before the competent tribunal or magistrates of the country.

ART. XXIX. In both countries the competent court or magistrate shall be empowered to condemn to a fine of at least eight shillings (ten francs), or to imprisonment for at least two days, persons who may infringe the regulations of the convention concerning—

1. The close season for oysters, and illegal possession of dredges on board during that season.
2. The letters, numbers, and names to be placed on the boats, sails, nets, and buoys.
3. The licenses or muster rolls.
4. The flags and lights to be carried by the boats.
5. The distances to be observed by the boats between each other.
6. The placing and anchoring of vessels and boats.
7. The placing and shooting of nets and the taking them up.
8. The clearing of nets.
9. The placing of buoys upon nets.

In case of repetition of the offence the amount of fine or period of imprisonment may be doubled.

ART. XXX. In all cases of assault committed or of damage or loss inflicted at sea by fishermen of either country upon fishermen of the other country, the Courts of the country to which the offenders belong shall condemn the latter to a fine of at least eight shillings (10 francs), or to imprisonment for at least two days. They may, moreover, condemn the offenders to pay adequate compensation for the injury.

ART. XXXI. Fishing boats of either of the two countries shall be admitted to sell their fish in such ports of the other country as may be designated for that purpose, on condition that they conform to the regulations mutually agreed upon. Those regulations, together with a list of the ports, are annexed to the present Convention, but without prejudice to the opening by either country of any additional ports.

ART. XXXII. The fishing boats of the one country shall not enter within the fishery limits fixed for the other country except under the following circumstances:

1. When driven by stress of weather or by evident damage.

2. When carried in by contrary winds, by strong tides, or by any other cause beyond the control of the master and crew.

3. When obliged by contrary winds or tide to beat up in order to reach their fishing ground; and when from the same cause of contrary wind or tide they could not, if they remained outside, be able to hold on their course to their fishing ground.

4. When, during the herring fishing season, the herring boats of the one country shall find it necessary to anchor under shelter of the coasts of the other country in order to await the opportunity for proceeding to their fishing ground.

5. When proceeding to any of the ports of the other country open to them for the sale of fish in accordance with the preceding article; but in such case they shall never have oyster dredges on board.

ART. XXXIII. When fishing boats, availing themselves of the privilege specified in Article XXXI, shall have oysters on board they shall not carry any dredges or other implement for taking oysters.

ART. XXIV. The commanders of cruizers may authorise boats belonging to their own country to cross the exclusive fishery limits of the other country whenever the weather is so threatening as to compel them to seek shelter.

ART. XXXV. Whenever, owing to any of the exceptional circumstances specified in the three preceding Articles, the fishing boats of either country shall be in the ports or within the fishery limits fixed for the other country, the masters of such boats shall immediately hoist a blue flag two feet (60 centimètres French) high, and three feet (1 mètre French) long, and shall keep that flag flying at the masthead so long as they remain in such ports or within such limits. The flag shall be hauled down as soon as the boat is outside the said limits.

Such boats must return outside the said limits as soon as the exceptional circumstances which obliged them to enter shall have ceased.

ART. XXXVI. The commanders of the cruizers of each of the two countries, and all officers or other agents appointed to superintend fisheries, shall exercise their judgment as to infractions of the regulations with regard to the fishery limits, and when they shall be satisfied of the fact of the infraction they may detain the boats of the offenders, or cause them to be detained, and may take them, or cause them to be taken, into port, where, upon clear proof of the offence, such boats may be condemned by the competent Court or magistrate to a fine not exceeding ten pounds (250 francs). In default of payment, such boats may be detained for a period not exceeding three months

In case of repetition of the offence the fine may be doubled.

ART. XXXVII. The proceedings and trial in cases of infraction of the provisions of the present Convention shall take place as speedily and as summarily as the laws in force will permit.

ART. XXXVIII. The terms "British Islands" and "United Kingdom," employed in this Convention, shall include the islands of Jersey, Guernsey, Alderney, Sark, and Man, with their dependencies.

ART. XXXIX. Her Britannic Majesty engages to recommend to Parliament to pass an Act to enable her to carry into execution such of the arrangements contained in the present Convention as require legislative sanction. When such an Act shall have been passed, the Convention shall come into operation from and after a day to be then fixed upon by the two High Contracting Parties. Due notice shall be given in each country by the Government of that country of the day which may be so fixed upon.

ART. XL. The Convention shall continue in force for ten years from the day on which it may come into operation, and if neither party shall, twelve months before the expiration of the said period of ten years, give notice of its intention to terminate its operation, the Convention shall continue in force one year longer, and so on from year to year, until the expiration of one year's notice from either party for its termination.

The High Contracting Parties, however, reserve to themselves the power to make, by mutual consent, any modification in the convention which experience shall have shown to be desirable, provided it is not inconsistent with the principles on which it is based.

ART. XLI. The Convention concluded between the High Contracting Parties on the 2d of August, 1839, and the Regulations of the 23d of June, 1843, shall continue in force until the day when, as provided in Article XXXIX, the present Convention shall come into operation, and shall then altogether cease and determine.

ART. XLII. The present Convention shall be ratified, and the ratifications shall be exchanged as soon as possible.

In witness whereof the respective Plenipotentiaries have signed the same, and have affixed thereto the seals of their arms.

Done at Paris, the 11th of November, in the year of our Lord 1867.

ADDITIONAL ARTICLE. It is agreed that Article XXXI of the convention signed this day shall not come into operation until the two Contracting Parties shall have come to a further understanding on the subject. Due notice shall be given of the day that may be fixed upon for its coming into operation.

The present Additional Article shall have the same force and validity as if it were inserted, word for word, in the Convention signed this day. It shall be ratified and the ratifications shall be exchanged at the same time as those of the convention.

In witness whereof the respective Plenipotentiaries have signed the same, and have affixed thereto the seals of their arms.

Done at Paris, the 11th of November, in the year of our Lord 1867.

APPENDIX C.

International Convention (of 1882 between Belgium, Denmark, France, Germany, Great Britain, and the Netherlands) for the purpose of regulating the Police of the fisheries in the North Sea outside Territorial Waters.

ARTICLE I. The provisions of the present Convention, the object of which is to regulate the police of the fisheries in the North Sea outside territorial waters, shall apply to the subjects of the High Contracting Parties.

ART. II. The fishermen of each country shall enjoy the exclusive right of fishery within the distance of three miles from low-water mark along the whole extent of the coasts of their respective countries, as well as of the dependent islands and banks.

As regards bays, the distance of three miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed ten miles.

The present Article shall not in any way prejudice the freedom of navigation and anchorage in territorial waters accorded to fishing boats, provided they conform to the special police regulations enacted by the Powers to whom the shore belongs.

ART. III. The miles mentioned in the preceding Article are geographical miles, whereof sixty make a degree of latitude.

ART. IV. For the purpose of applying the provisions of the present Convention, the limits of the North Sea shall be fixed as follows:

1. On the north by the parallel of the 61st degree of latitude.
2. On the east and south:
   (1) By the coasts of Norway between the parallel of the 61st degree of latitude and Lindesnaes Light-house (Norway).
   (2) By a straight line drawn from Lindesnaes Light-house (Norway) to Hanstholm Light-house (Denmark).
   (3) By the coasts of Denmark, Germany, the Netherlands, Belgium, and France, as far as Gris Nez Light-house.

3. On the west:

(1) By a straight line drawn from Gris Nez Light-house (France) to the easternmost light-house at South Foreland (England).

(2) By the eastern coasts of England and Scotland.

(3) By a straight line joining Duncansby Head (Scotland) and the southern point of South Ronaldsha (Orkney Islands).

(4) By the eastern coasts of the Orkney Islands.

(5) By a straight line joining North Ronaldsha Light-house (Orkney Islands) and Sumburgh Head Light-house (Shetland Islands).

(6) By the eastern coasts of the Shetland Islands.

(7) By the meridian of North Unst Light-house (Shetland Islands) as far as the parallel of the 61st degree of latitude.

ART. V. The fishing boats of the high contracting parties shall be registered in accordance with the administrative regulations of each country. For each port there shall be a consecutive series of numbers, preceded by one or more initial letters, which shall be specified by the superior competent authority.

Each Government shall draw up a list showing these initial letters.

This list, together with all modifications which may subsequently be made in it, shall be notified to the other contracting powers.

ART. VI. Fishing boats shall bear the initial letter or letters of the port to which they belong, and the registry number in the series of numbers for that port.

ART. VII. The name of each fishing boat, and that of the port to which she belongs, shall be painted in white oil colour on a black ground on the stern of the boat, in letters which shall be at least eight centimètres in height and twelve millimètres in breadth.

ART. VIII. The letter or letters and numbers shall be placed on each bow of the boat, eight or ten centimètres below the gunwale, and so as to be clearly visible. They shall be painted in white oil colour on a black ground.

The distance above mentioned shall not, however, be obligatory for boats of small burden, which may not have sufficient space below the gunwale.

For boats of fifteen tons burden and upward the dimensions of the letters and numbers shall be forty-five centimètres in height and six centimètres in breadth.

For boats of less than fifteen tons burden the dimensions shall be twenty-five centimètres in height and four centimètres in breadth.

The same letter or letters and numbers shall also be painted on each side of the mainsail of the boat, immediately above the close reef, in black oil color on white or tanned sails, and in white oil color on black sails.

The letter or letters and numbers on the sails shall be one-third larger in every way than those placed on the bows of the boat.

ART. IX. Fishing boats may not have, either on their outside or on their sails, any names, letters, or numbers other than those prescribed by Articles VI, VII, and VIII of the present convention.

ART. X. The names, letters, and numbers placed on the boats and on their sails shall not be effaced, altered, made illegible, covered, or concealed in any manner whatsoever.

ART. XI. All the small boats, buoys, principal floats, trawls, grapnels, anchors, and generally all fishing implements, shall be marked with the letter or letters and numbers of the boats to which they belong.

These letters and numbers shall be large enough to be easily distinguished. The owners of the nets or other fishing implements may further distinguish them by any private marks they think proper.

ART. XII. The master of each boat must have with him an official document, issued by the proper authority in his own country, for the purpose of enabling him to establish the nationality of his boat.

This document must always give the letter or letters and number of the boat, as well as her description and the name or names of the owner or the name of the firm or association to which she belongs.

ART. XIII. The nationality of a boat must not be concealed in any manner whatsoever.

ART. XIV. No fishing boat shall anchor, between sunset and sunrise, on grounds where drift-net fishing is actually going on.

This prohibition shall not, however, apply to anchorings which may take place in consequence of accidents or of any other compulsory circumstances.

ART. XV. Boats arriving on the fishing grounds shall not either place themselves or shoot their nets in such a way as to injure each other, or as to interfere with fishermen who have already commenced their operations.

ART. XVI. Whenever, with a view of drift-net fishing, decked boats and undecked boats commence shooting their nets at the same time, the undecked boats shall shoot their nets to windward of the decked boats.

The decked boats, on their part, shall shoot their nets to leeward of the undecked boats.

As a rule, if decked boats shoot their nets to windward of undecked boats which have begun fishing, or if undecked boats shoot their nets to leeward of decked boats which have begun fishing, the responsibility as regards any damages to nets which may result shall rest with the boats which last began fishing, unless they can prove that they were under stress of compulsory circumstances, or that the damage was not caused by their fault.

ART. XVII. No net or any other fishing engine shall be set or anchored on grounds where drift-net fishing is actually going on.

ART. XVIII. No fisherman shall make fast or hold on his boat to the nets, buoys, floats, or any other part of the fishing tackle of another fisherman.

ART. XIX. When trawl fishermen are in sight of drift-net or of long-line fishermen, they shall take all necessary steps in order to avoid doing injury to the latter. Where damage is caused, the responsibility shall lie on the trawlers, unless they can prove that they were under stress of compulsory circumstances, or that the loss sustained did not result from their fault.

ART. XX. When nets belonging to different fishermen get foul of each other, they shall not be cut without the consent of both parties.

All responsibility shall cease if the impossibility of disengaging the nets by any other means is proved.

ART. XXI. When a boat fishing with long lines entangles her lines in those of another boat, the person who hauls up the lines shall not cut them except under stress of compulsory circumstances, in which case any line which may be cut shall be immediately joined together again.

ART. XXII. Except in cases of salvage and the cases to which the two preceding articles relate, no fisherman shall, under any pretext whatever, cut, hook, or lift up nets, lines, or other gear not belonging to him.

ART. XXIII. The use of any instrument or engine which serves only to cut or destroy nets is forbidden.

The presence of any such engine on board a boat is also forbidden.

The high contracting parties engage to take the necessary measures for preventing the embarkation of such engines on board fishing boats.

ART. XXIV. Fishing boats shall conform to the general rules respecting lights which have been, or may be, adopted by mutual arrangement between the high contracting parties with the view of preventing collisions at sea.

ART. XXV. All fishing boats, all their small boats, all rigging gear or other appurtenances of fishing boats, all nets, lines, buoys, floats, or other fishing implements whatsoever found or picked up at sea, whether marked or unmarked, shall as soon as possible be delivered to the competent authority of the first port to which the salving boat returns or puts in.

Such authority shall inform the consul or consular agent of the country to which the boat of the salvor belongs, and of the nation of the owner of the articles found. They [the same authority] shall restore the articles to the owners thereof or to their representatives, as soon as such articles are claimed and the interests of the salvors have been properly guaranteed.

The administrative or judicial authorities, according as the laws of the different countries may provide, shall fix the amount which the owners shall pay to the salvors.

It is, however, agreed that this provision shall not in any way prejudice such conventions respecting this matter as are already in force, and that the high contracting parties reserve the right of regulating, by special arrangements between themselves, the amount of salvage at a fixed rate per net salved.

Fishing implements of any kind found unmarked shall be treated as wreck.

ART. XXVI. The superintendence of the fisheries shall be exercised by vessels belonging to the national navies of the high contracting parties. In the case of Belgium, such vessels may be vessels belonging to the State, commanded by captains who hold commissions.

ART. XXVII. The execution of the regulations respecting the document establishing nationality, the marking and numbering of boats, etc., and of fishing implements, as well as the presence on board of instruments which are forbidden (Articles VI, VII, VIII, IX, X, XI, XII, XIII, and XXIII, sec. 2), is placed under the exclusive superintendence of the cruisers of the nation of each fishing boat.

Nevertheless, the commanders of cruisers shall acquaint each other with any infractions of the above-mentioned regulations committed by the fishermen of another nation.

ART. XXVIII. The cruisers of all the high contracting parties shall be competent to authenticate all infractions of the regulations prescribed by the present Convention, other than those referred to in Article XXVII, and all offences relating to fishing operations, whichever may be the nation to which the fisherman guilty of such infractions may belong.

ART. XXIX. When the commanders of cruisers have reason to believe that an infraction of the provisions of the present convention has been committed, they may require the master of the boat inculpated to exhibit the official document establishing her nationality. The fact of such document having been exhibited shall then be indorsed upon it immediately.

The commanders of cruisers shall not pursue further their visit or search on board a fishing boat which is not of their own nationality, unless it should be necessary for the purpose of obtaining proof of an offence or of a contravention of regulations respecting the police of the fisheries.

ART. XXX. The commanders of the cruisers of the signatory powers shall exercise their judgment as to the gravity of facts brought to their knowledge, and of which they are empowered to take cognizance, and shall verify the damage, from whatever cause arising, which may be sustained by fishing boats of the nationalities of the high contracting parties.

They shall draw up, if there is occasion for it, a formal statement of the verification of the facts as elicited both from the declarations of the parties interested and from the testimony of those present.

The commander of the cruiser may, if the case appears to him sufficiently serious to justify the step, take the offending boat into a port of the nation to which the fisherman belongs. He may even take on board the cruiser a part of the crew of the fishing boat in order to hand them over to the authorities of her nation.

ART. XXXI. The formal statement referred to in the preceding Article shall be drawn up in the language of the commander of the cruiser, and according to the forms in use in his country.

The accused and the witnesses shall be entitled to add, or to have added, to such statement, in their own language, any observations or evidence which they may think suitable. Such declarations must be duly signed.

ART. XXXII. Resistance to the directions of commanders of cruisers charged with the police of the fisheries, or of those who act under their orders, shall, without taking into account the nationality of the cruiser, be considered as resistance to the authority of the nation of the fishing boat.

ART. XXXIII. When the act alleged is not of a serious character, but has nevertheless caused damage to any fisherman, the commanders of cruisers shall be at liberty, should the parties concerned agree to it, to arbitrate at sea between them, and to fix the compensation to be paid.

Where one of the parties is not in a position to settle the matter at once, the commanders shall cause the parties concerned to sign in duplicate a formal document specifying the compensation to be paid.

One copy of this document shall remain on board the cruiser and the other shall be handed to the master of the boat to which the compensation is due, in order that he may, if necessary, be able to make use of it before the courts of the country to which the debtor belongs.

Where, on the contrary, the parties do not consent to arbitration, the commanders shall act in accordance with the provisions of Article XXX.

ART. XXXIV. The prosecutions for offences against, or contraventions of, the present convention shall be instituted by, or in the name of, the State.

ART. XXXV. The high contracting parties engage to propose to their respective Legislatures the necessary measures for ensuring the execution of the present Convention, and particularly for the punishment by either fine or imprisonment, or by both, of persons who may contravene the provsions of Articles VI to XXIII inclusive.

ART. XXXVI. In all cases of assault committed, or of willful damage or loss inflicted, by fishermen of one of the contracting countries upon fishermen of another nationality, the courts of the country to which the boats of the offenders belong shall be empowered to try them.

The same rule shall apply with regard to offences against, and contraventions of, the present Convention.

ART. XXXVII. The proceedings and trial in cases of infraction of the provisions of the present convention shall take place as summarily as the laws and regulations in force will permit.

ART. XXXVIII. The present Convention shall be ratified. The ratifications shall be exchanged at The Hague as soon as possible.

ART. XXXIX. The present Convention shall be brought into force from and after a day to be agreed upon by the high contracting parties.

The Convention shall continue in operation for five years from the above day; and unless one of the high contracting parties shall, twelve months before the expiration of the said period of five years, give notice of intention to terminate its operation, shall continue in force one year longer, and so on from year to year. If, however, one of the Signatory Powers should give notice to terminate the convention, the same shall be maintained between the other contracting parties, unless they give a similar notice.

ADDITIONAL ARTICLE. The Government of His Majesty the King of Sweden and Norway may adhere to the present Convention, for Sweden and for Norway, either jointly or separately.

This adhesion shall be notified to the Netherlands Government, and by it to the other Signatory Powers.

In witness whereof the Plenipotentiaries have signed the present convention and have affixed thereto their seals.

Done at The Hague, in six copies, the 6th of May, 1882.

APPENDIX D.

Anglo-Belgian Declaration respecting the North Sea Fisheries.

ARTICLE I. Whenever a complaint involving a claim for damages shall be preferred by a fisherman of one of the two countries against a fisherman of the other country, it shall be referred for preliminary inquiry—in Belgium, to a Commission composed of at least two officers appointed by the Minister of Railways, Posts, and Telegraphs; in the United Kingdom, to a Commission also composed of at least two officers appointed by the Board of Trade; these officers shall hold their inquiry at the place where the allegations of the complainants can most easily be verified.

ART. II. No complaint shall be transmitted either to the British or to the Belgian Government, as the case may be, unless:

1. The commission has recognised it as well founded.
2. Such fishermen as are specified by the commission engage themselves to appear in person in case they should be summoned to give evidence.

ART. III. The complaints must be accompanied by—

1. A Report from the Commission of Inquiry.
2. A certificate from this Commission, verifying the ownership of the lost or injured fishing gear.
3. A certificate of an expert nominated (as the case may be), in the United Kingdom by the Board of Trade, in Belgium by the Minister of Railways, Posts, and Telegraphs, and giving an estimate of the damages in money value.

These certificates must be forwarded through the proper diplomatic channel, and shall be received as evidence unless the contrary is proved.

ART. IV. When a fisherman fouls or otherwise interferes with the fishing gear of another fisherman he shall take all necessary measures for reducing to a minimum the injuries which may result to the gear or to the boat of the other fisherman.

ART. V. In the Kingdom of Belgium the Tribunal which has cognizance of an infraction of the North Sea Fisheries Convention of the 6th May, 1882, or of Article 4 of the present Declaration, shall be empowered to award damages for injury to person or property at the request of the injured party and at the suit of the Official Prosecutor.

The execution of awards of damages shall be effected, on the application of the Official Prosecutor by the competent Administration, which will advance the costs and recover them from the condemned parties according to the usual process of law in such cases.

In the United Kingdom the Court before which proceedings are taken for the above-mentioned infractions shall be empowered, at the suit of the Official Prosecutor on the request of the injured party, to award damages for injury to person or property, and the Official Prosecutor shall, at his own cost, recover the sum so awarded, or so much thereof as is possible, from the parties liable.

The amount of damages recovered, as stipulated above, shall be remitted free of cost to the injured party through the proper diplomatic channel.

ART. VI. The High Contracting Parties engage to take, or to propose to their respective legislatures, the necessary measures for insuring the execution of the present Declaration, and especially for punishing, either by fine or imprisonment, or both, persons who may contravene Article IV.

ART. VII. The present Declaration shall be ratified, and the ratifications shall be exchanged at Brussels as soon as possible.

ART. VIII. The present Declaration shall come into force at a date to be agreed upon subsequently by the High Contracting Parties.

It shall remain in force for three years from that date, and in the event of neither of the High Contracting Parties having notified twelve months before the expiry of the said period of three years their intention of terminating it, it shall continue to remain in force for a year, and so on from year to year.

In witness whereof the undersigned Envoy Extraordinary and Minister Plenipotentiary at Brussels of Her Majesty the Queen of the United Kingdom of Great Britain and Ireland, and the undersigned Minister for Foreign Affairs of His Majesty the King of the Belgians, have drawn up the present Declaration in duplicate, and have affixed thereto the seals of their arms.

Done at Brussels, the 2d May, 1891.

APPENDIX E.

Fishery Articles of the Submarine Cable Convention of 1884.

ARTICLE I. The present Convention shall be applicable, outside of the territorial waters, to all legally established submarine cables landed in the territories, colonies, or possessions of one or more of the High Contracting Parties.

ART. II. The breaking or injury of a submarine cable, done willfully or through culpable negligence, and resulting in the total or partial interruption or embarrassment of telegraphic communication, shall be a punishable offense, but the punishment inflicted shall be no bar to a civil action for damages. This provision shall not apply to ruptures or injuries when the parties guilty thereof have become so simply with the legitimate object of saving their lives or their vessels, after having taken all necessary precautions to avoid such ruptures or injuries.

ART. V. Vessels engaged in laying or repairing submarine cables must observe the rules concerning signals that have been or shall be adopted, by common consent, by the High Contracting Parties, with a view to preventing collisions at sea. When a vessel engaged in repairing a cable carries the said signals, other vessels that see or are able to see those signals shall withdraw or keep at a distance of at least one nautical mile from such vessel, in order not to interfere with its operations. Fishing gear and nets shall be kept at the same distance. Nevertheless, a period of twenty-four hours at most shall be allowed to fishing vessels that perceive or are able to perceive a telegraph ship carrying the said signals, in order that they may be enabled to obey the notice thus given, and no obstacle shall be placed in the way of their operations during such period. The operations of telegraph ships shall be finished as speedily as possible.

ART. VI. Vessels that see or are able to see buoys designed to show the position of cables when the latter are being laid, are out of order, or are broken, shall keep at the distance of one-quarter of a nautical mile at least from such buoys. Fishing nets and gear shall be kept at the same distance.

ART. VII. Owners of ships or vessels who can prove that they have sacrificed an anchor, a net, or any other implement used in fishing, in order to avoid injuring a submarine cable, shall be indemnified by the owner of the cable In order to be entitled to such indemnity, one must prepare, whenever possible, immediately after the accident, in proof thereof, a statement supported by the testimony of the men belonging to the crew; and the captain of the vessel must, within twenty-four hours after at the first port of temporary entry, make his declaration to the competent authorities. The latter shall give notice thereof to the consular authorities of the nation to which the owner of the cable belongs.

APPENDIX F.

Convention between the United Kingdom and Denmark for regulating the Fisheries outside Territorial Waters in the Ocean surrounding the Faröe Islands and Iceland.

ARTICLE I. The provisions of the present Convention, the object of which is to regulate the police of the fisheries in the ocean surrounding the Faröe Islands and Iceland outside the territorial waters of these islands, shall apply to the subjects of the High Contracting Parties.

ART. II. The subjects of His Majesty the King of Denmark shall enjoy the exclusive right of fishery within the distance of three miles from low-water mark along the whole extent of the coasts of the said islands, as well as of the dependent islets, rocks, and banks.

As regards bays, the distance of three miles shall be measured from a straight line drawn across the bay, in the part nearest the entrance, at the first point where the width does not exceed ten miles.

The present article shall not prejudice the freedom of navigation or anchorage in territorial waters accorded to fishing boats, provided they conform to the Danish Police Regulations ruling this matter, amongst others the one stipulating that trawling vessels, while sojourning in territorial waters, shall have their trawling gear stowed away inboard.

ART. III. The miles mentioned in the preceding Article are geographical miles, whereof sixty make a degree of latitude.

ART. IV. The geographical limits for the application of the present Convention shall be fixed as follows:

On the south by a line commencing from where the meridian of North Unst Light-house (Shetland Islands) meets the parallel of 61st degree of north latitude to a point where the 9th meridian of west longitude meets the parallel of 60° north latitude, and from thence westward along that parallel to the meridian of 27° west longitude.

On the west by the meridian of 27° west longitude.

On the north by the parallel of 67° 30′ of north latitude.

On the east by the meridian of the North Unst Light-house.

The aforesaid limits are shown on the chart appended to the present Convention.

ART. V. The fishing boats of the High Contracting Parties shall be registered in accordance with the administrative Regulations in force in their respective countries.

For each port there shall be a consecutive series of numbers, preceded by one or two initial letters, which shall be specified by the superior competent authority.

Each Government shall draw up a list showing these initial letters.

This list, together with all modifications which may subsequently be made in it, shall be notified to the other Government.

ART. VI. Fishing boats shall bear the initial letter or letters of the port to which they belong, and the registry number in the series of numbers for that port.

ART. VII. The name of each fishing boat and that of the port to which she belongs shall be painted in white oil colour on a black ground on the stern of the boat in letters which shall be at least eight centimètres in height and twelve millimètres in breadth.

ART. VIII. The letter or letters and numbers which shall have been assigned to a vessel on its registration shall be painted in white oil colour on a black ground, and so as to be clearly visible on each bow of the vessel, eight or ten centimètres below the gunwale, provided the space admit it. The letters and numbers of vessels of fifteen tons burden (gross tonnage) and upwards shall be forty-five centimètres in height and six centimètres in breadth.

For boats of less than fifteen tons burden (gross tonnage) the dimensions shall, if possible, be twenty-five centimètres in height and four centimètres in breadth.

The same letters and numbers shall also be painted in oil colour on each side of the mainsail of the boat immediately above the close reef, and in such a manner as to be plainly visible; they shall be painted on white sails in black, or black sails in white, and on sails of an intermediate shade in black or in white, as may be decided by the authority superintending the marking, in accordance with Article V of the present Convention.

Steam fishing vessels shall, in addition, bear the above marks on the funnel in a plainly visible manner. These marks should be of the same dimensions as those on the bow.

The letter or letters and numbers on the sails shall be one-third larger in every way than those placed on the bows of the boat.

ART. IX. Fishing boats may not have, either on their outside, on their sails, or on their funnels, any names, letters, or numbers other than those prescribed by Articles VI, VII, and VIII of the present Convention.

ART. X. The names, letters, and numbers placed on the boats and on their sails and funnels shall not be effaced, altered, made illegible, covered or concealed in any manner whatsoever.

ART. XI. All the small boats, buoys, principal floats, trawls, grapnels, anchors, and generally all fishing implements shall be marked with the letter or letters and numbers of the boats to which they belong.

These letters and numbers shall be large enough to be easily distinguished. The owners of the nets or other fishing implements may further distinguish them by any private marks they think proper.

ART. XII. The master of each boat must have with him an official document, issued by the proper authority in his own country, for the purpose of enabling him to establish the nationality of the boat

This document must always give the letter or letters and number of the boat, as well as her description and the name or names of the owner or the name of the firm or association to which she belongs.

ART. XIII. The nationality of a boat must not be concealed in any manner whatsoever.

ART. XIV. No fishing boat shall anchor, between sunset and sunrise, on grounds where drift-net fishing is actually going on.

This prohibition shall not, however, apply to anchorings which may take place in consequence of accidents or of any other compulsory circumstances.

ART. XV. Boats arriving on the fishing grounds shall not either place themselves or shoot their nets in such a way as to injure each other, or as to interfere with fishermen who have already commenced their operations.

ART. XVI. Whenever, with a view of drift-net fishing, decked boats and undecked boats commence shooting their nets at the same time, the undecked boats shall shoot their nets to windward of the decked boats.

The decked boats, on their part, shall shoot their nets to leeward of the undecked boats.

As a rule, if decked boats shoot their nets to windward of undecked boats which have begun fishing, or if undecked boats shoot their nets to leeward of decked boats which have begun fishing, the responsibility as regards any damages to nets which may result shall rest with the boats which last began fishing, unless they can prove that they were under stress of compulsory circumstances or that the damage was not caused by their fault.

ART. XVII. No net or any other fishing engine shall be set or anchored on grounds where drift-net fishing is actually going on.

ART. XVIII. No fisherman shall make fast or hold on his boat to the nets, buoys, floats, or any other parts of the fishing tackle of another fisherman.

ART. XIX. When trawl fishermen are in sight of net or of long-line fishermen, they shall take all necessary steps in order to avoid doing injury to the latter. Where damage is caused the responsibility shall be on the trawlers, unless they can prove that they were under stress of compulsory circumstances, or that the loss sustained did not result from their fault.

ART. XX. When nets belonging to different fishermen get foul of each other, they shall not be cut without the consent of both parties.

All responsibility shall cease if the impossibility of disengaging the nets by any other means is proved.

ART. XXI. When a boat fishing with long lines entangles her lines in those of another boat, the person who hauls up the lines shall not cut them, except under stress of compulsory circumstances, in which case any line which may be cut shall be immediately joined together again.

ART. XXII. Except in case of salvage and the cases to which the two preceding Articles relate, no fisherman shall, under any pretext whatever, cut, hook, or lift up nets, lines, or other gear not belonging to him.

When a fisherman fouls or otherwise interferes with the fishing gear of another fisherman, he shall take all necessary measures for reducing to a minimum the injuries which may result to the gear or to the boat of the other fisherman.

ART. XXIII. The use of any instrument or engine which serves only to cut or destroy nets is forbidden.

The presence of any such engine on board a boat is also forbidden.

The High Contracting Parties engage to take the necessary measures for preventing the embarkation of such engines on board fishing boats.

ART. XXIV. Fishing boats shall conform to the general rules respecting lights and sound signals, as well as those concerning steering and navigation, which have been, or may be, adopted in respect of these boats by mutual arrangement between the High Contracting Parties with the view of preventing collisions at sea.

ART. XXV. All fishing boats, all their small boats, all rigging gear, or other appurtenances of fishing boats, all nets, buoys, floats, or other fishing implements whatsoever found or picked up at sea, whether marked or unmarked, shall as soon as possible be delivered to the competent authority of the first port to which the salving boat returns or puts in.

Such authority shall inform the Consul or Consular Agent of the country to which the boat of the salvor belongs, and the nation of the owners of the articles found. They (the same authority) shall restore the articles to the owners thereof, or to their representatives, as soon as such articles are claimed and the interests of the salvors have been properly guaranteed.

The administrative or judicial authorities, according as the laws of the respective countries may provide, shall fix the amount which the owner shall pay to the salvors. It is, however, agreed that this provision shall not in any way prejudice such Conventions respecting this matter as are already in force, and that the High Contracting Parties reserve the right of regulating, by special arrangements between themselves, the amount of salvage at a fixed rate per net salved.

Fishing implements of any kind found unmarked shall be treated as wreck.

ART. XXVI. The superintendence of the fisheries shall be exercised by vessels belonging to the national navies of the High Contracting Parties. In the case of Denmark such vessels may be vessels belonging to the state, commanded by Captains who hold commissions.

ART. XXVII. The execution of the Regulations respecting the documents establishing nationality, the marking and numbering of boats, etc., and of fishing implements, as well as the presence on board of instruments which are forbidden (Articles VI, VII, VIII, IX, X, XI, XII, XIII, and XXIII, paragraph 2), is placed under the exclusive superintendence of the cruisers of the nation of each fishing boat. Nevertheless, the Commanders of cruizers shall acquaint each other with any infractions of the above-mentioned Regulations committed by the fishermen of the other nation.

ART. XXVIII. The cruizers of the High Contracting Parties shall be competent to authenticate all infractions of the Regulations prescribed by the present Convention other than those referred to in Article XXVII, and all offences relating to fishing operations, whichever may be the nation to which the fishermen guilty of such infraction may belong.

ART. XXIX. When the Commanders of cruizers have reason to believe that an infraction of the provisions of the present Convention has been committed, they may require the master of the boat inculpated to exhibit the official document establishing her nationality. The fact of such document having been exhibited shall then be indorsed upon it immediately. The Commanders of cruizers shall not pursue further their visit or search on board a fishing boat which is not of their own nationality, unless it should be for the purpose of obtaining proof of an offence or of a contravention of Regulations respecting the police of the fisheries.

ART. XXX. The Commanders of the cruizers of the High Contracting Parties shall exercise their judgment as to the gravity of facts brought to their knowledge, and of which they are empowered to take cognizance, and shall verify the damage, from whatever cause arising, which may be sustained by fishing boats of the nationalities of the High Contracting Parties.

They shall draw up, if there is occasion for it, a formal statement of the verification of the facts, as elicited both from the declaration of the parties interested and from the testimony of those present

The Commander of the cruizer may, if the case appears to him sufficiently serious to justify the step, take the offending boat into a port of the nation to which the fisherman belongs.

He may even take on board the cruizer a part of the crew of the fishing boat, in order to hand them over to the authorities of her nation.

ART. XXXI. The formal statement referred to in the preceding Article shall be drawn up in the language of the Commander of the cruizer, and according to the forms in use in his country. The accused and the witnesses shall be entitled to add, or to have added to such statement, in their own language, any observations or evidence which they may think suitable. Such declarations must be duly signed.

ART. XXXII. Resistance to the direction of Commanders of cruizers charged with the police of the fisheries, or of those who act under their orders, shall, without taking into account the nationality of the cruiser, be considered as resistance to the authority of the nation of the fishing boat.

ART. XXXIII. When the act alleged is not of a serious character, but has, nevertheless, caused damage to any fisherman, the Commanders of cruizers shall be at liberty, should the parties concerned agree to it, to arbitrate at sea between them, and to fix the compensation to be paid. Where one of the parties is not in a position to settle the matter at once, the Commanders shall cause the parties concerned to sign in duplicate a formal document specifying the compensation to be paid.

One copy of this document shall remain on board the cruiser and the other shall be handed to the master of the boat to which the compensation is due, in order that he may, if necessary, be able to make use of it before the Courts of the country to which the debtor belongs.

Where, on the contrary, the parties do not consent to arbitration, the Commanders shall act in accordance with the provisions of Article XXX.

ART. XXXIV. The prosecution for offences against or contraventions of the present Convention shall be instituted by, or in the name of, the State.

ART. XXXV. The High Contracting Parties engage to propose to their respective Legislatures any measures which may be necessary for insuring the execution of the present Convention, and particularly for the punishment by either fine or imprisonment, or by both, of persons who may contravene the provisions of Articles VI to XXIII, inclusive.

ART. XXXVI. In all cases of assault committed, or of willful damage or loss inflicted, by fishermen of one of the contracting countries upon fishermen of the other nationality, the Courts of the country to which the boats of the offenders belong shall be empowered to try them.

The same rule shall apply with regard to offences against and contraventions of the present Convention.

ART. XXXVII. The proceedings and trial in cases of infraction of the provisions of the present Convention shall take place as summarily as the Laws and Regulations in force will permit.

ART. XXXVIII. The present Convention shall be ratified. The ratifications shall be exchanged in London as soon as possible.

ART. XXXIX. The present Convention shall come into operation from and after a day to be fixed upon by the two High Contracting Parties after it shall have been notified by the Danish Government that measures have been passed in respect of the Faröe Islands and Iceland, by which freedom of navigation and anchorage within the territorial waters of the said islands is accorded to British fishermen (vide Article II, paragraph 3). The Convention shall continue in force until the expiration of two years from notice by either party for its termination.

The High Contracting Parties, however, reserve to themselves the power to make, by mutual consent, any modification in the Convention which experience shall have shown to be desirable, provided it is not inconsistent with the principles upon which the Convention is based.

ADDITIONAL ARTICLE. Any other Government, the subjects of which carry on fishery in the ocean surrounding the Faröe Islands and Iceland, may adhere to the present Convention. The adhesion shall be notified to one of the Governments at Copenhagen or at London, respectively. Such notification shall be communicated to the other signatory Power.

In witness whereof the Plenipotentiaries have signed the present Convention, and have affixed thereto their seals.

Done at London, in two copies, June 24, 1901.

APPENDIX G.

Award of the Paris Tribunal of Arbitration of 1893 with respect to Concurrent Regulations for the Protection of the Fur Seals outside the limits of exclusive jurisdiction.

ARTICLE 1. The Governments of the United States and of Great Britain shall forbid their citizens and subjects respectively to kill, capture, or pursue at any time and in any manner whatever, the animals commonly called fur seals, within a zone of sixty miles around the Pribilof Islands, inclusive of the territorial waters.

The miles mentioned in the preceding paragraph are geographical miles, of sixty to a degree of latitude.

ART. 2. The two Governments shall forbid their citizens and subjects respectively to kill, capture, or pursue, in any manner whatever, during the season extending, each year, from the 1st of May to the 31st of July, both inclusive, the fur seals on the high sea, in the part of the Pacific Ocean, inclusive of the Behring Sea, which is situated to the North of the 35th degree of North latitude, and eastward of the 180th degree of longitude from Greenwich till it strikes the water boundary described in Article 1 of the Treaty of 1867 between the United States and Russia, and following that line up to Behring Straits.

ART. 3. During the period of time and in the waters in which the fur-seal fishing is allowed, only sailing vessels shall be permitted to carry on or take part in fur-seal fishing operations. They will, however, be at liberty to avail themselves of the use of such canoes or undecked boats, propelled by paddles, oars, or sails, as are in common use as fishing boats.

ART. 4. Each sailing vessel authorised to fish for fur seals must be provided with a special license issued for that purpose by its Government and shall be required to carry a distinguishing flag to be prescribed by its Government.

ART. 5. The masters of the vessels engaged in fur-seal fishing shall enter accurately in their official log book the date and place of each fur-seal fishing operation, and also the number and sex of the seals captured upon each day. These entries shall be communicated by each of the two Governments to the other at the end of each fishing season.

ART. 6. The use of nets, firearms, and explosives shall be forbidden in the fur-seal fishing. This restriction shall not apply to shotguns when such fishing takes place outside of Behring's Sea, during the season when it may be lawfully carried on.

ART. 7. The two Governments shall take measures to control the fitness of the men authorized to engage in fur-seal fishing; these men shall have been proved fit to handle with sufficient skill the weapons by means of which this fishing may be carried on.

ART. 8. The regulations contained in the preceding articles shall not apply to Indians dwelling on the coasts of the territory of the United States or of Great Britain, and carrying on fur-seal fishing in canoes or undecked boats not transported by or used in connection with other vessels and propelled wholly by paddles, oars, or sails and manned by not more than five persons each in the way hitherto practised by the Indians, provided such Indians are not in the employment of other persons and provided that, when so hunting in canoes or undecked boats, they shall not hunt fur seals outside of territorial waters under contract for the delivery of the skins to any person.

This exemption shall not be construed to affect the municipal law of either country, nor shall it extend to the waters of Behring Sea or the waters of the Aleutian Passes.

Nothing herein contained is intended to interfere with the employment of Indians as hunters or otherwise in connection with fur sealing vessels as heretofore.

ART. 9. The concurrent regulations hereby determined with a view to the protection and preservation of the fur seals, shall remain in force until they have been, in whole or in part, abolished or modified by common agreement between the Governments of the United States and of Great Britain.

The said concurrent regulations shall be submitted every five years to a new examination, so as to enable both interested Governments to consider whether, in the light of past experience, there is occasion for any modification thereof.

APPENDIX H.

Konvention angående fiskeriförhållandena i de till Sverige och Danmark gränsande farvattnen; afslutad i Stockholm den 14 Juli 1899 och ratificerad i Marstrand den 4 Augusti samt i Köpenhamn den 21 Juli s. å.; ratifikationerna utvexlade i Stockholm den 10 November 1899.

Art. I. I de till konungarikena Sverige och Danmark gränsande farvattnen skall, med de i Art. II nämnda undantag, det område, hvarest fisket är uteslutande förbehållet hvartdera landets egna undersåtar, anses utåt hafvet sträcka sig en geografisk mil ($^1/_{15}$ breddgrad) från kusten eller ytterst derutanför liggande holmar och skär, som icke ständigt af vattnet öfversköljas.

Med sagda farvatten förstås i denna öfverenskommelse:

Kattegat, begränsadt mot norr af räta linier, dragna från Skagens nordligaste udde till Vinga fyr och vidare derifrån till närmaste kusten af Hisingen samt mot söder af räta linier, dragna från Hasenöre till Gniben och från Kullen till Gilbjerghoved;

Öresund, räknadt från Kullen-Gilbjerghoved i norr till Falsterbo-Stevns i söder;

samt *af Östersjön:* farvattnen långs svenska kusten från Falsterbo till Simbrishamn äfvensom kring Bornholm och Kristiansö.

Dock skall det vara medgifvet att drifva fiske: för svenska fiskare vid ön Anholt på ett afstånd af intill ¾ geografisk mil från kusterna af denna ö, och för danska fiskare på enahanda afstånd utanför en rät linie, dragen från Hallands Väderös fyr till Tylö fyr.

ART. II. I Öresund skall fiske allestädes vara tillåtet för båda ländernas undersåtar utan åtskilnad, dock med den inskränkning att vid stränderna å ömse sidor sundet innanför ett djup af sju meter det andra landets undersåtar icke må drifva annat fiske än sillfiske med garn. Likaledes skall vid Bornholms och Kristiansös kuster samt vid svenska kusten från Falsterbo till Simbrishamn sillfisket med drifgarn vara gemensamt för båda ländernas undersåtar från den 1 Maj till den 31 Augusti.

Strand- och fiskerättsegare förbehållas de särskilda rättigheter, som dem jemlikt hvartdera landets lagar och författningar kunna tillkomma.

ART. III. Det skall vara båda ländernas fiskare tillåtet att, utan intrång i enskild rätt och under iakttagande af gällande tullföreskrifter samt andra

Convention regarding fishery relations in the navigable waters bordering on Sweden and Denmark. Concluded at Stockholm on July 14, 1899, and ratified at Marstrand on August 4 and at Kopenhagen on July 21 of the same year; ratifications exchanged at Stockholm on November 10, 1899.

ART. I. In the navigable waters bordering on the Kingdoms of Sweden and Denmark the region in which fishing is exclusively reserved to the subjects of each respective country shall, with the exceptions mentioned in Article II, be considered to extend out into the sea one geographical mile [=4 English miles], or $\frac{1}{15}$ degree of latitude, from the coast or from the farthest island or rock lying off shore and not permanently covered by water.

By said navigable waters are meant in this treaty:

Kattegat, bounded on the north by a straight line drawn from the northernmost point of Skagen to Vinga lighthouse, thence to the nearest coast of Hisingen, and on the south by a straight line drawn from Hasenöre to Gniben and from Kullen to Gilbjerghoved.

The Sound, reckoned from Kullen–Gilbjerghoved on the north to Falsterbo-Stevns on the south.

The Baltic: The navigable waters along the Swedish coast from Falsterbo to Simbrishamn, as well as around Bornholm and Kristiansö.

Nevertheless Swedish fishermen shall be allowed to fish at Anholt Island a distance of ¾ geographical mile [=3 English miles] from the coasts of said island, and Danish fishermen shall be allowed to fish a like distance beyond a straight line drawn from Hallands Väderös lighthouse to Tylö lighthouse.

ART. II. In the Sound fishing shall be allowed everywhere to the subjects of both countries without distinction, provided, however, that on the shores on each side of the Sound within a depth of 7 meters the subjects of the other country shall not engage in any fishing except for herring with nets. Likewise, on the coasts of Bornholm and Kristiansö, as well as on the Swedish coasts from Falsterbo to Simbrishamn, herring fishing with drift nets shall be allowed to subjects of both countries from May 1 till August 31.

To owners of shores and fishing rights are reserved the special privileges which may belong to them according to the laws and constitution of either country.

ART. III. The fishermen of both countries shal be allowed, without encroaching on private rights and observing the customs regulations as well as

dylika bestämmelser, ej mindre i Öresund än äfven å de enligt Art. I hvartdera landet förbehållna fiskeområdena fritt färdas och ankra.

ART. IV. Vid fiskets bedrifvande skola båda ländernas fiskare iakttaga att, sedan någon intagit en fiskeplats och behörigen utmärkt sin redskap, han icke må, så länge han har sin redskap behörigen utmärkt och begagnar densamma till fiske, utträngas derifrån eller lida intrång i sitt fiske af andra fiskare.

Sättes eller drifver fiskredskap på annan mans behörigen utmärkta redskap, eller drages not (vad) så, att behörigen utmärkt redskap skadas, skall dennes egare hafva rätt till ersättning af den, som tillfogat honom sådan skada, så framt icke skadan skett genom nödtvång eller annan orsak, som ej kan tillräknas denne.

För att redskap skall anses vara behörigen utmärkt, skola följande regler vara iakttagna:

1) *Bottengarn, ålhommesätt* ("ålestader"), *räkrusor, strandsätt för lax* och annan dylik redskap, som är fästad vid pålar, skall vid hufvudpålen eller den yttersta pålen vara försedd med en mörk flagg, som når minst en och en half meter öfver vattnet.

2) *Ryssjor* (hommor), som icke äro fästade vid pålar, skola, när de sättas spridda, hvar för sig vara utmärkta med en upprättstående stake utan topptecken, hvilken räcker minst tolf decimeter öfver vattnet. Utsättas ryssjorna (hommorna) i rad, kan afmärkningen inskränkas till en sådan stake för de två yttersta ryssjorna i raden och en boj eller mindre stake för hvar och en af de öfriga ryssjorna.

Tinor skola vara utmärkta genom en flytande träklabb.

3) För *annan fastående redskap*, vare sig densamma är bottensatt eller flyter närmare ytan, skall vid hvardera ändan af länken anbringas en stake, med eller utan tunna, hvars topp räcker minst tolf decimeter öfver vattnet och är utmärkt med en flagga, tre decimeter i fyrkant, för den ända af länken, som står i kompassens östliga halfcirkel (från norr genom ost till syd), samt två trekantiga, tre decimeter långa flaggor för den ända, som står i kompassens vestliga halfcirkel (från syd genom vest till norr). Mellan dessa märken skall anbringas en mindre stake utan topptecken eller en boj för minst hvar nio hundra fyrtionde meter.

4) *Snurrevadar* (strykvadar *och drifvadar* skola vid notpåsen eller kalfven (kilen) vara försedda med bojlina samt en svartmålad kagge eller boj utan topptecken. Vid fiske med snurrevad skall

other similar regulations in force, to navigate freely and to anchor both in the Sound and the fishing regions reserved in accordance with Article I to each country.

ART. IV. In engaging in fishing the fishermen of both countries must remember that, when a fishing ground has been taken up and the tackle is properly marked, the occupant is not to be driven away or suffer any encroachment in his fishing by other fishers as long as his tackle is properly marked and he uses it for fishing.

If fishing tackle is placed or drifts upon the properly marked tackle of another fisherman, or if a seine is so dragged as to injure properly marked tackle, the owner of such tackle shall be entitled to damages from the person who has caused him such injury, provided the damage was not caused by unavoidable necessity or other cause which can not be attributed to such owner.

In order that tackle may be considered as being properly marked, the following rules must be observed:

1. Bottom nets, eel traps (alhommesätt), shrimp traps (räkrusor), shore weirs (strandsätt) for salmon, and other similar tackle fastened with poles, must have attached to the principal pole or the outermost pole a dark flag reaching at least 1½ meters above water.

2. Lobster traps (hommor) which are not fastened with poles shall, when they are set out, each be designated by an upright stake without top mark, reaching at least 12 decimeters above water. If the traps are set out in a row, the marking can be limited to such a stake for the two outermost baskets in the row and a buoy or lesser stake for each of the other baskets.

Single pots should be marked by a floating log.

3. In the case of other stationary tackle, whether it be laid on the bottom or float nearer the surface, there shall be a stake at each end, with or without cask, the top of which shall reach at least 12 decimeters above water and be marked with a flag 3 decimeters square, at the end of the chain situated in the eastern semicircle of the compass (from north through east to south), and two triangular flags 3 decimeters long at the end situated in the western cemicircle of the compass (from south through west to north). Between these marks there shall be placed a lesser stake without top mark, or a buoy, at least every 914 meters.

4. Seines (snurrevadar) and drift nets (drifvadar) must be provided, at the bag or cod, with a buoy line and a black-painted keg or buoy without top mark. In fishing with a seine a stake with

från fartyget vara utsatt en stake med blå flagg i den rigtning, hvari vaden är utsatt.

5) *Drifvande eller svajande redskap* skall vid den fasta ändan af länken, som är förankrad vid botten eller fastgjord vid båten, utmärkas med en boj utan stake, samt vid den fria ändan med en boj med stake, som räcker minst tolf decimeter öfver vattnet.

Drifvande redskap skall, när fisket sker i Öresund, om natten föra en hvit lanterna pä denna stake; svajande redskap skall föra en trekantig flagg.

6) Inga fiskemärken, utom de i 1) nämnda, må räcka högre öfver vattnet än en och en half meter.

ART. V. Det i Art. IV nämnda skydd för fastående redskap gäller beträffande omkring Bornholm och Kristiansö utsatta laxlinor eller laxrefvar endast från och med den 1 Oktober till den 1 April.

ART. VI. Artiklarna IV och V hafva afseende å farvattnen utanför de hvartdera landet förbehållna fiskeområdena samt jemväl å de platser, der fiske enligt Art. II är gemensamt för begge rikenas undersåtar.

ART. VII. Öfverträdelser af de i artikel IV gifna föreskrifter skola, för såvidt de angå handlingar begångna utanför det hvartdera landet förbehållna fiskeområdet, äfvensom i Öresund på större afstånd än en geografisk mil från närmaste land, ö eller skär, som icke ständigt öfversköljes af vatten, straffas med böter från och med tio till och med tvåhundra kronor.

ART. VIII. Öfverträdelser, som i artikel VII omförmälas, åtalas och afdömas i det land, hvartill den skyldiges fartyg hörer.

ART. IX. De farkoster, som idka fiske i de farvatten, denna öfverenskommelse omfattar, skola vara tydligt märkta med nummer och stationsmärke, såväl å skrofvet som å storseglet.

ART. X. De båda ländernas regeringar förpligta sig att underrätta hvarandra om de åtgärder, som vidtagas för tillsynen öfver efterlefnaden af de i denna öfverenskommelse meddelade bestämmelser.

ART. XI. Denna konvention skall träda i kraft genast efter det ratifikationerna utvexlats och förblifva gällande intill dess sex månader förflutit från den dag, då endera af de höga parterna uppsagt densamma.

Till bekräftelse häraf hafva de respektive fullmägtige undertecknat denna konvention och försett densamma med sina sigill.

Som skedde uti två exemplar i Stockholm den 14 Juli 1899.

blue flag shall be set out from the boat in the direction in which the seine is set out.

5. Drifting or swinging tackle shall, at the fast end of the chain which is anchored on the bottom or fastened to a boat, be designated with a buoy without stake, and at the free end by a buoy with stake, reaching at least 12 decimeters above water.

Drifting tackle shall, when the fishing is done in the Sound, be provided at night with a white lantern on this stake; swinging tackle shall carry a triangular flag.

6. No fishing marks, except those mentioned under No. 1 above, shall reach higher than 1½ meters above water.

ART. V. The protection to stationary tackle mentioned in Article IV applies to salmon fish-lines placed out around Bornholm and Kristiansö only from October 1 to April 1.

ART. VI. Articles IV and V relate to the navigable waters beyond the fishing regions reserved for each country, as well as to the places where fishing is permitted alike to the subjects of both countries in accordance with Article II.

ART. VII. Violations of the provisions of Article IV shall, if committed outside the fishing regions reserved to each country, or in the Sound over four geographical miles from the nearest land, island, or rock not constantly covered by water, be punishable by a fine not less than 10 and not exceeding 200 crowns.

ART. VIII. Violations as mentioned in Article VII shall be prosecuted and punished in the country to which the boat of the guilty party belongs.

ART. IX. Vessels which engage in fishing in the navigable waters embraced in this convention shall be distinctly marked with a number and station mark, both on the hull and on the mainsail.

ART. X. The governments of both countries pledge themselves to inform each other of the measures adopted for the purpose of insuring the observance of the provisions contained in this convention.

ART. XI. The present convention shall go into force immediately after the exchange of ratifications and shall remain in force until six months after one of the high contracting parties has repudiated it.

In witness whereof the respective plenipotentiaries have signed this Convention and affixed thereto their seals.

Done in two copies at Stockholm, on the 14th day of July, 1899.

PROTOKOLL.

1. Till närmare bestämmande af den enligt art. X af den mellan H. M. Konungen af Sverige och Norge och H. M. Konungen af Danmark denna dag afslutade fiskerikonvention förutsatta tillsynen öfver konventionsbestämmelsernas efterlefnad hafva, efter dertill af regeringarne lemnadt bemyndigande, undertecknade, jemte förklarande att det ena landets fiskeritillsyn ej må sträckas in på det andra landets område, eller å farvatten, som ligger utanför det hvartdera landet förbehållna fiskeområdet, utöfvas mot andra än landets egna undersåtar, vidare afgifvit följande särskilda förklaringar.

Svenska regeringen förklarar sig vilja dels anbefalla vederbörande länsstyrelser förständiga sina underordnade att hålla noggrann uppsigt öfver att de i konventionens särskilda artiklar gifna bestämmelser icke af enskilde öfverträdas, dels ock söka, i den mån förhållandena det medgifva, bereda ytterligare anordningar för öfvervakande af att konventionens föreskrifter varda af de svenske undersåtarne vederbörligen iakttagna, och svenska regeringen har för sådant ändamål särskildt tänkt sig, att den kanonbåt, som under höst- och vintermånaderna plägar vara stationerad vid bohuslänska kusten, skulle kunna beordras att, då dess närvaro derstädes under dessa månader ej erfordras, och omständigheterna i öfrigt derför ej lägga hinder i vägen, besöka de i konventionen afsedda fiskeområdena för att utöfva ifrågavarande fiskeritillsyn, eller ock att, i den mån nödiga medel af Riksdagen anvisas, samma eller annan kanonbåt skulle äfven under andra tider af året for ändamålet användas.

Danska regeringen förklarar sig vilja träffa de för öfvervakande af konventionens bestämmelser och med hänsyn till polistillsynen nödvändiga åtgärder.

2. Vidare hafva undertecknade, dertill vederbörligen bemyndigade, öfverenskommit, att, derest mellan de kontraherande magterna meningsskiljaktigheter om tolkningen eller tillämpningen af konventionen uppstå och dessa icke kunna genom diplomatiska förhandlingar utjemnas, desamma skola hänskjutas till skiljedom.

Till yttermera visso hafva undertecknade underskrifvit detta protokoll i tvenne lika lydande exemplar och bekräftat detsamma med sina sigill, som skedde i Stockholm den 14 Juli 1899.

DEKLARATION.

Hans Majestät Konungen af Sverige och Hans Majestät Konungen af Danmark hafva bemyndigat undertecknade att afgifva följande deklaration:

PROTOCOL.

1. In order to determine more precisely the vigilance to be exercised, for insuring the observance of the provisions of the fishery convention concluded this day between H. M. the King of Sweden and Norway and H. M. the King of Denmark, in accordance with Article X of said convention, the undersigned, being empowered for the purpose by their Governments, have declared that the supervision over fishery exercised by one country shall not extend over the territory of the other country nor be exercised against the subjects of the other country on the navigable waters lying outside the fishing regions reserved to each country, besides which they have made the following special declarations:

The Swedish Government declares its willingness to order the respective district governments to exercise strict vigilance to prevent violation of the various provisions of the convention by private individuals, and it will endeavor, to the extent that circumstances permit, to prepare further regulations for the purpose of insuring the due observance of the provisions of the convention by Swedish subjects, for which purpose it has particularly deemed that the gunboat usually stationed during the fall and winter months along the coast of Bohuslän might be ordered, when its presence there during these months is not required and when other circumstances do not oppose, to visit the fishing regions set off in the convention in order to exercise the necessary vigilance over the fishing, or else, to the extent that the necessary funds may be provided by the Parliament, that the same or another gunboat might be employed for the purpose even during other seasons of the year.

The Danish Government declares itself willing to take the necessary steps to execute the provisions of the Convention and to maintain police supervision.

2. The undersigned, duly authorized, have furthermore agreed that in case of diversity of opinion between the contracting powers as to interpretation or execution of the provisions of the Convention, when such diversity can not be adjusted by diplomatic measures, the matter shall be submitted to arbitration.

In witness whereof the undersigned have signed this protocol in two copies and affixed their seals on same.

Done at Stockholm on the 14th day of July, 1899.

DECLARATION.

His Majesty the King of Sweden and His Majesty the King of Denmark have authorized the undersigned to make the following declaration:

ART. I. Art. II af den under den 14 juli 1899 i Stockholm afslutade konvention angående fiskeriförhållandena i de till Sverige och Danmark gränsande farvattnen erhåller följande förändrade lydelse:

I Öresund skall fiske allestädes vara tillåtet för båda ländernas undersåtar utan åtskillnad, dock med den inskränkning att vid stränderna å ömse sidor Sundet innanför ett djup af sju meter det andra landets undersåtar icke må drifva annat fiske än sillfiske med garn. Såsom drifgarn vid sillfiske få endast *närdingar* användas. Utanför den nämnda sjumetersgränsen i Öresund är allt slags fiske med trawl och vad förbjudet.

På Middelgrundet är det likväl tilllåtet att begagna agnnot. Med agnnot förstås sådan not, å hvilken armarnas längd tillsammans icke öfverskrider 7½ meter (4 famnar).

Vid Bornholms och Kristiansös kuster samt vid svenska kusten från Falsterbo till Simrishamn skall sillfisket med drifgarn vara gemensamt för båda ländernas undersåtar från den 1 maj till den 31 augusti.

Strand- och fiskråttsägare förbehållas de särskilda rättigheter, som dem jämlikt hvartdera landets lagar och författningar kunna tillkomma.

ART. II. Rödspätta, som i totallängd icke håller 25½ centimeter (21 centimeter från nosspetsen till stjärtroten), må ej finnas ombord i fartyg eller båt, som befinner sig i Kattegatt med dess vikar och fjordar på fiske eller för fiskhandel, och ej heller vid kusterna af Kattegatt med dess vikar och fjordar föras i land, hållas till salu eller utbjudas, säljas eller från ort till annan forslas, utan skall sådan rödspätta, därest den varder vid fiske upptagen i farkost eller på land, snarast och så vidt möjligt i oskadadt tillstånd i hafvet åter utsläppas.

För Öresund gälla samma bestämmelser, dock må, med undantag för det till städerna — å svenska sidan Hälsingborg, Landskrona och Malmö, å danska sidan Helsingör och Köpenhamn — hörande vatten- och landområde, i Sundet fångad rödspätta, som i totallängd håller minst 21 centimeter (17 centimeter från nosspetsen till stjärtroten), finnas ombord och föras i land för att förbrukas inom någon af de Öresunds kuster närmast belägna kommuner.

ART. III. Denna deklaration träder i kraft den 1 november 1907.

Till bekräftelse häraf hafva undertecknade underskrifvit denna öfverenskommelse och försett densamma med sina sigill.

Som skedde i Stockholm i två exemplar den 5 oktober 1907.

ART. I. Article II of the convention concluded at Stockholm on July 14, 1899, regarding fishery relations in the navigable waters bordering on Sweden and Denmark, is modified so as to read as follows:

In the Sound fishing shall everywhere be allowed the subjects of both countries without distinction, provided, however, that on the shores on both sides the Sound within a depth of 7 meters the subjects of the other country shall not engage in any other fishing than herring fishing with nets. Only "närdingar" may be used as drift nets in herring fishing. Outside the aforementioned 7-meter limit in the Sound all kinds of fishing with trawls or seines is forbidden.

On the Middle Ground (Middelgrund) the use of bait-nets shall also be permitted. As bait-nets are included nets in which the length of the arms does not exceed altogether 7½ meters (4 fathoms).

On the coasts of Bornholm and Kristiansö, as well as on the Swedish coast from Falsterbo to Simrishamn, herring fishing with drift nets shall be permissible to the subjects of both countries from May 1 to August 31.

Owners of shores and fishing rights shall retain the privileges to which they are entitled under the laws and constitutions of each country.

ART. II. Plaice which do not measure 25½ centimeters in total length (21 centimeters from tip of nose to base of tail) must not be found on board any vessel or boat engaged in fishing or in dealing in fish in the Kattegatt, its coves or fjords, nor shall they be imported on the coasts of the Kattegatt, its coves or fjords, or be kept for sale or offered for sale or sold, or conveyed from one place to another, but such plaice when caught while fishing, from a boat or from shore, shall be thrown back into the sea as soon as possible and as far as possible unhurt.

The same rules apply to the Sound; nevertheless, with the exception of the adjacent water and land at Hälsingborg, Landskrona, and Malmö on the Swedish side and Helsingör and Köpenhamn on the Danish side, plaice caught in the Sound and measuring at least 21 centimeters in total length (17 cm. from tip of nose to base of tail), will be allowed on board and may be imported for consumption in some of the communes lying nearest the coasts of the Sound.

ART. III. This declaration goes into effect November 1, 1907.

In witness whereof the undersigned have signed this agreement and affixed thereto their seals.

Done at Stockholm in two copies on the 5th day of October, 1907.

DISCUSSION.[a]

Mr. OLSEN. I have listened with very great interest to this excellent paper. A better one I do not think we shall be able to hear in this assembly, for it touches the chord of everything that affects the regulations of the fisheries on the high seas. With regard to Moray Firth, which the speaker referred to, I am sorry to stand here and confess that we have to-day about thirty English steam trawlers sailing under foreign flags, for the simple purpose of poaching in the Moray Firth. It seems to me disgraceful that such things should be done; but, on the other hand, it is quite right that the Moray Firth should be open to trawling, inasmuch as the 3-mile limit is considered and that the bay which they have drawn the line across is something like 90 miles in width, contains a great area of water, and that that piece of water is open to all nations, according to the convention of 1882. The poaching (I can not call it anything else) is certainly a very mean way of trying to avoid the law by putting the vessel under another flag. Such things I have personally objected to. This bone of contention, trawling in the Moray Firth, is a thing that the British Government can not legally enforce nor prevent, for it is not the property of the British nation, since it was agreed to in the convention of the contracting parties. It belongs to the convention only to police, and not to one country. I think it impossible either for this congress or for any other congress to induce the British Government to give up that piece of water. The only way I can conceive is that a tribunal, an international society, be formed for the purpose of adjusting all kinds of grievances respecting the fishery laws, etc., and that this society be able to so formulate the requirements as to bring it before the Government in question, with a lot of influence behind it to induce the home governments to legislate for the fishermen and all those engaged in the industry.

Mr. FRYER. Mr. President, ladies, and gentlemen, the very important diplomatic issues involved in the paper read before us just now, and especially in reference to the case of the Moray Firth in Scotland, are so serious that I feel I can not properly deal with them in the short space of time at our disposal this morning; but I think that one little explanation is necessary on the point of the apparently doubtful position which the United Kingdom has assumed in regard to jurisdiction beyond the 3-mile limit.

The facts are as stated in the paper; but one simple point was omitted, and that is in reference to the peculiar position of the boat against which the proceedings in the case referred to were taken. The justification for the apparent exercise of sovereign rights over a foreign vessel at a distance of more than 3 miles from low-water mark was found in the fact that this vessel was manned mainly by British subjects. The law in question was a domestic law; it was aimed at British subjects; and it was felt to be an improper thing that by the mere transfer of a ship from the British to a foreign flag, and by the employment of British subjects as fishermen, that vessel should be able to escape the purely domestic municipal law of the country which made it. This was the ground upon which the apparently inconsistent attitude of the British Government was justified and maintained in the high court in Scotland. The question has not reached its ultimate solution yet, but the position is so exceedingly delicate, and involves so many important diplomatic considerations—being, in point of fact, now the subject of diplomatic intercourse between the several nations of Europe which are fishing in this water—that I do not propose to enter further into it; especially seeing that, although I happen to be an

[a] As this paper was not read in full, the discussion pertains only to points treated in the abstract.

official of the British Government, I have no official authority here, and have no right to say anything in any way on behalf of my country, and I should hesitate to say a word which might be held to be anything like an official statement in the matter. However, I thought it necessary to point out that there was a reason for the apparently inconsistent attitude taken by my country in the premises.

With respect to one main question involved in the paper before us, namely, that the extension of the territorial limits was apparently necessary in order to give encouragement to the cultivation of the sea bed, in regard to such fisheries as those for shellfish, I would point out that the range covered by the existing limits is already sufficiently wide, without going further afield and giving proprietary rights beyond the 3-mile line. There are very few cases in which fisheries for shellfish, especially, are carried on to such an extent as to justify any proposal for placing any wider area of the sea bed under proprietary jurisdiction.

WORK OF THE INTERNATIONAL FISHERIES COMMISSION OF GREAT BRITAIN AND THE UNITED STATES

By David Starr Jordan

International Fisheries Commissioner

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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WORK OF THE INTERNATIONAL FISHERIES COMMISSION OF GREAT BRITAIN AND THE UNITED STATES.

By DAVID STARR JORDAN,
International Fisheries Commissioner.

The International Fisheries Commission represents a most interesting effort to settle at once a number of problems in international law, in constitutional law, in conflict of laws, in equity, and at the same time in biology, for no statute for the preservation and propagation of fishes can be effective unless the nature of the individual species, its food, its distribution, and its habits are primarily and persistently kept in view.

The boundary waters of the United States and Canada include two of the greatest fishing areas of the world. The Great Lakes constitute the greatest body of fresh water belonging to any single system, and are richer in fish life than any other. Puget Sound and the adjacent waters are part of the great Alaskan system, the region of all the world richest in salmon.

In these boundary waters the statutes of the Dominion of Canada, those of the different Provinces, and those of the different States of the American Union are more or less at cross-purposes with each other. Over Lake Erie, for example—the richest of the lakes in fisheries—four States and one Province claim jurisdiction, with the greatest variation in theory and practice of fish protection. In the treaty of April 11, 1908, an attempt is made to remedy this condition of affairs by the adoption by Great Britain and the United States of identical statutes relating to the fisheries, these statutes to hold for a period of four years without change, except by the joint action of both nations. Under this treaty two commissioners have been appointed to draw up this code of fishery statutes. These are Hon. Samuel Tovel Bastedo, of Toronto, as representative of Great Britain, and the present writer as representative of the United States. It is agreed that the code shall be submitted to both nations for adoption by the 1st of January, 1909.

This treaty involves a number of interesting principles: (1) Joint international action in the case of migratory animals moving from waters of one nation to those of another, in place of national control on the two sides of the boundary; (2) substitution of international legislation in this regard for that of the several

Provinces, States, and counties; (3) the code of statutes must depend on the nature of the different species of animals it is designed to protect, the matter becoming, at bottom, one of natural history.

In nearly all cases the final key to the situation is found in artificial propagation—the development of the hatchery. This demands, however, men who are willing to study their business and to learn thoroughly the nature of the fishes concerned—the egg, the fry, and the adult. Artificial hatching is not a process. It is an art, and like all arts it must rest on science. How much of the money spent on hatcheries has been wholly wasted no one can tell, but the amount is considerable. And the value of any hatchery is determined, not by the nominal output of eggs and fry but by the brains put into the business. Each species of fish, like each plant in the garden, has its own nature and must be met on its own ground. It is set in its ways and will not conform to the habits of any other species.

The species of fishes affected by this legislation are numerous, but they can be grouped into about six types, as represented by the herring, the whitefish, the red salmon of the Pacific, the black bass, the wall-eye, and the sturgeon.

The herring is a marine fish existing in incalculable numbers and swarming by the million in many places on both shores of the North Atlantic. The catch of herring in navigable waters is less than a drop in the bucket, and the fishery statutes must concern the protection and regulation of the fishing industry rather than the conservation of the herring itself.

The whitefish is a type of a group of fishes, part of them the helpless prey of the predatory fishes, the rest feeding freely on other forms, but all spawning in cooling waters, mostly in November. The eggs are large, free, and easily manipulated, so that they can be readily cared for by processes of artificial propagation. By caring for these eggs, perhaps twenty times as many young can be returned to the lake as would develop naturally. The best protection to such fishes is that of a size limit, forbidding the buying or selling of all that have not reached the degree of maturity involved in the second appearance on the spawning grounds. These fishes are fit for the table while the spawning process is going on. To forego catching them for a month or so before the spawning period, then to allow free fishing for adult fish on the part of those fishermen prepared to preserve the spawn is the best means of maintaining and increasing fisheries of this type. By this process the adult fishes are regarded as a ripened crop, which is removed to make way for the crop of next year. In this regard we already see every prospect of success in the Great Lakes, as even under present conditions, with the present hatchery facilities, the number of fishes of this kind is steadily increasing.

To another category belongs the salmon of the Pacific coast, which feed in the sea, spawn in the rivers, ascending the streams for the most part when

4 years old, all individuals, male and female, dying soon after the first spawning. In this case the fish are valuable only when about to leave the sea, or in the lower courses of the rivers. When the spawn and milt is ripe the flesh of the fish is worthless. Here the problem is to allow fish enough to escape the nets and to ascend the rivers to cover the spawning grounds and to keep the hatcheries occupied. The most valuable of these species in international waters, the red salmon, spawns only in streams at the head of lakes. In Puget Sound the supply has been greatly depleted by overfishing. Under such circumstances nothing is gained by statutes regulating the size of fish. The only thing to be done is to establish seasonal or weekly closed periods, when a certain large number shall have opportunity to pass up to the lakes. In this case, nearly all the spawning grounds are in Canadian territory in the tributaries of Fraser River.

The black bass is the type of still another group of fishes. The male bass maintains his own hatchery. The eggs can not be stripped and hatched by artificial means. The male fish builds a nest, and the fertilized eggs are deposited in it. Then he stands guard over them, driving away all intruders, including the mother bass, until the hatching is complete. Then he eats some of his own young—let us hope the least active, as a contribution to natural selection—while the rest escape. No artificial improvement over his method is possible. In this case protection consists in preventing the catching of the immature fish and the absolute preservation of the spawning grounds from intrusion of net or hook.

Another class contains predatory fish like the wall-eye and perch, spawning in spring in warming waters, but susceptible of assistance through artificial hatching. In general, these are adequately protected by the law of the size limit, by which the immature fishes are kept from the markets. Sometimes, however, nets must be kept out of the line of their spring migrations.

Still another class is composed of the sturgeon. It reaches a great size, and when running to its spawning beds in the spring is an easy victim to the pot hunter. The vast majority of the sturgeons in our lakes have been killed for the eggs, which are made into caviar. The sturgeon thus far has resisted the attempts at artificial propagation, by reason of certain peculiarities of its own. When ripe the eggs and milt are thrown as soon as the fish is touched. When the eggs and milt are unripe they die without maturing if the fish is confined in a pond. With the sturgeon there is but one method of artificial increase—to prevent all killing for a series of years, corresponding to the years of unlimited slaughter.

To protect for their greatest usefulness the varying groups of fishes, in all the lakes, rivers, and seas of our northern boundary, is the task of the International Fisheries Commission. In so far as this commission is successful, it

should extend the fisheries, increase the amount of available fish food, and bring about a more harmonious relation between the United States and Canada. Furthermore, it should improve the lot of each individual fisherman. If the work is successful it should furnish models for the statutes of the different States and Provinces which have like problems and like interests.

If this international project is carried out satisfactorily, the same remedy should be applied to the difficulties arising from the migration of fishes in interstate waters. The conditions are the same in Lake Michigan, controlled by the variant statutes of four States, as in Lake Erie with her five States and Provinces.

The problem of the Columbia with its magnificent fisheries at the mercy of the inadequate, greedy, and variant statutes of Oregon, Washington, and Idaho, is far more difficult and more hopeless than that of the Fraser River and Puget Sound.

Twenty-eight years ago in my report on the salmon fisheries of the Columbia I called attention to the fact that these fisheries would be depleted or destroyed unless the Government of the United States could intervene between Oregon and Washington. In each State fishermen try to take all they can get and the two legislatures can never agree on joint action of any kind adequate for the protection of the species. This has gone on from bad to worse until the Columbia fisheries are but a fraction of what they were in 1880. At the present time, under the referendum laws of Oregon, all fishing above tidewater is forbidden in Oregon, and all gill-net fishing by night below tidewater limit is also prohibited. This practically closes all fishing on the Oregon side, while on the Washington side and in the spawning grounds of Idaho there is no limit of any kind. These statutes may be set aside by the courts—one or both of them—but meanwhile very few fishes reach the spawning grounds, and the fisheries four years hence will amount to nothing. All this comes from a struggle, carried into politics, between the associated (gill net) fishermen on the one hand and the owners of the fish wheels up the river on the other.

The fisheries in the other boundary waters, Lake Michigan, the Mississippi, the Ohio, and the Potomac, are all in similar bad way. For this there is no remedy evident except for the United States to take control of all migratory animals of commercial value and to control and legislate for the interstate fisheries as it does for the interstate commerce and for the interstate weather. Matters of importance which no particular State can manage should be taken in hand by the United States. Problems which seesawing legislatures find insoluble because they can not agree on joint action are easy enough to a national commission. In this case the machinery for investigation and control (and all control must be based on scientific investigation) already exists in the United States Bureau of Fisheries.

SOME REASONS FOR FAILURE OF FISH PROTECTIVE LEGISLATION AND SOME SUGGESTED REMEDIES

By Oregon Milton Dennis

Former State Game Warden of Maryland

Address before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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By OREGON MILTON DENNIS,
Former State Game Warden of Maryland.

Mr. PRESIDENT, LADIES, AND GENTLEMEN: In speaking on this subject I want it distinctly understood in the beginning that, while my language will appear to be harsh and my criticism severe with reference to some causes for the failure of the passage of proper and effective fish protective legislation, I am dealing with this subject in generalities, and without particular reference to any person or protective association. I have come to the conclusions which follow after very mature deliberation, and shall deal with this, as I have with every other matter with which I have had to do, in an honest and fearless manner, my sole purpose being to aid in fish protection and to point out some of the reasons why it has failed. A long experience as secretary and counsel of a large protective association and as the state game warden of Maryland, as well as my legislative experience, has, I believe, fully qualified me to express some opinions on the subject-matter of this paper. Of course, this experience has been gained in my own state, and what I shall say will deal largely with the conditions in that state.

The political division of Maryland through the representation of county members in the legislature places the control of legislation within the power of the counties; notwithstanding the fact that while about one-half of the population is centered in Baltimore city the latter has only about one-fourth of the delegates. I mention this because protective influences originate very largely in the city, and the state's chief protective association is there, composed of men who, whether intelligently or not, frame the bills that are presented to the legislature for action. I say intelligently, because while this association includes some of the wealthiest and best of our citizens, its enthusiasm for protection of both game and fish and the bills framed by it are largely based on the selfish reasons of sportsmen, and largely without regard to intelligent conclusions with reference to the rights of the commercial fishermen, whose vote is sufficiently large in tide-water sections of our state to control the electorate. This being

true, the county members of the legislature, as well as the fishermen themselves, look with suspicion upon any measure presented to the legislature which has for its purpose the protection of fish and game when such measure is presented by city men.

Growing out of this condition (about two years ago) a fishermen's protective association was formed in Maryland for the distinct purpose of fighting the city association, on the ground that the latter was unfair and that its only interest in protection, it was believed, was to secure to the angler a good day's fishing without regard to the commercial fisherman's interest. This condition grew out of a policy of the game protective association of introducing measures abolishing the use of all sorts of nets, or so restricting their use that the commercial fisherman would be put out of business. I am happy to say, however, that during the past year, I believe largely through my own efforts as state game warden, the two associations have united on a number of measures for fish protection, though without specific results.

Unfortunately, the selfish interest of one class and the suspicions of another are largely the reason for the failure of proper fish protective legislation. The angler goes to the legislature with a bill based on his idea of what the law should be, and that idea is usually the prohibition of the use of all sorts of nets which will interfere with his sport; an other class, the commercial fishermen, prepare a bill to protect them in the use of the sort of nets with which they fish, and still another set of fishermen have a bill to protect them in their method. The result is that the legislative committee before whom these bills go is pulled and hauled and besieged and worked upon by the various interests to such an extent that it becomes disgusted and pigeonholes all the bills, so that none is passed.

Another reason is that while the state of Maryland spends thousands of dollars for fish culture it persistently refuses to make any appropriation for, or to give the state warden department any material assistance in, the enforcement of such laws as we now have; and while the state navy is charged by law to enforce the laws for fish protection, the character of its boats prevents them from going into shallow waters to do any work even if time permitted to divert the boats from oyster protection to do this.

What I have said above is but the foundation for specific reasons which I shall give for failure of protective legislation, and which in my opinion can be reduced to the following, to wit:

1. Up to this time it has been absolutely impossible to get the tide-water fishermen to agree on any bills, and, in my judgment, even if proper laws were enacted, under the system in our state they would absolutely fail of enforcement.

2. I declare, next to the above reason, that the greatest reason for non-passage of fish protective bills is the action and influence of the duck gunners

of Maryland, who, either by purchase or by lease, secure absolute control of water fronts in the tide-water counties for their ducking clubs and shooting grounds. These gentlemen, among the foremost citizens of our state, and largely residents of the city, are jealous of the rights that they claim they have paid for, and in order that they may preserve them are in constant conflict with the resident fishermen, who ply their industry in the waters fronting or adjacent to these shores. Against these men of wealth and influence there is small opportunity to prevail with the legislators when there is a conflict between the rights of the duckers and the fishermen.

There are a number of other reasons which, in my opinion, prevent the passage of proper fish protective laws, but these are sufficient for my purpose.

Now as to the remedy. I shall offer but one, but I think it will be sufficiently radical to bring down on my head all the knocks that I can stand up under. You will remember that I made this suggestion at the last annual meeting of the American Fisheries Society:

Admitting the necessity for protection of young fish after they have been placed in the waters by the States and the United States, the question that confronts us is, how? I believe that, if it comes within the constitutional powers of the Government, Congress should pass proper interstate laws for the protection of fish.

Thousands of dollars are being spent, practically wasted, for fish propagation in Maryland. The state has persistently neglected to provide for protection. Not until after fifty years of constant agitation and the practical extermination, commercially, of the oyster, has Maryland been awakened (and that but two years ago) to the fact that the oyster in Maryland must be protected or exterminated. If it has taken this long to awaken to the serious condition of the oyster, how long will it take to recognize the necessity for the protection of the fish, and thus save to the people of our own state and other communities and from extermination one of the greatest natural food products of the world?

Mr. Bryan, at the conference of the governors of the states held in May last in Washington, had this to say with reference to the protection of the great natural resources of the country—that he regarded "the development of water transportation as essentially a national project, because the water courses run by and through many states." In my judgment it is just as important for the National Government to protect the natural industry which has its life and being as a food product in and under the waters of this country as it is to enlarge and protect the waterways for the carrying away from and bringing to us the great commerce of the world. I believe it more important, because the products of the water provided food to man long before he thought of the creation of great fortunes by the use of water courses for commercial purposes.

I am a state's rights man, and am jealous of any action of the National Government which would deprive the state of a single right. But when I consider that the great bodies of water which produce natural food run through and by different states; when I consider that petty political influences, jealousies, and other equally silly reasons prevent a state from protecting from extermination a natural food product, I am convinced that the only solution of this question is in rational control of the fish by the Federal Government. I hope this congress will put itself on record to that end, for I believe that not until this is done and the Federal Government legislates for fish protection and supplies its powerful backing to the enforcement of such laws will the question of fish protection be solved.

NATIONAL ASPECTS OF ANGLING AND THE PROTECTION OF GAME FISHES

By H. Wheeler Perce

President National Association of Scientific Angling Clubs

Address before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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NATIONAL ASPECTS OF ANGLING AND THE PROTECTION OF GAME FISHES.

By H. WHEELER PERCE,
President National Association of Scientific Angling Clubs.

In view of the many mightier subjects confronting this distinguished body, I feel constrained to be brief, particularly as I know you will accord the official delegates from this association an opportunity to voice the sentiments for which we stand. My love of the sport of angling, however, and my regard for my fellow-anglers, are so great that I can not refrain from presenting a few of my ideas, Utopian though they may be, regarding the situation as I see it, and commenting also upon those points, reforms, and conditions which I know my fellows advocate. We are indeed gratified that angling and sport fishing constitute a portion of your programme, and I think it safe to say that many thousands of people will be more or less affected by what you may do in this one branch of your deliberations.

Whatever the arguments pro and con may be concerning angling as a sport, the fact remains that it is contributory to the happiness and health of very many of our citizens. The number of people who engage in the sport either crudely or in the most scientific manner, ranging from the boy with the cotton string and penny hook to the deft master of the delicate bamboo weapon, is simply astounding, and can not at present be estimated. But their name is legion.

Thousands upon thousands of dollars are invested in enterprises devoted solely to supplying these people with the paraphernalia appertaining to the sport. From one end to the other of this broad land of ours, wherever the waters attract, will be found buildings ranging from the rude slab cabin to the great caravansary, devoted to the needs of angler guests and in numberless instances catering only to this class. These investments aggregate millions of dollars and with their necesssary operatives constitute an industry in themselves.

Land and water transportation companies reach out for the business the angler's patronage means to them, in many instances even going so far as to expend funds in stocking the waters along their lines in order that these waters

may remain prolific and an allurement to the lover of fishing. Guides and boatmen by the hundreds, the owners of vehicles, the builders of boats, the dealers in specially prepared clothing, food, and equipments make up an army in themselves. Laying aside all my natural bias due to the intense interest with which I regard all matters appertaining to angling, frankly, it seems to me that these few enumerated facts are prima facie evidence of the importance attaching to the sport.

These great interests, however, combining both the strictly commercial and the no less important simply recreative, find themselves confronted with conditions that if not bettered will in a few years be no less than appalling from our standpoint. The causes of these conditions are many and varied and the necessary steps looking toward their reformation are fully as numerous.

Ruthless deforestation, that most horrid mark of man's insatiable greed, has contributed to the depletion of our beautiful waters. The inference here is plain that a renewal of the forests would be contributory to a reestablishment of earlier good conditions. Streams in many localities that but little more than a decade ago sheltered the fastidious grayling are now barren, for this beautiful creature must have eternal shade.

Manufactories by the thousand pour their foul refuse into the living streams with which God has blessed this glorious land. As a practical man, with some knowledge of filtration and disposal of refuse matter, I feel warranted in boldly asserting that this type of offense could be remedied in ninety-nine cases out of a hundred without any severe tax on the offender.

Night fishing with jack lights, seining, spearing, dynamiting, and all wastefully destructive methods of capturing game fishes, together with the use of obnoxious, murderous lures, constitute an unending menace to the game fish life of our American waters, both fluvial and lacustrine. The remedy here, as in all cases, is proper laws, but, more important still, their proper enforcement. It may be asserted in generalities that the different state laws now in existence, and all more or less meritorious, fail in results because of their nonenforcement in an efficacious way. In many cases this nonenforcement is not venal because of no available resources from which to raise funds to provide for the maintenance of a proper force of officers. It is gratifying to know that in a few localities wise laws prevail and are properly enforced, and in these few localities results indicate splendidly the value of such conditions.

Another potent cause of the falling off in numbers of our game fishes is their capture during the spawning season. This needs no dissertation, for we all know how prolific fishes are if given a chance to reproduce properly. Here again is a question for the lawmaker.

Not the least cause of trouble arises from that peculiar phenomenon in human nature, the respectable lawbreaker. Honorable men, who would not pick a pocket or cheat in business or lie or break any of the usual laws, in many

instances seem devoid of an appreciation of the law in its relation to game or game fishes. They not only do not seem to think it is wrong to break the law but to imagine it is entirely justifiable, their only concern being to avoid detection and capture. This type of offender usually reforms, particularly if he comes under the educational influences of some friend possessing the true sportsman's instinct, but his activities would be materially lessened and his education in sportsmanship hastened if the laws of the United States hung over him.

Would it not be possible, feasible, and advisable to have a federal law in relation to all of these abuses and concerning the proper protection and conservation of game fish? And would not the lawbreaker under such circumstances face the more serious difficulties always attendant upon federal prosecutions? Would not his respect for the law be greatly enhanced and his fear of the consequences of his ill doing increased? To-day, at the best, the lawbreaker confronts simply a state law enforced by a petty officer more or less subject to influences of an irregular sort and oftentimes in a community not in touch with the spirit of the law. Would not a federal law establishing a latitudinal closed season during the spawning period be of inestimable value? This would permit of the legal and sportsmanlike capture of game fishes immediately after the spawning season and would protect the fishes in those sections where spawning occurs earlier than in others and so on up through the different latitudinal sections from south to north. These divisions could easily be established from our knowledge of the spawning habits of game fishes and naturally apply more to basses than to trout, but in the latter case proper sectional provisions could be made.

Regulations restricting the number and size of game fishes to be taken in a given time in the open season by any one person and governing the type of appliance permitted for their capture—the number and kind of hooks used, etc., cuts an important figure—in the minds of many of us should be very stringent.

The sale of game fishes at any time, except for stocking purposes, should be absolutely prohibited, and in many quarters it is conscientiously believed this is the crux of the situation, and that if such a condition could be brought about the problem of depletion would be almost if not fully solved.

Another serious matter which threatens the welfare of the game fishes of our rivers and lakes is the introduction and rapid increase and spread of coarse types alien to the waters they now infest. Their ready adjustment to the new environment and their destructive habits are too well known to need comment, and their extermination is assuredly expedient, even at the expense of the small commercial value they represent, for this is surely of no moment as against the inestimable value of clear, undefiled streams, well supplied with noble food fishes, the rightful heritage of all the people and for their honest use in an honest way and as originally given by the Giver of all good.

Still another question that appeals to many of us and which could be adjusted through national legislation is nonresident discrimination in the matter of rod or gun license which exists in some of our States and which is unpatriotic and selfish, contrary to the spirit of the Constitution, and repellant to every free-born American who loves his entire country. To the true sportsman there are no divisional lines, and his neighbor from afar is as welcome to fish in his home waters as the citizen of his own county. Would it be asking too much of Congress that a congressional committee on game and game fishes be established? Assuredly it would not be too much to ask that the subject of game and game fishes be incorporated in the work of some existing congressional committee.

I have tried to restrain my enthusiasm and be as brief as possible, while according my subject at least some scant consideration. I have viewed the situation only as it exists in the United States. Surely our good friends from the older countries can give us great help and advise us wisely from their store of knowledge acquired through their longer experience.

SPORT FISHING IN CALIFORNIA AND FLORIDA

By Charles F. Holder

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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SPORT FISHING IN CALIFORNIA AND FLORIDA.

By CHARLES F. HOLDER.

It is not generally appreciated by the public that "sport" has economic value. By the unthinking it is not taken into account in the evolution of a country, being considered a waste of time, a mere amusement. Yet sport brings four or five million dollars into the state of Maine every year, and sport, particularly angling, brings quite as large a sum annually to California.

Over 170,000 people visit the Channel Islands of California every year. They make the attractive pilgrimage mainly to the shrine of Walton, for here, from Coronado to Santa Barbara and particularly at Santa Catalina and San Clemente (a United States Government island), is to be found the finest sea angling in the world.

Rod and reel fishing has been reduced to an exact science here, and this has been accomplished through the Tuna Club, an organization which includes in its membership most of the notable sportsmen of the country—as Ex-President Roosevelt, Henry Van Dyke, Gifford Pinchot, Charles Halleck, Casper Whitney, the late Ex-President Grover Cleveland, and many more. This club has introduced light-tackle fishing as a sportsmanlike movement, also to prevent the undue slaughter of fish, and thus accomplishes a most valuable work in conserving all the resources of the ocean. By this club's efforts business in fishing tackle has been enhanced a thousand times; hundreds of people find direct employment as boatsmen and employees in allied interests; large sums are brought into the state from numerous parts of this country and Europe and sport, or one feature of it, has been elevated and dignified as a state and national asset of unquestionable importance. In the present paper some of the most important of the great game fishes of southern California and Florida are described.

AT SANTA CATALINA ISLAND.

The black sea bass of Santa Catalina is a game and food fish which attains a weight of 800 pounds, averaging 250 pounds, and is very common in this locality, living in and about the kelp or nereocystean forests that surround the island. It appears in May in schools of six or seven, breaks up and is ready to

spawn in August. Professional fishermen take it for the market with "cod" lines and albacore bait, but the anglers of the Tuna Club use 24-ounce and 9-ounce rods with a reel that will hold 1,000 feet of a 9-thread Cuttyhunk line made for the purpose. The line is made in a building 700 feet long and is tested to pull a dead weight of 2 pounds to the thread. With this tackle the anglers go to the grounds in launches especially designed for the purpose, 18 or 20 feet long with 8 or 10 horsepower gasoline engines. In the stern are two comfortable chair seats, one fishing to the right, the other to the left. On reaching the ground the boatman tosses over the anchor, fixing a float to it that he can cast off. The angler straps on a belt with a socket for the butt of his rod, baits the number 7/0 O'Shaughnessy hook with half a barracuda, or a 6-pound whitefish, or a piece of albacore, and tosses it over in 40 feet of water. He may have to wait for a strike or he may get one immediately. The strike is delicate, and when it comes the angler pays out 10 or 20 feet of line, then strikes. If he hooks the fish there is a heavy rush and the boatman casts off the anchor (fig. 1, pl. 1) and follows the fish, or keeps the angler stern to it until he brings it to gaff, which may take an hour or five, according to the fish. The gaffer, if the fish is large, tows it in, if small (150 pounds), he takes it on deck (fig. 2, pl. 1) and goes into port (fig. 3, pl. II), where scores of people hurry down to the dock to see the fish weighed.

The tuna of the Pacific, or horse mackerel, or tunny, is taken in the Mediterranean in great nets, miles long, being driven in, and the nets at Sicily are of great value. In America the tuna, of three kinds, is taken as sport and is also used as a food fish. The leaping tuna comes into Catalina in June and remains until January. It is considered the greatest of all game fishes. The tackle is a 24-ounce rod, a 24-thread Cuttyhunk or other good line, and a large reel of Vom Hofe make. The angler does not wear a belt, but has a socket on the seat for the butt of the rod. (Fig. 5, pl. III.) Flying fish is the bait, which is trolled about 100 feet behind the boat. Anglers play the fish and troll for it. They also approach the schools and cast the heavy bait in front of them. The fish average 170 pounds (fig. 6, pl. III) and the record is 251 pounds with the tackle described. Market fishermen fish with heavy lines from sail boats, but the fish is so powerful that few care to do it. The fish is a famous leaper before it is hooked and when feeding, and preys almost exclusively on flying fish and squid. It is found in all temperate and semitropic seas, and often weighs 1,500 pounds. This tuna is fished for a quarter of a mile offshore on about 4 miles of coast at Santa Catalina and has not been taken with a rod in any other locality. It has been known to tow a boat for 30 miles.

The albacore, long-finned tuna, or alalonga, ranges up to 100 pounds and is found in many localities off Santa Catalina Island. It lives in deep water but near the surface. It looks something like the blue tuna but has very long

pectoral fins. It is followed by anglers and taken with either a 6-ounce rod with 6 or 3 thread line (this for experts) or a 9-ounce rod with 9-thread line. The bait is sardine and the fish are so ravenous that they will at times snatch a sardine from one's hand, or the game can be hooked at the side of the boat when the school is located, during which operation the bait is towed behind the boat.

The yellow-finned tuna, which is a beautiful fish and attains a weight of 100 pounds, averaging 45, is common in Japan and at Honolulu, and appears at Santa Catalina in September. The largest specimens are taken with rod and reel for market and sport. It resembles the leaping tuna but has a short fin, with the finlets a vivid lemon-yellow. (Fig. 11, pl. VI.) It will tow a boat 2 or 3 miles.

The bonito or skip jack is another of the beautiful fishes of California and other seas. It is taken with a 6-ounce rod, no. 6 line, small hook (7/0), and sardine bait. The hook in baiting is thrust through the mouth, out and into the side, the mouth of the fish closed by being wound by wire. The bonito attains a weight of 20 pounds and is a vigorous fighter, having a peculiar wriggling motion, and playing on the surface entirely. The angler follows it in launches.

The oceanic bonito comes in early spring. It attains a weight of 25 pounds, is beautifully barred and silvery. It is taken on a 6-ounce rod, and a line that will stand a dead strain of 12 pounds; sardine bait, a long piano wire leader, 6/0 hook and light sinker. (Fig. 4, pl. II.) The boat proceeds at a rate of 3 or 4 miles an hour trolling 80 feet of line, and the fish is gaffed when brought in.

The white sea bass is a food and game fish of California attaining a weight of 100 pounds. It is taken by market men in nets at Monterey, but at Catalina is a great game fish (fig. 7), and to encourage anglers to use light rods valuable prizes are offered for the big specimens. The club record is 60 pounds. The fish is taken with a 9-ounce rod, 9-thread line, by trolling with a sardine on a 7/0 hook and 6-foot piano wire leader. It makes a fine play, and requires skill to land. The white sea bass appears in May and disappears in August, and except in Monterey may be considered an offshore fish, being taken in greatest numbers at the Channel Islands of California. In the Gulf of California it attains a weight of 150 pounds, and is often taken in the surf on the east coast of the Gulf, north of Tiburon. It prefers flying-fish bait, but live smelt or sardine is good; also a Wilson spoon in trolling. The live bait is used in still-fishing, the plan being to drop an empty hook into a school of sardines and snag a fish, which, if there is a white sea bass around, will be taken at once. Remarkable catches are made in Avalon Bay, where the fish all weigh over 50 pounds. There is another species of the fish, averaging 15 pounds, called "sea trout," which is taken in the same way. Both species are related to the eastern weakfish, or squeteague.

The yellowtail of the Pacific coast is not the yellowtail of Florida, but is closely related to the amberfish, or amber jack, of the latter region. It is the common fish of southern California, where it attains weight of 100 pounds. The rod record is 60 pounds. It is a beautiful fish, blue, silver, with yellow median line fins and finlets, and all in all the hardest fighting fish known. It is taken by hand lines for the market in deep water near shore or at the surface. In the early season it runs in schools, but breaks up and solitary fish are often seen. If the winter in southern California is warm and dry, the yellowtail is taken every month in the year, but if cold the fish goes to offshore banks or down into very deep water, where its food supply also doubtless winters. It is taken from rowboats (fig. 8, pl. IV) or launches, with rods 6 or 9 ounce split bamboo, 6 feet or over in length; medium-sized reel, 9-thread line, with 6-foot leader of wire, 7/0 hook, and large flying-fish or small sardine bait (large fish take the former). It can be taken by still fishing or trolling, is a wharf fish as well, and is also taken under kelp patches miles out to sea. It is the fish of the people in California, worth thousands to the state as a game fish (fig. 11, pl. VI), and equally valuable as a food supply to the masses. It spawns in the summer.

The barracuda, found in schools in California in summer, is taken in gill nets, also on light tackle rods. It is a good food but poor game fish. In August the schools break up and individual fish are seen. The barracuda takes sardine or smelt bait.

The ocean sunfish (fig. 9, pl. V) taken for sport, attains a weight of 2,200 pounds in California, and is found all over the world in temperate waters. It takes bait but rarely. The author hooked one August 26, 1908, and landed it by rushing at it in a launch, gaffing it quickly, and holding on to it, despite its rushes. It weighed half a ton doubtless, and was 10 feet high. This fish is very common in southern California waters. On pleasant days it can be seen jumping, and the pursuit of it constitutes sport for those who like lusty pastimes at sea. It is generally taken with a spear, but to hook it and rush the launch in and gaff it before it goes down is a game that has no little excitement. I have taken large specimens off the Atlantic coast in this way and once off the Florida coast. No more extraordinary creature can be imagined than this colossus with no appreciable tail, a fish all head with its two huge fins pointing up and down, dotted with waving parasites, splashed and spotted with membranifera, sailing along in the deep blue sea. The small ones go in schools. The skin is used as sandpaper, the muscle as rubber for balls.

The California flying fish is taken as food in seven ways: One by setting a gill net at the surface; the fish is so stupid that the moment it touches the net it stops and turns over and is easily caught. The sportsmanlike way to take it is to shoot it with a shotgun. This I have accomplished by seating myself

in the bow of a fast launch, and as the flying fish rises on either hand shooting it either to the right or left. A good dog might be trained to spring and retrieve flying fish, though the ordinary plan is to run alongside and take them with a scoop net. The fish are in demand as food but are more valuable as bait for tuna or yellow-tail fishing, bringing $1 a dozen in the season from May to October. Numbers of people have been struck by them. One hit the writer in the neck and nearly knocked him overboard. The fish does not fly but soars, holding its wings rigid and covering a distance of a quarter of a mile.

At Santa Catalina the sheepshead is a good game fish. It is taken either from the rocks or from the boats near shore. The tackle used is an 8 or 9 ounce rod, a 6-thread line, and abalone or crayfish bait. A sinker should be used, as the fish is found on or near the bottom.

A good hard-fighting fish caught here is the leaping shark, taken from the beach of Catalina Harbor with a light rod. Like the tarpon, the fish will leap as soon as hooked, and for a while makes a very fair fight.

SALMON AND TROUT IN CALIFORNIA.

One of the finest game fishes in America is the salmon, taken with rod and reel in the streams and rivers of Canada. On the Pacific coast the salmon congregate in Monterey Bay before entering the rivers. At Monterey, Santa Cruz, and Capitola they are fished for from boats, the professional fishermen with big boats, using hand lines and heavy sinkers, in water 40 or 50 feet deep, with sardine bait, but the sportsmen using a rod weighing 9 ounces, with a 9-thread line and 7/0 hook baited with smelt, anchovy, or sardine. A sinker is needed, and an ingenious device is used to release the sinker and enable the man to play the fish. The line near the hook is connected by a thread on which is run a pipe sinker of lead. When the fish strikes the thread breaks, releasing the line, and the angler plays the salmon, which comes to the surface and leaps, making a fine play. Large catches are made (fig. 10, pl. v).

California abounds in trout, and the methods of angling are the same as in the East, 2, 3, 4, 6, and 8 ounce split bamboos being the rods most in vogue, with "E" silk lines and 6-foot leaders and one fly, of a kind depending upon the locality. At Klamath Lake, where the giant rainbows are found, the "March Brown" fly is the best, the fish making a fine play, leaping from the water. In Feather River, Plumas County, Cal., they are taken in the same way. The river is swift, and the fly fishing excellent, big deep pools being found everywhere here. A cork fly or "grasshopper" is very killing.

In the Sacramento, also in the Kern and other streams, the fishing is excellent with the fly. The black bass has been introduced, also the striped bass in the waters about San Francisco Bay.

ON FLORIDA COASTS.

Florida is famous for its game fishes, and, except the tarpon, they are also food fishes. The tarpon is the great game fish of the world. In some localities it is taken with hand lines, but the method in vogue among sportsmen is to take it with a 9-ounce rod, 9-thread line, and 10/0 hook with mullet bait. The boat (launch or rowboat) trolls slowly, with 30 or 40 feet of line out, and at the strike the fish goes into the air in repeated leaps, giving a fine play. One hundred miles south of Galveston, on the Gulf, is the Aransas Pass Tarpon Club, a well-known organization, and when brought to the boat here the fish is towed inshore, measured, and released. Here, as in Florida as well, in shallow water, the big jewfish also is taken, with 16-ounce rods, 24-thread line, large hook, and wire leader. This fish attains a weight of 400 or 500 pounds, is sluggish, and found in holes.

One of the interesting food and game fishes is the hogfish, beautiful in rich red tints and with waving plume-like fins. A hand line is used for its capture, the sinker on the bottom and large hook 2 feet above, so that it will swing clear of the coral. This is lowered in water from 30 to 60 feet deep in the coral, and catches of 15 pounds are taken.

In shallow waters the most beautiful of all the Florida fishes is the gray snapper. It is caught by the professionals with hand lines, as above, with crawfish or conch bait; but an 8-ounce bass rod is to the sportsman's taste, with a fine no. 6 line, and a bunch of small sardines for bait. The fish resembles a black bass, and plays like one, but does not jump. There are a number of snappers, all caught the same way.

Related to the snappers is the beautiful little yellowtail, with yellow stripes and fins. A 6-ounce rod, a no. 6 line, and 4-inch hook baited with crawfish is the lure, and on the shallow reef among the gorgonians or sea fans it is found in great numbers, affording good sport, besides being an excellent pan fish. This fish is quite different from the big yellowtail of the California coast.

Along the mainland is found the sea trout or squeteague, a fine game fish, taken with the same tackle. No fish makes a better fight. The bait for it may be sardine, smelt, or crab.

Common wharf fishes of Florida are the porgies, which throng some localities in myriads. They are good pan fish.

Notable food fishes here are the groupers. The red grouper is the most valuable, and specimens weighing 50 pounds have been taken. It is a deep-water fish, caught on a hand line, with conch bait or anything at hand. Other groupers are taken on the same tackle (hook above the sinker).

The ladyfish is a splendid game fish, ranging up to 6 and 7 pounds, long, slender, and silvery. A 6 or 8 ounce rod, 6-thread line, crab or fish bait is the

tackle. Upon being hooked the fish leaps into the air and literally dances over the water on its tail. The bonyfish is very similar in its action.

The common pan fish on the reef is the grunt, found literally in thousands. It is rather a poor game fish, but makes a fairly good play on a 6-ounce trout rod. Any bait is acceptable to the grunt, but especially crayfish. As its name suggests, it grunts when taken out of the water.

On the reefs are a number of fishes known as "jacks," ranging up to 16 pounds and over. They run in schools and chase sardines, and can be caught with this bait. Few fish make a more game play, dashing through the water and breaking the line of the novice. They are mostly caught on the hand line trolling, but the true way to take them is with a 6-ounce rod, 6 feet long, 6 line, 7/0 hook, and sardine bait. This tackle is small and delicate for the fish, but can take them in the hands of a skillful angler.

At Palm Beach, the amberfish is taken with a 10-ounce rod, 21-thread line, and sardine bait. Boats are rowed out beyond the surf and still fishing is the method. This fish is allied to the California yellowtail, and puts up a splendid fight. The angler wears a belt with a leather socket in which he secures a certain leverage, and often plays the fish an hour or more before he brings it to gaff. (Fig. 12, pl. VI.) Amber jacks of 50 or 60 pounds are taken in this way.

The northern bluefish is a splendid catch on a 9-ounce rod, 9-thread line. So are the channel bass, drumfish, and striped bass. All should be taken with this tackle

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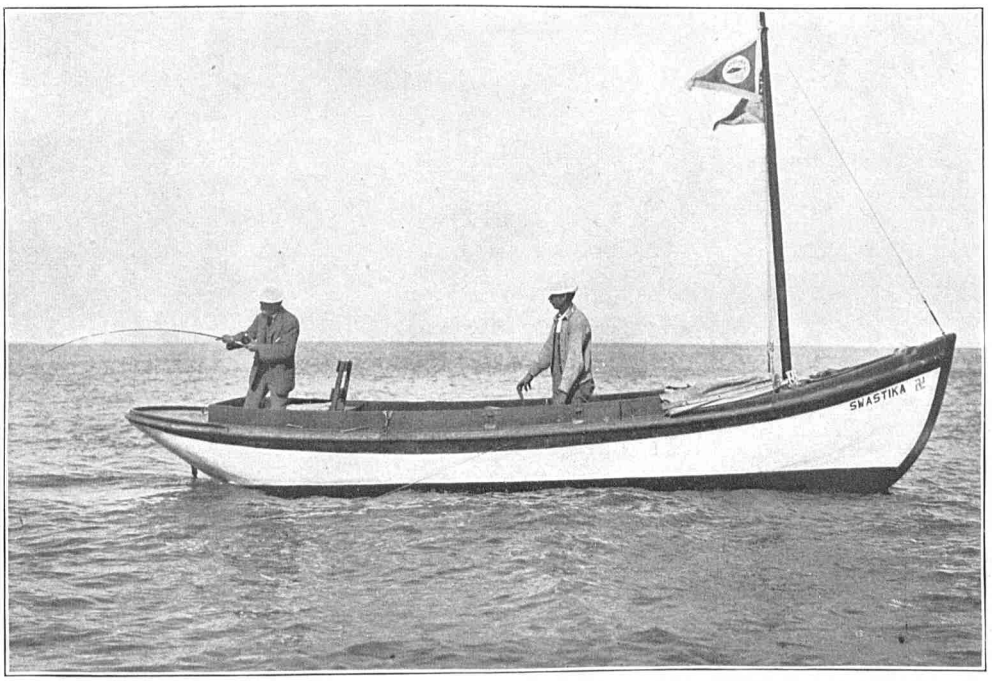

FIG. 1.—The strike.

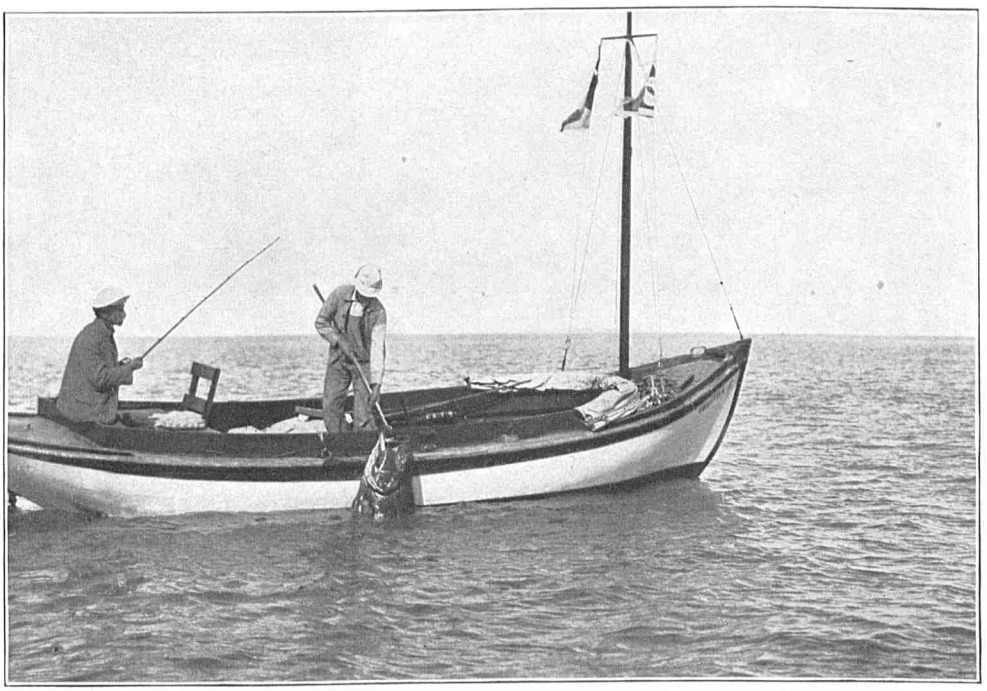

FIG. 2.—Gaffing a 240-pound capture.

ANGLING FOR BLACK SEA BASS, SANTA CATALINA ISLAND.

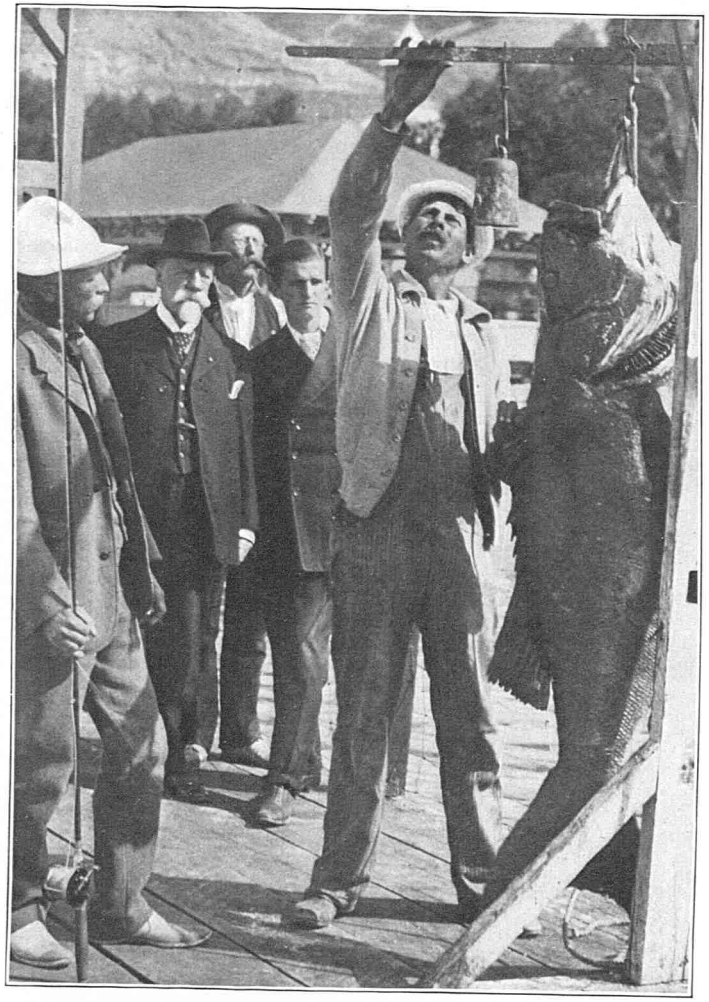

FIG. 3.—Weighing a big sea bass.

FIG. 4.—The record bonito, Tuna Club 1908, rod and reel. This fish, which weighed 22 pounds, fought for more than an hour. Note angler's belt with socket for rod butt.

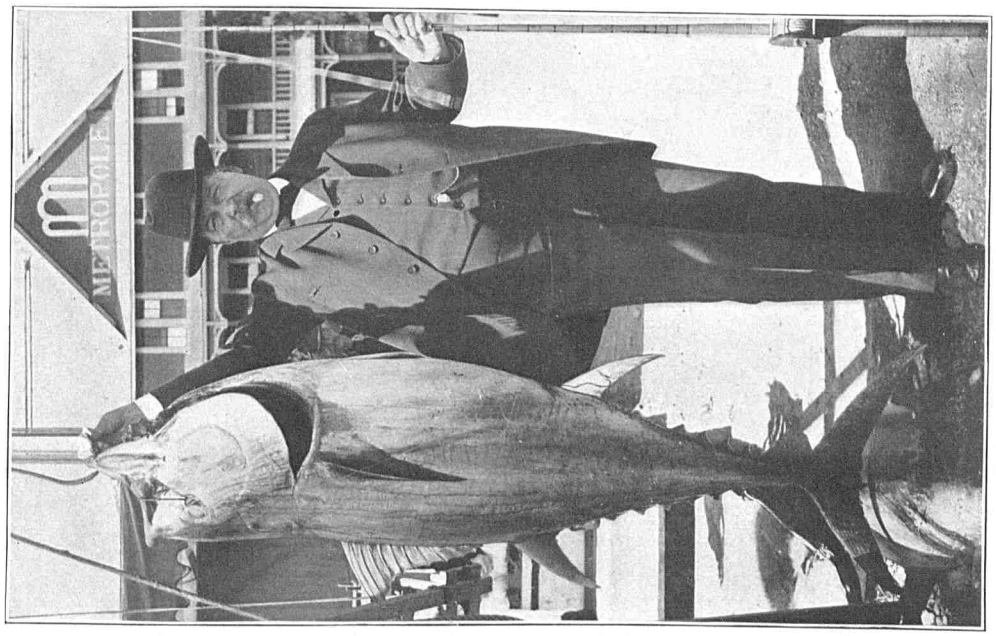

FIG. 6.—Leaping tuna caught with rod and reel at Santa Catalina.

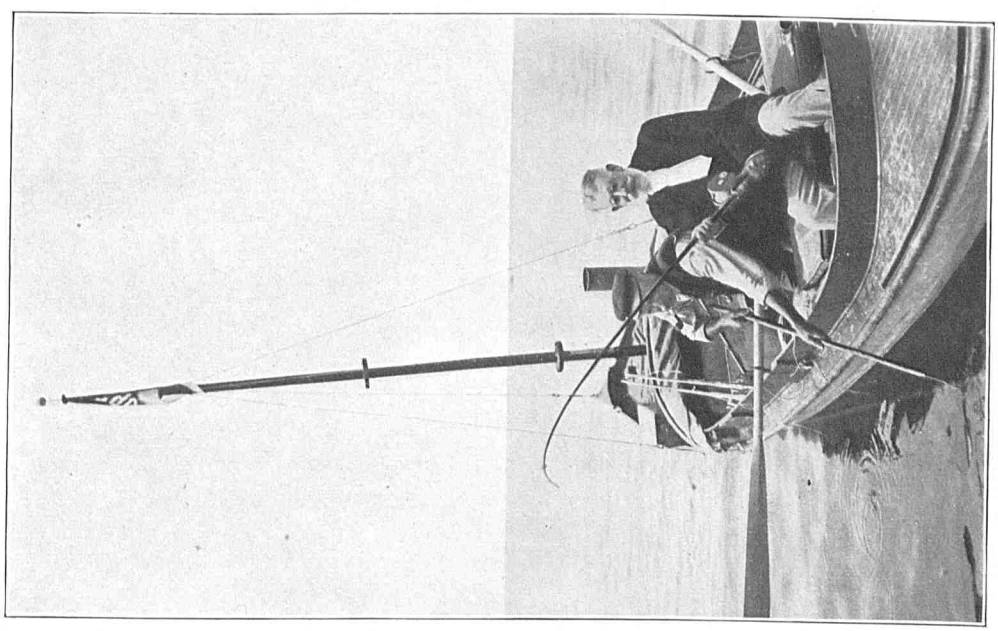

FIG. 5.—Angling for tuna, Santa Catalina. Typical launch and equipment.

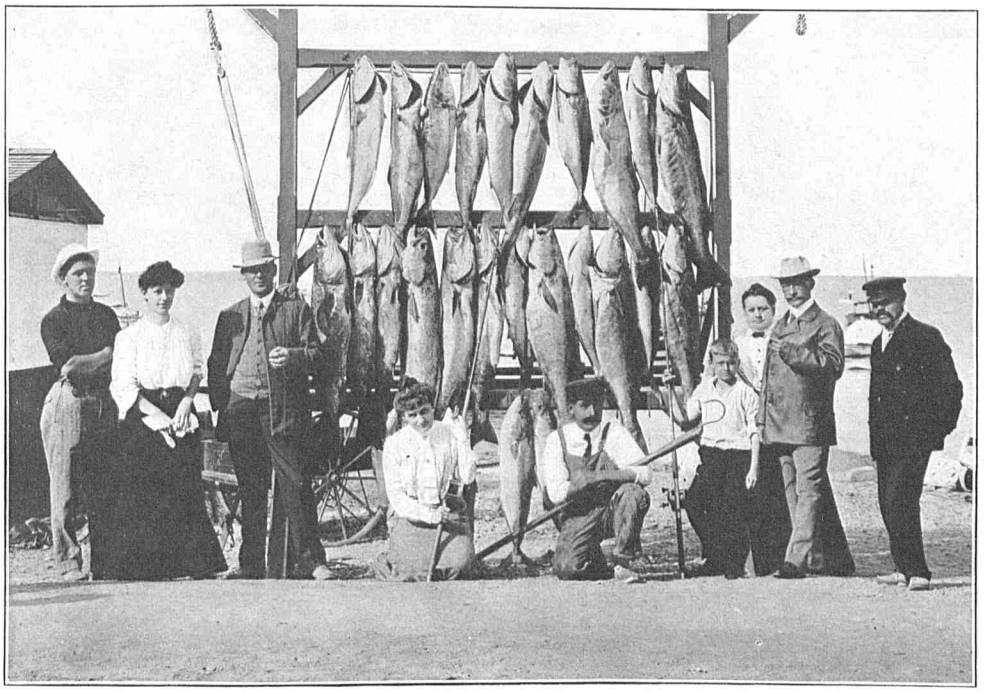

FIG. 7.—A day's sport at Santa Catalina Island with white sea bass.

FIG. 8.—The yellowtail anglers of Avalon Bay, California (Santa Catalina Island); 200 to 300 boats often seen, all fishing with rod and reel.

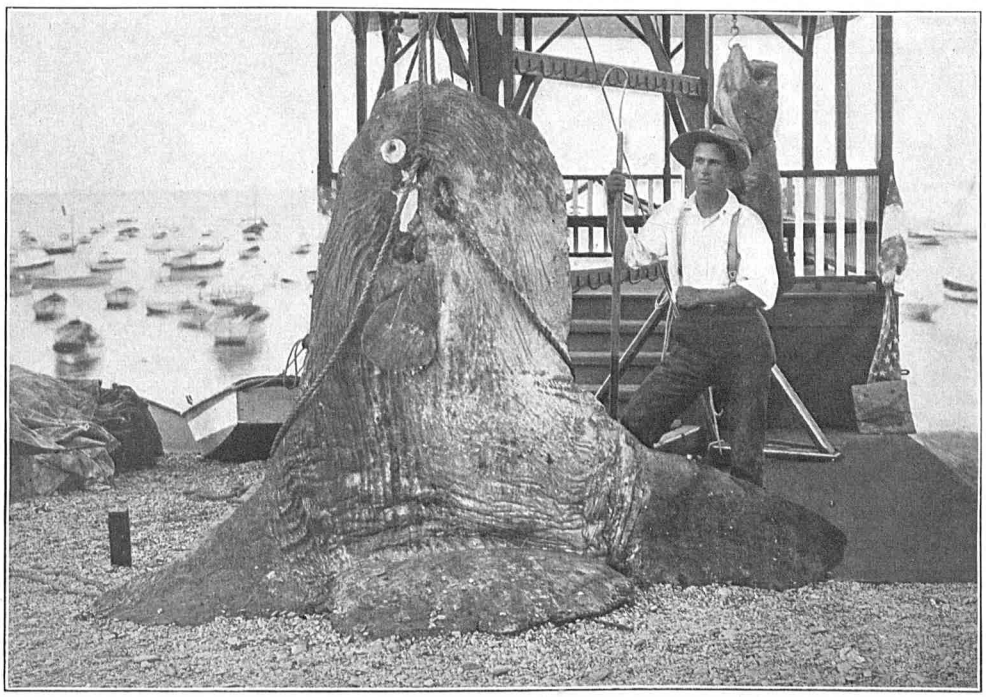

FIG. 9.—The record sunfish, Santa Catalina Island, too heavy to weigh; estimated at 2,500 pounds.

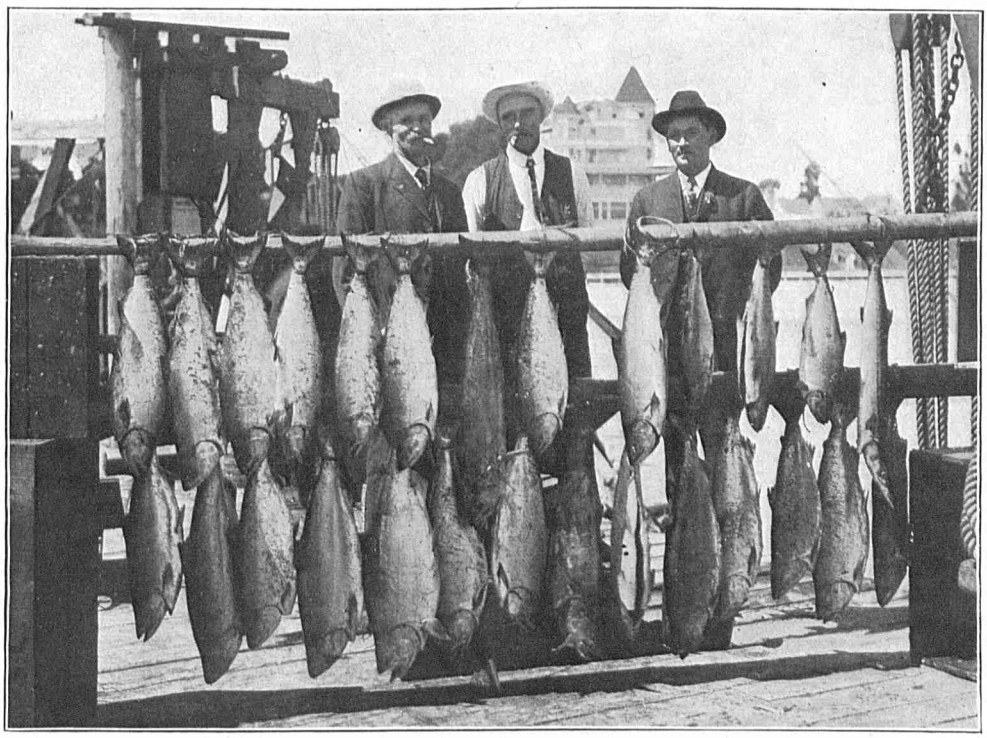

FIG. 10.—A salmon (rod and reel) catch, Del Monte, California.

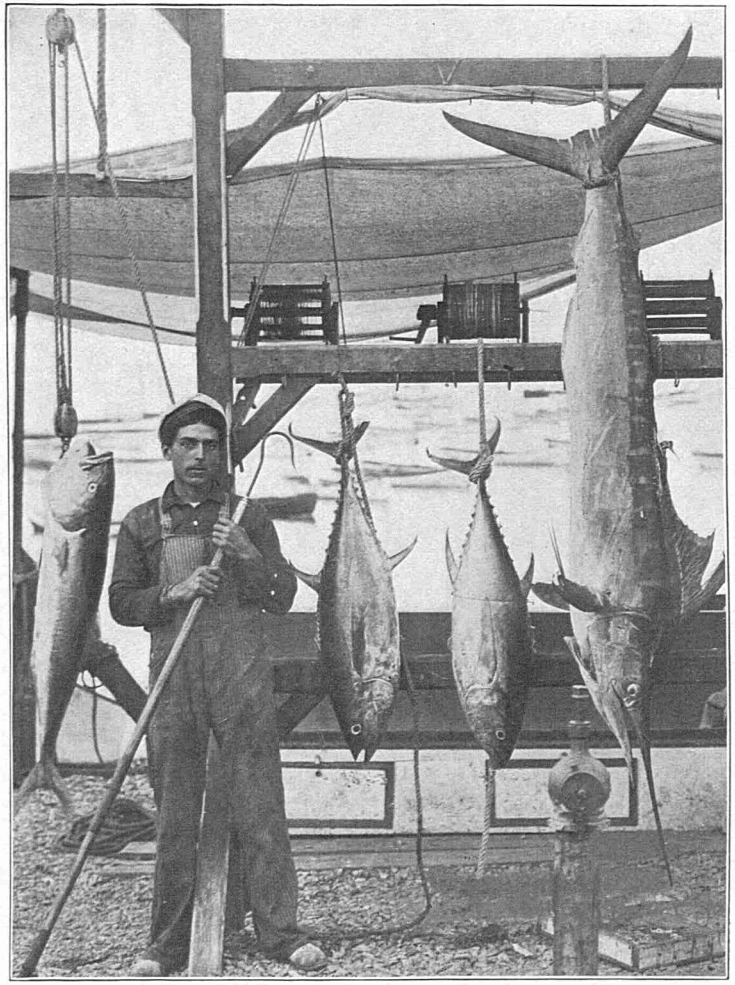

FIG. 11.—Swordfish (*Tetrapturus*), yellow-fin tuna, and yellowtail, caught with rod and reel at Santa Catalina Island.

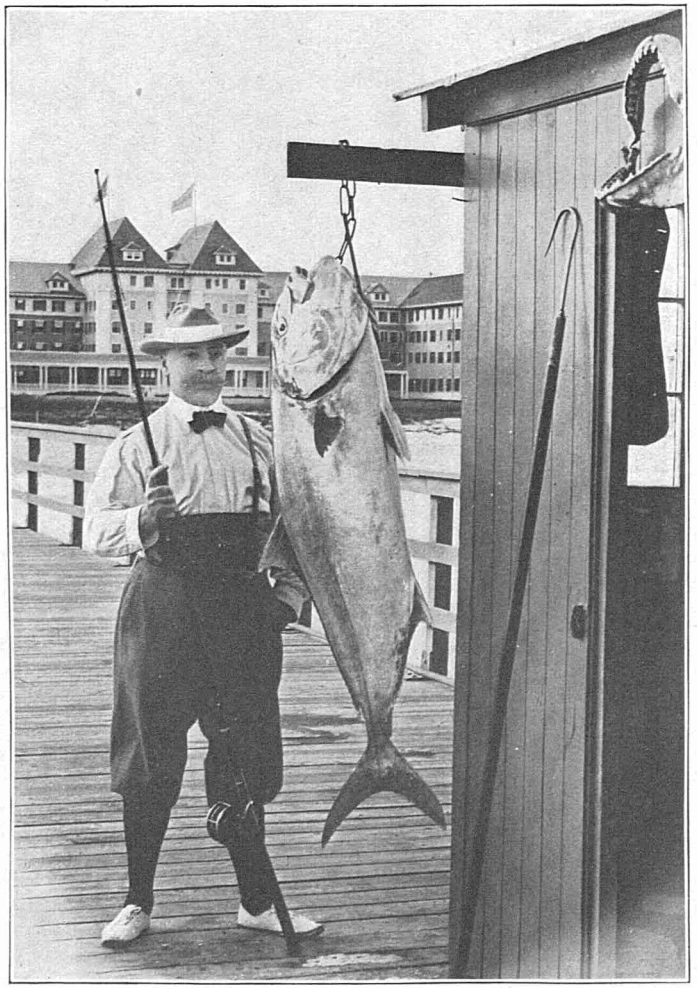

FIG. 12.—Amber jack, caught at Palm Beach, Florida.

LOBSTERS AND THE LOBSTER PROBLEM IN MASSACHUSETTS

By George W. Field

Chairman Massachusetts Board of Fisheries and Game

WITH DISCUSSION

Address before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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LOBSTERS AND THE LOBSTER PROBLEM IN MASSACHUSETTS.

By GEORGE W. FIELD,
Chairman Massachusetts Board of Fisheries and Game.

Mr. PRESIDENT AND GENTLEMEN OF THE CONGRESS: In 1873 it was found necessary in the state of Massachusetts to make some regulations restricting the catching of lobsters. At that time the first law was made, and, as subsequent experience has shown, it proved to be a biological blunder and a thoroughly illogical procedure. They started out with the assumption that if the lobster had an opportunity to lay one litter of eggs this would be sufficient to insure a supply for increasing demand. It was not long after that it was found the lobster supply in the neighborhood of the great cities—particularly New York and Boston, the great markets—was decreasing very rapidly; and that decrease has continued until now the supply in Massachusetts has diminished over 66 per cent in the neighborhood of Boston in three years. If we examine the evidence, there is absolutely no question that this decline in the lobster catch is an actual and not a theoretical one.

It is evident, first, from the fact that it is necessary for the fisherman to tend, not 10, 20, 30, or 50 traps, as he formerly did, but he must now have 100 or 200, in order to get the same number of lobsters. The number of men in the business has increased very largely. They are obliged to cover a larger area in order to get a proper supply. But most prominent of all is the fact that the number of egg-bearing lobsters has diminished in proportion to the total number of lobsters in the water. In 1890 statistical evidence indicated that there was about 1 egg-bearing lobster to every 20 which were not carrying eggs; whereas in 1907 it was found that this ratio had declined so that there was only about 1 egg-bearing lobster to every 101, showing that the egg-bearing lobsters were only about one-fifth as numerous as they formerly were. This has come about from the fact that we have been taking from the larger lobsters, the adult lobsters, each year. We have, in other words, been cutting off the big timber, which was producing the new material, the seed, and in that way we have diminished the reproductive capacity of the race. During the past four years, in my personal experience, we made measurements of about 3,500 or 4,000 egg-bearing lobsters each year. These measurements have been carefully made, and the lobsters

divided into two classes—those above 12 inches and those below. I have some figures here indicating the decline in the size of the egg-bearing lobsters, and with that comes the very important fact that there has been a corresponding decrease in the number of eggs laid. In 1905 we found there were 185 lobsters over 12 inches long to every 100 under 12. In 1906 this number had declined to 133 above 12 inches to every 100 under 12; in 1907 came the very astonishing reduction of 39 over 12 inches to every 100 under 12; in 1908 there was somewhat of a rise, and the number this year was 110 over 12 to every 100 under 12. Taking the average of the first two years, we find that the average for 1905–6 was 159 lobsters over 12 to every 100 under 12; and in 1907–8 this had declined to 75 egg-bearing lobsters over 12 to every 100 under 12.

This seems to me to indicate that we are going at the matter in the wrong manner; that the present laws are entirely illogical, and that we are decreasing annually the reproductive capacity of the race by destroying the best of the lobsters of reproductive age each year. To meet this situation we are suggesting to the legislature of Massachusetts that just as it was responsible for this original law, so it should pass another law to remedy the situation. It should consider the fact that it is necessary to have a law which will meet the conditions by protecting not alone the young lobster before it reaches an age of economic importance, but also the adult lobster, which produces the eggs necessary for propagation.

We need to support the work of the Bureau of Fisheries, which for many years has been propagating the lobster artificially; the admirable work of the Rhode Island commission, and the work of the Maine commission, all of which has been on the line of saving the eggs which have been laid. There should be some provision made for increasing the number of eggs which are annually produced, and it seems that this could best be done by protecting the adults, say above 11 or 12 inches long, in such a way that their capture may be entirely prevented. We are therefore suggesting that the traps be made with a ring 3¼ or 3½ inches in diameter, a size so small that the large lobsters of reproductive age can not enter. And thus we will have a law that will enforce itself automatically. The traps are to be officially inspected and sealed, and these traps must conform to the specifications, and in that way the law could be readily and economically enforced.

DISCUSSION.

The PRESIDENT. Is there approval or objection to the measure that has been suggested?

Mr. HENRY T. ROOT (Rhode Island). I was going to say, Mr. President, I hoped that the president would answer that question. I will say, however, while I am on my feet, that in Rhode Island the increase of lobsters has been amazing within the last three years. We lay it wholly to protection. We are enforcing the laws thoroughly. We put men in prison; we fine them hundreds of dollars; and we have got them now so that the fishermen are with us. Our laws are enforced, and the small lobsters are not put on the market. We save the egg lobsters and get more than we want by paying for them.

When we first started in the lobster business it was difficult for us to get 80 to 100 egg lobsters. This year we had no trouble in getting several thousand; last year we got more than we could begin to handle, simply paying the fishermen a little more than market price for egg lobsters. We save them in that way; we strip them, put them back in the water, and they go on; and in two years more, if the fishermen do not get them, we will have more egg lobsters—the same ones.

This method of Doctor Field's sounds very plausible, but with all his arguments the Rhode Island commission has not been able to give it their indorsement. I think thorough protection will increase lobster production, as it has in our waters of Narragansett Bay, where we got last year, in that little bay, over 1,000,000 pounds of lobsters. This year we should get many more; and the fishermen are getting rich in the short time they have to catch them. One man on Block Island made alone $1,300 catching lobsters in the open season. We feel that we are doing great work there. I wish that Doctor Mead was here. And, furthermore, I would like to say, while I am on my feet, the whole inception of our industry was inaugurated by President Bumpus.

The PRESIDENT. The figures that Mr. Root has mentioned are really very striking, both to us of this country and to our foreign friends; and when I tell the visiting delegates that this summer I have been paying 25 cents per pound for lobsters, and state the total amount of lobster meat taken in the lower part of Narragansett Bay, which is a small bay (the lobsters do not get very far up the bay of our smallest state), you have a sum of money coming in to the poor fishermen there that is really very considerable; those figures once more, Mr. Root? It was how many?

Mr. ROOT. One million pounds last year. This year it will be a good deal less.

The PRESIDENT. It was 1,000,000 pounds. This makes $250,000 that has come into the pockets of fishermen. There are only a few lobster fishermen in Narragansett Bay.

If you will permit the chair to comment a little further, I would say that I believe that the large catch of lobsters in Narragansett Bay at the present time is the direct result of the efforts of Doctor Mead and his associates on the Rhode Island commission in their methods of hatching the lobster during the first few stages of its development. You all know how the young lobster first hatches from the egg and swims upon the surface, a perfectly helpless, pelagic animal. After it has reached the stage of its fourth moult it is, psychologically, itself; it is no longer timid, but it becomes pugnacious. It is no longer a helpless and free-swimming animal. It settles to the bottom, and it is pretty well able to look out for itself. Now, what the Rhode Island commission has attempted is to keep the lobsters confined until the young lobsters have

developed sufficiently to reach that stage when they are able to look out for themselves. It is practically the same thing that the men interested in trout have been doing for the trout. They have kept the trout until they reached the fingerling stage, and the Rhode Island commission has been keeping the lobsters until they have reached the self-help stage. Of course a part of the itinerary in New England is a visit to the station at Wickford, where this work has been going on. And I might further add that I believe what I say in regard to the work of the commission there will be subscribed to by every practical fisherman in the state of Rhode Island, i. e., that the commission is working in perfect sympathy with the local fishermen.

The paper is now open to discussion. I am sorry I have taken so much of the time myself.

Mr. W. H. BOARDMAN (Rhode Island). Mr. President, I wish to corroborate Mr. Root's statement, and refer to something he did not mention—a fact which has been brought to my attention especially, because I went down to visit the Block Island lobster fisheries.

That year, or previous to two years ago, there was no lobster fishing there at all. The fishermen had gone out of business entirely. Of course at one time, years ago, the little ground surrounding the island was good ground for fishing; but, as I understand it, for the last six or seven years there have been absolutely no pots set around Block Island, because it did not pay. Last year two or three fishermen ventured to set a few traps, and they were successful to so great an extent that in this year, in July—no, in the early part of August—when I went down to visit those fisheries, I found 80 fishermen had engaged in the business, with 3,000 traps. In a visit of two or three days' duration I saw quite a number of lobster fishermen come in with their daily catch, and it was simply enormous. Each daily catch represented a large profit. In some cases it would take fifteen minutes to dip it with a bucket from the car to the vehicle on the shore with which they went to the markets. They claim, without exception, and I have no doubt they are uniformly enforcing the law, that it is all due to the Rhode Island commission's preventing the catching of less than 9-inch lobsters and the fishermen's sending what egg-bearing lobsters they have to our commission at Wickford, to be hatched and raised, as you say, to the fourth stage.

The PRESIDENT. This island is a relatively small island, some 10 square miles in extent, in the mouth of Narragansett Bay—an island of, say, 5 miles in extreme length and 3 miles in width.

I am inclined to dwell on this a moment, because the efforts to stimulate and revive a waning industry are so often fruitless that when activities result in apparently pronounced success it seems to me well for us to accentuate that.

Are there other comments to be made upon this matter of the lobster fisheries? I wish that Professor Prince, if he is here, would speak. The work in this line I know has been carried on in thorough sympathy between the two governments. Are there others who will speak? If not, the next paper will be called for.

Mr. DONAHUE (State Fish Commissioner of Maine). Mr. President——

The PRESIDENT. Will you be good enough to come to the platform? Permit me to say to the foreign delegates that the lobster industry of the Maine coast is one of the most important in the United States.

Mr. DONAHUE. During the remarks with reference to the lobster made by the gentleman who preceded me, it occurred to me that it might be of interest to some who are not as familiar with it as we are to know just what the conditions are as we find them in Maine, where we produce more lobsters than all the rest of the country combined and therefore think we ought to know something about the subject.

We produced last year 8,000,000 pounds of large lobsters. We do not make our measurement as small as the other states. Massachusetts and Rhode Island have a 9-inch law; so do the provinces. Our lobster, to be a legal lobster under the laws, must be approximately 10½ inches long. We changed our method of measuring at the last legislative session, which was a year ago last winter, on account of the curious way

the fishermen had of doing it. A lobster must as the law required measure 10½ inches from the end of the nose to the rear end of the tail shell. Now a lobster is in two sections, practically, so that he can be pulled out or shoved in; and if a fisherman wanted to make a lobster "go" that was a little short, he would give it a little wrench or pull and it would stay out. Then he would say to the buyer, "Measure him again;" and the lobster would be found to be all right. That was a very bad practice, and by it we have lost a great many lobsters. The fellow that caught the lobster might be able to sell it, but in a day or so the man who bought it would have a dead lobster instead of a live one. So we adopted a new law. A lobster now must be measured from the end of the nose to the rear end of the body shell. This is one solid shell, and there is no way to pull it up or stretch it in any way, so that 4¾ inches is the measure now, which is approximately the same 10½ inches, but measured in a different way.

Last year, as I say, we caught of that size of lobsters between 8,000,000 and 9,000,000 pounds; and the value of them, as received by the fishermen, who are the first hands, was a little less than $2,000,000.

We have a method of propagating in Maine which is a little different from that in Massachusetts, inasmuch as we buy the seed-bearing lobsters, or egg-bearing, as we call it, from the fishermen and pay 25 per cent more for them than the fishermen can get from the market man for the regular legal lobster. We do that to make it an object for the men to save every one of those seed-bearing lobsters, as we do not want to lose a single one.

The lobster is very prolific, producing from 25,000 to 80,000 seeds at a batch. They are great breeders. If they had not been, our lobsters would have been exterminated long ago.

By the way, I want to say that some lobster fishermen do not think it is a good plan to have these fish hatched artificially. They believe the best way is to throw them over into the natural element and let them do their own hatching. If the fisherman objects to our taking them, we say, "We will buy the lobster; and you may throw it overboard in the ocean, and if you catch that lobster to-morrow we will buy it again." But in order to find out how much we were getting "stuck" on that proposition, we took a small punch and punched the thin part of the tail. This does not hurt the lobster. We mark it, and in that way we keep tab on how many times we buy the same lobster in the same year. In one case we rebought a lobster four times, but very seldom do we buy one the second time.

We take those that the fishermen do not object to our carrying to the hatchery. We have a hatchery in the state, owned by the United States Government, at Boothbay Harbor, and they hatch all the lobsters that we can get for them. The State pays us the price that we pay for the lobsters, or the market price of the lobsters. Those lobsters are held in pounds throughout the winter and hatched the following spring, and last year (1907) the hatchery at Boothbay Harbor hatched and liberated on the coast of Maine approximately 140,000,000 of those small lobsters. They are taken out after they are able to swim around pretty well and take fairly good care of themselves and liberated in the coves, up in the mouths of the rivers, where the water is not too fresh, and some out in the ocean. It is more or less a question as to the best way to propagate the lobster, and how to get the best results. After the little fellows are once liberated, why, of course, we do not know any more about them, excepting the results we get the next season or two seasons after in fishing. We have been following that plan now for a number of years—it has been ten years—and our fishing last year showed a marked increase; the year before a slight increase. For this year the statistics are not entirely made up, yet as far as we have gone it appears that we are going to get a very fair increase in the catch of lobsters. The 9-inch law which is in force in Massachusetts and Rhode Island and the Provinces is more or less trouble among our fishermen, from the fact that a fisherman is more or less greedy; when he gets something that he has picked up out of the water he is apt to want to sell it; and we have enforced the law by making it a pen-

alty—a fine of $1—for each lobster found in any man's possession, whether he caught it or whether he bought it, under approximately 10½ inches in length.

That has been the system for a number of years. Two years ago, when I took charge of this department, I was very familiar with the lobster men and their habits, having lived among them for a number of years; and I adopted a different method of enforcement. While I enforce the same penalties and in some cases have to use the same methods, I commenced, instead of using legal suasion on the fishermen, using moral suasion, and have at the present time educated in the neighborhood of 2,000 of them (there are only about 3,000 that fish for lobsters) up to the idea that it is to their disadvantage to sell a lobster before he is approximately 10½ inches in length. So that at the present time there are nearly 2,000 lobster fishermen that are helping the wardens to enforce the law. Without moral suasion, as one of the wardens said to me, "It would take one warden to every fisherman, and then you could not enforce the law," which is true.

The lobsters of the state of Maine are unquestionably on the increase, and we are satisfied in the state that the method we have adopted there is the best method. The idea of selling the small lobster and preserving the big ones is thought the best way by some. As a fair illustration of that I would like to ask any of you gentlemen from the West, where you raise beef, what would you think of a man out there in the beef business who sold all of his veals? Where would he get any beef to sell later? Would not that be practically where we would be if we sold our small lobsters and did not save the big ones, the seed lobsters? What would result if we did not let the small ones grow? This method, I hope, will be the one that will be adopted by the other states. We were very sorry that Maine and Massachusetts could not agree upon a uniform law, because Massachusetts is our nearest neighbor and competitor, and we find it more or less difficult to enforce the law with Boston a market for 9-inch lobsters. I hope the time will soon come when we can all have the same law, and I have not a doubt that, if we do, and give the proper protection to the lobster, there will be no question but we will have all the lobsters that this country wants at fair prices. This year Rhode Island has a larger catch than for a number of years; in fact, it has been a long time since Rhode Island produced many lobsters, and the way it looks now lobsters ought to be sold at lower prices. They have been too high, and it is no wonder that the public found fault with the price. But with the proper protection of the seed and by giving the little ones a chance to grow there is no question in my mind but what we will all have lobsters at fair prices.

Mr. FRYER. There is one small point which has not been touched upon, and that is the question of what I may call the "average minimum size" at which lobsters are found to be egg bearing. The term "egg bearing" I assume is used in the sense of carrying the eggs externally. We have had in England precisely the same trouble that you have had here, accentuated by the fact that where we have tried a law prohibiting the landing of lobsters carrying berries we have found that the fishermen have evaded that law by brushing the eggs off, and in many cases, at certain stages of development, it is very difficult to prove that such a thing has been done and that the eggs have not been shed naturally. In the same direction we have adopted a method of regulation similar to that which you are adopting here, namely, regulation by size; but we are very much in doubt what is the proper size limit to fix. On some parts of our coast we are told that there is a diminutive race of lobsters, and that they never attain what is now the legal minimum size, namely, 8 inches; but within the last two years I have been having some rather extensive observations carried out with regard to the size of lobsters and their condition at the different sizes. One result of that has been certainly in the direction advocated by the last speaker, namely, that the minimum size at which lobsters may be taken needs increasing. We have found—I have not the exact figures in my mind, but I think I am within the limit in saying it—that not one in a thousand female lobsters under 8 inches in length has been found to be carrying eggs externally, which goes to show that our law, fixing the minimum at 8 inches, is per-

fectly inadequate. On certain parts of the coast the size has been increased to 9 inches, and the method that I personally favor, for the moment at any rate, pending more detailed information, is that, in order to meet the prejudices of the fishermen, the minimum size should be gradually increased—if it is only by half an inch per annum—until such a minimum size is fixed as will give at least a fair chance to every lobster—every female lobster—to reproduce once before it is brought to the market.

With respect to the very ingenious suggestion that has been made of a lobster trap which shall let out all the little ones and exclude all the big ones, I would suggest that the practical effect of that, if it works out as the fishermen would like to see it work, would be that you would allow the fishermen to catch all the lobsters at the reproductive size. They would spare them until they reach that size, and in the meantime they would be prevented from catching the larger patriarchs of the ocean. But those patriarchs of the ocean will not live forever, and the time will come when they will die off. You will then have killed off all those of the intermediate, egg-bearing size, and will only have those of the smaller non-egg-bearing size left.

Mr. PAUL NORTH (Ohio). Mr. President, it occurs to me that we of the West, who know nothing about the lobster, except our own peculiar brotherly kind that we have out there, do not help you eastern people to the extent of stopping our states from being the dumping ground of these short lobsters. All we see with us is the short lobster, and it seems to us that if we could pass laws in our state, where we do not raise lobsters, that would prevent the sale of lobsters below the legal limit, we would be assisting very materially in the enforcement of the lobster laws in the states where they raise them. The 6 and 8 inch lobster is common with us, except when they get man size.

The PRESIDENT. The question is raised: At what time does the lobster reach sexual maturity, i. e., the average time, as indicated by its size? I know that the United States Government has made a great many observations on that, and I dare say that Doctor Field has them at his tongue's end. Do you remember, Doctor Field? The smallest lobster to be found with eggs, I believe, was 7¾ inches.

Dr. GEORGE W. FIELD. How many? That was only one individual. Less than 3 per cent of those that have eggs are under 9 inches long, and the great bulk of those we have taken have had an average size of about 11 inches. There is a small number above that. We will say that with a curve the number below 11 inches and the number above 11 inches is about the same; but those above 11 inches will produce at least five times as many eggs as those on the other side—as those between 9 and 11 inches. You doubtless know that the first litter of the lobster is about 5,000 to 10,000 eggs, and then each two years later it doubles—10,000, 20,000, 40,000, 80,000, the largest being 96,000 eggs in a 17-inch lobster.

Now, our contention is that if you make a perpetually closed period on the large lobsters you preserve those large lobsters which produce eggs and have a continual supply of eggs hatching, and have young ones growing up from them; whereas, at present you have a wide-open season, so to speak, on all the lobsters above 9 inches which are exposed to capture. Under the laws proposed it will be legal to take them only when between 9 and 11 inches, and they are protected except during a very small portion of this breeding age, i. e., when below 9 inches.

In regard to the simile of the cattle breeder, it is perhaps not necessary to say that there is no sane cattle breeder who would kill off his very best stock. He would keep the best stock for breeders. He would kill off a proportion of the small stock, and keep the very best selected animals for breeders, and that seems to me is precisely what we ought to do in the case of the lobster.

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A METHOD OF LOBSTER CULTURE

By A. D. Mead, Ph. D.

Member of the Rhode Island Commission of Inland Fisheries

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908, and awarded the prize of one hundred dollars in gold offered by Hermon C. Bumpus for an original and practical method of lobster culture

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A METHOD OF LOBSTER CULTURE.

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THE PROBLEM.

Artifical breeding ought not to be content to do at its best only what nature does unaided. It obtains its real justification only when it is in a position to surpass nature in her achievements. Only thus can it accomplish the task set it—to fill up the gaps caused by years of excessive fishing. (Professor Ehrenbaum, in Mitteilungen des Deutschen Seefischereivereins, Bd. 23, Juni 1907.—Translated.)

In the case of the lobster, nature has made adequate provision for the protection of the eggs up to the very time they are hatched. As is well known, the eggs laid in July or later in the summer or in the early fall are carried attached to the swimmerets under the abdomen of the female lobster, and there are protected until the following June or July, when they hatch out (fig. 9, pl. XI). The young lobsters, also, when they have successfully passed through three moults and have attained the so-called "bottom stages" are equipped with structures and instincts which fit them exceedingly well for holding their own in the struggle for existence; but there intervenes between the hatching and the attainment of the first bottom stage a brief period of two or three weeks in which the young lobsters, having lost utterly the protection of the mother animals, and not yet having acquired either the structure or the instinct which would give them a reasonable degree of individual security, are exposed and helpless to an extraordinary degree.

Those who have studied the question of lobster culture agree that this short interval may properly be called the "critical period" in the lobster's life—the one in which occurs by far the greatest mortality. That the species has maintained itself without diminution (until the recent inroads by man) in spite of this unprotected period may be explained by the enormous productivity of the individuals. A lobster of ordinary size—say 12 inches—produces at one time, according to Herrick, an average of about 20,000 eggs, which are so well protected that practically all of them hatch. This excessive productivity, however, though a potent means of protection to the species, affords no protection to the individuals.

To one confronting the problem of lobster culture these cardinal facts in the natural history of the lobster point out clearly and exactly the line of attack. We can hardly expect to increase the number of eggs per lobster (and fortunately the number is at any rate very large) or to improve on the natural method of protecting and hatching the eggs, for up to the time when the eggs are actually hatched there seems to be little loss in nature. It is during that period directly after hatching, when in nature the larvæ are neither protected from without nor equipped for self-protection, that the great opportunity offers to "surpass the achievements of nature" by protecting these individuals. Not only is this period the weak spot which artificial culture may be expected to strengthen, but the superabundance of larvæ normally produced for sacrifice is advantageous because it furnishes readily the material for cultivation. Still another condition particularly favors the cultivation of lobsters: It is that the critical period between the perfectly protected eggs and the well-equipped bottom-living lobsterlings is so short (only two or three weeks). Altogether, then, there would seem to be no doubt that the greatest practical results of lobster culture can be obtained by concentrating efforts upon protecting the fry through the critical larval period. This has been quite generally and independently recognized as a fact by those who have studied the lobster problem, and it has been an incentive to the many attempts made by experimenters on both sides of the Atlantic to rear lobsters through the larval stages. It has been, likewise, the incentive to a continuous series of experiments and operations extending over exactly ten years, which have resulted in the method of lobster culture presented in this paper.

CHARACTERS AND HABITS OF LARVAL LOBSTERS.

It is a necessary preliminary to an intelligible account of the method itself to sketch briefly the habits of larval lobsters and to indicate some of the peculiar difficulties which the method has to overcome.

Hatching.—The hatching of the ripe eggs of an individual female lobster is a gradual process requiring at least several days and varying with the temperature of the water and perhaps with the lateness of the season. In the latter part of June, when nearly ripe lobsters are brought into the warm water of a shallow estuary, the hatching is accelerated. The fact of the gradual breaking loose of the eggs is undoubtedly of importance in the economy of the lobster under natural conditions, for it prevents the possibility of the swarming of the young fry and the attendant dangers of speedy recognition and capture.

When the larval lobsters first break out of the egg membrane they are closely coiled in the form of an oval spheroid with the terminal segments of the abdomen bent over the rostrum. In a few moments they straighten out and expand and then immediately take up the pelagic life and instincts which they retain until they reach the so-called "fourth stage," after shedding their skins three times.

Mode of swimming.—The young lobsters swim by means of vibratory movements of their exopodite appendages, which stand out like blades from the thoracic legs, and the swimming is augmented by irregular jerky strokes of the very muscular "tail" or abdomen, which, in all the larval stages, is bent at a considerable angle to the cephalothorax. The swimming must be characterized as slow and weak when we have in mind for comparison that of most young fishes. At any time during the three larval stages the fry can easily be picked out by means of a small scoop, or even with the hand.

In general, too, the swimming seems to be aimless in direction, so that the fry are easily carried along by the slightest current. This statement, however, though generally true, requires qualification, for under the influence of special stimuli the movements often become directive. The larvæ respond to varying directions and intensities of light and, in experimental tests, to the direction of electrical currents. They avoid, in many cases, light-colored objects if near, and they are attracted by food to a rather slight degree. They will go only very short distances, however, after particles of food or living prey. During all the larval stages they exhibit practically no instinct of fear and, while they avoid light surfaces, they do not try to escape capture. The heliotropic and photopathic reactions and what may be described as the general aimlessness of movement are things to be reckoned with in developing a practical method of lobster culture.

Food.—The natural food of the lobster must, of course, consist of pelagic organisms. In an examination by Dr. L. W. Williams of the stomach contents of larvæ in all three stages taken from the rearing bags at our station,[a] a large percentage were shown to have fed upon copepods and diatoms. The young lobsters, however, are not distinctly fastidious in this respect, and the nature of the stomach contents of the fry in their natural habitat would doubtless be found to vary according to the variety of available pelagic food.

Moulting and the larval stages.—The instincts and behavior and the general appearance of the three successive larval stages are generally similar in respect to the features just referred to. The stages are, however, structurally well defined and readily recognized, there being for each a number of clearly diagnostic peculiarities. (See text figures p. 224 and 225.) Among the most obvious and easily recognizable are, for the first stage, the small size of the larvæ and the absence of swimmerets on the under side of the abdomen; for the second stage, the somewhat increased size, the presence of several pairs of swimmerets and the absence of "tail fins" or the lateral appendages of the penultimate segment; for the third stage, the presence of both swimmerets and "tail fins." All stages have the exopodite swimming appendages and the corresponding pelagic habit; none has the functional chelæ or "big claws" of the adult lobster.

According to the observations made by Doctor Hadley at our station the average measurements of the three successive larval stages are 8, 9½, and 11

[a] Station of the Rhode Island Commission of Fisheries at Wickford, R. I., on Narragansett Bay.

millimeters, respectively. There is, however, a considerable range of variation in size, particularly in the second and third stages, and there is good evidence that in general the larger specimens are the better fed. For this reason the average size of the lobsters of the various stages in particular rearing experiments forms, perhaps, a basis for judging whether the lobsters are doing well or not.

The length of the combined larval stages varies greatly and is directly and powerfully influenced by the temperature and food. It ranges from nine to

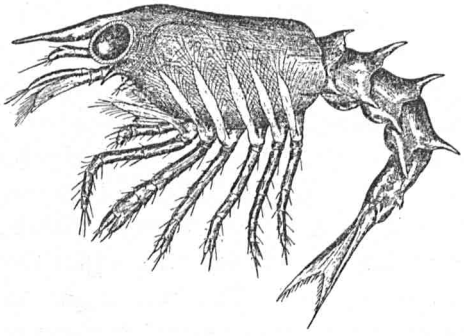

FIG. 1.—First stage.

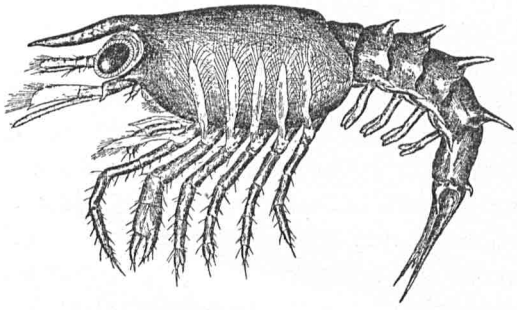

FIG. 2.—Second stage.

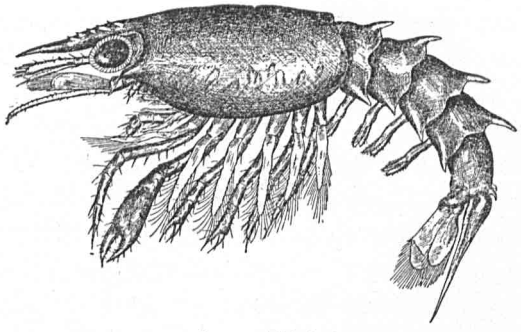

FIG. 3.—Third stage.

LARVAL LOBSTERS, LATERAL VIEW.

more than twenty-five days (twenty-one days is extremely long at Wickford). From the viewpoint of practical culture, the length of the total larval period is of very great importance, though the duration of the first, second, and third stages severally does not seem to be so.

DIFFICULTIES IN REARING.

In artificial culture, of course, the fry must be confined in large numbers, and it is practically impossible to separate them from one another. Therein appears an initial difficulty which all experimenters have had immediately thrust upon them. The fry, under these circumstances, at once exhibit a most

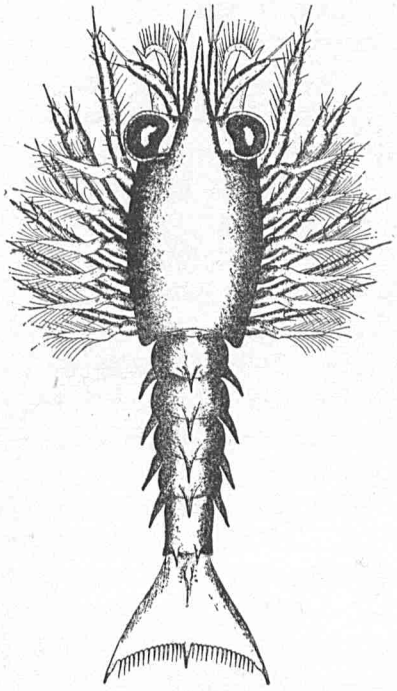

FIG. 4.—First stage.

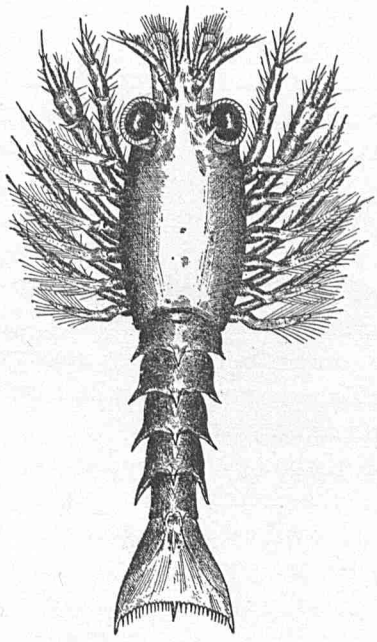

FIG. 5.—Second stage.

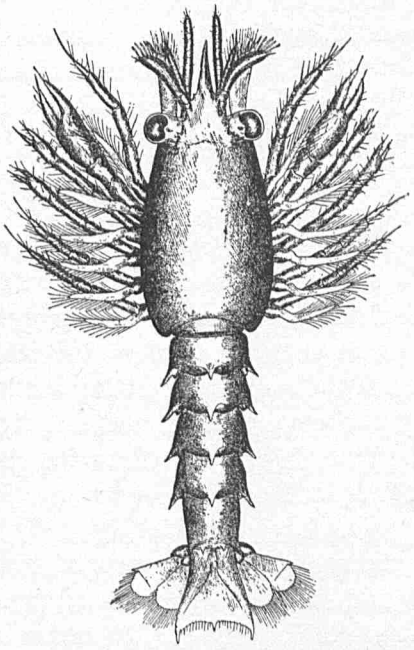

FIG. 6.—Third stage.

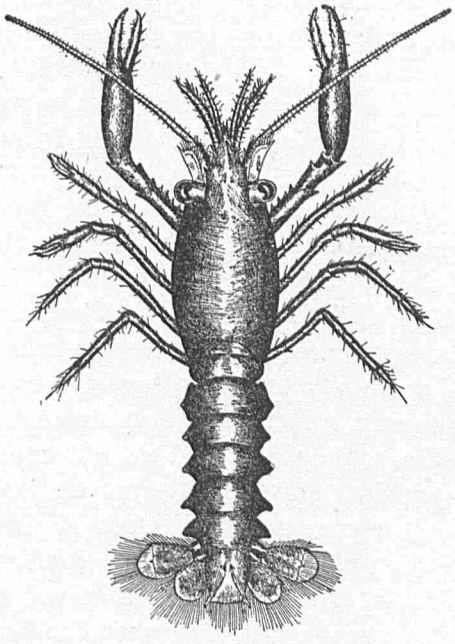

FIG. 7.—Fourth stage.

LARVAL LOBSTERS, DORSAL VIEW.

unnatural and vicious cannibalism which Professor Morgan might well have added to his enumeration of characteristics impossible of development through natural selection and the survival of the fittest, for it can hardly be exercised at all under natural conditions. But whether this evil instinct arises from one or another biological antecedent cause or is a special inspiration in each particular case, its reality is a constant and serious menace to lobster-culture operations. The cannibalistic tendencies are manifested as soon as the fry are hatched and continue throughout the larval period and, for that matter, even far beyond it. Not only do the larger and stronger specimens devour the weaker, but individuals of equal strength attack one another, and, apparently, some initial advantage determines the outcome. During the moulting period the mortality from these sources is naturally aggravated, because it is easy to tear to pieces the soft-skinned, freshly moulted individuals, while they, on their part, are unable to fend off attacks.

Swimming habits.—The comparatively aimless and weak swimming habit which characterizes the larvæ of the first three stages would seem, even in nature, to afford no protection, but for cultural operations, where large numbers of larvæ are given the restricted liberty of a small arm of the sea or are more closely confined in cars of any sort, it contributes to one of the most exasperating difficulties. For example, it happened that when the fry in one of the early experiments of this series were placed in a small cove or inlet from the sea, especially prepared and apparently well adapted to their requirements, they were carried out by the first ebbing tide, and when, subsequently, a screen was stretched across the gateway they were carried against it and left stranded high and dry. In the many attempts to confine them in various forms of cars, when the current was allowed to pass through to prevent stagnation, a like result followed—the unresisting fry were always finally borne against the sides or bottom.

Once upon the bottom the larval lobsters are utterly helpless; they lie upon their sides or backs beating the water with their exopodite "fins" and "kicking" with the whole body. They can not crawl; their only salvation is to "kick" themselves loose from entanglement and once more rise in the water. When confined in considerable numbers, even in still water, they inevitably find their way to the bottom as a consequence of their aimless drifting mode of swimming. There they accumulate in corners, pockets, or eddies, and, entangled in débris, they fight and eat one another until, from injury or suffocation, they all perish. For the full appreciation of these difficulties there must be, however, the personal recollection of particular rearing bags in which from day to day the precious living larvæ vanished from sight, and of the quarts of bright pink colored dead specimens mixed with dirt and silt and remnants of unused food that came into view when the bag was raised for inspection. In one of the

earlier experiments 5,000 handsome first-stage larvæ, appropriately designated from their condition the "gilt-edged lot," were placed in a new scrim bag 12 feet square and about 4 feet deep and were carefully tended. Out of the number only two individuals came successfully through to the fourth stage.

Light reactions.—As far as the movements of the larval lobsters are not aimless, they seem to be directed mainly by responses to light stimuli, and vary according to the intensity, color, and direction of rays. They also seem to be modified, indirectly, by background. Doctor Hadley in a study made at our station of the behavior of lobsters observed that the character and responses bore a fairly constant relation, not only to the stage, but to the period within the stage. In cultural operations, where cars are used, the photopathic responses of confined lobsters tend to bring them together into close quarters and are often therefore inimical because of the encouragement that this gives to cannibalism. In attempts to retain the fry in pounds or small estuaries, these responses would very likely tend to carry the lobsters to the shore, to be entangled in the vegetation or stranded at the ebb tide.

Parasites.—External parasites, including stalked protozoa, fungi, diatoms, etc., are often a plague to the confined larvæ. They grow upon the shell and so encumber the larvæ that feeding and moving and breathing also are difficult or impossible. Not infrequently, in fact, the larvæ are so completely covered with these foreign growths that they can hardly be recognized. The parasites are got rid of at each moult, but often they so weaken the larvæ that moulting itself is made impossible. The danger from this source is greatest when, by reason of the low temperature of the water, the duration of the periods between moults is increased.

Food.—Not the least of the difficulties connected with rearing lobster fry is the providing of proper and available food. In small experiments the live copepods and other pelagic food natural to the lobsters in these stages can be supplied; but on a large scale this is not an easy matter. Naturally, food that sinks to the bottom can not be reached by fry that normally swim or float.

Requisites of water, etc.—The foregoing facts regarding the characteristics of the fry in general and the peculiarities which they manifest when in confinement have to be taken into consideration in any attempt to rear the lobster through the critical period of its life. To these considerations must also be added the important question of an adequate supply of water, uncontaminated by chemical or bacterial impurities, constantly furnished with the proper amount of oxygen, and sufficiently free from injurious gases arising from the metabolism of animal or bacterial content. Finally, in any method of lobster culture there must be taken into consideration its practicability when applied on a large scale and its feasibility with regard to the cost of operating.

THE METHOD.

ESSENTIAL FEATURES AND POSSIBLE VARIATIONS.

A method by which lobsters can be reared through the larval stage in such proportions and numbers and at such a cost that it may be called a "practical" method has been gradually evolved at the floating laboratory of the Rhode Island Commission of Inland Fisheries at Wickford, R. I. (fig. 1, pl. VII). Essentially, the method consists of confining the larval lobsters in cars, either of porous material or provided with screen "windows," set into the ocean itself, and of maintaining within the cars, by mechanical means, a continuous gentle current of water having a rotary and upward trend. In details the method allows of wide variation. Good results have been obtained in small cars made out of water pails; in cars approximately 1 foot, 3 feet, 6 feet, and 10 feet in horizontal diameter and 1, 3, or 4 feet deep; and in either square or circular cars of cotton or linen scrim, of bobbinet, of canvas, or of wood. Any constant motive power can be used, according to the exigencies of particular cases—steam, hot-air, or gasoline engines; spring, weight, or water motors; or the water can be stirred by hand, with much labor but good results, as in our early experience. Various forms of power transmission may also, of course, be utilized; belt and rope drives over pulleys and sheaves, and steel shafting with mitered gears, worms, etc., have all been successfully utilized.

HOW THE METHOD MEETS THE DIFFICULTIES.

The way in which this very simple method overcomes the many difficulties of confining larval lobsters may be described in general terms as follows: In the first place the rearing cars are placed directly in the sea, and thereby all the disturbing factors so difficult to control in case of aquarium water which has been pumped and forced through closed pipes, stored in tanks, aerated by air pumps, etc., are at once avoided, and at the same time the various known and the subtle unknown requisites of healthy sea water are assured. The continuous upward spiral current of the contained water is the panacea of numerous troubles. By the upward trend of the current the larvæ are kept always afloat, which is their normal condition and the only one to which they are by structure and habit adapted. The strength of the current easily overpowers their own weak efforts at swimming, sweeps them round and round, and effectually prevents their congregating in common response to the stimuli of light.

When the fry are prevented from getting to the bottom and from congregating anywhere, several difficulties vanish. The effects of cannibalism, which constitute perhaps the most serious difficulty of all, are thereby greatly alleviated, for the fry are to a comparatively great extent prevented from reaching one another, and of course the disastrous effects of their becoming stranded on the sides or lying entangled and fouled at the bottom are also obviated.

Another most important function of the current is the holding in suspension of solid particles of food, so that they come within easy reach of the larvæ. Incidentally, also, it increases the supply and availability of pelagic living food, for the latter is drawn into the car through the bottom and kept alive by normal conditions of the water. An adequate supply of available food is perhaps the most efficacious preventive of cannibalism.

The maintenance of normal conditions of water in a car is also accomplished by this method. The temperature and density of course vary little from that of the surrounding water. The water is constantly renewed either through the porous sides or, in the case of wooden cars, through screen windows in the bottom, egress being allowed for by screens in the sides. Since the current is internal and mainly tangential to the sides of the car, the fry are not carried violently against the ex-current screens, as in the case of a tidal current passing in one side and out the other. There is not much need of rapid renewal of water, however, because the water is continuously brought to the surface by the upward trend of the current, where by exposure to the air it is recuperated with oxygen and relieved of waste gases due to the metabolism of contained animals or the decomposition of unused food.

In a word, it may be said that by this method the pelagic lobster fry may be kept in confinement and under observation in inclosures of natural water, protected from their usual predatory enemies, maintained in natural pelagic condition by being prevented from going to the bottom, provided with either living or artificial food held in suspension, and that the tendency to cannibalism, always evinced when the fry are confined, can be considerably mitigated.

APPARATUS.

The particular form of apparatus by means of which this method has been successfully applied to the rearing of lobster fry during the last few years at Wickford is in some respects a special adaptation to the establishment in connection with which it has been evolved, and certain details of construction are vestiges of former experiments too good to be cast aside, but not to be exactly copied in new construction. As it stands to-day, the apparatus consists of a houseboat built like a catamaran of two pontoons, with a "well" or open space between them, originally intended and used, indeed, for holding experimental cars. At both ends the space between the pontoons is decked and on each deck is a small house. The houseboat floats on the water, moored securely in a small cove directly over the channel in a good tideway (fig. 1, pl. VII). It forms the nucleus of a collection of skeleton rafts which nearly surround it and which all together occupy a considerably larger area than the houseboat itself. Four rafts, 19 by 75½ feet, lying two on either side of the houseboat, contain the cars for hatching and rearing lobster larvæ. The rafts of each pair are bolted fast together and buoyed by barrels (fig. 1). The inside rafts on either side of

the houseboat are fastened to the latter with eyebolts sliding over vertical rods to allow solely for up-and-down motion. Each of the four rafts contains six rearing cars, 10 by 10 feet square and 4 feet deep, so arranged that they can be held down in place or raised out of the water to be cleaned (fig. 4, pl. VIII). The rearing cars are provided with removable windows covered with 16-mesh bronze woven wire screens to allow for renewal of water and to prevent escape of fry. There are two windows about 2 feet square on the bottom and two long narrow ones in the middle of two opposite sides.

For several years previous to last summer canvas bags about the dimensions of these boxes and provided also with screen windows were used almost exclusively. They equaled or perhaps surpassed the boxes in point of efficiency when they were in perfect condition, but were less durable and were more difficult to clean.

The apparatus for keeping the water in motion consists of a two-bladed horizontally placed propeller of about 4½ feet radius not unlike those sometimes in use over restaurant tables (fig. 3 and 4, pl. VIII); the latter, in fact, suggested their adoption. The propeller blades are hung inside the car near the bottom and are made to revolve slowly—about nine revolutions per minute. The motive power for the propeller is furnished by a gasoline engine situated in one of the houses and connected with the propeller shaft by a system of steel shafting and mitered gears (fig. 1, 2, 3, pl. VII and VIII). Each propeller can be thrown in and out of gear independently.

HATCHING METHODS.

Handling the egg lobsters.—The method now used in hatching the eggs is simple. The old female lobsters carrying eggs about ready to hatch (fig. 9, pl. XI) are put directly into boxes and the paddles are set in motion. As the old lobsters crawl about on the bottom of the cars, the eggs hatch out one by one and the larvæ, caught immediately by the upward revolving current, are carried up and off the bottom as they are in the ocean. Twenty to 30, or even 50 to 100, lobsters may be put in one car. When the number of old lobsters is large, we have found it well to replace the long propeller by a shorter one hung somewhat farther from the bottom so that the old lobsters will move freely over the bottom with tails extended and not crowd up into the corners. Screens placed over the top of the box, thereby shading them from the strong light, also help to prevent crowding (fig. 7, pl. X). As soon as a sufficient number of fry have hatched out the old lobsters are removed to another car to repeat the operation. The length of time required to hatch out a full complement of fry in one box varies, of course, according to the various conditions; that is, the number of egg lobsters, the condition of the eggs, the temperature of the water, etc.

Precaution as to age of fry.—It is of great practical importance to have a full complement of fry hatch out as quickly as possible—within at least one day—so that all will be about the same age. Otherwise, when the fry moult the older

individuals, having passed through the moult and recovered their strength and appetites, are very destructive to the smaller or freshly moulted larvæ. The effects of this discrepancy in the ages among lobsters of one batch are especially injurious when the older individuals reach the fourth stage, for the fourth-stage lobsters are endowed with strength, sagacity, directive power of movement, and voracity of appetite far beyond that of the other stages. When, through a difference in age, a number of lobsters enter the fourth stage considerably in advance of the others, they become veritable "sharks," as they are jocularly called by the attendants. On this account in the first experiments with wooden cars a considerable loss was sustained because certain boxes were reserved as hatching boxes and the fry rather than the "hens" were periodically removed (fig. 5, pl. IX). It being impossible to get them all out at one time, those that remained were often taken out together with a younger lot and later on became "sharks" to this brood.

Circulation current.—For the benefit of the fry there is no doubt an optimum current within the car. The current can be controlled to a surprising degree by manipulating the propellers, although the number of revolutions per minute remains constant. A slight inclination to the blades makes a current very slow, while the maximum inclination creates a current like a mill race. The length of the blades, the amount of taper from base to apex, and the height of the blades in the water cause different effects in the character of the current; for example, the relations of the rotary and the upward components of the current can be thus controlled and varied within wide limits. By these and other variations the fry can be made to scatter evenly at all depths and distances from the center or to occupy various zones or strata. Experience and judgment must decide the question of optimum current at each particular phase. In general, it may be said that a gentle, even current made by a long, well-tapered blade and slight angle of inclination is usually best.

Containers for eggs and fry.—When the rearing was done in canvas bags the old lobsters were confined in crates suspended in the bags, because, if let loose in the bottom, they were apt to tear the canvas. The crates were necessarily less spacious and had the objection of being in the way of the newly hatched fry, which were sometimes swept against them with considerable force by the current. To the other advantages of the wooden car as compared with the canvas bag must be added its capacity to function as a hatching pen. The design and construction of these wooden cars, together with many other recent improvements, should be credited to Mr. E. W. Barnes, the superintendent of the station.

In the beginning of the experiments at Wickford the fry were transported from the Woods Hole hatchery by the Bureau of Fisheries, with whom we were in cooperation. Later experiments showed that the eggs could be stripped off in the usual way and placed in small rearing bags, where they would hatch.

From these the fry were transferred to rearing cars. This method gave place to that of putting the ripe egg lobsters in shallow crates floated near the surface in the big canvas rearing bags, and then the two modifications just described were introduced.

CARE OF THE FRY.

After the fry have been hatched and transferred to the proper rearing car they respond well to careful treatment, and the degree of success of an individual experiment depends to a large degree on the care that is given.

Screens.—Attention to the condition of the screens is worth while, for the intake and outflow of water can thus be regulated and, incidentally, the fine particles of food can be retained in the car for longer or shorter time by this means. The screens which we have used have been made of copper wire, bronze, galvanized iron, galvanized steel, scrim, and painted wire of various meshes and sizes of wire or thread. None is thoroughly satisfactory. They are all apt to clog up or to tear easily. It is to be hoped that the perforated sheet brass or bronze, which has been tried by Professor Gorham to his satisfaction in small experiments, will prove to be a great improvement.

Food.—An appropriate and available food supply sufficient in quantity to fulfill the demands of healthy growth is, of course, a prime requisite in any fish culture, but in the case of the lobster larvæ even this may not be adequate. Not only should the fry have food enough for their healthy growth, but they should never be allowed to go hungry. From hunger to cannibalism is a short step, and although, by means of the current, the fry are kept from congregating, and danger from cannibalism is, therefore, greatly lessened, there still occur chances of individuals coming momentarily in contact with one another, and, if hungry, they make the most of these opportunities. When not hungry, and when the cannibal instinct is not aggravated by the crowding together, they are fairly peaceable.

The question of the best food for the lobster fry is still open. There are many kinds that the fry will eat, and fortunately by means of the stirring apparatus small pieces of almost any kind can be held suspended and therefore made available, but the fry have preferences, and, furthermore, the choice must involve the consideration of cost, the labor of preparation, waste, and the effect upon the water in the cars of the grease or decaying residue.

In some of the earlier experiments several years ago the highly epicurean diet of lobster liver was offered, and the young larvæ, innocent of its antecedents and, as it proved, unaware of its consequences, devoured the finely divided morsels ravenously. This diet did not agree with them and was discontinued partly on this account and partly because for operations on a large scale there were financial objections to its use. Shredded codfish, finely cut or ground fish of various kinds, clams, mussels, raw beef, beef liver, boiled beef, and many other foods have been tried. The fry are extravagantly fond of fresh fish,

especially the strongly flavored and oily varieties, but the pieces uneaten foul the car and are therefore objectionable. Clams cut out and finely chopped or ground have been in very general use with us. The expense, however, of digging and opening and the considerable waste in the larger pieces of tough muscle, together with the amount of decayed residue which accumulates in the course of two weeks during which the fry usually remain in one car, are objections to its continued use.

In a careful series of food experiments at our station Doctor Emmel decided, after using clam, liver, beef, and some other foods, that chopped raw beef gave best results, all points considered. However, with a large quantity of fry to feed, it was found to be difficult to prepare cheap raw beef finely enough divided for practical use. Boiled beef coarsely ground (Hamburg steak), boiled, and ground again, and then beaten up in water with an egg beater, was used with gratifying results during the latter part of the present season. It has the advantage that it is easily prepared, even though the cheapest and toughest is chosen, and that when prepared in this way the pieces are small and correspondingly numerous. The particles are readily held in suspension, and when put into the water little by little with a long-handled scoop or shaken through a fine netting (fig. 6, pl. IX) they form a cloud of light-colored and easily visible particles and are distributed so evenly that they are available at every feeding to all the thousands of individuals in the car. Prepared in this manner, the beef leaves scarcely any residue; most of the uneaten finely divided pieces are carried out gradually through the windows. In its use one prime precaution must be taken; it must not be allowed to become stale or previously soaked with water. Care should also be taken to put the raw beef into boiling water and so to coagulate and conserve its albumens.

For the reason alluded to, namely, to keep the larvæ not only well fed but constantly satiated, thereby preventing cannibalism, it is necessary to feed them often, and we adopted the schedule of feeding every two hours through the night and day. Even with the best possible food—and this has yet to be discovered—there is a "knack" in feeding, and it is one of the points in the care of the fry which repays careful attention, for, besides having the advantages just mentioned, adequate food undoubtedly increases the rate of growth and shortens the larval period.

Parasitic growth.—The dangers from diatomaceous, fungous, and similar parasitic growths are especially serious when the time between moults, due to cold water or poor food, is relatively long. For this reason the temperature is a factor to be considered, when possible, in locating a hatchery. At our station the duration of the whole larval period is from nine to (rarely) twenty-one days, most of the larvæ hatching in about twelve to fourteen days. We have found that shading the cars, as Professor Gorham recommended, seems to prevent to a marked degree the growth of diatoms, and also that in the wooden cars recently

adopted the annoyance from this source is very slight when the cars are shaded. The insides of all of the boxes were painted, four of them white and the rest green. We could not see that either color had an advantage, judging from the output of fry. Whether the comparative immunity from diatoms of fry in boxes as compared with those in canvas bags was due to the painted surfaces of the wooden sides or to some other factor it is difficult to say. Animal growths, barnacles, molgulas, oysters, mussels, etc., were abundant even on the painted surfaces, and were scraped off each time the cars were raised. Canvas screens on frames (fig. 7, pl. x), set up like the sides of a roof so as to afford shade and to shed rain water, which occasionally comes down in such quantities as decidedly to freshen the upper strata of water, are strongly to be recommended.

RESULTS.

CRITERIA OF EFFICIENCY.

As was stated at the outset, this series of experiments and operations was undertaken in the conviction that the paramount problem of lobster culture was to raise the larvæ to the fourth or lobsterling stage. It has been constantly borne in mind that a method of doing this to be practical must be able to produce large quantities and without too great expense either for the cost of the plant or for operation. Further criteria of efficiency are, first, the proportion of fourth-stage lobsters to first stage, and, second, the number of "fours" to egg lobsters, provided, of course, that the egg lobsters on hand do not overcrowd the capacity of the particular plant. In placing a value upon proportions of "fourth stagers" to newly hatched fry, the number of fry dealt with in a single experiment has been considered; e. g., a proportion of 50 per cent carried through in an experiment with 500 or 1,000 fry can not fairly be compared with the same proportion in an experiment in which 5,000 or 20,000 fry are used. We have allowed ourselves also to mark our progress and the value of the method by comparison, first, with our former results, and, second, with the experiments undertaken elsewhere having the same end in view.

YEARLY PROGRESS AND OUTPUT.

Since this year happens to be the decennial of this particular series of experiments and operations, the presentation of a short summary of yearly results in regard to total output is appropriate.

In 1898 Doctor Bumpus, now the honorable president of this congress, and at that time director of the United States Fish Commission laboratory at Woods Hole and member of the Rhode Island Commission of Inland Fisheries, had the faith and courage to undertake a new series of experiments in rearing the larval lobsters. Judged by the ingenuity put into them, and the experience and encouragement got out of them, these experiments during the first year were

successful, though the number of fry reared was small. The total output is summarized in the report of the work in these words:

> Several lobsters were actually raised to the stage when the characters of the adult are assumed—the fourth moult.[a]

The next year, 1899, the results were better because of the use of "a large bag of scrim made after the fashion of a fish pocket and hanging down into the water from a square floating frame." The output is given in the following words:

> By the methods above described, and after many failures, accidents, and reverses, we succeeded in raising several hundred lobsters to the fourth stage.

During the following season, 1900, several lots of newly hatched fry were transported from the United States Fish Commission station at Woods Hole to the new floating laboratory of the Rhode Island Commission of Inland Fisheries at Wickford, R. I. (the two commissions working in cooperation), where further experiments with scrim bags were started parallel to those still being conducted at Woods Hole. At the floating laboratory at Wickford the trials and reverses of the previous year at Woods Hole were again experienced, but the experiments were under the eye of the person in charge, by night as well as by day, because the small houseboat functioned as a residence. The greatest virtue of the loosely hung scrim bags consisted in the undulatory "peristaltic" movements, due to wind and tide, which tended to keep the lobsters off the bottom, but it was observed that during the nights there were periods of dead calm and of slack tide, when the fry sank to the bottom and died. This led to the simple conclusion that if the fry, left to themselves, persisted in sinking to the bottom to die they must be stirred up and prevented from sinking; so after this they were stirred with an oar continually night and day. The total reared to the fourth stage was 3,425. The results showed unequivocally that the proper principle had been discovered, and immediately plans were laid to substitute a mechanical apparatus by which this method could be less laboriously carried into effect. Curiously enough, some large two-bladed fans revolving over a restaurant table for the purpose of driving away flies suggested the type of apparatus suited to the purpose, and this type has been in use ever since.

The next year, 1901, the United States Bureau of Fisheries again cooperated with the Rhode Island commission. Some of the fry were imported from Woods Hole and some were hatched at Wickford. An apparatus for using the two-bladed propeller was designed and installed by Mr. G. H. Sherwood. The results confirmed the correctness of the principle, and the output for the year was 8,974.

During the subsequent years the method has been developed and the apparatus again and again remodeled to incorporate the results of our failures and

[a] Bumpus, Twenty-ninth Annual Report of the Rhode Island Commissioners of Inland Fisheries, 1898, p. 98.

successes and in the effort to obtain results on a scale large enough and with cost small enough to deserve the adjective "practical." The total outputs for the years are:

1898	(a)	1902	27,300	1906	c189,384
1899	(b)	1903	13,500	1907	d294,896
1900	3,425	1904	50,597	1908	e322,672
1901	8,974	1905	103,572		

The rearing of considerably over 300,000 lobsters in the small plant at Wickford recalls the confession of faith written ten years ago, at the conclusion of the first season's work:

> We know perfectly well that many others have failed in doing what we attempt, but until we are thoroughly convinced that the young lobster can not be "brooded" we propose to continue our work.[f]

Manner of determining output.—It was early realized that "estimates" of the number of lobsters in experimental work are practically worthless and therefore all the fourth-stage lobsters which are taken account of at all (many thousands of others have accidentally escaped) have been individually counted. Within the last few years, when the numbers have run up into hundreds of thousands, the operation of counting individuals has consumed much time, but the satisfaction of accuracy in results has been sufficient compensation. A comparatively easy and very accurate method of counting is now in use. The "lobsterlings" are dipped out of the hatching boxes with flat woven-wire strainers which take up from one to twenty at a sweep; these are recorded on an automatic counting register held in the hand. The count at each sitting is then posted (fig. 7 pl. x).

It is of little use to estimate the number of a lot of first-stage fry. More than once the lots so estimated, even by experts, have yielded not more than 10 per cent of the estimated number; sometimes, no doubt, they would run considerably over. For this reason, in order to ascertain the proportion of newly hatched fry to the fourth stage, the individuals must be counted both before and after the experiment. This is a rather tedious process, but it is warranted and necessary when new methods or new devices of construction are tested for their relative efficiency.

Tested by this method both the large canvas bags used until this year and the present boxes have yielded on several tests 40 per cent of fourth-stage lobsters from lots of 20,000 newly hatched fry. In one test of the canvas bags 48.2 per cent were obtained in a 20,000 lot. In testing for relative value of foods in

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a "Several."
b "Several hundred."
c 24,800 to fifth stage.
d 4,900 to fifth stage.
e 5,481 to fifth stage.
f Bumpus, op. cit.

1907, 40.6 per cent and 39 per cent were obtained in two respective tests, while one of the boxes yielded 42 per cent. About 40 per cent may be considered a fair yield for lots of 20,000 under the present system of operation. By using more fry more fourth-stage lobsters can be obtained from a single car, but the percentage probably falls.

There is another very different point of view from which the efficiency of the present method may be judged, namely, the number of fourth-stage lobsters which it will produce per egg lobster under fair conditions. Toward the latter part of the season two years ago, when the supply of eggs from the ordinary source had suddenly been cut off, 56 egg lobsters were received from Noank through the courtesy of the Connecticut Fish and Game Commission. From these there were hatched and reared to the fourth stage 84,896 young lobsters, giving an average of somewhat over 1,500 per egg lobster.

SUMMARY AND INTERPRETATION.

Summarizing the actually obtained results of rearing lobster fry to the fourth stage by the method herein described: Since the present method was first put into operation in its crude form where the water was stirred by an oar the output has each year (with one exception) increased. The extremes are represented by the total of 3,425 in 1900 and of 322,672 in 1908. The grand total for the eight years is 1,014,320, more than half of which were produced in the last two years. With lots of 20,000 newly hatched fry from 40 to 48 per cent (counted) have been carried through to the fourth stage frequently, and 40 per cent may be said to be a fair average to expect under good conditions. From 56 egg lobsters nearly 85,000 fourth-stage lobsters were obtained, showing an average of about 1,500 per individual.

In order to interpret these results fairly, there are certain things which deserve consideration. Even when operating on a practical scale, we have been feeling our way over new ground to further improvement of the method. Not a year has passed without decided changes in the method or the apparatus. While this procedure leads to the best final outcome, it does so at a sacrifice of immediate results. Accidents, also, of certain classes—for example, the loss of larvæ through broken screens—must be charged against the present apparatus and not against the method. Delays in construction, difficulty in getting egg lobsters, etc., may be due to misfortune or to mismanagement, but do not affect the permanent value of the method.

Capacity and efficiency of plant.—The plant as it stands to-day must be judged by the results actually attained; but having watched closely its operation I may venture the personal opinion that it has not yet produced to its full capacity and that the 24 cars are capable, under good conditions and with allowances for inevitable mistakes, of hatching and rearing 500,000 lobsters in the

six or eight weeks which constitute an average season. This is a conservative estimate based on the following deductions: If all the 24 cars were filled three times, allowing two weeks for passing through the moults, with an average output per car of 10,000 each time (which is considerably below frequent actual production), the total output would be 720,000. With a constant supply of fry sufficient to fill the plant to its full capacity throughout the season, this estimate could probably be raised.

As has been stated before, many features of the present installation are to be considered as vestigial structures and others as designed for one function and adapted to another in the course of the evolution of the plant. A new plant, therefore, built to operate the same rearing cars would be different in many details. The cost of a plant capable of duplicating the work of the one at Wickford has been calculated by Mr. E. W. Barnes, superintendent of the Wickford plant, at approximately $2,000, specified as follows:

COST OF A REARING PLANT CONSISTING OF 24 REARING BOXES CAPABLE OF TURNING OUT OVER 500,000 LOBSTERLINGS IN A SEASON.

2½ horsepower engine	$200	24 boxes	$350
Houseboat	300	Miscellaneous supplies	200
Four rafts	350		
Gearing	400	Total	1,800

The above items have been figured economically but quite liberally, and in localities where materials can be readily secured the cost might be considerably lessened. The actual cost of rearing lobsters to the fourth stage is a little less than $3 per 1,000. This includes labor, food, gasoline, and in fact all necessary running expenses, but does not include the cost of egg lobsters.

This amount would, of course, vary with the time and place where the plant was constructed and also with the kind of materials used.

Self-protective ability of fourth-stage lobsters.—An acquaintance with thousands of fourth-stage lobsters from personal observation and through the special scientific studies of members of our staff increases even our former estimate of their superiority over the larval lobsters. Immediately after arriving at this stage they are able to crawl over the bottom, to burrow and hide, to fight, and to forage in most striking contrast to the larval lobsters in any stage of development. In the first few days of the fourth stage the lobsterlings are good swimmers—this is their "redeeming vice"—but the swimming is strong and bears no comparison to the aimless drifting movement characteristic of larval stages. The lobsterlings dart hither and thither in pursuit of food, and for the first time they show a decided fear and strive to avoid capture. When left in the rearing cars, which have a strong internal current of water, thousands of these lobsters are often seen all swimming mightily in one direction against the strong current for hours at a time; but these same lobsters when taken out of the car and put into another one provided with sand and gravel will often take immediately to the bottom and behave as if they had always lived in this habitat.

It is an interesting and important fact that the tendency to swim decreases rapidly during their sojourn in the fourth stage and also that they can be encouraged to live on the bottom by being brought into contact with it. These facts have suggested two modifications in the usual procedure in liberating lobsters—first, that of holding the lobsterlings in special rearing cars for a few days after they reach this stage, keeping up the current in order to keep the lobsters separated and to keep their food in suspension, and, second, that of liberating them in such a manner that they will immediately touch the bottom, in which case they are not so apt to make swimming excursions through the water. An ingenious device for the latter purpose has been invented by Mr. Barnes. The young lobsters are sunk in barrels which have the numerous holes for their exit so covered up that while the lobster can get out predacious fishes can not get in.

It is comparatively easy to care for fourth-stage lobsters. Space and plenty of food are about the only requisites. Like the fry, they are cannibals in proportion as they are hungry and crowded together; but unlike the fry, they control their own movements and go where they please, whether swimming, or crawling, or burrowing, and they have, moreover, a strong instinct of self-preservation.

Fifth-stage lobsters.—There is much to be said in favor of rearing lobsters to the fifth stage before liberating them, and this is not difficult to do, but requires space. In some experiments conducted without great care 80 per cent were carried from the fourth to the fifth stage in large lots of several thousand. In addition to the advantage in the matter of size, strength, and bottom-loving instinct, which favors the fifth-stage lobsters, an additional advantage lies in the fact that the duration of the fourth stage can be shortened by abundant feeding. Doctor Emmel showed in a most convincing manner that by feeding alone, all other conditions being identical, the duration of this moult can be varied from an average of eleven to an average of twenty-four days.

Liberation of young lobsters.—Every visitor at the rearing plant asks the embarrassing question, "What proportion of the liberated lobsters live to grow up?" Only once was a definite and satisfactory answer given to this question and that by a new recruit on his first day's duty.

In 1901 when the experiments began to indicate that a large number of lobsterlings could most likely be liberated from our establishment, investigations were started to find out whether the physical conditions of the waters of Narragansett Bay were such that the young lobsters could live here throughout the year. Of this there is now no doubt, for the specimens reared from the egg have year after year been kept over winter in cars sunk or floated in the harbor at Wickford. Several were kept for three successive years and finally were lost through accident.

EVIDENCE OF INCREASE IN LOBSTER SUPPLY.

The young lobsters have been liberated mainly in the upper half of Narragansett Bay, because for many years previous to our operations small lobsters have been conspicuously absent from these precincts, according to the statements of fishermen. Within the last three or four years a great many reports have come in of small lobsters from an inch to 4 or 5 inches in length being caught in the lobster pots and escaping through the slats when the pots were drawn up; also of small lobsters up to 8 inches in length dug out of the mud in the early spring by the clam diggers. These reports have been numerous and are increasing and apply to those particular districts in the upper part of the bay in which our lobsters have been liberated. They have occasioned remarks of surprise by the fishermen, because this region has been so long barren of small lobsters. Whether this can be taken as good evidence of the effect of liberating in these waters about half a million of young lobsters reared to the bottom stage (the number up to two years ago) is at present of course entirely a matter of opinion.

ECONOMIC EFFICIENCY OF THE METHOD.

At the end of an account of the method of rearing lobsters and of the results actually attained, a brief speculation with regard to the efficiency of the method from the economic standpoint may be permissible.

It is often true in biology that one can draw conclusions as to causes and effects from observation and comparison of normal occurrences. In the breeding of animals we seem to have a case in point. Fishes which produce many thousands of eggs at a time, but whose young are left almost utterly unprotected, often do not maintain so great a numerical abundance as do other species (like the dogfish), which produce only a very few individuals at a time, but give the young a high degree of protection.

While the relative values of the larval and fourth-stage lobsters can not, for a long time at any rate, be determined accurately by direct experiment, it would seem that a comparison of the breeding habits of the lobster and the crayfish would, as Ehrenbaum has pointed out, furnish data for a tentative valuation. Where the lobster produces at one time 20,000 fry (Herrick got an average of 21,351 eggs from 414 observations of 12-inch lobsters), the crayfish produces approximately 100 young (Ehrenbaum), which it protects to a stage comparable with the fourth-stage lobster. Assuming, then, that the 100 young fourth-stage lobsters and the 20,000 newly hatched lobster fry are of equal value for maintaining the species, the ratio of individual values would be 200 : 1. Our method of artificial culture is capable of obtaining 8,000 fourth-stage lobsters from 20,000 fry. It is able, therefore, by taking advantage of the lobster's great productivity, to obtain 80 times as many young of this particular advanced stage as are necessary for the maintenance of the species under natural conditions.

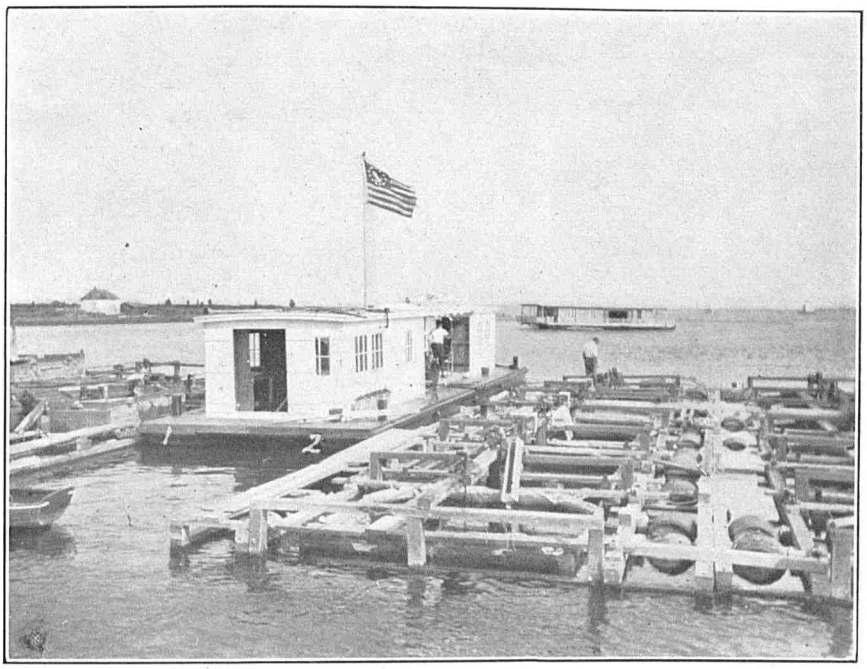

FIG. 1.—General view of house boat with floats attached, looking forward. The ends of the pontoons show at 1 and 2. The general relation of the rearing cars, alleyway, and barrels is seen in the right-hand floats.

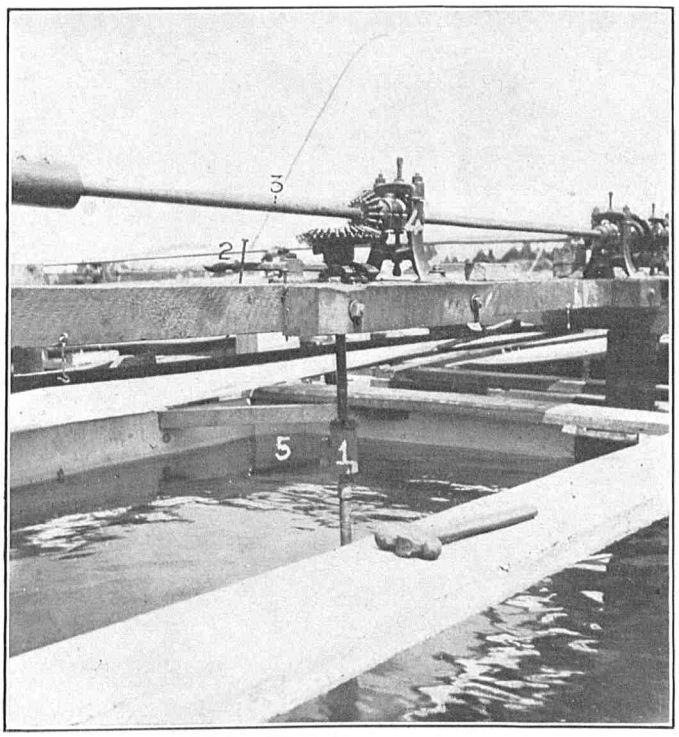

FIG. 2.—Inside of box toward one corner. 1, Sleeve coupling for disjointing propeller shaft; 2, lever for throwing shaft out of gear; 3, train of mitered gears reducing speed of propeller shaft; 4, type of adjustable hangers in general use; 5, inside corner of box.

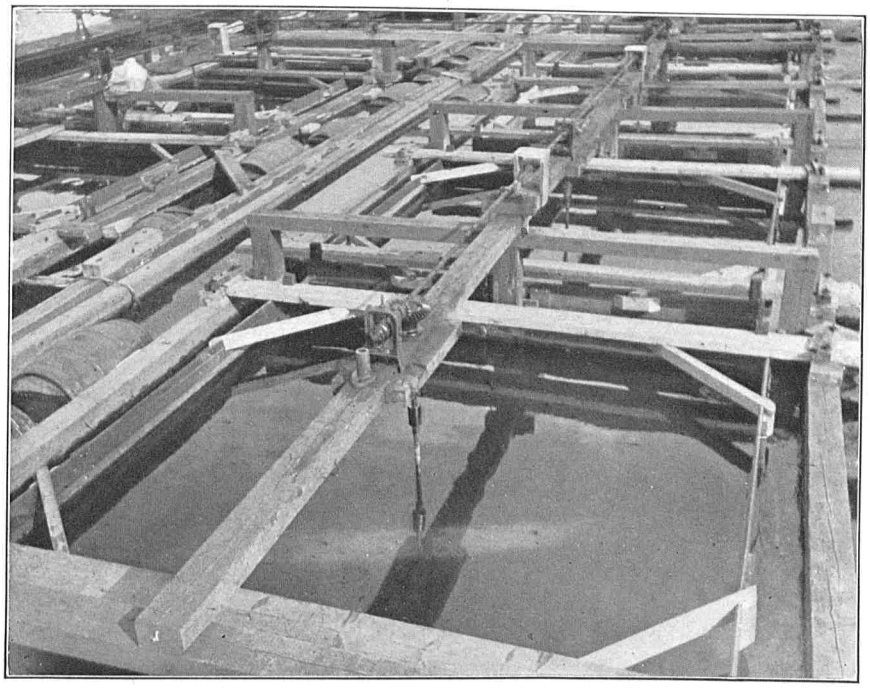

FIG. 3.—Floats from outer corner looking forward and toward house boat. The appearance of the car in the water and the gearing of the propeller shafts are shown in the nearest car.

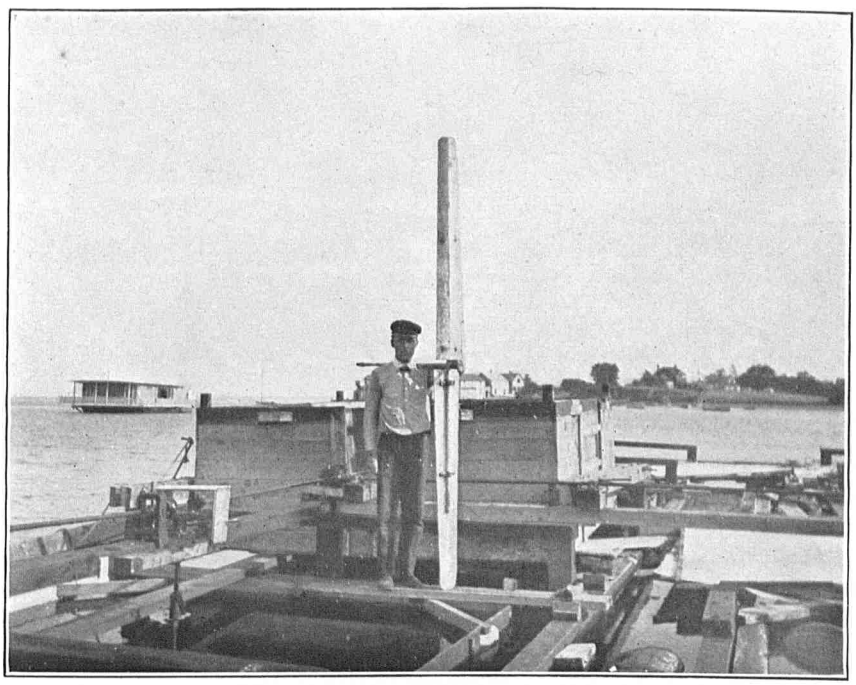

FIG. 4.—One of the outside floats, car raised. The size and shape of the propeller is well shown.

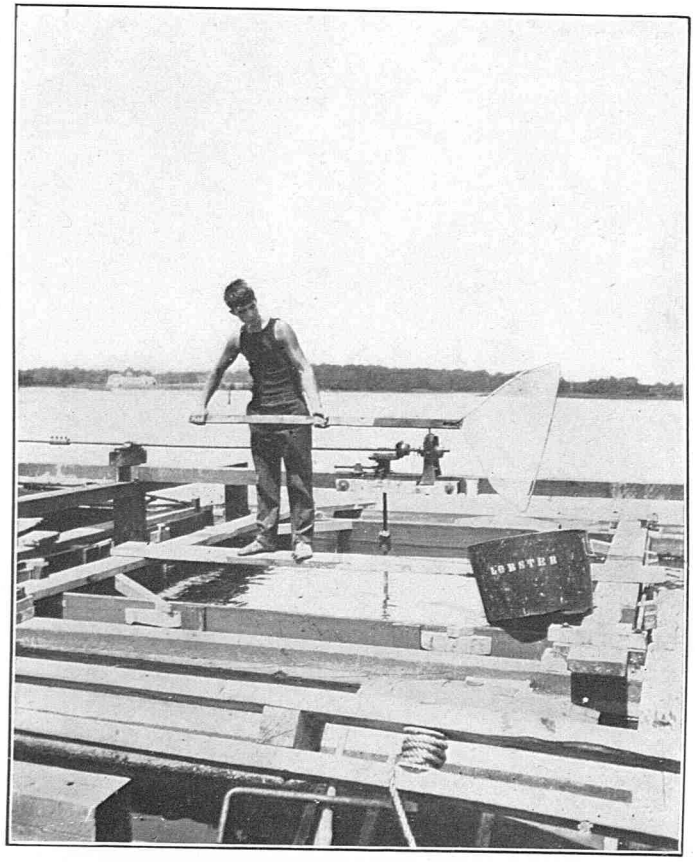

FIG. 5.—If the fry have to be transferred, they are scooped out on a flat net of this style and immediately shaken off into a tub of water, thence taken to the car prepared for them.

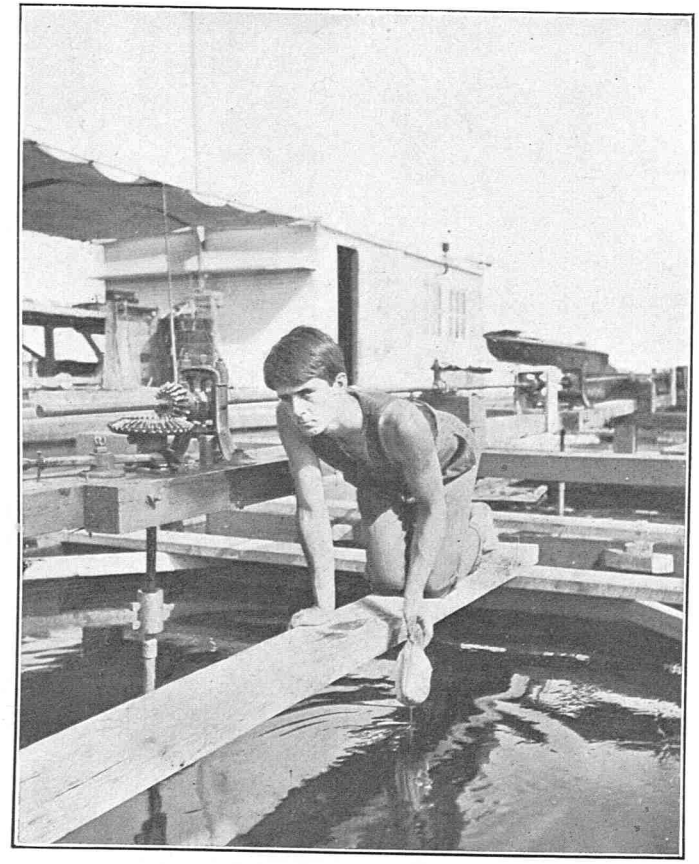

FIG. 6.—Feeding by means of ground food shaken from a piece of netting. This prevents the larger pieces of food from getting into the car and also tends to prevent any sticking together of smaller pieces.

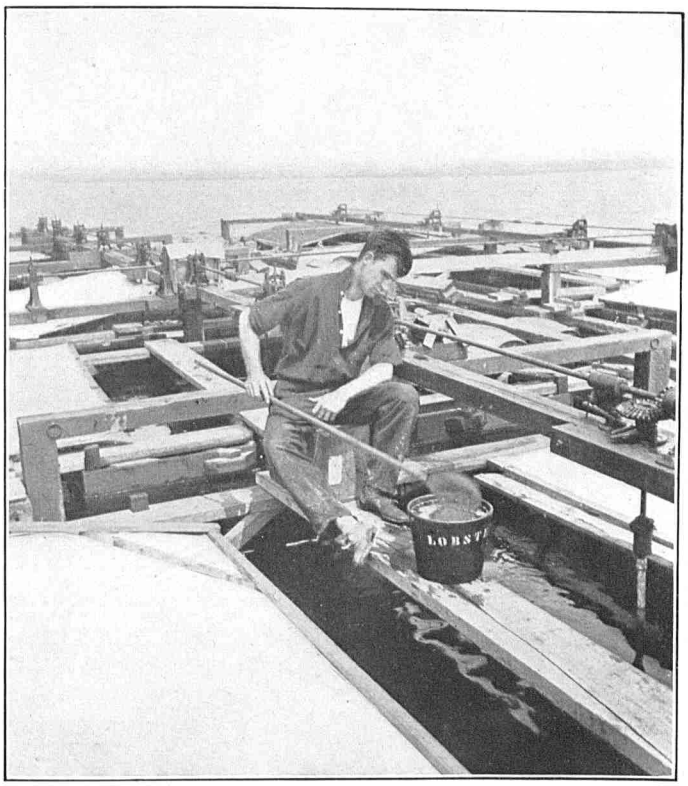

FIG. 7.—Method of counting fourth-stage lobsters. The awning is laid aside. The lobsters are caught up in the woven-wire dipper and shaken off into a bucket of water. In the left hand is held the automatic counter.

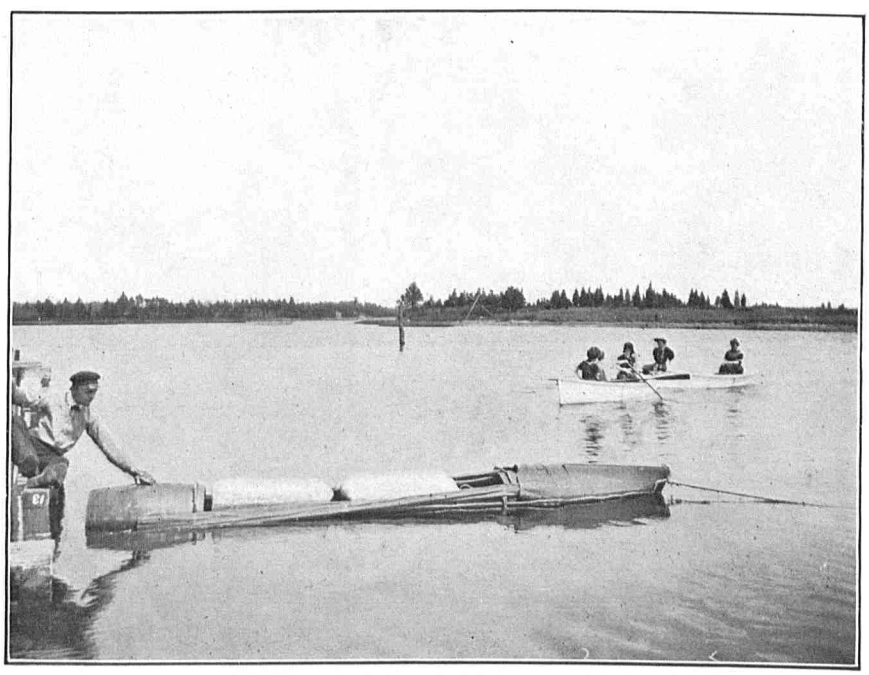

FIG. 8.—Improved towing car designed by Mr. Barnes from an old model. The egg lobsters are towed in this car, and fishes of various kinds have been towed for many miles with the most excellent results.

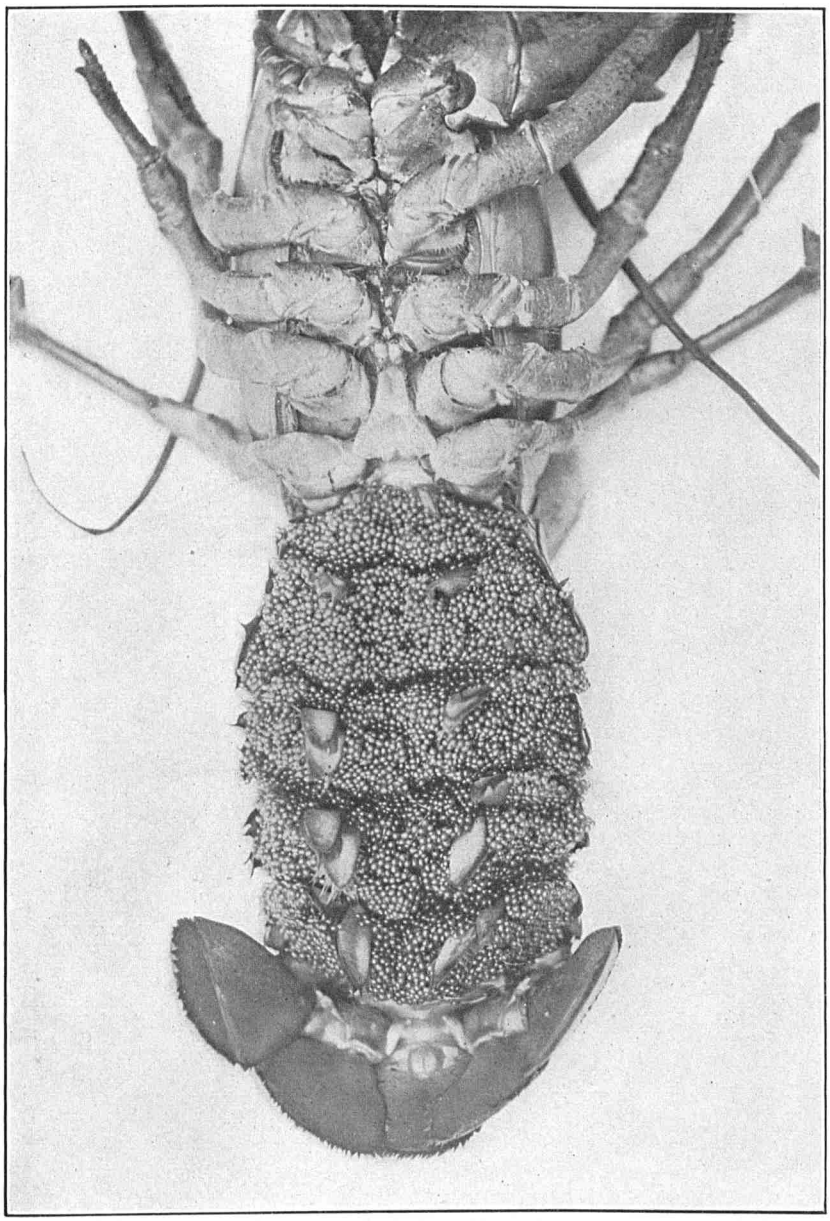

FIG. 9.—Lobster with eggs.

SEA MUSSELS AND DOGFISH AS FOOD

By Irving A. Field

U. S. Fisheries Laboratory, Woods Hole, Mass.

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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SEA MUSSELS AND DOGFISH AS FOOD.

By IRVING A. FIELD,
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Of the two sources of human food, the possibilities of the land have been extensively studied while those of the ocean have been greatly neglected. Only a few observations are necessary to show how in ignorance and prejudice we have been overlooking and rejecting enormous quantities of valuable food material which are daily going to waste. With our rapidly increasing population the capacity of the soil to produce enough food is gradually approaching its limit. The resources of the sea, on the other hand, are practically unlimited. It is there our opportunities lie for meeting the increased demand for food which can be supplied at prices suitable to the laboring man's purse.

For the past three summers I have been employed by the Bureau of Fisheries to investigate the food value of certain hitherto unused marine animals. Of the forms studied I wish to speak to-day concerning the sea mussel and the smooth and the horned dogfishes.

A food substance to be considered a good marketable commodity must measure up well to four standards: It must be palatable, digestible, nutritious, and so abundant that it can be marketed at little cost.

To determine the palatability of the substances I was concerned with, the obvious method was for me to eat the substance and if no ill results followed persuade others to eat it, then average opinions in regard to it. The scientific staff of the Woods Hole Laboratory gave me first opinions in these tests. If they found the flavor good, I had the dish served on mess tables of the Marine Biological Laboratory at Woods Hole and to other persons interested enough to try it.

The second test, digestibility, involves several requirements—namely, the proportion of the substance that can be digested, the ease or rapidity with which it can be digested, and the manner in which the food is accepted by the stomach. Comparatively little is known concerning the relative rapidity of digestion of different foods within the body. Most of the current statements on the

subject are apparently based on experiments made outside of the body by artificial methods, imitating as closely as possible the conditions in the body, but not at all certain to be exactly the same. The artificial process takes much longer than the natural, yet proportionally the results are similar. For example, under natural conditions soft-boiled eggs will digest more quickly than hard-boiled ones. By the artificial method the process takes twice the time for each, but about the same proportionate results are obtained.

The third requisite, nutritive value, involves such questions as the ratio of edible portion to refuse, together with the chemical composition. A good food must supply for the least money a proper amount of nutrients to build and repair tissue and furnish energy for the body.

In the fourth place, the food must be so abundant and easily obtained that it can be sold reasonably cheap.

Any hitherto unused substance that measures up well to these standards ought to find its way into our regular bill of fare.

THE COMMON SEA MUSSEL.

Now the common sea mussel, *Mytilus edulis*, is one of our most common shellfish, in size varying from 2 to 4 inches long by about 1½ inches in diameter. The shell is very thin, of a violet color, and covered with an epidermis of shining blue-black. Mussels grow in great beds along both our Atlantic and Pacific coasts, and on the coasts of Europe and Asia.

Very little use is made of the mussel in this country, it being utilized only as bait to some extent and on Long Island for fertilizer. In Europe it entirely replaces as a food the common clam, which, though abundant, is used neither for bait nor food. Why the mussel is so neglected in America Ganong lays to the fact that the Indians superstitiously avoided it, while they ate the clam, thus leading the early white settlers to do the same thing, a habit that has been continued to this day. Only in and about New York City do we find a call for mussels as food, and this is limited.

From the standpoint of palatability I have unanimous testimony from scores of persons who have eaten mussels prepared in various ways—pickled, steamed, roasted, and fried. All acknowledged that in flavor they are superior to clams and quite equal to the oyster. I have unsought testimony from a lady who, with her daughter, spent a season on the Rhode Island coast and there learned to eat the mussel. She says:

> Two years ago we boarded a little while at Matunuck, R. I., 3 miles west from Point Judith. There are large mussel beds there, and we were told that they were particularly nourishing for people of weak digestion. My daughter was very fond of them. We boiled them like clams or roasted them on hot stones and found them most delicious, particularly when roasted. We ate quarts every day and have longed for them ever since. My daughter gained strength while there, and it was the only time that she seemed to gain during the summer.

From the standpoint of digestibility the mussels take high rank. Persons with weak stomachs can eat them without suffering any inconvenience. They can be eaten before going to bed and cause no discomfort. One of the men at the Woods Hole Laboratory who became very fond of them expressed his opinion that the pickled variety was just the thing to eat before retiring. Another man says that while meat does not ordinarily agree with him he can partake freely of mussels and feel perfectly well. Personal experience on the part of many testifies that the mussel is more digestible than either the oyster or the clam. The reason for this, I believe, is in the character and properties of the flesh, which by cooking is made tender and mealy, whereas in the oyster and clam it becomes very tough.

The rate of digestion and amount of nutriment absorbed from the mussel by the human system have not yet been determined. The nutritive value from a chemical standpoint is much higher than that of the oyster and about the same as that of the clam. In ratio of edible portion to refuse, the mussel compares just as favorably with the oyster and clam. With its light shell it has little waste, whereas the oyster with its thick, heavy shell has a high percentage of useless parts. From equal quantities of mussels and oysters by weight the mussels will yield between two and three times as much meat.

From the standpoint of economy, mussels rank equally high. They are widely distributed and extremely abundant, being found in the bays and estuaries of our eastern coast from North Carolina northward and on our Pacific coast from Alaska to San Francisco. They grow in great beds, often acres in extent, on the surface of mud or sand at low-tide mark. They also grow in the deeper water, where they may be dredged up by the ton. I am informed that there are places in Narragansett Bay where a man could easily obtain 50 bushels a day throughout the whole season from May to November, if he had a partner to take and dispose of the catch, and it is considered that 35 cents a bushel would be a reasonable price to ask for them under these circumstances. The mussels breed at a prolific rate, the method of reproduction being similar to that of the oyster, so that it is an easy matter to cultivate them by artificial means.

In Europe the demand for mussels as food and bait is so great that mussel culture is practiced on a large scale. Two methods of cultivation are followed, one of which may be termed the "buchot" system or French method, and the other the bed system or British method. The French method of cultivation dates back to the year 1035. It was invented by an Irishman named Walton, who was the sole survivor from a shipwreck in the Bay of Aiguillon near the village of Esnandes. He was kindly received by the French fishermen, who, up to that time, had been able to make a very scanty living from the sea. In a short time he was able by his ingenuity to give them a lasting reward by establishing the buchot method of mussel culture, which has continued to this day and at the present

time gives support to several thousand inhabitants of that region. In 1905 the village of Esnandes alone marketed 215,253 bushels of mussels, valued at $112,433. The total number of mussels cultivated on the French coast in 1905 is estimated at 425,492 bushels, valued at $222,439.

Walton's buchots, or wooden inclosures, for the rearing of mussels were made V-shaped, with the apex pointing out to the sea, the purpose of the arrangement being to protect the structure from the destructive action of the winds, waves, and ice. At the present time a buchot is made up of a row of stakes placed about 2 feet apart and interlaced with a mesh work of flexible willow or chestnut branches some 12 to 18 feet long and 2 inches in diameter at the larger end. The stakes are trunks of trees varying from 6 inches to 1 foot in diameter and from 12 to 15 feet in length, and are driven into the ground for about one-half their length. The length of a buchot at any particular place varies with the character of the bottom and the tides. In the Bay of Aiguillon they are 250 yards long and placed about 30 yards apart, running at right angles to the shore. The buchots are arranged in two divisions, one for collecting the spat, the other for the growth and fattening of the mussels. The two divisions may be composed of as many as five buchots, extending from between tide marks out into deep water. The structures out in the deep water may be as much as 3 miles from high-water mark and are exposed only at the lowest tides. They are composed merely of solitary stakes placed about 1 foot apart, which serve for collecting the spat and forming a most advantageous position for its early growth.

When about 5 months old the seed mussels are scraped off the piles and transferred to the next buchot nearer the shore, where they are fastened in parcels by means of old netting. By the time the netting has rotted away the mussels are firmly attached to the timbers by their byssal threads. When they have grown so large as to be crowded on the wicker work they are thinned out by removing the larger ones to the next higher buchots, and so on from one section to the other, each time transferring the mussels to the buchots nearer the shore. The mussels are attached by the same operation already described, but are not wrapped so carefully, since their size is such as to enable them to be more securely fastened without help of the netting. The work of transferring mussels goes on day and night whenever low tide permits.

After about one year's treatment upon these structures the mussels attain marketable size, which is between 1¾ and 2 inches in length. Before ready to be offered for sale, those that have reached the desired size are transplanted to the highest row, where although left dry twice each day they thrive well and can be easily handled when desired for market. Having become inured to exposure upon these upper rows, these mussels consequently keep longer and fresher than those from the lower rows. The poorest cultivated mussels are considered better than the best mussels grown under natural conditions.

The British method of mussel culture, briefly, is to collect young mussels from various places and transfer them to beds in favorable localities, usually in estuaries, where the water is brackish and where they are exposed at low tide, both of which conditions are supposed to favor growth and fattening. It has been estimated that the average yearly yield of an acre of such mussel beds is 108 tons, worth at least $262, which is about ten times as much as the agriculturist expects from his farm.

To summarize the qualities of the mussel, we have a shellfish as palatable as the oyster, much more nutritious, and more digestible. It contains only half as much waste as the oyster, is more abundant, is more easily cultivated in that it requires less special conditions for growth, and it is adapted for making a greater variety of food preparations. Furthermore, it is in season for the table when the oyster is out of season.

THE SMOOTH AND HORNED DOGFISHES.

The smooth and the horned dogfishes constitute another article of food that prejudice is keeping from our tables. Of these I will merely state the results of my investigations. The smooth dogfish is common on our eastern coast south of Cape Cod during the summer, and, as I have shown in a recent paper, is a most destructive enemy of the lobster. The horned dogfish during the summer months has its range north of Cape Cod, where it is exceedingly abundant, and during this season plays havoc with the herring, the mackerel, and other fishing operations. This species, although it has a general resemblance to the smooth dogfish, is easily distinguished by the two horns, one lying in front of each dorsal fin. The habits, composition, and food properties of the two species are very different.

The smooth dogfish is a bottom feeder, preying almost entirely upon crabs, lobsters, and other crustaceans. It does not run in schools, as does the horned dogfish, which goes in enormous numbers, preying upon the large schools of herring, mackerel, and upon fish caught on the trawler's line.

In composition the flesh of the smooth dogfish is free from oil, resembling most closely the cod. The horned dogfish, on the other hand, contains a large percentage of oil and in this respect most closely resembles the salmon.

From the standpoint of palatability I have good testimony that the fresh smooth dogfish is just as good as flounder, halibut, or any other of the standard food fishes. I have had the fish served several times in various ways at the mess of the Marine Biological Laboratory, at one of the private boarding houses in Woods Hole, Mass., and in a number of private homes. In all cases, whether or not the persons knew what they were eating, favorable comments were made as to the texture and flavor of the fish. Not one adverse criticism was heard. Concerning the flavor of freshly prepared horned dogfish I can not speak from

personal experience, but there is abundant testimony that it is good. The Commissioners on Fisheries and Game of Massachusetts have personally reported its palatability, the lack of odor or "strength," and the good consistency when cooked or canned. They say it closely resembles halibut. The horned dogfish has in recent years been exploited in England as a valuable cheap food. A writer in a London paper states that the Plymouth council engaged an expert cook to prepare dogfish for the table with and without sauce, and that the published opinions of those who partook were excellent as to the color, flavor, and firmness of the food. Both species are nutritious and boneless and are therefore a safe food for both the young and the aged.

The dogfishes are not only palatable in the fresh condition, but are as good as many other fishes when preserved by the standard methods. The horned dogfish being in composition most like the salmon is best adapted for canning and is considered as good as the medium grades of salmon. A packer in Petit de Grat, Cape Breton, in 1904 sent me a dozen cans of dogfish he had packed. I passed them around to my friends, who prepared the contents in different ways (fried, scalloped, creamed, etc.). In these forms the canned article was highly praised for flavor and palatability. Samples were also sent to several hotels, where the fish was served to the guests as "Japanese halibut," and was pronounced most acceptable. An establishment at Halifax has been canning large quantities and putting them on the market labeled "ocean whitefish." A firm at Charlottetown, Prince Edward Island, has been successful in selling the canned article as "sea bass."

The smooth dogfish found south of Cape Cod is preserved best by salting and drying according to the same method employed for preparing dry salt cod. The product very much resembles cod, but has the advantage of being boneless. I have had creamed salt dogfish served in the mess hall of the Marine Biological Laboratory to a score or more of persons. They all reported that they could detect little or no difference between it and the ordinary salt codfish.

The flesh of the dogfish is apparently just as digestible as that of other fishes, is palatable, nutritious, and easily preserved. The fish are so abundant and easily obtained that they are ridiculously cheap. But prejudice is barring this wholesome food from our menus. People seem more willing to starve than to eat this fish, just because it bears the name "dog." The problem now is how to put the fish on the market without an offensive label and at the same time meet the spirit and letter of our pure-food law.

The packing of both mussels and dogfish ought to become a large industry. Conditions are good for creating a market for them. They are a cheap, wholesome food for the masses and constitute a field of opportunity for the fisherman, the packer, and the merchant.

DISCUSSION.

Dr. OSCAR NORDQVIST. I think that those cheap fishes—for instance, the dogfish and such other kinds as are not used for food—would be a very good food for fish in our hatcheries. I think we could get in that way a cheap food for trout and other fishes in ponds, and I think it would be a good thing; by taking only the more appreciated kinds of fish from the sea and from lakes we disturb the balance in nature and give most chance for those poor fish to increase. And I think it would also be a very good thing for the cultivation of fish in the lakes, for instance, to take away those poor kinds of fish. I think it would be useful for the improvement of the fisheries in the lakes. So I think the more we can use those poor kinds of fish and other species of fish, the better it is for our lakes, and also of course for the sea.

Doctor GILL. I can bear testimony to the edibility of both mussels and dogfish—that is, the common dogfish (*Mustelus*), not that of the northern coast (*Squalus*). We are in the unfortunate position of having the same name for very different animals, unfortunate because of differences of habits of the other fishes of the same name. The word "mussel" in the greater part of this country in the interior is known almost entirely in connection with the species of the enormous family of Unionidæ.

Mr. WHITMAN. When you say that a mussel is a very edible mollusk, some one in the interior will say: "I have tried it. It is the toughest thing I ever attempted to eat, and worthless."

Doctor GILL. So it is; the fresh-water mussel family (Unionidæ) are really worthless; at least it requires a greater power of eating—using the teeth—than I have. But in regard to the mytilids, to which the name "mussel" was originally given, that can not be said.

With regard to the dogfish we have the same dilemma. "Dogfish" is applied in this country to a fish in the interior that is also worthless, having no relationship whatever to the fish that is known as dogfish on our eastern coast, and even the species of our eastern coast have no close relationship to each other. The so-called dogfishes of our eastern coast are as different from each other as a horse from a rhinoceros—in fact, much more so. They belong to an entirely different section of the shark branch. The only similarity is that superficial one resulting from the size and general appearance being about the same, and from the assemblage in schools being about equal. Those are the only points of similarity. They differ entirely in other features; in the dorsal fins and in the anal—one is without that fin while the other has it; the teeth are also entirely different. When we examine the interior we find the differences are really more. There is really no structural similarity, and consequently we are deceived by the similarity of the names. If we could only have different names we might get along a good deal better with the facts.

Now, perhaps you might consider this new name for the dogfish of the south—"mustel." That is not a long name; it is an euphonious name. Call the fish of the northern coast "acanth"—that is not a long name—and perhaps then we would have a solution. The fish would be just as palatable as they are now under the name "whitefish" or "herring" or anything else.

Mr. FRYER. It is quite a poetic idea that the fish culturist should turn the tables on the dogfish and feed other fish on this voracious beast. Much the same idea induced

the fishermen of England to take up the question of putting the dogfish on the market. Three years ago we had in our southern waters quite a plague of dogfish. They approached our shores in unprecedented numbers, and caused very great havoc, not only among the fish, but among the nets; even taking lobster pots and swallowing the lobsters and pots and all, with the result that in sheer desperation the fishermen armed themselves with stronger nets and set out in search of the dogfish and brought him home and put him on the market instead of putting him back again unharmed into the sea. The efforts that were made to open up the markets to this fish have resulted in a considerable amount of success. A great deal of prejudice existed in consequence of the name, the point to which reference has been made. The fish itself came to be known in the northern markets of Lancashire as Darwen salmon. It was rather a slight upon the salmon, I think. Afterwards a prize was offered by the municipality of Plymouth for a name which would be palatable, if I may use the expression, and also for a means of making the fish more palatable, and the name "flake" was pretty largely, at any rate, adopted; but this is not a satisfactory name, and I think the proposal that a euphonious title might be made up out of one of its scientific names—of one of the species of the fish, at any rate—is a very good suggestion, which might be followed up with advantage. In England I suggested the use of the word "tope," which is the Cornish name for one species of dogfish.

As regards its edibility there is no question about its being a good fish. I can vouch for that myself, and I have encouraged a great many people to eat the dogfish, especially immediately after capture. It is very much better then than if it has been kept for any length of time.

With regard to the mussel, I know that mussels are edible. I can not vouch for their quality personally so much as I can for the dogfish, because I do not like them, but there can be no question that all the virtues attributed to the mussel as an article of food are justly attributed; and there is, I should imagine, in this country a very large market for mussels, put up in some such way as these before us, at a very low price.

Reference was made to the practice in England of cultivating mussels for food purposes. I think the writer was somewhat misinformed on one or two matters, since he stated that the mussel "lays," as they are called, on which the mussels are placed for fattening purposes, are put in places where they are exposed. Now, the great object is not to expose them—not to place them above low-water mark. We find by experience that mussels that get carried up in the course of nature farthest above low-water mark develop less rapidly and get much more stunted, even when fully grown, than those which are constantly under water, even where all other conditions are similar.

Undoubtedly the brackish waters are, as in the case of the oysters, found to be more favorable for the fattening of the mussel than the very salt waters.

As regards the season: Again, I think a little slip was made, unless the habits of the mussel on this side of the Atlantic differ very much from those on the other, when it was stated that the mussel was in good season for food at the time when the oyster was in closed season or was not good for food. With us the two seasons are practically the same. The spawning season of the mussel is the same as the spawning season of the oyster. I am not sure whether I am rightly informed, but in some of your states I understand there is no closed season for oysters; but with us a closed season is established during what are held to be the most common spawning months, those being the months whose names have no letter "r" in them—after the month of April until you come to September is a closed time both for mussels and for oysters as well.

I heartily indorse from my own experience on the other side the suggestion that steps should be taken to encourage the development of fisheries for both these products; the one because it is an undoubted nuisance and for the further reason that while we are reducing the numbers of what are known as edible fish we are altering the balance of nature and leaving the dogfish unattended to. Of course in this country I need not,

I think, refer to the possibilities of the dogfish as a producer of oil and manure. I imagine that already the fish is used in those directions. The paper is limited to the question as to its use for food.

One little matter in regard to the mussels occurs to me: It is very easy indeed once an industry is established for bringing the mussels to market, to fish out natural beds, or scalps, as they are called in England; and I would recommend that if this question is taken up—the question of developing the trade by opening up the markets—the other side of the question should be dealt with at the same time and precautions taken against the possible depletion of the natural beds.

Mr. T. E. LIBBY (Maine). I just want to say a word in regard to the dogfish, for the simple reason that it is the most destructive thing to the fisheries that I know of. It is an international question, as all those familiar with it know that there is no fish along the Atlantic and Canadian shores that is so destructive to the fisheries, especially for the ground fish. As I understand from United States Fish Commissioner Bowers, there was a bill introduced in Congress appropriating $25,000 to see what could be done in regard to the dogfish—the best way to utilize it. This bill, as I understand, has got no further. There have been also bills introduced in the Massachusetts legislature, but nothing has come from that; I am pleased to state, however, that I understand, and we will no doubt hear from Professor Prince, that the Canadian government has been doing and is doing to-day something in regard to the extermination of the dogfish, not making it an article of food, but using it for the oil and as a fertilizer. I think that the dogfish as found along the southern shores is much different from the one found on the northern shores, for the reason that it has a smooth skin and the one on the northern shores is of a rough skin. I know I have seen some of those cured myself, and the northern dogfish when cured is very white at first; inside of a month, however, it will turn a yellowish cast, and I have seen efforts to put it on the market, but these were unsuccessful, because of its turning in color. The dogfish in the north has a very large liver, which of course makes it produce a very large amount of oil. For this reason the oil is all through the meat and causes it to turn.

This is a very important question, and I hope there will be some resolutions introduced in this congress encouraging the passing of some bill by the National Congress for the extermination of the dogfish.

Mr. FRYER. I do not want to become a dogfish and monopolize the conversation, but the remark Mr. Libby was good enough to make to me just now that the dogfish is used for the purpose of oil reminds me that experiments have been made in England with the eggs of the dogfish, with the result that in an immature state they have been declared to contain constituents almost exactly similar to those of hen's eggs, and to be extremely nutritious. The only thing against them is their flavor; but following that up, further experiments have shown that the eggs can be used for the production of a very high class of medicinal oil. I think that the suggestion might possibly be of practical advantage if it were made known.

Doctor GILL. What dogfish do you mean?

Mr. FRYER. The dogfish known as "rough hound." I forget the scientific name for the moment.

Doctor GILL. Yes, you mean sharks of the family of scylliorhinids; they differ very greatly from the dogfishes of our coast; they lay eggs inclosed in cases, whereas the piked dogfish or acanth, as well as the smooth dogfish, or mustel, do not hatch eggs at all externally; in fact they are viviparous.

Mr. FRYER. It is the *Squalus catulus* I am speaking of.

Doctor GILL. A scylliorhinid.

The PRESIDENT. It may be that another possible use for the eggs of the dogfish would be for the purpose of producing albumen for preparing photographic films. That only occurred to me at this moment.

Mr. FRYER. I doubt if there is very much albumen in them; they are chiefly oil.

The PRESIDENT. I am glad to be corrected. I think Mr. Atkins was about to speak.

Mr. C. G. ATKINS. I have not a great deal to say, Mr. President, but having tried the flavor of these various things that have been spoken of, I would like to say that I found personally the flavor of the dogfish was agreeable to me, and the flavor of the salt-water mussel, but that fresh-water mussel was very disagreeable.

As to Doctor Nordqvist's suggestion that we make use of the dogfish and other refuse sea fishes for feeding fish, I have been for several seasons trying to induce the fishermen to sell it for that purpose—to bring the dogfish in—but I got very few from them. I propose to carry the matter further and try to get quite a supply of them; in fact, to try them further for feeding salmonoid fishes. They are very numerous in my vicinity. Late in the summer they become a dreadful pest in all the fisheries—haddock, cod, and all those other fisheries along the coast.

Mr. JOHN J. PEW. I have tried dogfish where it has been tinned—I understood the northern dogfish. We had some tried in our office, which were sent us to see what it would be worth for mercantile purposes. We tried the flavor and to keep them in the can awhile. The color was disagreeable, not taking at all, and the flavor was not very acceptable to any of us, and we thought it was a waste of time and money to try to put them to use in our trade. We concluded the best method was to destroy them and use what we have on our coast for oil and fertilizer purposes.

Professor PRINCE. I do not want to inflict myself too much on the congress, but the subject which was brought up before us in the very excellent paper by Doctor Field has a great personal interest to me.

The first official work I ever did in fisheries was on a mussel commission in the old country, and I happened to be secretary of that commission. We went very fully into the uses of the mussel, and in our report published a number of interesting facts. One was the enormous amount of mussels annually consumed in London and other English cities as food. The amount was appalling, 10,000 tons per annum in London, if I remember correctly. Then we found that there was a very large amount used for bait by the long-line fishermen. They relied upon the mussel as their principal bait, and such a demand was there for these mussels for bait that British supplies were insufficient and mussels were imported from Holland, where mussel cultivation has been carried on to a very large extent; and I am only sorry that Doctor Hoek is not present, because he has a very thorough knowledge of what has been done in the Netherlands in the matter of mussel cultivation. The Dutch have gained wealth from their mussel beds. They export very largely to Scotland, because the Scottish beds were not large enough to supply the demand.

Personally, I have very pleasant recollection of mussels from my early days. By most people in England the mussel was considered rather a delicate morsel. I remember as a boy going to bed after a supper of mussels, and I sometimes feared the consequences, but I do not think I ever suffered harm. There is a large amount of hepatic matter in the mussel, the liver being very large indeed; but, at any rate, it is a most excellent and succulent mollusk, and it is astonishing that it has not been more utilized on this continent for the two purposes which have been mentioned, namely, bait and food.

Perhaps we ought to be cautious in recommending the use generally, without some tests being made. I may be wrong, but I have some recollection that when Captain Cook navigated the Pacific coast some of his crew went ashore and ate mussels, and I think one of the men died. That may have been due to the fact that it was not properly a mussel, but I know on some parts of the Canadian coast the mussels are not quite equal to the mussels of Europe. The matter is one that can well be looked into.

The dogfish question is one which has very seriously occupied the Canadian government. The dogfish have been for eight years or more a perfect pest on the Atlantic coast especially. They have been very numerous on the Pacific coast, and on the Pacific coast they were turned to account in the manufacture of oil, in the vicinity of Queen Charlotte Islands, but the carcasses were thrown away. In Canada the proposition was made that they should be utilized in some way or other. My own original proposition to the government was that we should adopt some method of extermination, without any idea of utilization, as Australia dealt with the rabbit pest on land. I favored methods of extermination, to get rid of the pest as soon as possible.

Another scheme, for which I am to a large extent responsible, was dogfish reduction factories for grinding up these fish into fertilizer materials. But the oil in the tissues was a very great trouble; there seemed to be too much oil to get rid of; but a very good fertilizer material was produced by three large government fertilizer works. Doctor Field, of Boston, will be able to tell us something about that. He has just visited these works. They are using a large number of these dogfish for purposes of fertilizer, and the government has spent a large sum annually on reduction works; but these factories have not done anything in regard to utilizing them as food. The three works at Shippegan, Chaleurs Bay, Canso, Nova Scotia, and Clarke's Harbor, western Nova Scotia, have all utilized the dogfish for fertilizer, and the supply of that fish was often far larger than the works could possibly handle. These enterprises encourage the destruction of the dogfish; and I believe the last reports regarding the dogfish indicate they are not so plentiful. If Mr. E. C. Whitman, of Canso, is present he might tell us something about the dogfish on the Nova Scotia coast at the present moment.

With respect to their use as food, I recommended to the Dominion Government that a bounty be given, in order to bring "ocean whitefish," as canned dogfish has been called, upon the market, but as they had to be placed upon the English markets at a very low price, in order to compete with salmon and other cheap canned fish, our Government did not see its way clear to bonus this enterprise. I requested this because I am satisfied that if the canned dogfish, properly put up, once gained any hold in the markets—the great markets of populous countries—the demand would be assured for the future. It is a most excellent food, and while Mr. Libby said—at least one of the gentlemen present told us—that the appearance of the fish deteriorated by keeping, so far as I know the dogfish which were canned in Cape Breton and Canada as an experiment had a very good appearance a long time after they had been put up. I have some of them in my office at present, and upon opening them at least a year after packing the color had not much deteriorated.

There are really a great many things to say about this question. Now, the wharves and floors of the reduction works at Canso at times were just covered with dogfish eggs nearly as large as hen's eggs, and they certainly could be turned to account. In Norway they have been used for a century or more for domestic consumption; women collect them and make puddings of them. I do not think they are good boiled or poached, but they are suitable for puddings.

There is another point that I have often referred to, in regard to this dogfish question—so serious a question for our fisheries. It is this: That the fishermen should be discouraged on all hands from simply opening the female fish full of living young and liberating them in the sea, as they have constantly done. I have been on boats when the men just did this in order to see the young dogfish swim away, which is a kind of artificial fish culture that we ought to deprecate in the strongest terms.

The PRESIDENT. Do you desire to have the discussion still continued? I wonder if any serious effort has been made to use the skin of the dogfish for leather?

Dr. GEORGE W. FIELD. The fish commission of Massachusetts had this dogfish matter placed before them for the first time about three or four years ago. They have

instituted various inquiries and experiments, and, among them, the question of the possible utilization of the skin. The chief difficulty appears to be in getting the skin off, but when it was once taken off and tanned it makes a very satisfactory leather for use on sword hilts and pocketbooks. It is a very delicate and rough leather, not unlike lizard skin, so much in vogue for certain ornamental articles.

In regard to the use of the dogfish as food, we have had some practical experience. We served the dogfish to the Biological Club, together with halibut, and students accustomed to make observations were unable to taste the difference, and claimed that it was equally good.

On the other hand, the practical packers are up against a very grave difficulty. They put this dogfish in competition with salmon, and they found very great difficulty in getting an adequate supply of the dogfish. The supply was intermittent; they would get one day more than they could handle, and then the factory would be obliged to remain idle a week, a month, or perhaps longer. So that in utilizing the dogfish it seems to me that the question of a definite supply to the factories in whatever way they are utilized is the most important one.

The Massachusetts Commission of Fisheries and Game has taken up the question of determining the valuable content of these fish. They are determining the amount of oil in the liver, in the flesh, and in the egg; how much glue there is in the skin and head and fins; whether the fins may not be utilized as they are in China and Japan for making a material for soup; whether the skins can not be utilized as leather, or some method devised by which they may be utilized more cheaply. In other words, we are trying to get a scientific basis by which the manufacturer can be in a better position to know exactly what he can do with the raw material, in order that we may say to the manufacturer, "Your process is deficient in this point or the other, and there is an opportunity for you to get better returns than you are securing at present." We are also going to attempt the consideration of the question whether there may not be devised some better method of securing a permanent supply of these dogfish to the various factories where they may be utilized, and the possibility of running a vessel about among the fishing fleet, where the dogfish may be collected and brought to the factories. We have in Massachusetts a considerable number of factories and fertilizer works where fish scrap is made, and those factories may use it to a certain extent if we can find some way by which the fishermen can be induced to bring the fish in. At present there is a tremendous prejudice against the dogfish. They are an ugly fish to handle; are a difficult fish to get off the hook if you attempt to bring them into the boat, and the only successful method is to bring them onto the edge of the boat and slap them off. The factories in one section object to handling them, whereas in Canada they are able to get all the dogfish they can handle at times at $4 or $5 a ton, and it is a question whether the fishermen in Massachusetts, who deal in the fresh fish and run the largest possible quantity of fresh fish in the least possible time to the Boston market, would care to take it up from the same point of view that the Canadian fishermen do.

There are a number of practical questions that we hope to have light on at a later time.

Mr. HATHAWAY. I will say a word on just one point that Doctor Field called to mind, in relation to an experiment made by the Fisheries Commission, to which I made reference here on Tuesday and which was conducted under my observation. One of the steamers that had been used in menhaden fishing was rigged up with an ocean overdraft, for the purpose of experimenting and seeing how the seine would work. We took the steamer at Timothy, R. I., and began operations just before sunset off 10 miles to the south of Marthas Vineyard Island. We made one haul and caught some 20 or 30 bushels of dogfish, a great variety of other fish, but none of any particular amount or value. We ran down the coast that night near to Shinnecock, Long Island, and began the next morning at daylight operating up toward Block Island. We cast a seine

some half dozen times that day, I should say, and at each haul got quite a number of dogfish, together with other fish, but no other fish in any quantity. About 2 or 3 o'clock in the afternoon, when fishing in water somewhere near 20 fathoms deep and about 10 miles to the south of Block Island, we made a big haul, and I am satisfied that that twenty-four hours' operation landed some 12 or 15 tons of smooth dogfish; so I have no doubt in the world that they can be taken in that way to great advantage. We were not able to use these fish as fertilizer, because the nearest factory to the point of operation was some 200 miles and under the conditions then existing these fish could not be run through the menhaden cookers, the knives being too small. Of course that could be easily remedied, and I understand has been remedied in the Canadian factories. If those fish could be used or had any value at all, I have no doubt in the world that in the deep-sea trawl fishing along the coast from Shinnecock to Sandy Hook, where my experience lay, dogfish could be caught in quantities and sufficient to make it a commercial value to the fishermen.

As to the edibility of the dogfish: They have been eaten for years and years along part of our southern coast, particularly in the lower Chesapeake Bay, from which I originally came; and it is said that they have been used in connection with crab meat, which is so abundantly put up.

The mussel is very abundant along the coast, and I two years ago purchased from a fisherman, to be used for fertilizer—for manure—a thousand bushels for $50. He landed them on the wharf at the farm lot in Little Egg Harbor, near New Gretna, New Jersey. Now, those mussels were opened up by this fisherman, giving him sufficient wages to live, for 5 cents a bushel. All along the coast, from Cape May to the Maine coast, they are very abundant. They are not very abundant below Cape May.

Mr. WHITMAN. Reference has been made to government dogfish reduction works at Canso, Nova Scotia, and as I have just come from there it may be interesting for you to know that those works are now taking in all they can handle each day. The works have a capacity of 25 tons of dogfish a day, and if they had a capacity of 500 tons a day there would be no trouble to supply them. Just at this season the dogfish are very abundant, and I recently saw one vessel bring in 50 tons, which would of course supply the works for two days. But they are making no use of them except to extract the oil and convert the residue into fertilizer. This has been going on for the past three years, since the Canadian government decided upon this method of dealing with the dogfish pest. It is not a commercial success. The government always pays out more money than it receives, but that is chiefly because the operating season is so short. The works operate only some two months of the year, and the fishermen will not catch dogfish at $4 a ton if they can get more profitable fishing to do. It is only when the dogfish become so plentiful that they can not carry on regular fishing for food fish that the fishermen turn their attention to the dogfish.

The oil is of superior quality, and both the oil and the fertilizer find ready sale. The fertilizer up to this time has been marketed in New York at $35 a ton. The oil sells for 30 cents a gallon. Experiments are now being made to see if other products can be taken from this fish, such as glue and isinglass; and if the skins can be used as Mr. Field has suggested, that will be good, but up to this time they have been treated only for the oil and fertilizer.

The PRESIDENT. Shall we close the discussion?

Dr. GEORGE W. FIELD. As Professor Prince has said, we visited last month three factories, to which Mr. Whitman has referred, and we got statements in regard to the amount of dogfish they had destroyed at two of these works. We made a rough estimate, and we figured that those two factories had destroyed about one-fourth of what the entire Massachusetts fleet catch in one year. We figure the Massachusetts catch at about 27,000,000 dogfish a year; and we found that about 7,000,000 dogfish were de-

stroyed, i. e., turned into fish scrap, at these two factories during the time they were running.

Mr. WHITMAN. It might be of interest for you to know that the steam trawler that was brought over from England to operate on our Nova Scotia coast in one hour recently filled her trawl net so full with dogfish that it parted the lines, and carried the net away. The captain estimated more than 15 tons of dogfish in the net. He says that he usually avoids the places where dogfish are. He knows them by the oil on the surface of the water. But this time the net was cast in the wrong place and in a few minutes it had filled so full that the weight carried the net away.

Doctor GILL. I think that Doctor Field of Woods Hole labors under some misapprehension as to the clam. He remarked, if I understood him rightly, that the clam was not esteemed in England. They have no clams, in our sense of the word, in England. The family of venerids is represented by only two small species of no economic value, their place being taken economically by the cockles or cardiids. By a curious coincidence, the name "clam" is in very little use in England, and what they call a clam is not like our hard clam at all. It is a very interesting fact that we derive the name clam from England, but we apply it in a very different way from what it is applied in England. Of course, I can not go into the full history. Suffice it to say that the word "clam" in England is mostly applied to the piddock—that is, to a species of the family of pholadids.

Dr. IRVING A. FIELD. In reply to Doctor Gill's criticism, I want to say that it is not from personal experience that I speak about the clam of Europe; that is a quotation from Ganong's Economic Molluska of Acadia, in which he states that the soft-shell clam occurs in Europe, but is not used. He calls it the soft-shell clam.

In regard to the poison mussel: There are cases of mussel poisoning on record. There are also cases of poisoning from clams, from lobsters, from crabs, and other animals in that group. I wish to state, however, that there are no cases on record of poison from mussels that were collected from what might be called pure water, in good circulation. The most notable cases of mussel poisoning on record are those which occurred at Wilhelmshaven, Germany, in the early eighties, and in these cases it was found that the mussels came from stagnant water. These mussels, which were very poisonous, when placed in free-circulating water became harmless in about two weeks. On the other hand good mussels placed in the impure water became poisonous. We may say, therefore, that poisonous mussels come from poisonous water. These results were obtained by Virchow and also by Wolff in 1886.

Doctor GILL. You have found persons pretty generally prejudiced against mussels?

Dr. IRVING A. FIELD. Yes; for that reason.

Then as to the season for mussels, I wish to say again that I was right when I said that the mussel is in season when the oyster is out of season, for the mussel is the very best to eat during the breeding season, or just prior to the breeding season. After the breeding season the mantles become very thin and there is very little meat to the mussel at all.

I stated in my paper that they breed at a prolific rate. I have not been able to locate the center of the reproductive gland. In fact the whole animal is a reproductive gland at the height of the breeding season. If you take a mussel in June or July you will find the reproductive organs covering the floor of the body, filling the mantles full and extending over the liver, so that the whole mussel appears to be a great reproductive gland. Eggs, of course, are very nutritious, and it is at this period we find the mussel containing about 18 per cent of protein. In September and October, or the latter part of August, September and October, when the sexual products are liberated, mussels lose probably two-thirds or three-fourths of their weight, become very thin and shrivel up, so that when cooked they are no larger than the end of one's little finger.

Now, coming to the dogfish, I think it was Mr. Libby who said there was trouble in dry-salting northern dogfish, which at first are white and nice but later become brownish

and very disagreeable in appearance. I have had that experience myself. It becomes the most nasty-looking stuff, covered with a brown, gelatinous substance; but I have found that if you keep the dogfish in a brine they will remain white for an indefinite period. I have some two years old in good condition. You can take them out of the brine and soak them for a few hours before cooking. If put on the market in brine they can be made a good food product, and persons can keep them at their homes a week or two before they will turn brown.

The dogfish may be of economic value from the standpoint of the production of gelatine. There is a very high percentage of gelatine in the flesh of dogfish, and when extracted it comes out beautifully clear and white, and apparently needs no refinement, the only objection to it being that it has a fishy flavor. I think possibly Doctor Alsberg, the chemist at Woods Hole, will be able to tell us a great deal about this in a short time.

Doctor GILL. That is quite right about the clams along this coast, south of Cape Cod. The common or hard clam is the *Venus mercenaria*, a representative of the family of venerids; the clam along the north coast, or soft clam, is the *Mya arenaria*, a species of the family of myids.

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THE WHOLESOMENESS OF OYSTERS AS FOOD

By Henry C. Rowe

President Connecticut Oyster Growers' Association and New York and New England Oyster Shippers' Association, New Haven, Conn.

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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THE WHOLESOMENESS OF OYSTERS AS FOOD.

By HENRY C. ROWE,

President Connecticut Oyster Growers' Association and New York and New England Oyster Shippers' Association, New Haven, Conn.

The necessity for the conservation of the resources of the nation has recently been brought emphatically before the public. The increase of our population in the past and its greater prospective increase emphasize the importance of not only conserving our resources but of encouraging the creation and development of productive industries. During the past thirty-five years such an industry has been created and developed in the propagation and growing of oysters. This industry produces already annually a great amount of valuable food, its yearly value in the states of Rhode Island, Connecticut, New York, New Jersey, Virginia, and California amounting to $9,316,252. Other states are developing the industry, but these named have taken the lead. A large population is supported directly by it, and perhaps still more by contributory industries.

During the same period, while a large portion of our forests have been destroyed, the oyster farmers and cultivators have purchased from the different States permission to cultivate the hitherto barren ground covered by the waters of our bays and sounds to a depth of 25, 50, or even 100 feet, and have, by expensive and hazardous experiments, caused this unproductive ground to yield annually 10,235,566 bushels of oysters, a valuable and nutritious food, and furnished employment and livelihood to thousands.

While the United States and the various states have at public expense propagated millions of swimming fish, to be caught by those who are engaged in these fisheries, the oyster grower and planter has at his own cost propagated his own crops and worked out his own results by patient labor, costly experiments, and large investment. Instead of having his crops produced and protected for him, as has been done for the fishers of swimming fish, he has paid large sums to the states for the use of the ground on which he might create and prosecute this industry. In Connecticut, for example, the oyster growers have paid to the state

and towns over $260,000 for the franchises permitting them to cultivate oysters and in taxes upon these franchises, and have paid many hundreds of thousands more in taxes upon the steamers, shops, wharves, and other appurtenances of a great industry. In Rhode Island, besides the general benefit to the prosperity of the state resulting from a great productive industry—which is, of course, the principal consideration—the oyster growers pay annually to the state a very large sum in rentals for oyster grounds. The income to the state from this source in 1907 was $96,000, and it is estimated that in 1908 it will be more than $100,000.

The oyster industry has been created and developed notwithstanding many and great obstacles. Great storms have swept away the results of the outlay of millions of dollars in experiments and planting. The natural enemies of the oyster, especially the starfish and the drill, have destroyed millions of dollars worth of the product, and the oyster farmers have expended millions more in catching and destroying these enemies. They have suffered great losses from many causes and have encountered and defeated unnumbered difficulties, perils, and vicissitudes. Hostile legislation and litigation have been overcome. The lawless have sought to find flaws in the titles, so as to reap the fruits of the labor of others. Demagogues have appealed to the underlying anarchistic or poacher sentiment, which exists among some classes of voters.

One of the most trying experiences which the oyster grower has been called upon to meet is the recent storm of public notion in decrying oysters as an unwholesome food. People have been accustomed to regard oysters as a nutritious and especially as a digestible food, and one which is most welcome to the palate of the epicure. It is but natural that they should desire to know whether there is any foundation for the sensational assertions that have been made against oysters. In recent years many kinds of food, perhaps a majority of all the kinds, have been claimed to be objectionable in one way or another. They have been found adulterated, in insanitary environment, or exposed to contamination by the germs which are blown about in the dust of the streets. Milk has been found to be swarming with the bacilli of typhoid, diphtheria, and tuberculosis, and water with typhoid and malarial germs. These have caused hundreds of epidemics of typhoid fever and other diseases. Flies and mosquitoes have conveyed in multitudes of cases typhoid and malarial infection. Among them all probably no article of food has been attacked in so sensational a way, with so small reason or ascertained fact, as oysters. Some so-called scientific writers have attacked them because the subject was novel and sensational, although previous scientific research had proved the oyster to be a most nutritious, easily digested, and valuable food. A novelty is a welcome subject for a magazine or newspaper article.

It has been claimed, perhaps truly, that there were formerly a few places where oysters were planted or floated that might be considered insanitary. While 1 bushel in 100,000 might be so situated, the other 99,999 are grown in the deep pure water of the great bays and sounds. In those cases where there was suspected danger of insanitary effects, or even criticism, the great oyster-shipping firms voluntarily discontinued floating and shoring oysters, and the other shippers have been required by law to discontinue doing so. It is now forbidden to market any oysters from places that are not approved by the health authorities. But notwithstanding these facts, certain writers and reporters have continued to work this profitable vein of sensationalism. There was no definite statement that any typhoid fever germ had ever been found in an oyster, but there was a mass of insinuation and innuendo which wantonly injured a great industry.

It is contrary to public policy that a food such as oysters, which are noted for their great palatability, easiness of digestion, and high food value, should be lightly thrown aside without any evidence worthy of being called such. Every thoughtful man is compelled often to recognize the prevalence of popular errors. Many of the accepted theories and beliefs of twenty years ago have been disproved by facts later ascertained, and some were consigned to the scrap heap within a tenth part of that period. Among these subjects the theories of the causes of disease and how to avoid them are no exception, and have had a history of many radical changes, in which imagination and notion have by no means been absent. Hence reason dictates that we should be slow to accept theories, even of thinking men, until clearly proved, and far more, that our opinions ought not to be influenced in the least degree by the waves of popular notion which are promulgated by the sensational press to supply the morbid hunger of the unthinking multitude for novelty and excitement. The president of Columbia University has aptly said:

> The daily press, with its hectic headlines and its guillotine-like opinions, assists us to form the habit of acting and judging without thinking. * * * A distorted and inaccurate account of some important happening will serve to fix our permanent attitude toward a man or an event, and we may never know how hopelessly inadequate or erroneous the grounds for that attitude are.

Careful observation and examination lead to the conclusion that the recent attacks upon the healthfulness of oysters have little or no foundation in fact.

The most prominent case in which positive statements were made that typhoid fever was contracted through the use of oysters was published in a New Jersey newspaper within the past year and copied from that newspaper throughout much of the United States and Canada. These statements were thus placed before millions of readers. It was stated that two persons,

Ferdinand Bendt and his wife, Rosa Bendt, of Newark, N. J., had died from typhoid fever, the result of eating infected oysters. On investigation it was found that the official report of the board of contagious diseases shows that neither of the persons had eaten oysters, but that they had eaten other foods which are sometimes infected by typhoid fever. Also the death certificates showed that one of them did not die of typhoid fever, but of cerebro-spinal fever.

Before the original article was printed, the attention of the reporter was called to the fact that the deceased had not eaten oysters, but he ignored the information and printed the sensational report regardless of truth. Later the newspaper was asked to correct the misstatement, and replied that a correction would be printed if the space required to do it was paid for.

In another case to which much prominence was given, a young physician gave to an evening paper an item in which it was stated that a certain young lady, a teacher in a public school, was very ill with a malignant case of typhoid, incurred by eating oysters. A careful investigation of the facts proved that she was but slightly ill, and not with typhoid fever; in fact, the doctor was unable to diagnose her case, but he half jestingly asked her one day if she had been eating oysters, and he was informed that the family had received some sent by a friend. He overlooked the fact, however, that she had not eaten any of them, while her mother and brother had done so and were not ill. A written statement signed by the mother and nurse of the patient established these facts. The result of the newspaper item was to give this young physician some free advertising, as having brought the young lady through a course of typhoid fever, and incidentally to instill an unfounded prejudice against oysters in the minds of thousands of readers of the newspaper.

Another illustration is afforded by the action of the health officers of Poquonnock, in Connecticut, where, several years ago, an epidemic of scarlet fever was attributed to the culture of oysters within the limits of the town. The health officers went so far as to require the destruction of the industry in their waters, for which the state of Connecticut some years later paid damages. At the present time no one believes that the oysters had anything to do with the epidemic which was then charged to them.

Many other instances can be cited in which sensational reports have been published with very little, if any, evidence underlying them. In many cases the motive for these reports is clearly that the reporter is paid for the "scoop," as he calls it, and it is an unfortunate fact that there are some newspapers that will accept and publish any sensation which is not actionable. Also it may possibly sometimes occur that a physician or health officer will carelessly allow himself to make public a suspicion or surmise which does great injustice, though it may perhaps enhance his own importance in the public eye.

Then, too, there is an incentive to sensational reports about oysters, because the claim that they cause disease is a novelty. Milk has been found to be the cause of typhoid fever in so many thousands of cases that such reports no longer secure so much attention in sensational journalism as does one alleged or suspected case that is attributed to oysters.

I would not be understood to say anything against the general and almost universal use of milk as a food. The most that we would claim is that care should be taken to keep milk free from contamination, but there is not one-thousandth part as much evidence to cause us to fear the contamination of oysters with disease germs as there is of milk; in fact, recently a great variety of foods have been declared dangerous to health. According to "The Jungle" and the investigations resulting, the methods under which meat was prepared for the market were revolting. Milk has been found to be swarming with the bacilli of tuberculosis, typhoid fever, and diphtheria. Flies have been proved to carry the germs of typhoid fever and other diseases, and deposit them upon every kind of food upon which they alight. Analysis has disclosed harmful adulterations in many of the prepared foods and drinks. Public and private supplies of drinking water have in many instances caused devastating epidemics of typhoid fever, and the bacilli have been found in vast quantities not only in the water but in milk which had come in contact with cans washed in the water.

Among these many dangers from food and drink, it becomes necessary to discriminate between those foods which are known to be dangerous to health and those to which mere suspicion is attached. We must eat and drink; therefore we need to know in what foods disease germs have actually been found, and, on the other hand, those to which unproved suspicion has attached.

To those who have read the sensational statements against oysters, it will be a surprise to know that although many expert bacteriologists have searched diligently for typhoid bacilli in oysters, I have not been able to learn of one single authenticated case in which bacilli have been found in oysters in the United States, except when placed there for purpose of experiment; while the germs have been found in milk and water in innumerable instances and are known to multiply in these media to an extent beyond arithmetical expression and beyond the comprehension of human intelligence.

Another assertion that has been recklessly made about oysters concerns the use of preservatives. When oysters are handled as they are under modern methods—caught by steamers on one day, opened the next and, after being thoroughly chilled with ice, shipped into the country, there is not the slightest need or occasion for the use of chemical preservatives. I can say without hesitation that not an ounce of any preservative excepting ice has ever been used

in oysters shipped by my firm during an experience of forty years, and I have no doubt that other reputable firms are equally particular. The fact that 99.9 per cent of the oysters now marketed are taken from deep salt water causes them to be incomparably more free from disease germs of all kinds than is true of most of our ordinary foods, which come in contact, while exposed for sale, with the air and dust of the streets, in which disease germs abound.

Hundreds of instances could be cited of the amazing multiplication of the typhoid-fever germ in drinking water, but one will suffice as an illustration: A few years ago there was a single case of typhoid fever in a house that was situated on a slope which led, a considerable distance away, to one of the water supplies of the city of New Haven. A little drainage proceeding from this house ran over the frozen ground of winter to the lake. There the germs multiplied to such stupendous extent as to communicate the disease to more than 500 of those who drank the water in that section of the city, with over 50 deaths.

The following statement from the Medical Journal gives a recent authority ("Milk and Its Relations to Public Health," Bulletin No. 41, Hygienic Laboratory, Public Health and Marine-Hospital Service) upon the subject of milk, which is so generally and freely used, as follows:

> The conviction that is forced upon the reader of these startling reports by men who are writing, not to cause a sensation but to state facts, is that the "jungle" as a disseminator of disease is as nothing compared with the dairy. The thought of eating meat prepared under the conditions that prevailed at one time in Chicago and that still prevail in other cities, whence emanated such pharasaical condemnation of the Chicago methods, may not be pleasant, but the actual danger to health from this cause is almost negligible when we consider the morbidity and the mortality directly traceable to milk from the ordinary farm or even from many a so-called model dairy. Dr. John W. Trank, of the Marine-Hospital Service, gives in this bulletin a tabulated report of 500 epidemics of typhoid fever, scarlet fever, and diphtheria caused by contaminated milk. These epidemics were only a few of those which have been reported and are accessible in the literature, and how many there may have been in the past which were never reported or the origin of which was never found can only be imagined. In addition to this, a report by Doctor Anderson shows the part which infected milk plays in the dissemination of tuberculosis. He examined 272 samples of the market milk of Washington, supplied by 104 dairies, and found that 6.72 per cent of the samples contained virulent tubercle bacilli, and of the dairies there were 11 per cent the milk from which contained these micro-organisms. One institution for children was found to be feeding its inmates on milk which caused tuberculosis in guinea pigs. Doctor Mahler's investigation led him to the conclusion that probably 25 per cent of the cows supplying milk to the District of Columbia are tuberculous.

Let us compare the preceding with the statement in the bulletin of the Chicago Board of Health, dated November 23, 1907, that the bacteriologists of the board of health of the city of Chicago examined samples of all the oysters shipped from the various sources to Chicago during the preceding month and found all of them absolutely free from any contamination or danger to health.

In addition to the preceding comparison, no bacilli of tuberculosis, diphtheria, or any other disease have been found in oysters, and there has been no case, even of circumstantial evidence, showing that cooked oysters have caused typhoid fever, or any other disease, except possibly ptomaine poisoning, which may occur in any one of hundreds of foods if proper care is not exercised. It is conceded, however, that proper cooking will destroy bacilli in oysters if any do exist.

The limits of this paper forbid the introduction of a vast amount of available evidence along these lines, but it is clear that compared with the conclusive proof of the occasional danger in the use of milk and water, the evidence against the wholesomeness of oysters is so trifling as to be negligible. Let me repeat that I do not urge or imply the disuse of milk and water, but merely use a comparison with which we are all familiar, and I believe it is clear that so long as milk and water are freely and universally partaken of it is unreasonable to harbor the least prejudice against oysters as a food.

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EFFECTS OF MENHADEN FISHING UPON THE SUPPLY OF MENHADEN AND OF THE FISHES THAT PREY UPON THEM

By Walter E. Hathaway

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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EFFECTS OF MENHADEN FISHING UPON THE SUPPLY OF MENHADEN AND OF THE FISHES THAT PREY UPON THEM.

By WALTER E. HATHAWAY.

The object of this essay is to determine impartially, as nearly as possible from the facts and information obtainable, the effects of fishing, with modern and improved apparatus, on surface-swimming fishes and on such fish as prey upon them. This inquiry, therefore, will naturally proceed from two standpoints: First, the effect directly on the surface-swimming fishes, and, second, the effect on such predatory fishes as feed upon those of the former class.

While it is the habit of nearly all of the migratory fishes that inhabit the waters of the middle and north Atlantic coasts of the United States during the spring, summer, and fall months of the year, such as bluefish, weakfish (which south of the Delaware Bay are known by the general name of "trout" and north and east of Montauk Point as "squeteague"), drum, bonito, mackerel, and menhaden, while on passage, to travel in schools and largely on or near the surface of the waters, these all, except the mackerel and the menhaden, disperse when reaching their feeding grounds and appear infrequently on the surface thereafter. While the mackerel is at times during the entire summer and fall a surface-swimming fish, and is also found in schools, it is more generally found in small and scattered numbers and often deep under the surface.

Therefore for the purpose of this inquiry the menhaden alone will be considered, as of all the fishes that inhabit these waters it alone, strictly speaking, is a surface-swimming fish, and invariably swims in schools. However, conditions of the weather, especially the temperature of the water, and the presence of enemies, whether man or fish, have great influence upon the actions of these fish. They have often been known to be in certain waters in great abundance for days, weeks, and even months, but in such scattered numbers that they could not be successfully taken in purse nets, and at such times appearing on the surface only at intervals, longer or shorter, under the most pleasant and favorable weather conditions.

No notice will here be taken of such fish as shad, herring, and alewives, which seek the shores only to spawn and not for feeding grounds. The principle governing the catching of them is entirely different from that of catching the menhaden, which come to the shores to feed and not to spawn.

HABITS OF THE MENHADEN.

It is true that the menhaden do spawn on the Atlantic coast of the United States, but only in limited numbers. Spent fish have been found all along the coast from Maine to Florida, but never on their passage north. Such fish have been examined in Maine as early as July 15 and on the Atlantic coast of Florida as late as December 15. The small fish of that season's spawning are found all along the coast south of Sandy Hook, for the most part during the months of August and September. They have rarely been seen north and east of Long Island. During the first week in September, 1906, the writer saw several schools of very small menhaden, from 1½ inches to 2 inches long, in the harbor of Vineyard Haven. Old fishermen, whose observation of those waters had extended over long periods, in one case fifty years, stated that they had never seen them there before.

It is unquestionably a fact, although up to this time not demonstrable from actual observation and investigation, that the menhaden spawns principally in the warm waters south of the United States, probably in the Caribbean Sea, and mainly during the months of January, February, and March. The writer examined many hundreds of menhaden caught from the 20th of November to the 10th of December, 1906, between Cape Lookout and Georgetown, S. C., and without a single exception they were fish due to spawn in from thirty to sixty days; those fish were moving south at a rate of from 20 to 50 miles per day.

Menhaden are also found in large quantities and have been and are being taken for commercial purposes in the Gulf of Mexico, but these are slightly different in appearance and habits from the menhaden found in the Atlantic Ocean, being a little heavier in body in proportion to length and less active. It is believed that they do not migrate into the Atlantic, but remain about the Gulf coasts of the United States and Mexico.

Many different theories have been advanced and maintained as to the spawning habits of the menhaden and also as to their habitat during the winter and early spring months; but it is believed by the writer, from a very careful personal observation of these fish for the past twenty years and over the entire eastern coast of the United States from Maine to Florida, that the statements herein made are, as nearly as present knowledge of the subject will justify, correct and accurate. This statement, however, is made with due modesty; for upon one occasion when he asked an old fisherman who had taken menhaden for fifty years, and all the way from Casco Bay, in Maine, to Port Arthur, Tex., "Captain, what do you know about menhaden?" the answer, very emphatically given, was, "Not a damn thing."

It is, however, a clearly established fact that the menhaden seek this coast for food and not to spawn.

The menhaden, scientifically known as *Brevoortia tyrannus*, has many local names along the coast—in North Carolina, "fat backs;" in Virginia, "old wives;" in New Jersey and New York, "moss bunkers;" and generally in New England, "pogies."

As is common with all migratory fish, the oldest and strongest go farther afield, in the case of the menhaden farther north. Therefore the size of the fish found on various parts of the coast differs; the average size of the fish caught on the principal grounds being, in Maine, about 12 inches; in Long Island Sound and adjacent waters, about 10 inches; on the "Jersey beach" and in Delaware Bay, about 9 inches; in Chesapeake Bay, about 8 inches, and south of Cape Hatteras, 6 to 7 inches.

On their journey north, which begins usually in March, the fish do not follow the coast, but travel some distance out at sea, the schools "striking in" near their usual feeding grounds. Returning, which migration begins from New England waters early in September, those about and north of Cape Cod usually disappear first from Nantucket Shoals and the waters adjacent to No-Man's Land. From Cape Cod to Sandy Hook they sometimes follow the ocean side of Long Island and the New Jersey coast as far as Cape May, sometimes disappearing off Montauk Point. Those spending the summer on the "Jersey beach" and south of the Delaware usually follow the coast to Cape Hatteras and often even to the Savannah River. Therefore in the late fall and early winter large fish are often taken as far south as Charleston.

Having thus with reasonable certainty established the nature and habits of the menhaden, the next and most important part of our inquiry is, What effect has the taking of them by man had upon the supply and quantity, and also upon their movements?

THE MENHADEN FISHERY.

Menhaden have been taken along the Atlantic coast since the first settling of the country by white men. Indeed, it is believed that the Indians were acquainted with the use of fish to enrich the ground. Up to about 1870 they were taken in small quantities only, in the smaller bays and inlets and in the mouths of the rivers, generally in shallow water, with very simple devices, and they were used mainly for fertilizer or manure, but in part for food. For many years they have been used in a small way for food by the negroes and poorer whites along the southern coast country. Properly cleaned and salted they can be eaten with relish in default of a better fish. The fresh roe, fried, is not bad food and is sometimes eaten in the coastal country south of Cape Hatteras, when the fish are taken on their way south in the months of November and December. The whole fish, either applied directly to the land or composted with barnyard manure or woods litter, has been used as a fertilizer all along the Atlantic coast of the United States since early colonial times.

But this was a wasteful and ultimately injurious process if continuously applied, because the oil in the fish was not only lost but in time seriously damaged the soil, causing it to become stiff, gummy, and sour. The first commercial use of the oil was due to the ingenuity of a woman, about the year 1850. The process of extracting the oil was at first very crude, and the remainder of the fish, the "scrap," was for the most part thrown away. Both the oil and the "scrap" are now manipulated with improved and expensive machinery and apparatus.

At the present time there are about 30 factories with 70 steamers engaged in the business of taking menhaden and making them into "scrap" and oil. The average annual catch is about 600,000,000 fish, producing some 70,000 tons of "scrap" and 35,000 barrels of oil. The industry has been on its present basis since about 1885. During these twenty-three years the annual catches have varied greatly, from about 250,000,000 in 1892 to over 1,000,000,000 in 1903, but there has been little or no variance in the average for a period of years. The catch per steamer per season has also greatly varied, owing to locality of operations and the proverbial luck of fishermen, from 3,000,000 or 4,000,000 to 23,000,000. The season of 1906 was a poor one; last season, 1907, was poorer, the total catch not being over 350,000,000. This season up to the date of this writing, September 7, has been one of the best ever known, and prospects are for a catch of at least 800,000,000. These facts seem to demonstrate clearly that so far as abundance is concerned, taking an average period of years, there has been no diminution of the quantity. Weather conditions, particularly the temperature of the water, govern the movements of menhaden greatly. This has been an ideal season, the weather along the coast from Hatteras to Montauk having been uncommonly mild and pleasant; during the previous two seasons of 1906 and 1907, on the contrary, these conditions were exceedingly unfavorable.

EFFECTS OF THE FISHERY UPON MOVEMENTS AND NUMBERS OF MENHADEN.

What effect has this fishing on the movements of the fish? Generally, the constant operation of modern seines and steamers at, in, and about the mouths of the narrower estuaries of the ocean have a tendency to keep the fish out of such waters. To illustrate, the daily operation during the early months of this season of some 30 steamers about the mouth of the Chesapeake Bay undoubtedly kept fish that had started for that water away, and turned them both up and down the adjacent parts of the Atlantic coast, and notwithstanding the general abundance of these fish this year they have been uncommonly scarce in the upper part of the Chesapeake Bay and the rivers emptying into it. The fishing on the present scale has kept the fish out of the smaller bays, inlets, and rivers in the immediate neighborhood of large seining operations in the near-by ocean. Also, excessive or reckless fishing, even when on very large schools, and especially when the fish are on their migratory move-

ments, will often cause them to scatter, become wild, and even disappear altogether.

To sum up, the annual taking of some 600,000,000 of menhaden per season for the past twenty-three years has to no perceptible extent or in any perceivable amount diminished the average number in the ocean and its great estuaries; but it has lessened the quantity in some of the smaller water areas adjacent to large fishing operations, in some cases almost to extinction. The self-evident lesson to be learned by the commercial menhaden fishermen—and the nature of this fish is such that no one else has even a remote interest in it—is that in the future these fish will be largely taken in the ocean with larger and faster steamers and more improved appliances.

EFFECTS OF THE MENHADEN FISHERY UPON PREDATORY FISHES.

There have been no menhaden, only a few excepted, north of Cape Cod since 1898. This is due in part, no doubt, to the increased destructiveness, in those waters, of dogfish, but scientists believe it to be due principally to the temperature of the water. Even the large and vigorous menhaden do not go to or remain in water cooler than 60°. It has been contended that these northern fish were all caught up by the steamers. Even were this true, for the last season in which there was any menhaden fishing in Maine, 1898, why have they not returned? There have been comparatively no menhaden taken north of Cape Cod for ten years, and they have been abundant south of the Cape several years since 1898, notably in 1903, when over 1,000,000,000 were taken.

It is distinctly the opinion of this writer, following the dictum of Colonel McDonald,* that no migratory fish can be materially diminished, much less destroyed, by any appliances that the brain and ingenuity of man have yet devised, when not taken on their regular spawning grounds. The herring and mackerel fisheries, both in this country and in Europe, satisfactorily demonstrate this truth.

Lastly, let us consider what effect the taking of menhaden by man has on the fish that prey upon it. Nature's evident purpose in producing the menhaden was to supply food directly to fishes, and indirectly to man on account of its value for fertilizing purposes. It is, perhaps, the most promiscuously prolific of all fishes.

Almost all predaceous fish prey upon menhaden. In the order of their destructiveness, estimating the entire Atlantic coast of the United States, I would name the shark, the bluefish, the dogfish, the weakfish or squeteague, the porpoise, and the bonito. The shark is their principal enemy south of the Chesapeake. The writer opened one shark taken off the mouth of the Cape Fear River, in North Carolina, and actually counted 352 well-defined menhaden taken from its stomach, at least half of them entirely whole; and he has seen thousands of them preying on schools of menhaden in the same waters. Many

sharks are caught in the menhaden nets, as many as 275 having been taken by one steamer in one day. In the beginning of the menhaden fishery at the mouth of Delaware Bay sharks were very numerous in those waters, much more so than they are now, and it is believed that the constant taking of them in menhaden nets has caused this decrease. There can be no doubt that whenever any fish that produces its young in such small numbers can be taken in any given water in large quantities its practical extinction is only a matter of persistence and reasonable time; and the writer, who has seen 7 tons of dogfish taken at one lifting of a deep-sea trawl, in experiments conducted by The Fisheries Company to the south of Block Island in September, 1907, is entirely satisfied that that pest of the North Atlantic coast can practically be exterminated.

The bluefish is so erratic in its nature and habits and of such uncertain and irregular habitat that little can be said about it with any positiveness. It unquestionably eats and destroys large quantities of menhaden, especially north of Delaware Bay, but as it is never caught in quantities in seines, and feeds on all other varieties of fish smaller than itself, it is not believed by the best authorities that the taking of menhaden by man has any effect whatever on bluefish.

The only food fish of any particular value, other than the bluefish, that feeds to any extent on the menhaden is the weakfish, or squeteague. There is quite an extensively entertained opinion in certain places along the coast, especially in New Jersey and southern Massachusetts, that the constant taking of menhaden by the steamers materially diminishes the quantity of weakfish and squeteague for the anglers—for the reason that the food being taken the weakfish and squeteague seek other waters more profitably supplied. If these people would only just for a moment realize that only the largest weakfish feed on menhaden, those under 3 pounds rarely ever eating any but very small menhaden, and that the large weakfish is a sea fish and seldom frequents the small bays and inlets, they would know how silly this belief is. It is a fact that the catch of weakfish in the pounds on the New Jersey coast and by the New York fishing smacks has increased year by year, notwithstanding the large numbers of menhaden annually taken from the same waters. It can be asserted with entire confidence that the taking of menhaden by man has had absolutely no effect on the abundance or movements of weakfish during the existence of the menhaden industry.

G. Brown Goode, in his "History of the American Menhaden," says:

> Is it too much, then, to multiply the three hundred millions of millions of menhaden probably consumed by the full-grown bluefish alone on the coast of New England in the summer months by ten? This would allow three thousand millions of millions of menhaden, old and young, annually destroyed in the waters of the United States, in comparison with which the number annually taken by men is perfectly insignificant. This estimate will seem extravagant at first sight, but I believe that it will be found a very moderate one by any who may take the pains to investigate the question for themselves.

This opinion has been approved and concurred in by Professor Baird, Colonel McDonald, and Dr. Hugh M. Smith, than whom there are no higher authorities on the subject to be found. Assuming that it is even approximately correct, can any intelligent person, even with the greatest stretch of fancy, imagine that the comparatively few menhaden taken by man can in any way affect the fish that prey on the menhaden, which have for thousands of years been taking thousands of menhaden for every one that man has taken during a few years?

CONCLUSION.

There can be no question but that the fishing by man has in no way diminished the quantity of menhaden in the ocean, the only effect having been to retard or change the movements of small lots, in and about specially located bodies of water. Nor has it had the minutest effect on the predaceous fish that feed upon them, except the possible decreasing of sharks in the waters north of Cape Charles, and this may be due to other causes than taking them in nets with menhaden. Extensive investigations made under the authority of Dr. Hugh M. Smith, of the United States Bureau of Fisheries, have clearly demonstrated the fact that food fish are seldom taken in the menhaden nets and never in any quantities. The writer, first and last, has seen perhaps 100,000,000 menhaden taken, among all of which there were not 1,000 food fish of any kind.

When we consider the illimitable vastness of the ocean's extent; the marvelous fecundity of the menhaden, one female producing sometimes 18,000 eggs; the incalculable numbers there must be in all the waters, as many as 500,000 having been taken from a space of less than an acre's surface; we can inevitably reach but one conclusion: That they were designed in the all wise provisions of nature for man's use and benefit, and it behooves man, with such skill as his wisdom and ingenuity can devise, to take them and use them, believing that for every one he can take each year probably tens of thousands die and are destroyed by other agencies.

DISCUSSION.

The PRESIDENT. The menhaden always provokes discussion. I know the Bureau of Fisheries has for twenty years been making observations at Woods Hole on the breeding habits in the neighborhood of Buzzards Bay and Vineyard Sound. I dare say that Doctor Smith will give information in regard to the results of the observations made upon the breeding habits of the menhaden in the north.

Dr. HUGH M. SMITH (secretary-general). Mr. President and ladies and gentlemen, I do not intend to discuss the menhaden question, but there is just one point brought up by the last speaker to which I would invite attention. Mr. Hathaway is undoubtedly in error in regard to the spawning of the menhaden. The spawning habits of this fish are now pretty well known, thanks to the efforts of the United States Bureau of Fish-

eries and several of the States on the middle Atlantic coast. There appears to be a double spawning period, quite similar to that of the sea herring on the Atlantic coast of the United States. In spring and early summer the menhaden spawns in abundance on the middle Atlantic coast—northern part of the middle Atlantic and southern part of the New England coast; and in late autumn and early winter the menhaden spawns in great abundance on the southern part of the middle Atlantic coast and the northern part of the south Atlantic coast. Ripe eggs from both of these regions have frequently been examined.

Mr. ALEXANDER COOPER (Delaware). I have but a few words to say. The importance of an international congress to consider the foreign and domestic fisheries of the United States is universally conceded. The time has come when something must be done to preserve the food fish, which are rapidly disappearing from American waters. I speak particularly of the shad and sturgeon fishing along the Atlantic coast, and still more particularly of that great industry as it exists in the Delaware bay and river. The most direct cause of this depletion with us consists in the pollution and contamination of the waters in which these fish live and propagate their species by the owners of oil refineries, factories, and mills permitting their poisonous and refuse matter to flow into the water, thereby practically destroying the spawning grounds or so affecting them as to drive the fish to other localities. There are other causes for this depletion of these fish, which seem to be pretty well known. One of them may be stated in connection with Mr. Hathaway's paper. I have had the pleasure of meeting Mr. Hathaway before. About two years ago I was appointed one of a commission of three from the state of Delaware, to meet with a like commission from the state of New Jersey, to consider a compact which had been entered into between these two states and which has since been ratified by Congress, and to draft uniform fishing laws for the two states, regulating their respective fishing rights in the Delaware bay and river. A serious question presented itself to us in regard to the menhaden fisheries—whether the men engaged in these fisheries caught food fish, and particularly shad. Mr. Hathaway appeared before us and urged that they did not catch any food fish worthy of mention. The shad and shore fishermen contended on the other side that they did—that the shad passed out into the ocean in large schools, particularly in the month of September, swimming on the surface of the water like the menhaden, and were caught like the menhaden, and used as such.

I do not present this matter in a controversial way, but suggestive only, so that the matter can be investigated and, if true, remedied in some way. It has long been an important question to the shad fishermen of the Delaware River.

Mr. GEORGE P. SQUIRES. I heard Mr. Hathaway, who is my neighbor; I have also heard this kind gentleman. I am no lawyer. I am simply a fisherman of fifty years' hard labor. I have this to say to this gentleman and to everyone of this congress. I do it upon the authority of my governor, and do it with pleasure. I do it with the authority of our Association of Menhaden Fishermen of the Chesapeake Bay.

Just as this kind gentleman has stated, the great object is to save the food fish. I, as the president of our association, am authorized to say to gentlemen who are here, foreign or of our own country, that we will welcome them to come among us. We will place one of our steamers at their disposal—any man or men; we will treat you as Old Virginia can treat you. Come, and see for yourselves. Take our crews and work them by yourselves. Come, gentlemen, and see how much the menhaden fishery is a benefit to the future of the fish of our country. Come on!

EFFECTS OF THE MENHADEN AND MACKEREL FISHERIES UPON THE FISH SUPPLY

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Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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EFFECTS OF THE MENHADEN AND MACKEREL FISHERIES UPON THE FISH SUPPLY.

By W. C. KENDALL,
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SCHOOLING OF FISHES.

There are various degrees of gregariousness among fishes. Probably there are but few fishes that do not swim in schools at some stage of their existence, and there are few, if any, that are always in schools. The very young of most species, as a rule, occur in schools of greater or less extent. The broods of fishes from ova laid in more or less stationary collections or floating agglutinated masses naturally occur in family groups of brothers and sisters. Floating eggs, while sometimes scattered, are perhaps oftener assembled through the effects of winds, minor currents, etc. The young from such eggs to some extent constitute brotherly and sisterly aggregations, though probably they are more frequently mixed broods. Some species commonly regarded as nongregarious are occasionally observed in schools in their young or adult stages.

The schooling habit is so common among fishes that it must in some way be an advantage to them, although it not infrequently is an obvious and decided disadvantage. The most pronounced types of gregarious fishes are comprised in the scombroid and clupeoid groups, but among the species of these groups there is considerable diversity in respect to the habit. The most representative and perhaps the most perfect examples of the schooling fishes of these two great groups are, respectively, the common mackerel and menhaden.

The eggs of the mackerel float. They are supposedly deposited at the bottom, whence they rise to the surface and are subject to the influences of winds, waves, and currents, which factors determine whether they shall be scattered or aggregated.

Practically nothing is known of the place of spawning of the menhaden or the character of its eggs—whether agglutinated, attached to objects, or free, or whether they sink or float. But the fact remains that as soon as the young of either the mackerel or the menhaden are observed they are in schools. The very young of either species have not been observed except in the case of arti-

ficially hatched mackerel. When naturally hatched mackerel are first observed they are at least 3 or 4 inches long, and menhaden have never been seen under 1 inch in length.

Eggs that are stationary or agglutinated, if they are from a single parent and all subject to the same conditions, will hatch at approximately the same time and produce fish of comparatively uniform size. Aggregations of floating eggs are likely to be derived from several parents, laid at somewhat different times, and consequently will produce young of somewhat more diverse sizes. In both instances the rate of growth of individuals varies, causing a difference in size, but on the whole each school of young fish is composed of individuals of fairly uniform sizes. This uniformity appears to be to a great extent permanently maintained; yet it not infrequently happens that schools of two or more sizes become mixed, especially when a school is first broken up by any means and the scattered fish subsequently join other schools.

Whether the schooling habit of the early stage is retained and is the basis of the schools of larger sizes up to adults is impossible to say. That such is the case is indicated by the comparative uniformity in size of individuals of schools of larger fish. Sometimes, however, a school is so large that it could hardly be the original brood or aggregation only, but several, or perhaps many, broods. But such a "raft" is composed of individuals of comparatively uniform sizes, or of sizes suggesting that the fish are of about the same age.

The occurrence of such extensive "rafts" or "bodies" of uniformly sized fish in the spring of the year suggests that possibly the younger fish have a somewhat different habitat from the older ones at that season of the year when they are beyond observation—that is, after they have "left the coast" and prior to their "return." But, as mentioned in the case of young fish, accidentally mixed schools of older fish of the same species, as well as schools containing unrelated species, are not uncommon. Mixed schools of large and smaller fish, or schools containing adventitious species, are likely to occur when the schools have been broken up and driven about by predaceous animals or by purse-seiners. Such broken-up schools or straggling individuals, or even small schools, are prone to fall into the procession when a larger body of fish happens along, even though it is of a widely different species, if it is not inimical. Another possible cause of mingling is when the fish are feeding upon the same kind of food and the food happens for any reason to be bunched.

INADEQUACY OF AVAILABLE INFORMATION.

Since the History of the American Menhaden, in 1877, and a brief summary of that work in 1884, also by G. Brown Goode, there has been little published regarding the habits of this fish. This history is remarkably comprehensive, there being hardly a point regarding the menhaden that is not treated more or less exhaustively. The work was, however, an enlargement of manu-

script notes furnished by Professor Baird, based upon opinions and information elicited by means of circulars from fishermen, manufacturers, customs officers, light keepers, etc., supplemented to some extent by observations by United States fisheries agents. Doctor Goode states that it was found necessary to make allowances for many inaccuracies of statement on the part of his correspondents, and that some of them, having been unable to obtain exact information, had ventured to guess at what they did not really know from experience. It might possibly have been added that some of that which they "really did know from experience" may have been inaccurate from misinterpretation of phenomena or errors of observation. Doctor Goode admits also that there remains much to be learned, but presents his views regarding the most plausible theories, which must, until more thorough and systematic investigations are made, take the place of actual knowledge. These theories have taken the place of actual knowledge, so far as publication is concerned, to the present day, for since Goode's History there is no adequate account of the menhaden accessible to the student or the public.

During the early nineties the United States Bureau of Fisheries made the menhaden and mackerel subjects of special investigation, and a vast amount of data was accumulated, though never utilized, at least in publication. The present writer was engaged in both investigations during those years and has since from time to time had opportunities, of which he has availed himself, to observe both species under various conditions and in various places. It is upon the personal observations thus made, together with some of the unpublished notes in the files of the Bureau of Fisheries, that this essay is based. Owing to present limits of space, however, the writer is compelled to leave his statements mainly unsupported by any transcription of the copious notes mentioned, and also must assume that the audience is familiar with the published literature upon the species herein treated.

HABITAT AND MOVEMENTS OF MENHADEN AND MACKEREL.

That the habits of some fishes of different ages differ to some extent in regard to their food, and consequently their habitat, is well known. It is a matter of common observation to those who have given attention to the habits of the menhaden that the different sizes, as a rule, are found in different places and under different conditions. The smaller the fish, the shallower the water and the farther up creeks and streams it occurs, even in fresh water. This may be for either or both of two reasons: (1) Owing to different character of food of the different sizes, or (2) for protection against enemies. Perhaps the latter is the more probable.

Young mackerel 4 to 5 inches long occur sometimes abundantly well up harbors, even about the docks, where larger mackerel never appear. They have been plentiful in Gloucester and Portland harbors, in the former place sometimes

close to shore in shallow water. As suggested before, in the case of menhaden, they may enter these places for food or for protection, but as they subsist to a great extent upon minute crustaceans which abound outside they could hardly be there solely for the sake of food.

During the period when they are beyond observation it is, of course, not known to what extent menhaden and mackerel feed. But the inference is that mackerel, at least, and probably menhaden, do not feed during this time, as the fish appearing in the spring, which apparently could be only those of the previous season's production, are about the same size as when they left, and early adult mackerel are always lean. A similar condition seems to obtain to some extent among the menhaden, for often the early menhaden are very poor, according to the reports of the fishermen. It can hardly be imagined that the fish would refrain from eating for a long period if food were plentiful unless they to some extent hibernate. If they do not hibernate—become more or less dormant and inactive—it is hard to explain why they should resort to a foodless region when food abounds in other places.

In respect to the menhaden, not so much is known regarding its food as is known of the mackerel, but it has been shown to feed to some extent upon minute crustaceans, as do mackerel, and such food abounds in the winter months in the localities that both menhaden and mackerel have apparently left. The natural inference is then that temperature is the controlling factor. Both menhaden and mackerel endure a rather wide range of temperature and both linger late in the fall in northern littoral waters. Rather curiously, young menhaden seem to remain longer than adult fish and will stand reduction of temperature to a low degree. An experiment made by Mr. Vinal Edwards at Woods Hole, which will be described, supports the statement. The ultimate death of the fish may have been due to the sudden changes of conditions to which they were subjected rather than to the low degree of temperature alone.

On October 16 Mr. Edwards placed in the inner pool of the United States fisheries station about 1 barrel of young menhaden from 2 to 6 inches long. In three or four days they formed together in one school and continued so until December 21, when the temperature fell to 35° F. The school then broke up and scattered about in the pool, some swimming near the surface, others near the bottom. When the sun was shining all would seek the sunny portions of the pool, avoiding the shade. On December 24 the temperature in the pool was 31.5° F. and most of the menhaden swam near the surface but seemed otherwise undisturbed. On December 26 the temperature dropped to 30° and the fish were less active, some swimming on their sides. On the night of December 26–27 it became much colder and snowed, and in the morning all of the fish were dead.

Thus it would seem that the disappearance of young and old in the late fall is to avoid extreme and sudden changes of temperature. They disappear,

but where they go has not been determined. Like all species whose winter quarters are unknown, the menhaden has been consigned by theory to the mysterious depths or contiguities of the Gulf Stream, a region ichthyologically lying beyond the "Pillars of Hercules." Warned by falling temperature, the fish is said to seek a stratum of congenial thermal conditions. All the known facts regarding this species indicate that it makes no extensive coastwise migrations, and since the requisite equable temperature, it is thought, can not be found anywhere else, the fish must find it in or near the Gulf Stream, notwithstanding the fact that so little is actually known about the winter conditions there. But why the fish should seek that locality for so brief a period has not been shown. Mackerel remain in northern waters until November and December and menhaden have been taken in quantities in southern Massachusetts in January, where they reappear in April.

Waters corresponding in temperature with those to which the fish have been accustomed in the summer or early fall could hardly be conducive to inactivity. Activity necessitates food. If the fish are sojourning in the midst of food and in an active condition, they would necessarily eat. Eating, they would continue fat. But mackerel and menhaden when first seen in the spring are as a rule very thin, indicating abstinence from food. If the fish live among an abundance of food, abstinence must be due to disinclination to eat. Such a condition could be ascribed to some degree of hibernation, but that would be inconsistent with warm waters. If, then, the fish is in such winter abode, it must be assumed that there is little or no food there. This, too, is contrary to the usual conditions. Food such as mackerel subsist on extensively, and menhaden to some degree in early spring, is particularly abundant in the spring, at least, in the Gulf Stream and its neighborhood. Moreover, during the alleged fall migrations the fishes are not observed moving offshore. Such movements as are observed are coastwise. After all, the fish are somewhere, but where is yet to be learned. Theory does not satisfy. As spring approaches immense bodies of fish often appear swimming at or near the surface. This appearance of the fish has been ascribed to rising temperature and the breeding instinct. Surely the depths of the Gulf Stream or the equable stratum have not become uncomfortably warm and forced them into the "cold wall" or arctic current? It is conceivable, however, if the fish were at or near the surface of the stream the warming water spread by southerly winds would cause the fish to advance with it. But these conditions are not invariable, and even if they were it would require some other impulse to force them into the much colder northern coastal waters. "Breeding instinct" fails to explain why immature fish are impelled to move in the same way as the adult breeders.

Let it be assumed that the fish—mackerel, menhaden, or other species—have not gone in the winter "migrations" quite beyond the mysterious "pillars;" that they are lurking somewhere along the coast, outside or within the bays, or

both, according to the size of the fish; at a greater or less depth, and, if not dormant or hibernating, that they are more or less inactive and disinclined to rise to the surface, where the temperature and other conditions are so variable and subject to sudden changes; that is to say, they are residing quietly at a depth of comparatively constant and uniform temperature, but of such degree that the fish are disinclined to activity, therefore requiring no food, but subsisting, as it were, upon the accumulated fat of the previous festal period. The regions, too, where, under this hypothesis, the fish reside are different for those of different sizes; in this instance, however, not on account of different feeding habits, but owing, perhaps, to the instinct of self-protection.

It is a well-known fact, as has been previously stated, that young or small-sized menhaden, up to 6 or 8 inches long, linger in the bays long after the larger ones have disappeared. It would therefore seem that the smaller fish are either less susceptible to the changes due to approaching winter, or that some other force predominates over their inclination to leave.

Granting, then, that the foregoing assumptions are true, when spring brings milder weather and less rigorous and sudden changes, the fish appear at the surface and their movements are again to some extent observable.

Regarding adult mackerel, it is known that these movements or so-called "migrations" precede the spawning process, but in immature fish—"blinks," "spikes," "tinkers," etc., which have like movements—this can not be so. In menhaden as a whole it is not evident that the spring "migrations" are for spawning purposes. In the adult of both species the growing ova and milt doubtless warn the fish of the approaching "critical period," but this can not be the case with the immature fish. What, then, is the impelling force that causes the fish to come to the surface and move about in definite or indefinite directions? If the previously suggested hypothesis is still followed, it may be reasonably assumed that the fish, having consumed their accumulated fat, are impelled by their desire for food. If such is the case their movements will be in search of food and in the line of least resistance. Their subsequent movements also, except as controlled by the breeding instinct, whether at the surface or below, will be for food, although they may be directly and indirectly affected by the same meteorological conditions, such as light, temperature, etc. When feeding the schools do not seem to move about very fast in any direction; therefore when in rapid motion they are probably in search of "pastures new." In support of this is the well-known fact that fish are seen going swiftly in directions exactly opposite to those that should be followed according to the "migratory" or breeding instinct. Such movements are usually, and sometimes correctly, ascribed to enemies heading them off and driving them in that direction. But if this were true in every case there should be, and surely would be, some further evidence of the enemies; for whenever the fish have been observed to be pursued by predaceous animals these animals are quite conspicuously manifest.

The movements of both mackerel and menhaden when feeding, as mentioned before, are not rapid from place to place for any great distance, but up and down, here and there, and around and around in that movement termed "cart-wheeling." While the latter movement is considered by many "just play," the manner of occurrence of minute organisms in aggregations of greater or less extent suggests that the fish are circling about in a school of these organisms, "scooping them in."

SPAWNING MIGRATIONS OF THE MACKEREL.

Regarding the migrations of fishes to their spawning places, every known fact in relation to menhaden points to no extensive migration for the majority of the fish. Mackerel apparently travel greater distances, but there is no evidence in support of the former belief that they traverse the whole length of the coast from Hatteras to Labrador and the Gulf of St. Lawrence. It is hardly possible that one man would have sufficient endurance to observe day and night a body of fish for so long a period, and a change of watch would vitiate the evidence. While it is perhaps possible that a body of mackerel would remain at the surface continuously day and night, it is more than merely probable that it would occasionally sink below the surface. If it did, the observer could not be sure that the fish appearing subsequently were the same school.

Some years ago mackerel sighted by the seining fleet off Liverpool, Nova Scotia, were "followed" along the coast and around the eastern extremity of Cape Breton. The fish were up and down, sometimes a day or a night elapsing with no fish seen. It was noticed that while the schools of mackerel along the western portion of the Nova Scotia coast had alewives and shad mixed with them, those caught after rounding the eastern end of Cape Breton had none of these adventitious fishes, but many schools were mixed with large herring, called by the fishermen "Newfoundland bloaters." Here, too, the mackerel were somewhat larger than those on the south shore.

Of course in the nature of things there is nothing to prevent the mackerel constituting the "body" from varying in size in different schools, each school perhaps having different fish mixed with it. But it is hardly probable that had the alewives gone around Cape Breton, or the herring been at the south or west of that point, some would not have been caught there. This gives rise to the suspicion that extensive migration is more apparent than real.

The condition of the reproductive organs of these fish, too, indicated that they were near the spawning time. According to the observer, each batch examined was thought to be within a week or so of it, which suggests that the fish may have been spawning along the coast. That those caught were not ripe offers no contra-argument. For it is possible that as the fish ripened they sank to some depth below the surface, where they spawned, and occasional few spent fish indicated that all did not reappear immediately afterwards. It is

well known that some fishes linger on their spawning grounds long after they have spawned, and it is not impossible that mackerel remain near the place where the spawn is deposited for some time afterwards. The same may be said of menhaden. In support of this is the fact that sooner or later all adult menhaden disappear from the Virginia shores and, temporarily at least, from the Carolina coast. There are not wanting fishermen, however, who aver that they catch menhaden along the Carolina shores at any time in suitable weather throughout the winter.

SPAWNING OF MENHADEN.

The time, place, manner, and duration of the spawning act of the menhaden are not known, and such meager data as are available on that subject are confusing. Direct observations by persons qualified to solve the problem have not been made, and the testimony of those who handle the greatest number of the fish is contradictory; individuals not infrequently change their views—sometimes even while being interviewed. Conjecture, however, is not evidence, and until thorough observations are made throughout the year the question can not be positively settled. But careful study of such data as are at hand suggests that there is no one definite spawning season such as appears to be the case with mackerel, but that the conditions are analogous to those of the common herring, which spawns in some localities in spring or early summer and in others in late fall or early winter, and perhaps more or less all summer. Some menhaden taken in Buzzards Bay throughout May and June up to July 15 are well advanced, and a few ripe fish have been observed; but of the many examined few are found that are more than "well advanced," and it is unsatisfactory to try to estimate the length of time necessary to ripen the "well-advanced" fish. Out of 500 large menhaden taken at Sakonnet, R. I., on July 5, 1892, 410 were females in various stages of development from very small to "nearly ripe." Of the 90 males, the majority contained milt "well advanced" and some were "ripe." From November 17 to 20, during the same season, at North Truro, Cape Cod, large menhaden were found with ova and milt in various degrees of development, some males being "well advanced" and a few females "nearly mature."

From the last part of October to the first of December, 1894, a large body of menhaden was observed to extend from Delaware Bay to Cape Lookout, "outside." These fish differed in appearance from the few taken within the bays at this time, being longer and their reproductive organs apparently very near maturity. Very many taken off Chesapeake Bay were examined, and the organs of those over 10.5 inches long always seemed to be in the same condition, which the observer could account for in no other way than that the fish were passing south toward warmer water to spawn. Subsequent observations off the

coast of North Carolina in the vicinity of Beaufort, however, revealed hardly any appreciable change in the conditions of the reproductive organs.

It is the consensus of opinion among the fishermen of the Chesapeake that the "bay menhaden" spawn in February and March, and they present evidence to that effect. But they believe that the outside fish in late fall spawn at sea near the Gulf Stream or off the coast farther south.

In May, 1908, there was received at the United States National Museum a portion of a menhaden the length of which indicated that the whole fish was about 13 inches long. It contained undoubtedly nearly ripe roe. It was caught in the Chesapeake on the 8th of April and was brought in to Solomons, Calvert County, Md. This suggests, at least, that the opinions and statements of the fishermen regarding the spring spawning of menhaden in the Chesapeake may be correct.

The above-mentioned occurrence of large bodies of menhaden outside, apparently near spawning condition, suggests also a fall or early winter spawning in that region, as do the data regarding the fish at North Truro. But the lack of knowledge regarding the length of time that would be required for the ova to mature prevents positive conclusions, for, instead of a few days or a week or two, a month or two or more might be necessary. The latter condition would bring the fish to maturity in February or March. In favor of the fall spawning, however, is the fact that a few undoubtedly recently spent fish were secured.

The evidence derived from young fish is unsatisfactory, since very little is known of their rate of growth. Young menhaden are seldom seen in the Woods Hole (Mass.) region before July, when they range from 1½ to 3 inches in length, more often from 1½ to 2 inches. In November in the same locality they range from 2 to 5 inches in length, the majority being about 3 inches long, and all through the season there is another lot of immature fish, which, perhaps, average 8 inches in length.

In Chesapeake Bay young menhaden are said to appear in May, when they run from 1½ to 2 inches in length. In March, 1894, young menhaden from 4 and 5 to 6 and 8 inches long were collected, and again in July from 1½ to 5 inches. This indicates that there are two stocks of young fish—the earlier, perhaps, from the breed of the previous fall, and the later and smaller from that of the spring of the same year.

It has been suggested, because adult menhaden are seen far up bays and streams and the young are found still farther up, that the fish spawn in these localities; but there is nothing to indicate this. Fish, especially the young, run into shallow waters and often long distances up streams—even to the headwaters of small streams and creeks—probably, as has been previously stated, to escape enemies.

The most that can be said regarding the spawning places of menhaden is that nothing is positively known.

RELATION OF MENHADEN TO FISHES THAT FEED UPON THEM.

Goode says:

Among the enemies of menhaden may be counted every predaceous animal which swims in the same waters. Whales and dolphins follow the schools and consume them by the hogshead. Sharks of all kinds prey upon them largely; one hundred have been taken from the stomach of one shark. All large carnivorous fishes feed upon them. The tunny is the most destructive. * * * The pollock, the whiting, the striped bass, the cod, the squeteague, and the garfish are savage foes. The swordfish and the bayonet fish destroy many, rushing through the schools and striking right and left with their powerful swords. The bluefish and bonito are, however, the most destructive enemies, not even excepting man; these corsairs of the sea, not content with what they eat, which is of itself an enormous quantity, rush ravenously through the closely crowded schools, cutting and tearing the living fish as they go, and leaving in their wake the mangled fragments. Traces of their carnage remain for weeks in the great "slicks" of oil so commonly seen on smooth water in summer. * * * I estimate the total number destroyed annually on our coast at a million million of millions; in comparison with which the quantities destroyed by men yearly sink into insignificance.

Such estimates, Goode states, are only approximate. It may be a question as to whether they are even approximate. If he deduces his estimates from a sufficient number of well-established facts, they may be considered approximate; but the evidence is that he reaches his conclusion by induction from a limited number of facts. One shark is known to have eaten 100 menhaden. One shark might contain 1,000 menhaden as a day's feast, but that would not be sufficient evidence upon which to base a conclusion that all sharks eat 1,000 menhaden each day in the year. One tunny may have been observed to almost annihilate a school of menhaden, but it does not follow that all the tunnies in the region consume a school of menhaden each every day. A school of bluefish is occasionally seen to wreak havoc upon hundreds of menhaden, but it does not sufficiently indicate that they do it every day. One squeteague having been found to devour nearly 50 menhaden does not clearly prove that the exclusive menu of the squeteague is nearly 50 menhaden a day. An average of 100 menhaden a day to a shark or its equivalent for three hundred days would require 333,333,333,333,333 sharks, or their equivalent in eating capacity, to devour a million million of millions menhaden in that length of time.

It is not a justifiable assumption that all of the predaceous animals previously enumerated feed exclusively and daily upon menhaden, even during the time that they are concurrently on the coast. Among fishes concerning whose habits we are better informed than those under discussion, it is known that they change their diet from time to time, and there are periods of days when they do not feed at all. One is almost as fully justified in assuming that a fish which is found to have eaten nothing during the day does not feed at all as that one found to contain a few menhaden feeds continuously and exclusively upon menhaden. Yet undoubtedly enormous quantities of menhaden are destroyed annually by fishes and other predaceous animals. Professor Goode further remarks that in estimating the importance of the menhaden to the United States it should be borne in

mind that its absence from our waters would probably reduce all our other sea fisheries to at least one-fourth their present extent. If his premises are sound, the estimate is probably approximately correct, otherwise it is subject to criticism. In the Gulf of St. Lawrence, where, for a portion of the year at least, the principal food of the cod is capelin and herring, the absence of these foods is concomitant with the absence of cod.

In the second report of the Commissioner of Fisheries of the United States, Baird ascribes the decadence of the inshore cod fishery of New England to the enormous diminution in the number of alewives; "at least," he says, "the coincidence is remarkable." If the same relation is known to exist between the cod and the alewives on the New England coast as between the cod and herring or capelin in the Gulf of St. Lawrence, then such a conclusion is well founded. But as it is not shown to be a fact, it can be considered only a conjecture. Surmises based on coincidences will not solve problems. Therefore, in order to determine even with any degree of approximation the effects of the reduction in numbers of any species in our waters upon other species to any extent feeding upon them, the habits of not only these forms but others as well must be very thoroughly known in all their intricate interrelations.

The list of fishes enumerated by Goode as destructive enemies of menhaden does not comprise all the species that at times eat menhaden, and it includes some that are not known to feed upon them at all. The assumption that they do is made partly from the fact that they are built on the model of predaceous fishes, and partly because they are sometimes caught on menhaden bait. The first part is to some extent justified, since it is safe to assume that a species which to any extent eats other fishes will eat menhaden if it can get them; but it is not safe to infer that it consumes enormous quantities, as its habits may be such that it is not brought in contact with such numbers, or food which it prefers may be at the same time present. That a fish is caught on certain kinds of bait or that the bait is the most successful to use does not signify that the principal food of the fish is the species used as bait. Not infrequently the best bait for some fishes is something that does not coinhabit those waters.

To what extent any species subsists upon menhaden and the number of species that feeds to some extent upon them is not known. Therefore no reliable deductions can be made regarding the effect upon such fishes were they deprived of the supply of menhaden. However, every menhaden caught reduces the number of those fish by one; every thousand or million reduces the number by a thousand or a million. Therefore the menhaden fisheries must, theoretically at least, have their effect upon the species that feed upon the menhaden by depriving them of so much food. They also have effect upon the menhaden sought by rendering those that escape capture more liable to be eaten by predaceous enemies.

Whether the effects of fishing are of appreciable injury to the fish depends upon the time, place, and amount of fishing, as well as upon the habits of the fish and the number caught. If the fish have a limited spawning ground to which they resort every year—for instance, a small bay, estuary, or mouth of a stream—constant fishing with purse seines and obstructive pounds and traps must necessarily seriously affect the number of fish reaching the spawning ground, consequently the number produced that season. And if such fishing is carried on at or near every spawning place of the species, as well as at a distance from it, the injurious effects would obviously be still greater, and in time would result in a diminished number of the species. If the species is greatly reduced in numbers, then the food supply of the fishes depending upon this particular species for subsistence is correspondingly reduced. The consequence of this would be that this species would be reduced by starvation or would be forced to depend upon other species for food. The latter is the most natural effect, and this in turn would deprive still other species of their food or reduce their numbers either as adults or young, or both. Other species being deprived of their food would repeat the process, and thus it would go on until nothing remained.

While such a condition is theoretically conceivable, it is not so in fact, except to the extent that if for any reason the food of a species is withdrawn the species disappears, doubtless in search of food elsewhere, and when its principal food is abundant the fish feeding upon it would naturally be plentiful. Exceptions that might be cited may be only apparent, for, as has been previously suggested, probably no fish feeds exclusively upon any one thing or depends upon any one species. The shark, tunny, or bluefish would hardly be likely to distinguish schools of menhaden from schools of other silvery fishes like the alewives, which sometimes equally abound with the menhaden along the coast. Thus the absence of bluefish from any section when menhaden are present or the presence of bluefish when menhaden are absent in each instance is due to the same thing—the presence of satisfactory food in one place or the other. There is no doubt that the bluefish disastrously pursues menhaden, but it is known to pursue other species with equal disaster.

The effects of the complete extermination of menhaden from the seas may be inferred from the effects of local disappearances for a term of years and where there is no evidence that the fishes that fed upon them there suffered in consequence of their departure. It may with propriety be stated here that such "unaccountable" disappearances took place long before modern fish traps and purse seines were known. Subsequent like disappearances and reappearances, again disappearances without reappearances, can not, then, logically be laid to the purse seines and steamers. But there can be no doubt in the minds of those who have observed the operations of menhaden and mackerel purse seines that there is at least a temporary more or less modifying

effect upon the movements of the schools of fish. It may still, however, be an open question whether the mackerel have not always been fully as intelligent as they now seem to be when they evade the nets so successfully that the fishermen call them "educated fish."

CONCLUSION.

In this paper there has been no attempt to explain the mysterious phenomena exhibited by the fishes discussed, but merely to suggest lines of investigation that might be worth making. There have been frequent more or less critical references to the contributions of Baird and Goode, but with no wish to attempt to controvert any of their sound arguments. The theories advanced by them are as logical and sound as the evidence upon which they were based would permit, since the conclusions were reached by assembling and sifting the testimony of unscientific observers. Such evidence is difficult to collate satisfactorily, owing to the more than frequently contradictory character of even that obtained from intelligent, observant, and equally honest persons. The views of the purse seiner may be quite contrary to those of the gill netter, trap, or pound fisherman, yet each probably is honestly convinced of the correctness of his views.

It is needless to say that in this paper few, if any, new facts have been added to the knowledge of the fishes to which it refers. But its object will be attained if, by indicating possible errors in the theories previously held, it causes a realization of the prevalent profound ignorance regarding the greater part of the life of many of our common and commercially important fishes and almost total lack of knowledge of the habits and life history of the menhaden, and thus proves instrumental in instigating the much needed thorough, systematic investigations of those subjects.

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AN IMPROVED AND PRACTICAL METHOD OF PACKING FISH FOR TRANSPORTATION

By A. Sölling

Commissioner to the Danish Government Fisheries Department, London, England

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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AN IMPROVED AND PRACTICAL METHOD OF PACKING FISH FOR TRANSPORTATION.

By A. SÖLLING,

Commissioner to the Danish Government Fisheries Department, London, England.

It was about forty years ago that ice was with good result first used on board English fishing ships for packing fish. Before that time fishing ships made only short voyages, to insure the fish reaching market in a good condition. But it was necessary to bring in the best and firmest fish only, those that could be kept fresh the longest time, such as soles, turbot, brill, and halibut, which fish retain the name of "prime fish." Other kinds of fish, such as plaice, cod, and haddock, could not be brought in, as they would not keep, and so had to be thrown overboard as useless.

In the eighties, when steam trawlers were introduced for fishing purposes, the fishermen went away for ten to fourteen days, sometimes three weeks, for their catch, and it was then necessary to make provision on board for a large quantity of ice, so that the catch might reach port in good condition. In spite of this precaution, however, a large quantity of fish caught at the commencement of the voyage was, and is still, landed in a very poor and stale condition, especially during the heat of the summer. People seem to enjoy iced fish, even though it has lost its flavor, believing that there is no possibility of procuring it otherwise. But when they have once tasted good fresh fish, cooked immediately after being caught and killed, they lose their taste for iced fish at once.

It was after seeing the poor treatment to which fish is exposed in England, from the moment it is caught—carried in ice in the trawler's hold, discharged and repacked, and finally laid out on the fishmonger's marble slab, occasionally being sprinkled with lukewarm water to make it shine—that I was led to experiment for a means of packing fish for transportation and keeping it in a better and sounder condition.

Many different experiments have been made in an effort to find the best and most practical means of keeping fish fresh and sound for a lengthened period, but all these methods, whether with or without the use of chemicals, have been found wanting in efficiency, the fish losing its fine appearance, and more especially its flavor.

Freezing is a good and sound method of preserving, but it is difficult to keep the fish frozen in hot weather on long distances, as for instance on railway journeys. Moreover, on being thawed the fish lose their flavor, and they soon decompose on exposure to the deleterious influence of the air. Packing in ice is a method in very general use for transportation, but as the fish is constantly in close contact with the ice and ice water this method also has disadvantages. The idea in using ice is, of course, to keep the temperature low, thereby preventing decomposition as long as possible. But the exposure to ice and ice water destroys the flavor of the fish; they become stale, and when exposed to the air they quickly decompose, especially during mild weather.

The chief thing to be kept in view in preserving food is to keep it as free as possible from harmful bacteria and from the surrounding air charged therewith. It is, furthermore, necessary to prevent the ice water, which is also more or less full of bacteria, from coming into direct contact with the fish, but at the same time using the low temperature produced by the ice to prevent the further development of the bacteria invariably contained in the fish.

In using my method of wrapping fish in improved fish-wrapping paper and afterwards laying it in crushed ice, the latter in pieces about the size of a walnut, the air is excluded and the ice water prevented from coming in direct contact with the fish. The low temperature of the ice is acting directly on the fish through the paper, and by these means the fish is kept sweet and fresh for a longer period than is otherwise possible, the bacteria of decomposition being thus prevented from developing.

The chief point to be observed in this method of packing fish is that the fish be gutted and bled and the gills cut out as soon as possible after the fish are caught. The sound, found in some species, must be cut lengthwise to insure the removal of all blood particles underneath. Further, the fish should be cut open so far behind the vent that all accumulations of blood may be easily removed. They are then washed and scrubbed inside and out with a stiff brush in clean salt water, or in a solution of fresh water with 4 to 5 per cent of salt, until all blood specks have been removed, then they are laid aside for a short while to allow the blood and water to drain off, and very special care must here be taken that no water be left remaining on the inside. Each fish is then carefully wrapped in the wrapping paper, which is cut square, each dimension being at least one and a half times the length of the fish.

To wrap, place the fish across the nearest corner of the sheet, roll it over very firmly, turn in the two side corners, and roll the package over again until the fourth corner is reached, then tie with a piece of twine.

Objection might be raised that too much trouble is involved in treating fish in the above manner, and that it takes too much time. But the time,

trouble, and small expense incurred are very soon repaid by the higher prices which are obtainable for the fish, owing to their far better appearance, and to the very important fact that they will keep fresh after fish that have been treated in the old way have spoiled. The fishmonger, too, will soon find his profit in having for sale fish which not being sold to-day will turn out just as fresh eight or fourteen days hence, even in the hottest weather. It may be remarked that all kinds of fish may not profitably be treated according to this method, but prime fish, such as soles, turbot, brill, halibut, and haddock, perhaps cod and plaice, will fetch a much higher market price if so treated.

The more expensive fresh-water fish, such as salmon, carp, and trout, are always shipped in ice without being gutted, but even they would have a far better appearance if wrapped in this paper instead of being exposed to the influence of air and ice water. I would here, however, draw attention to the fact that the fundamental feature of my method of wrapping fish is that the fish be gutted, that the entrails and the gills be removed, and the fish thoroughly washed.

The first important experiment with the method here presented was carried out in October, 1905. The necessary fish were caught by special permission of the Danish Government in the steamer *Thor*, which otherwise was engaged in international sea investigations. For the purpose of comparison the fish were packed in four different ways:

1. Gutted, wrapped in paper, and laid in ice.
2. Not gutted, wrapped in paper, and laid in ice.
3. Gutted and, without paper, laid in ice.
4. Not gutted and, without paper, laid in ice.

Altogether 147 fish were packed in these different ways. The flat fish included soles, turbot, brill, plaice, lemon soles, and whitches; the round fish were haddock, cod, whiting, hake, and gournard.

On October 6 and 7 the fish were packed, and on October 17 the method was explained and specimens of the different kinds of fish were shown to people interested, including press representatives, fishmongers, and others well acquainted with such matters. The following results were revealed:

1. The fish gutted and wrapped in paper and ice were perfectly white and firm, without any smell whatever, the skin was not discolored, and most of the fish had retained the stiffness of death.

2. The fish not gutted but wrapped in paper and ice were in most cases damaged in the inside.

3 and 4. The fish gutted and not gutted (round) and not wrapped in paper but placed in direct contact with air and ice water were soft and stale and the skin discolored.

On October 21, fifteen days after having been wrapped, some of the fish packed under method no. 1 were taken out and examined. Seven different kinds, after being boiled, were found perfectly fresh and to have retained their flavor in full.

Another test, the following spring, gave results as follows:

On March 26, 1906, 3 halibut weighing about 2 stone each were packed in Grimsby, according to my method, and the same day sent by steamer to Copenhagen in a box containing ice. To afford a comparison, a fourth halibut, treated exactly as the others except that it was not wrapped in paper, was inclosed in the same box.

On April 9, after having been wrapped up for fourteen days the first halibut was taken out, and I was informed (not being present myself) that it was found perfectly fresh and without any discoloring of the skin at all. The halibut which had not been wrapped in the paper and therefore had remained in direct contact with the ice was discolored on the skin and was quite stale.

On April 20, after being wrapped for twenty-five days, the second halibut was taken out in the presence of several well-known gentlemen, when I also was present. It was found fresh, firm, and white in the flesh, and, after being cooked, to have retained its full flavor.

On April 26, after being wrapped for thirty-one days, the third and last halibut was taken out, and found to be firm and white and also without any discoloring of the skin. It was tasted by several people, myself included, and found to have retained its full flavor.

A third practical experiment was carried out by order of the Royal Greenland Trading Company, of Copenhagen. Thirty-nine halibut caught in Davis Strait were treated according to my method on August 12, 1906, and forwarded in boxes filled with ice in the steamer *Hans Egede*, which landed them at Peterhead on September 1. The fish, in the boxes, were sent by rail to Grimsby, where they arrived in splendid condition and were sold on September 3, fetching a comparatively high price.

Upon the basis of the different experiments, I can safely affirm that by wrapping fish in this manner and treating them as described they can be kept fresh for a much longer period than is possible by the old method. Further, in consequence, the fish will prove to be a far better and more healthy food when treated in this manner than when kept in direct contact with air and ice water.

I would mention in conclusion that my method of packing need not be limited to fish. Meat also will keep during the hottest weather when wrapped up perfectly fresh and laid in ice; and for experiment lobsters boiled in Canada have been sent to London. After being boiled and cooked, the lobsters were wrapped in the paper and sent in cases with ice, as a result retaining their full flavor for about fourteen days.

The paper I use is called vegetable parchment, but I prefer to call it simply fish wrapping paper, for by employing this name I am able to retard the use of bad imitations with the consequent poor result and possibly damage to the reputation of my improved method of packing. The paper is at present to be had only in London. It is of two weights, the heavier parchment a dark brownish gray, the lighter weight a yellowish brown. The dark heavy paper, for wrapping large fish such as halibut, will shortly be made in sheets 5 feet square. The yellow paper, for wrapping smaller fish, is to be had in sheets 28 inches square.

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A PROCESS FOR PRESERVING THE PEARL-OYSTER FISHERIES AND FOR INCREASING THE VALUE OF THE YIELD OF PEARLS

By John I. Solomon, B. Sc.

Presented before the Fourth International Fishery Congress, held at Washington, U. S. A., September 22 to 26, 1908, and awarded the prize of one hundred dollars in gold offered by the New York Academy of Sciences for the contribution, not entered in competition for any other award, which should be judged to have the greatest practical value to the fisheries or fish culture

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A PROCESS FOR PRESERVING THE PEARL-OYSTER FISHERIES AND FOR INCREASING THE VALUE OF THE YIELD OF PEARLS.

By JOHN I. SOLOMON, B. Sc.

CONDITIONS IN THE PEARL-OYSTER FISHERIES.

The process of obtaining natural pearls is carried on throughout the world to-day in precisely the same manner that it has been done ever since mankind has prized this product of the sea as a gem. The only qualification that can be made to the above statement is that since the invention of modern diving apparatus there has been, in certain parts of the world, a modification in the method of securing the pearl oyster. This so-called improvement, however, has perhaps done more, within a very few years, to deplete former valuable natural beds than had centuries of previous fishings, when the ability of man to strip the beds of all the oysters they contained was prevented by the limitations of naked diving. The divers could then go to but comparatively shallow depths, and could gather the oysters only in a haphazard manner as they groped about for a minute or two at the bottom. Also, because of the inability of naked divers to carry on operations in any but calm and warm weather, the season for fishing was comparatively short. As a result of these conditions the beds in even comparatively shallow waters were never entirely stripped of all their oysters, while those lying at depths greater than the physical ability of the divers to reach were untouched. There were thus always sufficient oysters left for breeding purposes, and in spite of the wastes of the method for securing the pearls—the killing of all the oysters to get the contained pearls from about 10 per cent of them—the beds continued to give a comparatively uniform yield.

Since the adoption of diving apparatus the conditions have entirely changed. With the divers enabled to remain under water for a considerable period and in weather which would prohibit naked diving, and to go to greater depths and work in a thorough and systematic manner, the old natural beds have been completely stripped, and beds heretofore inaccessible have been or are being depleted in the same way. This has already been accomplished in most parts of Australia, the waters off Thursday Island, Costa Rica, the Mergui Archipelago

of Lower Burma, and in practically all the places heretofore fished by white men. The business in the East, excepting the fisheries of Ceylon and the Persian Gulf, where the local fisheries and conditions due to the nature of the oysters and other local influences are peculiar, is now practically in the hands of Japanese and Chinese, who alone are satisfied with the small returns from the now meager beds. The Europeans formerly engaged in the business are seeking other occupations. In Burma most of them have gone into tin mining, and at the present time just a single white man is there engaged in the pearl industry. In Australia and the islands of the East Indies there is a constant exploration now for virgin beds and a seeking for better divers and apparatus to go to greater and greater depths. There one hears a constant wail at the limitations of man and his apparatus to combat the great pressures of depths where the oysters are supposed still to be in abundance, and the more imaginative, speculative, or daring are now talking of submarines to go after the oysters. In this connection I would state that a submarine of special construction has recently been built in France for sponge fishing in the Mediterranean off the coast of Algiers.

As a result of the wastes of past and present methods and the general conditions of the industry as now carried on, both in the pearl fisheries of the seas as outlined above, and in connection with the fresh-water pearl fisheries of the United States and other countries, the statement has been freely made in the past few years by prominent pearl dealers of Europe and America that no large pearls will ever again come to market, except those in the possession of eastern magnates and potentates who may be induced by the extravagant prices offered to part with heirlooms held in their families for generations. In other words, the pearl of size and value is tending to extinction. Although the scientific propagation of oysters and other shellfish has been made a great commercial industry in Europe and America, the idea of conserving the pearl-oyster beds and attacking the problem of securing pearls and shells other than by the ruthless destruction of the natural beds seems never to have entered the minds of those engaged in the industry. I have never received any encouragement from a single one of them with whom I have corresponded or whom I have met; and although the installation which I have myself started has proved the undoubted soundness and utility of the process, and the fact of its establishment has now become more or less known throughout the East, I have yet to learn of the interest of any individual or corporation engaged in the pearling industry. In view of the recent agitation in the United States because of the destruction of the fresh-water mussel pearl fisheries, I hope that in my own country more interest will be disclosed.

PRINCIPLE OF THE PROCESS.

An electrical engineer by profession, my first knowledge of the pearling industry was gained through an acquaintance with a family having social and

business relations with Colombia, Panama, and Costa Rica, who thereby had a knowledge of and who dealt in pearls fished in the waters of those countries. It was because of this acquaintance and the knowledge thus gained of the conditions that I conceived the idea of utilizing the X ray for preventing the losses and wastes of present pearling methods and for increasing the yield of fine pearls. In this connection, I would state that I am not the first to have thought of utilizing the X ray for these purposes. Although I did not know it until later, Prof. Raphael Dubois, of the University of Lyons, had a few years before suggested such a use of the X ray. I had the pleasure, in the month of December, 1907, of paying a visit to Professor Dubois. But from a particular question asked by him I found that his investigations had been slight and not very extensive on living oysters.

The question asked by Professor Dubois was one which I had great difficulty in explaining away to the laymen whom I induced to become financially interested in my enterprise, "Will the X rays kill the oysters?" I had made this test at the very commencement of my experiments, once I had become enabled by skillful exposure to disclose pearls which I had placed inside of large Rockaway oysters in New York. Having previously made arrangements at the New York Aquarium, I placed in tanks there live oysters which I had subjected to continuous exposure of powerful X rays for as long as a period of ten minutes. These oysters lived for months without showing any ill effects whatever. In my process the time of exposure is not one-tenth of this. I made this experiment only in order to satisfy the minds of my subscribers, for, after consultation with specialists having a full knowledge of the physiological and pathological effects of X rays on animal tissues and organisms, I was myself convinced that the slight exposure necessary for the process could have no effect.

My first intention and experiments were with the idea of using the fluoroscope for the detection of the pearls within the living oysters, but having learned that in Ceylon they had taken as many as 41,000,000 oysters at a single fishery (one season) I saw that the conditions were not as in Costa Rica and some other places. I accordingly adopted a radiographic method. A comparatively few oysters may be examined individually and carefully by means of the fluoroscope, but by the other method great numbers may be automatically handled and many inspectors may leisurely examine radiographs made practically automatically; and the radiographic method in practice has done all I expected it to do. In the same time that would be required to examine a single oyster by the fluoroscopic method a single tube and operator can make radiographic images of hundreds of oysters, and, as has been found in surgical work, a radiograph will show up more minute particles and detail than can ever be disclosed by a fluoroscopic examination.

In order to accomplish the object sought, I had to devise a process and apparatus, and I subjoin hereto a description and the claims of the first of several

patents which have been granted to me by the governments of Australia, Ceylon, India, Japan, and other pearl-producing countries, or countries which have pearl-producing colonies and dependencies.

DESCRIPTION OF INVENTION AND CLAIMS AS PATENTED.

The object of this invention is (1) to provide means for taking radiographs or of making fluoroscopic examinations of separate pieces of matter or objects in considerable quantities, so that they may be taken simultaneously for the purpose of making radiographic examination of these objects and pieces of matter, and then (2) readily to identify each radiograph as being that of the particular object or piece of which it is the representation.

The manner of taking radiographs at present is to make exposures of individual objects placed upon photographic plates, or other sensitive radiographic media, either in direct contact or with the plate properly inclosed in paper to keep out light. The exposures having been made, by means of the X rays, Röntgen rays, or any other rays penetrating matter opaque to light, the object is removed from the plate or other sensitive medium and set aside, the sensitive medium being then developed through ordinary photographic process and examined.

This method is cumbersome and expensive, and precludes the radiographic examination of many different materials. Also it can not be utilized in connection with large bodies or numbers of objects for commercial purposes. My particular aim in connection with the present invention is the ascertaining of the presence of pearls of any size or form in pearl oysters (*Margaritifera vulgaris*) without injury to the oysters; but the invention is not limited with respect to the character of the objects under examination, as it may be used for any objects whatever. Ordinary processes and apparatus could not be used for this purpose, for the reason that they would be too cumbersome, slow and expensive, and entirely unsuited.

For the purpose of examining the material quickly and cheaply, I utilize a tray or conveyer of considerable surface, over which the material may be spread or carried, and this tray or conveyer is then laid upon the sensitized radiographic medium. The latter is of a size larger in area than the tray or carrier itself, the excess being sufficient to allow for the distortion due to the rays falling upon the outer area at a considerable angle.

The exposure having been made, the tray is lifted from the sensitized medium, or in the event of the conveyer it is so adjusted as to be carried beyond the sensitized medium. The latter is then developed, and the resultant radiograph, which is the full size of the tray, except for the increase in size due to the distortion, can be compared to the objects or material on the tray itself, these objects or material not having been disturbed, and occupying at this time the same relative position as in the particular radiograph on the sensitized medium.

When pearl oysters are the objects examined, the pearls will clearly appear in the radiograph, as they obstruct the passage of the rays to a greater extent than other portions of the oysters. I also use in connection with the tray or conveyer a means for identifying the particular group of objects which have been radiographed so that the radiograph may be afterwards compared with the objects on the tray and their identity established. With pearl oysters, those that have pearls may thus be identified, and the position and size of the pearls be ascertained, without destroying the oysters.

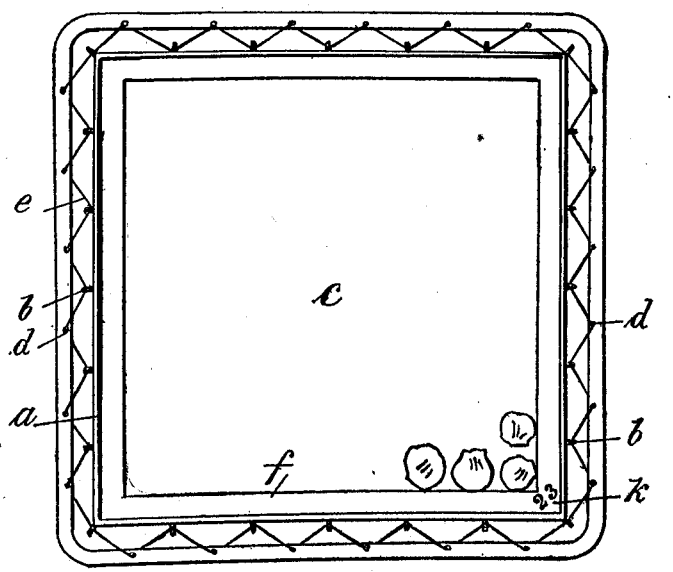

FIG. 1.—Plan of tray to contain pearl oysters for radiographing.

The essentials of the tray bottom or conveyer are two: (1) That the material be composed of a substance which renders little or no resistance to the passage of the X rays, Röntgen rays, or any other rays penetrating matter opaque to light, and allows them to affect the sensitized medium practically as though it had not been interposed; and (2) that the tray bottom be as thin as possible, in order that the matter when held on it be but little further away from the sensitized medium when on the tray than when placed directly on the sensitized medium, so that as good definition as possible may be obtained.

The tray may be of any shape or size desired, and may be constructed of cork, fiber, wood, fabric, aluminum, celluloid, vulcanized rubber, or any other material the qualities of which, as outlined above, are such as to afford the least amount of resistance to the rays. That wet objects may be examined without warping or distortion of the tray, I propose that a tray be made with the bottom of canvas, duck, or other such fabric. Such a receptacle is shown in the attached drawings, of which figure 1 is a plan and figure 2 a longitudinal section. It consists of a rigid frame (*a*) made of strips of metal, wood, or other suitable material, and having hooks or pins (*b*)

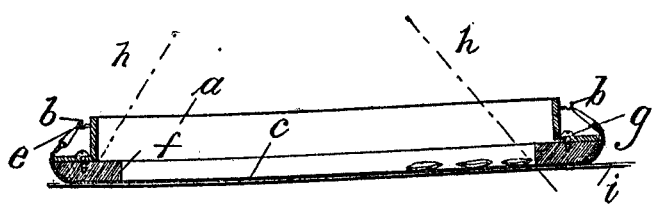

FIG. 2.—Longitudinal section of tray shown in figure 1.

on the outside. The canvas (*c*) can then be placed under this frame, and having suitable eyelets (*d*) in its edge, can be stretched tightly upon the frame by a lacing (*e*) which is passed through the eyelets (*d*) in the canvas (*c*) and the hooks or pins (*b*) on the frame. In order that the radiographs of objects along the sides may be complete and properly made, and be not intercepted by this frame (*a*), another frame (*f*), of wood or other material which will allow the rays to pass through, is placed between the canvas and the first frame (*a*) and secured to the latter by means of screws (*g*). The frame *f* projects sufficiently inside of the frame *a* to hold the materials that are being examined at such a distance that the rays (*h*) pass through the very outside of the material, clear of the frame *a*, and will produce the desired effect upon the sensitized medium (*i*) underneath the tray.

Upon the tray and preferably upon the second frame (*f*), or upon the canvas, is placed a number, letter, or some other device by which to distinguish the trays from each other. This sign (*k*) is here shown as a number (23), cut out of metal,

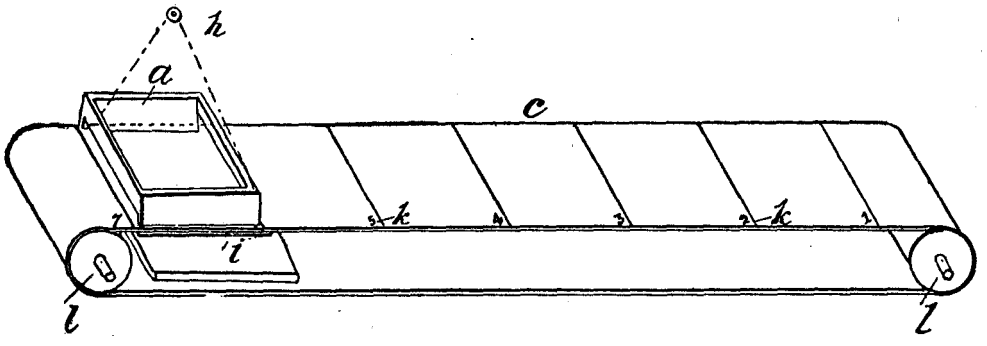

FIG. 3.—Conveyer to substitute for tray of figures 1 and 2.

which is impervious to the ray, and properly secured to the frame *f* or the canvas.

The invention may be modified, as, for instance, by substitution of a conveyer in place of the tray. One form of conveyer is shown in figure 3. Here the canvas (*c*) is an endless strip passing over rollers (*l l*). The frame (*a*) is shown as raised above the canvas a sufficient height to allow the objects placed upon the canvas to be moved under it. The canvas is in divisions equal in size to the frame, and each division is provided with a distinguishing mark (*k*), as already described. In operation of this modification, the objects are placed within the frame and upon one division of the conveyer. The sensitized medium (*i*) is placed under it as shown, and the radiograph is then taken. The conveyer is then moved by turning one or both of the rollers, so that the objects will have passed to one side and an uncovered portion of the conveyer is exposed. More objects are placed upon this within the frame, and a second radiograph is taken. This will be repeated, the first radiographs being developed while others

are being taken. The conveyer belt should be sufficiently long to allow the developed radiograph to be secured and examined with the corresponding original objects without disturbing the continuity of action of the machine. Each radiograph will have printed upon it the distinguishing character of that portion of the conveyer, and the different objects may be identified before they are disturbed.

A further modification of the invention may be made by utilizing the principles of the fluoroscope. In this form, in place of the sensitized medium would be used the ordinary fluoroscope screen, formed of any suitable material, as, for instance, the tungstate of barium or of strenium, in crystallized form, or barium platinum cyanide. The conveyer carrying the objects should in this case be placed between the X-ray tube and the fluorescent screen.

Having now particularly described and explained the nature of my invention, and in what manner the same is to be operated, I make the following claims therefor:

(1) The herein described process of examining separated matter or different objects, such as pearl oysters, in quantities, which consists in placing them upon a suitable support of a character that will not obstruct or only slightly obstruct the passage of X rays, Röntgen rays, or any other rays penetrating matter opaque to light; placing the sensitized medium below the support and exposing the objects and medium to the action of the rays; removing the support without disturbing the positions of the objects and then developing the sensitized medium, whereby a radiograph of the objects will be obtained, which can be compared with the objects without disturbing them.

(2) In an apparatus for examining matters or objects in bulk, the combination with a support for the objects, the said support being formed of material readily penetrable by the rays, and having upon it a distinguishing mark, made of material not penetrable, in combination with a means for producing rays.

(3) An improved tray, made of material which is of such quality and dimensions as will permit objects to be placed thereon and readily radiographed as though such tray had not been interposed between such objects and the sensitized medium.

(4) The combination with a tray of canvas (*c*) and a rigid frame (*a*) to which the canvas is stretched.

(5) The combination with the bottom and frame of a tray and a second frame above the bottom, the said second frame being for the purpose of keeping the matter which is examined a sufficient distance away from the first frame, in order that the rays passing through such matter will fall clear of the first frame and upon the sensitized medium.

(6) The combination with a conveyer and a frame of means for supporting the sensitized medium below the conveyer, and means for producing rays and securing a radiograph upon the sensitized medium.

(7) The use of a fluoroscope in connection with any form of device shown in the drawings or covered by the preceding claims.

In addition to having to devise a special method, of which the above is a description, it was necessary to adopt radiographic apparatus and materials of such a nature as to make the methods and costs of the process commercial. For instance, it was necessary to be able to make X ray exposures over a large area in order to include sufficient oysters at an exposure, an area larger than had been before attempted or rather required in the field of surgery, in which I found the use of the X ray exclusive when I commenced my investigations; also photographic material of a nature and cost suitable for the work had to be sought. Without going into details, I may say that I overcame the various difficulties, as I believe the accompanying exhibits prove.[a]

PRACTICAL DEMONSTRATION OF THE PROCESS.

After considerable correspondence, I went to Ceylon to start my enterprise, and established my equipment on the island of Ipantivu, in the northwestern Province of Ceylon, and near to the famous pearl fishery of the Gulf of Manaar. I have there invested in buildings, machinery, boats, equipment, and photographic supplies the sum of nearly $50,000, some of it my own money, but most of it subscribed by different people in smaller or larger amounts, to whom I or my friends had explained my ideas and the possibilities therefrom. I proposed to get oysters when they were freshly fished, and instead of indiscriminately killing all in order to get the pearls of value contained in the few, to subject the oysters to the process. Those found to contain pearls of value could be immediately opened; those containing small pearls of but little or no value, could be planted under suitable conditions to remain until they had become older and larger, and the contained seed pearls also larger and of value; while those found to contain no pearls could be returned to the sea either in

[a] The following exhibits were appended to the manuscript submitted by the author:

Exhibit A, showing a part of the installation on Ipantivu Island—the water distilling building and chimney, the process building, and bungalow.

Exhibit B, showing a panoramic view of the installation.

Exhibit C, showing coolies arranging oysters in trays.

Exhibit D, showing coolies carrying trays of oysters up to the process building to be subjected to the X ray.

Exhibit E, a small radiograph of some growing oysters containing pearls.

Exhibit F, a small string of seed pearls.

Exhibit G, a radiograph of an oyster containing a seed pearl of a larger size and a string of pearls of which Exhibit F was a part. Note the line down the center of the pearls showing the drilling. Undrilled, in their natural state, these pearls would show up even more clearly.

Exhibit H, a part of a full-size radiograph showing some oysters containing small seed pearls.

Exhibit I, a full-size but only partly "fixed" radiograph of 120 oysters, showing number of tray made by lead number thereon, and arrangement of oysters in regular rows by means of which the oysters held on the trays are identified. The marks made by the inspector for seed pearls, large pearls, or obscurity, or for other things are also shown.

the hope that they would become inoculated with the pearl-inducing cestode or at least to propagate and maintain the growth of oysters on the banks.

The immediate objects in view were therefore—

(1) The prevention of the theft of pearls from the rightful owners of the oysters.

(2) A great increase in the yield of valuable pearls from a given number of oysters.

(3) The maintenance of the yield of oysters from the natural beds, if not a positive increase therefrom, as against the destruction of the fisheries under present methods.

In actual working the radiographs are brought wet out of the process building, wherein all exposure and developments are made in "dark-room" light, and with good light and the wet radiograph practically nothing can escape. It is easier to disclose that an oyster contains a pearl than actually to extract the pearl. If the process errs, it errs on the side of safety. We find that we set apart many oysters as containing seed pearls, which further examination shows contain none, but that what was shown in the radiograph was an imperfection in the film, an air bubble, a piece of coral outside the shell, etc. With practice, even these mistakes can be eliminated, but they are not of such a nature as to make us lose or eliminate an oyster which has the possibility of developing a valuable pearl. With sufficient and proper help and auxiliary appliances, the plant on Ipantivu Island, with its single tube equipment, can radiograph up to 400 oysters per minute. These thin-shelled, small Ceylon oysters (*Margaritifera vulgaris*) are easy to handle. But we can attain just as much success with the fresh-water mussels of the United States and other countries, and with the larger *Margaritifera maxima* peculiar to Australia, Burma, etc. In fact my first experiments were made on these. We can not, of course, do so many at a time or so quickly, as they require a longer time of exposure, but on the other hand, the product is of much greater value. My plant on Ipantivu Island has completely fulfilled all expectations, and, so far as concerns the possibility of radiographing pearl-bearing oysters on a commercial scale in order to disclose the contained pearls and without injury in any way to the oysters, has proved my process to be a complete success.

Unfortunately, owing to certain conditions which arose after I came to Ceylon and invested my capital, and which have prevented my getting live oysters, I have up to now been unable to prove the next and equally important stage of my process. However, as to whether pearl oysters known to contain seed pearls can be kept under such conditions as will make them continue to live and grow and thrive, and the majority of the contained seed pearls likewise to increase in size and consequent value, I leave it to the members of the International Fishery Congress to decide.

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FUR SEALS AND THE SEAL FISHERIES

By Charles H. Townsend

Director New York Aquarium, New York City

Address before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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FUR SEALS AND THE SEAL FISHERIES.

By CHARLES H. TOWNSEND,
Director New York Aquarium, New York City.

The history of the world's seal fisheries is largely one of wasted resources. Very few sealing industries have been conducted according to methods designed to perpetuate the race. Yet from a commercial point of view, seals are the most important of the carnivorous animals. As a group they are probably also the most abundant of the larger wild mammals at the present time. It is doubtful whether the herds of bison in America and of antelopes in Africa ever exceeded the seals in point of numbers. They are of world-wide distribution, and although the fur-seal fisheries of the North Pacific have received much international consideration during recent years, they were formerly not the only seal fisheries of importance. The pursuit was at one time carried on in the Antarctic regions as well as in the Arctic. The Antarctic sealing grounds have long been exhausted commercially, however.

All seals breed on land or on ice floes, and return, after their migrations, to their accustomed breeding places with great persistence. They can seldom be driven entirely away, stupidly lingering until brought near the point of extermination. So certain are they to return to their breeding grounds that the reestablishment of the different species soon follows the protection of these places. The safeguarding of depleted sealing grounds would, in fact, be a good business proposition even at this late day, if they could be protected under the authority of the various governments laying claim to such lands.

ANTARCTIC SEALS.

The various species of Antarctic fur seals (genus *Arctocephalus*) were found about the southern shores and islands of South Africa, Australia, New Zealand, and the islands of the Antarctic generally. About the close of the eighteenth century there sprang up a traffic in the skins of fur seals, and as the result of the many voyages to those distant regions enormous numbers of the animals were taken. By 1830 the supply of fur seals in the southern seas was nearly exhausted. The species exists to-day as mere remnants of the great herds that were once found in those regions.

In this sealing no discrimination was made in the character of the seals taken. All animals whose skins were of any value were slaughtered, and the newly born young, usually left on the killing grounds, died of starvation. In the rush to the Antarctic sealing grounds the markets were frequently glutted and much of the catch wasted.

The South African fur seal (*Arctocephalus delalandi*), frequenting small islands off the west coast of South Africa, became very rare from indiscriminate sealing. It has, during very recent years, been protected by the government of Cape Colony. The yield of skins from this source has been as follows: 1902, 1,300; 1903, 4,800; 1904, 7,400; 1905, 1,231; 1906, 12,640; 1907, 16,786; 1908, 13,649.

One resort of the genus *Arctocephalus*, the Galapagos Islands, lying on the equator, about 800 miles west of Ecuador, furnishes an especially striking illustration of wasteful sealing. These seals (*Arctocephalus philippi*) were taken in important numbers by early voyagers. Between 1870 and 1882 the rookeries were again visited by sealers, and, as far as shown by the meager records collected from the sealers still living who engaged in this fishery, about 20,000 seals were taken. This is of course a trivial number as compared with the total catch made during that period, the records of which are not available. Later voyages resulted in the killing of all the seals that could be found. At the time of my first visit to the Galapagos Islands, in 1888, I was informed that there were only a few seals remaining, and those about the uninhabited westerly islands of the archipelago.

It was a matter of great surprise when, in 1897 and 1898, a vessel returned to San Francisco from the Galapagos Islands with a catch of several hundred fur seals. It appears that the few that had escaped the slaughter of the last voyage, fifteen years before, had established themselves on the identical rookeries from which they had been driven, as comparisons of the log books of the vessels showed. Unknown to anyone, the nucleus of a fine herd existed there, which no doubt could have been developed into an important seal fishery if the fact had been known in time to prevent its destruction by raiders. It is probable, indeed, that a few individuals have escaped this last slaughter, and with the prompt protection of the rookeries by the Government of Ecuador a fishery could yet be established.

Another species of fur seal (*Arctocephalus townsendi*), the most northerly offshoot of the Antarctic race, formerly inhabited Guadaloupe and other islands off the west coast of Lower California. From the scattered records that have been found it appears that 15,000 seals have been taken there within comparatively recent years. (The earlier records are not available.) During the writer's visit to Guadaloupe, in 1892, straggling fur seals were observed about the island, and specimens obtained proved the species to be new to science. It

is possible that there is a sufficient remnant to warrant the belief that the race could be reestablished if the islands were properly protected by the Government of Mexico. The value of fur-seal skins taken in tropical or semitropical localities is, however, small as compared with those from cold climates.

In all the history of Antarctic sealing there is but one chapter of wise management and thought for the future: The Government of Uruguay has, throughout all these years, carefully preserved the fur-seal rookeries of Lobos Island, at the mouth of La Plata River, inhabited by *Arctocephalus australis*. These small rookeries illustrate the good resulting from the careful protection of the seals upon their breeding grounds. Commercial sealing was carried on at Lobos Island prior to 1820. The lessees of the island, operating under the direction of the Government of Uruguay, placed upon the London market, from 1873 to 1904, 377,033 skins, or an average of over 13,000 a year, worth in 1901 $100,000. All these were derived from a single island less than 1 mile in length. The following data show the yield of skins from Lobos Island during recent years: 1902, 12,922; 1903, 10,994; 1904, 8,349; 1905, 2,025; 1906, 8,398; 1907, 4,373; 1908, 2,990. The Lobos seals are now menaced by pelagic sealers, and some vessels have been seized by the Government of Uruguay.

In 1888, when in the Straits of Magellan, I found the fur-seal herds of that region nearly exterminated by the hunters working among the Fuegian Islands. The recent catch from what is called in the trade the Cape Horn region is as follows: 1905, 11,190; 1906, 13,628; 1907, 16,786; 1908, 8,262.

NORTHERN FUR SEALS.

The history of Robbin Island, in the Okhotsk Sea, is especially noteworthy. This island is about 600 yards in length and less than 100 yards in width, and yet incomplete records show that more than 60,000 seals have been taken there by raiders since 1870. A remnant of this herd has remained annually to repopulate the rookery, which at the present time contains little more than 1,000 seals and is protected by the Russian Government.

The scattered fur-seal rookeries in the chain of volcanic islands stretching northward from Japan, known as the Kurils, have also been destroyed by raiders during recent years. The history of the extermination of these seals, as furnished to the writer by men who engaged in the slaughter, is exceedingly interesting. Notwithstanding the fact that raids were made year after year, the scattered remnants of the herds still clung to their old breeding grounds. The incomplete records at hand show that more than 25,000 seals were taken from the Kuril Islands by raiders since 1880. These rookeries were visited by the United States Fisheries steamer *Albatross* in 1897, and all the rookeries were found to have been wiped out with the exception of one, upon which there

were about 100 seals remaining. It is believed that these will be protected by Japan, to which country they belong. The seal inhabiting Robbin Island and the Kuril Archipelago is now known as *Callorhinus curilensis*.

The only important strongholds of the diminishing northern fur seals to-day are the Pribilof and Commander islands, in Bering Sea. The species established on the Commander Islands is *Callorhinus ursinus*, while that breeding on the Pribilofs is *Callorhinus alascanus*. Although the two species breed upon islands lying in the same latitude and less than 1,000 miles apart, there is no commingling. The former migrates southwestward in winter along the Asiatic coast, while the latter migrates southeastward along the American coast.

Upon the discovery of the fur-seal islands of Bering Sea, more than a century ago, seals were found in great multitudes. For many years they were killed indiscriminately, but the Russian Government finally took charge of them and directed the fisheries in such a way that they were regularly productive. The Pribilof Islands in the twenty years after the accession of Alaska yielded more than $7,000,000, the price paid for the entire District. About twenty-five years ago the practice of pelagic sealing—the killing of seals in the open sea—developed into an extensive industry, since which time the supply of seals has steadily decreased.

Although during the winter months the fur-seal herds migrate into the Pacific Ocean, they are in summer located on their anciently established breeding places in Bering Sea. The fishery is conducted under government supervision, and a certain number of seals may be killed on the islands, selection being made in accordance with the natural habits of the animals. Fur seals are highly polygamous, and the rookery communities are divided up into harems. The males arrive at the islands and fight furiously for the possession of territory. The females, arriving soon after the males have established themselves, are divided up among them, in numbers varying from a dozen to a hundred to each male in extreme cases. This arrival occurs in June, and the young are born the last days of June or in the early part of July. The young seals remain with their mothers until the latter part of August. The seal herd lingers about the islands until late in the fall, when the annual movement into the Pacific Ocean takes place.

The highly polygamous habit of the fur seals naturally results in a large surplus of males, which surplus, when the rookeries were in their best condition, amounted to about 100,000 immature males a year on the Pribilofs and over 35,000 a year on the Commanders. These half-grown males herd by themselves, on so-called "hauling grounds" adjacent to each breeding rookery, and it is from them that the annual catch on the islands has always been made. The seals are quietly surrounded, and without difficulty are driven inland, entirely away

from the rookeries of breeding seals, as easily as a band of sheep. They are killed and skinned by the natives, the skins are counted by government agents, and are then placed in the salt houses of the lessees of the islands for a month's curing, when they are shipped to London, which has always been the world's fur-seal market. The selecting and killing are accomplished without noise or disturbance, and everything is done decently and in order. The United States and Russian Governments have never allowed any disturbing of the breeding rookeries and have never permitted the killing of female seals. The breeding stock upon the islands has therefore remained undisturbed, and would, but for the international nuisance of pelagic sealing, have yielded forever a world supply of sealskins.

Pelagic sealing, however, practiced in the open sea both in and out of season, permits of no selections being made, and the catch consists of young and old, male and female. By far the greater portion, however, is female seals, for these, after the young are born, go to sea to feed, ranging as far as 200 miles from the islands and returning at more or less regular intervals to nurse their young. The killing of females at this season is followed by the starvation of all nursing young on the breeding grounds, the loss of young in this manner corresponding with the number of mother seals taken by the sealing vessels. In ten years pelagic sealing in the adjacent waters and in the Pacific Ocean destroyed the value of the Pribilof and Commander islands as government properties. The seal herds are now so decimated that the surplus males available for killing on the Pribilof Islands are less than half as many as in 1896.

Pelagic sealing at the present time is engaged in by vessels belonging to British Columbia and to Japan. The British Columbia fleet has greatly diminished in numbers as the seals have become fewer and it found the profits less, but there has been an increasing number of Japanese sealers in recent years, until in 1908 the latter fleet numbered 38 vessels, which took 13,197 skins. The British Columbia fleet in that year numbered 8 vessels, and took 4,452 skins. This total of 17,649 skins is, however, a great decrease from the pelagic catch of 61,838 skins in 1894, and shows the results of the indiscriminate slaughter.

So long as pelagic or indiscriminate sealing in any form remains, the restoration of the fur-seal fisheries will be impossible. The Bering Sea controversy was precipitated by the seizure by the United States Government of Canadian sealing vessels in Bering Sea. Later on, the matter was placed in the hands of the Tribunal of Arbitration at Paris. This tribunal having decided that the United States had no jurisdiction over Bering Sea outside of territorial limits, pelagic sealing continued in but slightly modified form. Renewed efforts have been made by the United States Government to put a stop to it, however. American citizens, a small number of whom were engaged in pelagic sealing,

have been prohibited from engaging in the pursuit of seals at sea, and Congress has passed laws prohibiting the importation of skins taken by pelagic sealing into the United States.

The seals taken at sea are shot or speared, and the skins, thus injured, are consequently less valuable than the land catch. The class of skins obtained under government direction on the Pribilof and Commander islands is of the highest quality, the animals selected being 3-year-old males of nearly uniform size, killed when the fur is in best condition. This catch in 1908 amounted to 14,964 skins, which sold at an average of $30 per skin.

ECONOMIC CONDITIONS OF THE FISHERIES IN ITALY

By Guido Rossati

Representing the Italian Ministry of Agriculture, Industry, and Commerce

Address before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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ECONOMIC CONDITIONS OF THE FISHERIES IN ITALY.

By GUIDO ROSSATI,

Representing the Italian Ministry of Agriculture, Industry, and Commerce.

Honorable PRESIDENT, LADIES, AND GENTLEMEN OF THE CONGRESS: It is a gratifying duty that I have to perform in thanking the honorable gentlemen who have welcomed us to this congress and the members of its organizing committee for the courteous invitation extended to Italy to be represented at this important gathering. I do so personally and in the name of the Government of Italy, whom I have the honor to represent. I can assure you that the Government of my country takes the utmost interest in this assemblage of eminent scientists and technical men, gathered here for the purpose of studying the multifarious problems connected with fishing and of promoting an industry which is probably the oldest to which man has applied himself for his sustentation. The Government of Italy attaches the greatest importance to this congress because it is in sympathy with the development of fish culture, and not only the Government but also the scientists of Italy will follow with great concern the labors of this congress, as is evidenced by the presence here of one of the best-known Italian authorities on the subject, viz, Prof. Decio Vinciguerra.

No better place for a fishery congress could have been chosen than Washington, the capital of a great and modern nation, stretching from one to the other of the two largest oceans of the earth and embracing a great variety of climates, which enable it to avail itself of a great diversity of sea food; traversed by numberless rivers, among them some of the largest in the world; containing some of the greatest inland water basins; a country rich in streams, bays, gulfs, inlets, where the supply of fish is so abundant; in brief, a land which combines so many natural advantages and favorable conditions for fishing as to be beyond comparison with any other part of the globe.

But there is another and yet stronger reason why the United States of America has attained preeminence in the fishing industry, and this is to be found in the fact that its people have sought and are continually striving for a better utilization of these natural factors of economic wealth, thus standing as an object lesson to other countries where the bountifulness of nature has not always been a stimulus to development and to the exercise of such effort as to

attain a high standard of progress. It is this exercise of endeavor to a constant betterment of conditions in all branches of human activity that characterizes this nation essentially, and it is this characteristic that most strikes the attention of foreigners when viewing the economic and social conditions of this country. It is this spirit which pervades the national life, the factor, quite as important as the natural wealth, that has brought the United States to the front in all lines of activity, and that makes it the object of admiration of all civilized countries.

To this well-directed and successful effort through the Government, associations, and private individuals, and to the splendid work of the American fisheries bureau and of the many stations, scientific laboratories, and aquariums, is due the fact that this country derives from the fisheries greater profit than any other, although it is only about half a century since the pursuit of fishing has been able to avail itself of the advantages of scientific research and discoveries—this itself a line of work in which American talent and ingenuity have probably many followers, but none surpassing them. Owing to these conditions we come to this congress as to a school from which we are certain we shall go away greatly enlightened.

The country which I have the honor to represent has since time immemorial occupied itself with the pursuit of fishing. The lacustral inhabitants of northern Italy who had built their homes on the lakes in order to attain the conditions of safety that were essential to their social life must unquestionably have been fishermen. We learn from ancient historians of people living on the shores of the Mediterranean who were great consumers of fish. Sea food figured prominently in the fare of the ancient Romans, especially in the great dinners with which Lucullus, Hortensius, and other Roman amphitryons used to delight Roman society during the golden period of Latin history. We have all read about the "muræna," a favored dish with the Romans, and which, according to an ancient writer, had to swim three times—in water, in sauce, and in wine—a habit of swimming which fish still preserve to-day. That the Romans favored fishing, notwithstanding the primitive methods by which it must have been carried on at that time, there is no doubt, for we know that sea food entered largely into the diet not only of the rich but also of the plebeian classes. Moreover, we can not peruse the Georgics of Virgil or the Metamorphoses of Ovid without meeting frequently with references to the inhabitants of the deep. The advice of Ovid, "Semper tibi pendeat hamus quo minime credas gurgite, piscis erit" (Let thy hook be always ready, as a fish will often be in waters where thou least thinkest of it), is in both fishing and common life still of up-to-date application.

During the middle ages and the troublous times which characterized that period of Italian history, the Church, which had built on the ruins of the Roman Empire a new order of things based on Christian teachings, became the patron

of the fishing industry chiefly by reason of the dietetic precept of abstinence from meat during certain days of the week which it imposes on its followers; and we are reminded of the fact that the Church was established by a fisherman, and that several of his colleagues were of the same calling. It is undeniable that the Church exercised a favorable influence on the industry of fishing, which flourished and received further stimulus when Italy, under the republics of Venice, Genoa, Pisa, and Amalfi, which were essentially maritime states, began to send fishermen all over the Mediterranean and found in fishery the most efficient and practical school for raising a population of able seamen, to whom is essentially due the greatness acquired by those famous republics.

Even to-day Italy maintains preeminence in fishing in the Mediterranean, which is due to the Italian labor engaged in this industry. Italian fishermen are to be found all along the coast of Algeria, Tunis, Tripoli, the eastern shore of the Adriatic, and in the Greek Archipelago, often engaged in the most dangerous and varied forms of fishing, whether it be spearing the swordfish in the Messina Straits or plunging into the waters surrounding the Lampedusa Isle in search of sponges, trapping the tunny-fish on the western coast of Sicily and Sardinia, netting the shoals of sardines on the coast of Tuscany, or exercising themselves in the ingenious methods of coral fishing on the north African coast; all of which are special branches of fishing in which the Italians have attained great proficiency and enjoy a world-wide prestige and demand. They are also the support of important industries, such as the canning of tunny-fish, sardines, and anchovies, which find natural facilities in Italy's large production of the olive oil required in their packing.

Italy, however, with a seashore extending over 4,300 miles and a population of about 115,000 men that derives its means of livelihood from the sea, manning about 24,500 fishing boats, has a yearly output of fresh fish representing a value of only about 22,000,000 lire. Even allowing for the imperfection with which the statistical data are gathered, considering the great extension of her shore and the great amount of labor engaged in this pursuit, these figures show at once that the fishing industry in Italy, however traditional and assisted by the natural inclination of the people to it, is still far behind the reasonable expectations of the country, especially from the standpoint of the profit that the fisherman derives from his industry, which is unfortunately lower than in any other important country of Europe.

The cause of these conditions, which make the task of the fisherman in Italy a rather thankless one, is not to be found in any want of activity or energy on his part, but to circumstances over which the husbandman of the sea has practically no control and very little means whereby to better things. Such are, for instance, the much discussed depauperation of fish in the waters where he exercises his activity, accentuated by the fact that no tentative effort has yet been made in Italy with regard to the restocking of maritime waters with fish;

what has been done in this direction being confined to the restocking of inland waters with choice species, where the conditions of the industry are perhaps enjoying the advantages of greater attention. This is not surprising considering the fact, almost general even in the most progressive fishing countries, that fishing on inland waters is much easier and not fraught with the uncertainty and perils of the sea, and is therefore assuming every day more of a cultural character, the pisciculturist cultivating the water as the agriculturist cultivates the soil for the feeding of man.

But, returning to maritime fishing, the main reason why Italy does not make a better showing in its results from an economic standpoint is the primitive methods by which fishing is still carried on, entirely by small sailing craft, which in other countries have been largely supplanted by motor power to propel the boat and operate the nets. Then, the absence of proper organization and intelligent cooperation, which are necessary factors to secure a prompt and wide distribution of such a perishable article as fish, is another cause. Steamboats to carry the catch promptly to distributing ports; good landing facilities and a quick and well organized railroad service to expedite the delivery of the fish to the markets in the shortest possible time; an intelligent application of the use of ice and refrigerating plants in the transportation, preservation, and distribution of this perishable commodity; cooperative action among fishermen in order to secure to themselves the highest percentage of the profit deriving from their labor; credit within easy reach and at a moderate rate of interest to fishermen; elimination of octroi duties and the fiscal dues which at present handicap this industry—these are some of the essentials for rehabilitating its destinies.

Besides maritime fishing, Italy is greatly interested in inland water fishing, its numerous rivers, lakes, and lagoons suitable for this purpose occupying practically one-eighteenth of the surface of the Kingdom. Filippo de Filippi, a noted Lombardian zoologist, who was the pioneer of fish culture in Italy, stated that if there is a country favorably laid out by nature for the development of inland fisheries it is certainly the Valley of the Po.

Notwithstanding the inherent love of the Italian gentleman for angling, evidenced by the fact that there is no villa of any importance in Italy not provided with a "pescheria" where fish are raised, not for sale but for the private use of the owner who can exclaim with Carew—

> Thus mean in state and calm in sprite
> My fishful pond is my delight—

fishing in fresh water is probably in not much better condition than the maritime industry, and the value of the annual output of inland fisheries in Italy does not exceed 6,000,000 lire.

We have no special statistics to show what is the value of the fish taken from lagoons or estuaries, where fishing is an art that has engaged the attention

of the adjacent population from the earliest times. This blank in the Italian statistics is all the more deplorable as it is unqestionably from this source that a good deal of revenue from the fishing industry is derived. Of what importance these lagoon and delta fisheries, in Italy comprehensively called "vallicoltura," are to a considerable number of the Italian population may be seen from a glance at the hydrographic map of Italy showing the considerable extent of the Venetian lagoon, famous for its mullets; of the Valli di Comacchio, formed by the delta of the Po, where the eel, sung by Ariosto and Tasso, is the staple of fishery; and of the Mare Piccolo of Taranto, noted for its oyster beds, already celebrated in antiquity as were the esculent bivalves from Lakes Fusaro and Lucrino, which the Parthenopean siren offers to the visitors with the allurements of White Capri.

It is the fishing on inland waters that has received the greatest attention on the part of the Government, although even sea fishing has not been neglected, at least from the standpoint of legislation. With the progress of hydrobiology, a science which has developed practically within the last fifty years and to which the genial labors of such men as Spallanzani, Rusconi, Canestrini, Issel, and other Italians have largely contributed, dates the action of the Government to the fostering of this branch of national economy.

The lines upon which governmental action has been directed to the promotion of the fishing interests are summarized in the following paragraphs:

First. The policing of maritime and inland waters in order to discipline the catching of fish by prohibiting fishing during the time of the spawning and reproduction; by fixing the minimum distance from the seashore where fishing is allowed, as well as the depth at which fishermen may lower their nets; by establishing the kind and quality of the nets and the minimum size of fish that is allowed to be marketed; by prohibiting the use of explosives and poisonous materials in the catching of fish, and also the use of undesirable fishing apparatus; all of which disciplining is done according to the dictates of science with a view of regulating the supply, its continuance and increase. The enforcing of the laws and regulations on fisheries (the fundamental one of which dates from 1877) is intrusted to the captaincies of the ports, to the custom-house officers, to the officers of the royal navy in the case of maritime fishing, and to forestal officers, local police, and custom officers in the case of inland waters. Unfortunately this policing of fisheries in Italy leaves yet much to be desired in its application, and the law is frequently violated with great loss to the fishing industry, both through the incentive of illegitimate gain, and in a good many cases also through mere ignorance. Hence the necessity of insisting upon a greater spread of knowledge among the masses of the people regarding the habits of fish, the time and way in which their reproduction take place, migrations, and all technical information which may be conducive to greater enlightenment on the subject. This would be the best measure of prevention against damage often done through sheer ignorance.

While, of course, the necessity of laws and regulations disciplining fisheries in order to maintain their productiveness is unquestionable, we believe, nevertheless, that instruction and education are also great factors in preventing abuses and reaching a better standard. Instruction to this effect ought therefore to be imparted to the people at large in elementary and secondary schools, and this without speaking of the necessity of greater education along these lines to those who will be called upon to exercise their activity in the economic life of the nation.

Second. In having established advisory bodies, such as the Central Consultative Commission for Fisheries and compartimental commissions subordinate to the former, operating in the four or five maritime districts in which the peninsula has been divided for this purpose, and in having established besides provincial commissions on fishing. There are altogether about 25 such bodies.

Third. In having created three piscicultural stations, one at Brescia, another at Belluno, and a third at Rome, the latter in charge of Professor Vinciguerra, whom we have the pleasure of seeing at this meeting. These stations are intrusted with manifold duties, the principal of which is the incubation of the spawn and raising of the fry wherewith to provide for the repopulation of inland waters with fish of choice variety, and I am glad to state in this connection that millions of fry have been introduced of late years in the principal lakes and rivers of Italy, among the new varieties introduced being several American species of trout and whitefish. The directors of these stations are also required to give periodical lectures on fish culture and to spread useful information in regard to the industry. It is superfluous to state that the results obtained have been excellent, when the comparatively small appropriation for their sustenance is considered, and their action bids fair to exercise a deep influence in the revival of fish culture in Italy. The Government has also in late years, with the cooperation of local bodies in Venice, established a school for fishermen and for the preparation of technical men, which has supplied a want that had indeed been long felt and which has already accomplished much good in organizing the fishermen of the Venetian shore for a cooperative method of work. Courses of biology in connection with fish culture have also been instituted at the universities of Rome and Messina and at the Agronomical Institute of Milan, and have become popular among the students.

Fourth. In having provided money prizes and awards in medals for encouraging cooperation among fishermen and rewarding the efforts of any society or private party endeavoring to foster the interests of fish culture in the Kingdom. The action of the Government has been ably seconded by such bodies as the Società Lombarda per la Pesca e l'Acquicoltura, Società regionale Veneta per la Pesca e l'Acquicoltura, and Società 'Aaliona per la Pesca.

It is to the concomitant efforts of the Government, of technical institutions, and of men such as Pavesi, Carazzi, and others that a greater interest is

being taken to-day by my country in developing the resources of its waters, an interest which will eventually lead to larger appropriations from the national treasury for aiding this industry in a way more adequate to its possibilities and requirements.

Hydrobiology and its recent discoveries have opened new horizons to the possibilities of what has been comprehensively called "water culture." The natural depauperation is being remedied with the restocking in all waters inland, where new fields of fishery are suggested, such as the raising of carp in rice fields, as well as in the sea, evidenced by the restocking of the fjords of Norway with the eggs of the codfish.

The importance of the plankton to fish life, of the flora and fauna living on the borders and in the bottom of waters; the relation of temperature to the inhabitants of the deep, which has suggested in certain localities the application of the thermometer to fishing; the relation of the chemical composition of water and of its greater or lesser saltiness to the population of the seas; the pathology of fishes, the application of artificially promoted diseases to obtain industrial results, such as the grafting on the pearl-producing oyster of the parasite which is the cause of the formation of the pearl, an original suggestion by Professor Issel of Italy and utilized by Herdman on the waters of the Ceylon island; the habits and various stages of life of different fish having partly a pelagic and partly a fresh-water habitat, such as the eel; the prevention of the inquination of waters from the refuse of industrial establishments; the reforestation of lands to prevent muddy waters that are prejudicial to the life of delicate fish—all these subjects are to-day far better understood and studied than ever before, not only by the general scientific world but also by progressive ichthyologists.

Although the "cultivation of the water" is a far more difficult problem than that of the solid crust of the earth, not only because of the greater perils with which the former is identified, but also because we are less acquainted with the conditions of existence of the animals which populate the water, still it is one of those problems the importance of which the future will make even more evident and impellent. The preoccupation manifested years ago by Sir William Crookes with regard to scarcity or insufficiency of the staple of life confronting humanity in a near future need not engross the minds of economists, because it will find its natural solution in the increased rate of production of wheat which is within the sphere of reasonable possibilities, and also because human ingenuity, as the population of the earth increases, will develop other sources of supply of food. If in the past humanity has called upon the earth for its main sources of sustentation, the humanity of the future will call upon the water in a more intensified form for this need; and the "intensive cultivation of water" as well as of the earth will be a conquest probably not so remote as we may believe.

The contribution that Italy has already given, and I hope will be able to give in the future in greater degree, toward this desirable end is and will be

notable, judging not only from the standpoint of the eminent services which her scientists have rendered to the progress of this, as well as of many other branches of activity, but also from the viewpoint of the aid that her seamen will give in the domain of the multiform energies of the water. Those fishermen who, through no fault of their own, can scarcely make a living on home waters, you will find industrious and prosperous where natural and economic conditions have been more generous to humankind. And thus you see Italian seamen controlling fishing in several parts of this country, such as certain parts of the Pacific and the Florida coasts.

Hence the importance that Italy attaches to this congress, in which she is taking more than a passing interest, for the promotion of American fisheries means also the promotion of the interests of a large class of countrymen of mine engaged in this field; and the best wishes for the successful labors of this congress, the result of which I shall report to my Government with that satisfaction that comes not only from the acquiring of new knowledge, but also from the certainty that this new knowledge will be highly beneficial to all countries interested in the exploitation of the waters.

THE FISHERIES AND THE GUANO INDUSTRY OF PERU

By Robert E. Coker

Lately Fishery Expert to the Government of Peru

Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

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THE FISHERIES AND THE GUANO INDUSTRY OF PERU.

By ROBERT E. COKER,
Lately Fishery Expert to the Government of Peru.

I. THE FISHERIES.

Doubtless the fishes and the fishery resources of no country represented at this congress are less known to the world than are those of Peru. That the resources are unstudied is not attributable to their inadequacy or to the failure of the people of Peru properly to value them, for Peru possesses a wealth of certain valuable forms, and no people could be more highly or more generally appreciative of fish food; nor is it because they have any recent origin that the industries are little known. In fact, there is reason to believe that centuries before the Columbian period the occupation of fishing was pursued in Peru, not simply as an unorganized food hunt, but as an important industry. Therefore neither the natural conditions nor the nature of the people can account for the scant knowledge of the fishery resources or the inadequate state of the industry. The explanation is found rather in the unfortunate history which has burdened the country since the overthrow of an earlier social and industrial life. It is only recently that a stable government has been able to give serious and effective attention to the many phases of industrial life of the nation, and to include in its many endeavors the effort to conserve and develop the valuable resources of the sea.

CONDITIONS AND RESOURCES OF THE REGION.[a]

The traveler from the north has his first glimpse of the coast of Peru as the steamer, after passing down the Guaya River from the chief port of Ecuador, enters the Gulf of Guayaquil. The steamer may, as sometimes happens, touch at

[a] For the scientific names employed in this report I am indebted to those who have kindly identified the specimens collected in Peru: Dr. Barton W. Evermann and Mr. Lewis Radcliffe (fishes), Dr. W. H. Dall (mollusks), Miss Mary J. Rathbun (crustaceans), and others.

A forthcoming series of systematic papers by various writers will give a comprehensive view of the chief aquatic resources of Peru as far as known at present. For detailed information regarding the methods of fishery, as well as the conditions and resources, reference is made to various reports by the present writer in the "Boletin del Ministerio de Fomento," Lima, vol. v., no. 12, Dec. 1907; vol. vi., no. 2, 3, 4, and 5, Feb. to May, 1908, and others in press.

the port of Tumbes, well known as the landing place of Pizarro. If so, the first impression of Peru is that which may have been anticipated of a tropical latitude—a region of thick vegetation, chiefly mangrove trees in swamps intersected by narrow winding estuaries, and traversed by a permanent river of considerable volume. The local conditions are similar to those that prevail in the neighboring territory of Ecuador. Naturally in such a region there is an abundance of shellfish, including oysters and many species of clams and crabs.

Typical, however, as this Tumbes region may seem for the latitude (3½° S.), and fitting perfectly to the region lying northward, the locality is entirely unique for the coast of Peru. About 20 miles beyond the territorial line the aspect of the shore presents the sharpest change. As the southern limit of the delta of the Guaya is passed, the green luxuriance disappears abruptly to give place to shores of barren and desolate appearance, and this new aspect continues practically unchanged for the remaining 1,400 miles of the Peruvian coast, and onward, in fact, into the domain of Chile. (Fig. 1, pl. XII.)

The type of coast characteristic of the country is, then, the reverse of what one might expect of a tropical region. With shores rainless and barren, a most significant feature is the practical absence of large rivers emptying into the sea or mingling with the ocean waters in coastal sounds or bays. The portion of the country west of the lofty western cordillera, the watershed of the continent, is a steeply sloping desert interrupted by the narrow valleys of numerous little rivers formed from the melting snows of the Andes. In the cooler season (May to September) the scant waters of these precipitous streams are soon exhausted by natural evaporation or seepage, or spent in the irrigation ditches of the fertile valleys. On the other hand, although in the warm period of November to March the melting snows swell the rivers into torrents, the coast at this time is enduring its driest season, and the soils and irrigated farms are making their greatest demands upon the rivers' flow. Such portion, then, as may eventually reach the coast in any season can form but a small lagoon, and this may be quite separated from the ocean by a narrow levee of shingle, which the surf builds up against the river. The mouth of the Rimac offers a good illustration of this interesting type of river mouth, across which one may walk dry-shod. (Fig. 2, pl. XII.) Beneath one's feet the lagoon empties gradually into the ocean through the loose formation of water-worn stones. Only in times of excessive flood is the levee actually broken through to form a visible mouth.

It is unnecessary to point out the significance to the fisheries, or to the natural history of the coast, of this general absence of estuaries, sounds, or brackish bays, such as would offer a quiet breeding ground for some kinds of ocean fishes, or afford a favorable environment for oysters, clams, and other valued shellfish.

No fishes ascend the upper courses of the rivers and the very few species found in the lower parts are very small and of negligible economic value. These little rivers are of great importance to the fisheries, however, as the habitat of the most important shellfish of the country, the excellent "cameron de rio."[a] This fresh-water shrimp is a most highly and deservedly prized product, the equal in quality of any crustacean form. The rivers are also significant, since in the time of flood the most important of the food fishes, the large "corbina," is found in greatest numbers in the neighborhood of the mouths, probably feeding upon the small crustacea which find their way out of the river. The season of "agua nueva" (new water) is a propitious one for the fishermen.

Consequent upon the absence of large rivers and the steepness of the coast, there are few good bays or harbors. Most of the ports are upon a more or less exposed shore, where embarkation must be effected through the surf, unless a long pier has been built out beyond the ordinary breakers. Even in comparatively calm weather, the great swells rolling into the open bays often assume such proportions as to make landings impracticable even with the use of long steel piers. Fortunately, the coast is entirely free from storms; but the fisheries as well as commerce are seriously handicapped at such ports as Eten, Salaverry, Cerro Azul, and Mollendo, where for days at a time communication between sea and land is rendered impossible by the prevalence of "la mar brava" (the wild sea).

Untropical as is the coast of Peru in its aspect as described above, it is equally so as regards the temperature of the ocean water. There is no more significant feature of the coast than the Humboldt or Peruvian current which flows northward and northwestward along the west coast of South America, bringing the cold antarctic waters down to the equatorial region. To find upon the coast of the United States a summer temperature of the ocean water corresponding to that of Callao at 12° S. one would go to about the latitude of New York on the Atlantic side (41° N.) or Monterey on the Pacific (36° N.). The Peruvian current, in conjunction with other factors, particularly the constancy of the winds on the coast, produces a relative uniformity of temperature conditions. There is little variation in the water temperature from hour to hour during the day, little difference from month to month during the year, and a relatively small change from latitude to latitude. It is probable that such variations as are found are due more to very local conditions, or to the swinging of the current, than to seasonal changes or differences of latitude. At Callao (12° S.) the water in early summer was at 15–19° C. (59–66° F.) and in early winter from 16.5 to 19° C. (61–66° F.); at Paita (5° S.), in April, records from 15.5° to 20.5° C. were taken, with an average of 17.5° C. (63.5° F.);

[a] *Bithynis cæmentarius gaudichaudi* (Milne-Edwards).

while at Mollendo (17° S.), more than a thousand miles to the south—or as far away from Paita as New York from Miami, Fla.—the midwinter temperature was 16° C. (61° F.). This current leads the fishermen to go southward from the port instead of northward, if a prompt return journey is desired, and its supposed swinging movements are of further significance, as it causes certain pelagic fishes to approach or recede from the coast.

With such low-water temperatures a tropical fauna is, of course, absent. Corals are wanting, sponges nearly so, and the general character of the fauna and flora of the region is such as would ordinarily be found in much higher latitudes.

In contrast to the barrenness of the coast there is a peculiar wealth of certain forms in the open ocean. The great red seas, formed sometimes, at least, of myriads of microscopic dinoflagellates, are of common occurrence. They are of uncertain value and sometimes seem to work much injury. Sometimes, too, great areas of the surface of the sea are reddened by the vast numbers of small crustacea (*Munida*), which then play a part of great importance as food for the fishes and for the guano-producing birds. More striking still are the immense schools of small fishes, the "anchobetas" (*Engraulis ringens* Jenyns), which are followed by numbers of bonitos and other fishes and by sea lions, while at the same time they are preyed upon by the flocks of cormorants, pelicans, gannets, and other abundant sea birds. It is these birds, however, that offer the most impressive sight. The long files of pelicans, the low-moving black clouds of cormorants, or the rainstorms of plunging gannets probably can not be equaled in any other part of the world. These birds feed chiefly, almost exclusively, upon the anchobetas. The anchobeta, then, is not only an article of diet to a large number of Peruvians, and the food of the larger fishes, but, as the food of the birds, it is the source from which is derived each year probably a score of thousands of tons of high-grade bird guano. It is therefore to be regarded as the most valuable resource of the waters of Peru. No more forcible testimony to its abundance could be offered than the estimate, made roughly, but with not wide inaccuracy, that a single flock of cormorants observed at the Chincha Islands would consume each year a weight of these fish equal to one-fourth of the entire catch of the fisheries of the United States.

The fishing grounds and opportunities, especially with the methods of fishery now in use, are restricted by the scarcity of good bays and by the rapid deepening of the water off the shore. Yet there are compensatory features. In proximity to almost every port are groups of islands, often with numerous coves and abundant outlying rocks, which offer a varied home for many species of rock and shore fishes. Along the coast proper some of the same species are found, with a good representation of the drums, the lizas, the flounders, and silversides.

To mention the most esteemed and important fishes:[a] The "peje-rey" or silverside (an atherinid), the most delicate of all fishes, is most easily taken in early or mid winter when it is depositing its eggs upon the algæ near the shores; the "corbina" attains a size of 30 or 40 pounds, and from its abundance and fine quality is the fish of first rank in importance; the "liza," or mullet, and the "lenguados," or flounders, are also of the first class. Yet perhaps none of these is superior to the congrio (representative of the Ophidiidæ), which is not commonly taken except in the southern part of Peru. Nearly a hundred food species could be mentioned, but only two or three more of these deserve mention for special reasons.

The bonito, though poor in quality, is, from its abundance and cheapness, the fish most available to the poorer people. The anchobetas (*Engraulis*) are favored by the indigenous Peruvians. Large quantities are preserved in the crudest way by mixing with salt and spreading on the ground to dry in the sun. They are then sacked to be sold at a small price ($1 the sack, more or less). This little fish of manifold uses is all the more significant because of the rare opportunity it offers for the preparation of an excellent preserved product—an opportunity that is not now utilized.

The selachians (sharks, rays, guitar-fishes, and angel-fishes) are not in most countries accounted important food fishes. But they occur in remarkable abundance in the northern region of Peru, where they are freely used and esteemed by the indigenous population. Just northward of the Peruvian waters our steamer passed for hours through an enormous aggregation of various kinds of selachians, the great giant rays, and sharks of all sizes, hammer-head and sharp-nose. On one occasion, in December, 1907, the beaches of the island of Lobos de Tierra seemed literally fringed by the protruding fins of sharks basking in the shallow waters.

The preparation of such fishes by drying them in the sun constitutes an important industry for the fishermen who frequent the island of Lobos de Tierra during the season when it is not closed for the protection of the guano birds. This island, unlike the others of the coast, is surrounded by sand bottoms favorable for net fishing. It is only 10 miles from the coast, but about 70 miles from the nearest fishing ports (Eten, Sechura). The fishermen form a camp here, coming out with their families in balsas (Sechura) or balandras (Eten, Paita). All kinds of fishing are pursued, but the most characteristic is the use of large-meshed nets of strong material for the capture of selachians and large flounders. The skillful manipulation of these fishes for preservation with or without the use of salt merits special description in a later connection.

[a] Peje-rey, *Basiliehthys jordani*, etc.; corbina, *Sciæna gilberti* Abbott; liza, *Mugil cephalus;* congrio, *Genypterus blacodes;* bonito, *Sarda chilensis.*

Naturally a coast like that of Peru does not offer a favorable environment for many kinds of the better shellfishes. The scallop[a], "concha abanico," "senorita" or "conchita," as it is variously called, is, however, very abundant in many places and often attains a large size. It ranks next to the freshwater shrimp, the "cameron de rio." Mussels, beach clams, the spiny lobster,[a] and various crabs are found in the market, but quite irregularly. The small region about the port of Tumbes in the extreme north is as unique for the coast of Peru in its fishery resources as in its physical features. From the mouth of the Tumbes River to Capon, near the Ecuador line, there is a network of salt and brackish estuaries in which thrive a variety of crabs, clams, and mussels. But the chief resource of the region is the abundant oyster,[a] which grows attached to the roots and branches of the mangrove trees margining the salt creeks (fig. 3, pl. XIII). The fishery for oysters is very restricted at present, but there is undoubtedly a fair opportunity for its development.

An allusion should be made to the pearl fishery which, in 1900, was exploited in the region from the Bay of Sechura to Paita. It appears that at the start the fishery was a success, but after a very brief period ceased to yield, and subsequent efforts failed entirely to locate any banks of pearl oysters. It is possible that the discovery of these beds awaits only the prosecution of a systematic investigation with deep drags or by diving. The "pearl oyster", or "concha perla" of the region is *Pteria peruviana* Reeve, the shells of which may not infrequently be found upon the beaches.

Perhaps in no other country is fish food more generally esteemed and used when available. So we find that not only the usual edible fishes and larger crustacea and mollusks, such as have been mentioned, but a wide variety of smaller and less generally esteemed forms are sought and prepared for the trade. In some parts of Peru there is hardly an available shore form that is not taken to be used as food. As articles of diet, we should include some species of sea weeds, the *Hippa*, hermit crabs and barnacles; the conchs, large and small; the crepidulas, patellids, fissurellids and chitons; the excellent sea-urchin and the sea-cucumber; the sea-anemone and ascidians—or almost everything of suitable size except annelids and jellyfishes.

Along the entire coast a considerable element of the population finds its support in taking fish for personal use and for the trade. In the larger ports the greater part of the product is eaten in fresh condition, but at other places where the fish must be conveyed a greater distance to port, or distributed over a wider territory on land, the fishermen salt or dry their catch by methods adapted to their means and knowledge.

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[a] Scallop, *Pecten purpuratus* Lamarck; spiny lobster, *Panulirus ornatus* (Fabricius); oyster, *Ostrea chilensis* Philippi and *O. columbiensis* Hanley.

HISTORY AND PRESENT STATE OF THE FISHERIES.

Many of the present methods employed in the capture or preservation of fishes probably date back to a very remote time; for it is interesting to note that Peru not only claims an ancient fishery but offers some evidence to indicate that centuries ago the fishery and related industries had a relatively high degree of organization. The interesting story is often told of the system of transportation of fresh fish from the coast to the royal home in Cuzco, a region where fresh sea fish is never available now.

Through the earliest writers we know of the appreciation and use by the earlier Peruvians of the guano deposits of the coast for their great agricultural industries. The rigorous edicts for the protection of the guano-producing birds were evidence of admirable foresight and antedated by centuries any further effort to preserve the birds. Relics of pottery and gold are found buried in the sand or in the guano, and it is an interesting fact that modern explorations upon the coast and islands indicate that the villages necessarily supported by the fishery or guano-working industries possessed a degree of wealth that could have resulted only from an industry of relatively high development.

The great shell heaps and the islands and causeways of shells in the estuary region of the Gulf of Guayaquil testify to an early fishery of oysters and clams pursued in no rude or half-measure way. A thousand years of the present oyster fishery would not leave a trace comparable to these.

In short, it is probable that the ancient Peruvians were as competent in the fishery as in agricultural, textile, and other industries. Nevertheless, whatever may have been the condition in this earlier period, this industry, like all others, certainly fell to a very low stage after the conquest. During the past few years new fishermen have come in, new methods have been introduced, and better facilities have appeared; and yet the industry is but poorly developed, and its condition is distinctly unsatisfactory.

In attempting to give a brief account of the fishing industry as it is now carried on, it is not necessary that modernly introduced methods should receive more than the mention. It may be of value, however, to speak more fully of those forms of fisheries which may be presumed to have continued in use since the pre-Columbian period—those which are not borrowed but are actually and historically "home industries."

FISHING CRAFT.

It would seem natural that a people who could construct magnificent buildings and walls of stone that endure to our present admiration, would have fashioned good wooden boats, if the forests of timber had been available; but with the coast region desert and barren except for the scrubby growth of algaroba, with its dense and heavy wood, the ordinary materials of boat construction

were absent. A resourceful people found a substitute for wood in the reeds growing thickly near the rivers; bound together in sufficient numbers, these were made into remarkably strong craft which continue even now to serve a useful purpose. The "caballito" (fig. 5, pl. XIV) in its simplest form, as now used at Pacasmayo, for example, is made of two long bundles of "totora." The reeds are individually weak and flimsy, but the bundle, which is well wrapped with twine, is strong and comparatively stiff. Each bundle is about a foot in diameter at the aft end; forward it enlarges a little, and then tapers to a point at the other end. The two bundles are securely bound with rope, and the long tapering ends curve upward in graceful form. At a short distance from the stern (about one-fifth of the entire length) the inner and upper reeds of each bundle terminate squarely to form the forward end of a small pit, where the fish may be kept. The pit, which is about a foot deep at its forward end, rises gradually to the top of the caballito near the stern.[a] The craft derives its Spanish name of "caballito" (pony) from the method of its use. The fisherman sits astride, just forward of the pit, with his legs hanging in the water or resting on the side of the boat. For a paddle he uses a plain split of bamboo cane, paddling with each end alternately. With its shapely taper and upturned pointed end, the caballito, mounted by an Indian fisherman, not only presents a picturesque appearance, but is most serviceable for use in the short swell near the beach where an ordinary boat would be unwieldy. With his caballito anchored just beyond the surf, the fisherman sits just in front of the pit and facing astern. Of the three lines in use, two are attached to his belt while the third, which is stout and carries a large hook, is secured to the caballito. If both hands are busy with one line, the other is held with the toes. The fish must be killed with a small stick before being thrown into the pit, from which they might easily escape if alive.

The caballito is also used in net fishing. The net is in the form of a very large small-meshed bag which when in the water is kept open by gourd buoys attached to the top of the mouth on each side and by stone sinkers on each side below. The mesh may be 1½ to 2 centimeter bar. Extending outward from each side of the mouth is a "brazo" (arm) of some 8 fathoms length and of very large mesh. To the ends of the arms are attached the hauling lines. The fishermen astride of their caballitos haul this net through the water to take a school of "sardinas" or other fishes, all the time making as much noise in the water as they can with feet and paddles. The same type of net may be worked from canoes or flat-bottomed boats. (Pacasmayo, Chimbote).

The totora reeds may be bound together to form a much heavier and larger craft than the caballito. The "balsa" of Cerro Azul is made, like a raft, of

[a] Dimensions of a caballito: Length, 4.50 meters; width at stern, 0.56 meter, stern to forward end of pit, 0.94 meter; depth of pit, forward, 0.30 meter.

three logs well lashed together, but each log is only a bundle of totora, which tapers slightly toward the forward end, where it is gently curved upward. The diameter at the stern is about 25 centimeters. The bundle consists of an inner core or heart ("corazon") and a thin outer shell, so that as the exposed reeds decay under the action of the water and the sun they may be removed and replaced without disturbing the entire balsa.

The most elaborate boat of reeds[a] is the balsa used in Lake Titicaca, where it is fashioned in a more boat-like form. (Fig. 6, pl. XIV.) The squarish sail is woven of the same reeds and somewhat in the fashion of a Venetian blind. These balsas are broad, and excavated so that they may accommodate an entire family bringing their various products to market. Though we are not at this point immediately concerned with the fisheries of the lake, an allusion should be made to the use of these totora reeds in the construction of fishing weirs. At the small end of the funnel-like weir there is set a net fixed on a conical framework of poles which can be raised or lowered from the balsas.

These boats of reeds could not have sufficed for the longer fishing voyages and the commerce from port to port, but this need was supplied by the introduction of the balsa wood growing in Ecuador. This exceedingly light wood possesses the merit of not absorbing water, so that it will float indefinitely. From these logs, rafts or balsas are constructed in all sizes, from the small ones of about 6 feet length to the large 30 or 40 foot balsas, which have an upper deck and are fitted with a large squarish sail. On these the Indians with their families will live for weeks. The fishermen of Paita and Sechura find their most profitable fishing grounds about the islands of Lobos de Tierra or Lobos de Afuera, at distances of 70 to 100 miles from port. Living on the commodious balsas, the fishermen navigate along the coast, fishing where it is desirable, or moving to their camps on the islands, to remain until a cargo is salted away.[b]

Some type of canoe is found at every port. Most of these are made from wood brought from the region of Guayaquil. "Canoas" of the commoner woods are said to last only a few years; "figaroa" is a much better wood; "huachapelí," however, is most highly esteemed, and it is said that canoes of this wood have a life of a hundred years or more. One of these canoes was nearly 15 yards in length, but the ordinary length is from 6 to 9 meters. The canoe is usually strengthened with timbers and given greater freeboard by the addition of a pine plank on each side. They may be fitted with a large squarish sail called a "vela cuadrada" or a "banda."

Boats of good modern types are to be found at almost every port. When the first foreign fishermen (Italian and Spanish) came over, Mediterranean

[a] *Malacochæte totora* is used for boats, sails, pontoons, weirs, thatching, etc.

[b] On the brief trip to Mollendo the writer did not have opportunity to examine a balsa made of the hides of sea lions, the description of which must, therefore, be omitted.

types of boats were introduced, and it is said that for some time the ready-built boats were imported by ships coming around the Cape. However that may have been, the boats are all built in Peru now and chiefly of American white pine strengthened with oak. A variety of types are in use, of which the neatest is the felucca ("faluca" or "falucho") as it is employed at Callao. This has a round bottom and smooth sides, is pointed at both ends, and may be entirely decked. There is a long, narrow hatch, the "escotilla," and in the extreme aft end a small "escotilla de popa" opening into a compartment in the stern dignified by the name of "salon" and used for the storage of nets or fish. With the covers of the escotillas in place, the little boat is snugly decked in. The space under the forward deck serves for bedding, clothing, and other things, while under the side decks are spaces ("escafetas") for the keeping of cooking utensils, provisions, and miscellaneous equipment. Though the boats are small, yet for the period of a fishing trip the fisherman regards his boat as his home and equips it accordingly. A typical Callao felucca is 5½ meters in length, 2 meters in width, and 0.65 meter in depth.

As typical of the felucca, the mast stands about midway and supports a triangular lateen sail; that is, a triangular sail which is attached by its fore margin to a lateen yard or "entena." The entena hoists obliquely to the mast. For use in the scallop dredging, greater power and convenience are secured by modifying the sailing rig. The mast is then placed well forward and a boom and gaff sail (schooner-like) is used.

These closely decked feluccas are found only at Callao. In other ports the boats are usually square of stern and uncovered. At all ports the boats seem to have no other name than "bote de pescadores" (fishermen's boat), the designation by which they are distinguished from the bote chalanos, canoas, balsas, and caballitos.

One of the common inferior boats of the coast is the bote chalano, with square stern, steep sides, and flat bottom, or, as at Callao, with a wedged but fore-and-aft planked bottom. At Callao it is used with a large square sail.

All of the boats are without centerboards and are comparatively poor sailers into the wind. Therefore if a fishing trip is made to northward of the port, the return journey against both wind and current is always tedious. The use of the centerboard is unknown.

The best sailing craft are the "balandritas" or small sloops of Pacasmayo. The balandras used there for trips to the Lobos Islands are 25 to 30 feet in length, with a 7 to 10 foot beam and a depth of 3½ to 6 feet. Square of stern, well decked in, and with a small cabin, they have fair seagoing qualities and may carry from 10 to 14 tons. The balandritas are of the same form, but smaller.

They are good sailers and are well adapted for trolling in the bay for the 40-pound robalos.[a]

Reference to boats would not be complete without mention of the American whaleboats which from time to time have been left by the whalers in the region of Tumbes. They are used in the local whale fishery and for other purposes. Valuing economy of nervous energy more than saving of time, the fishermen of Tumbes avoid any trouble from the centerboard, and cripple their boats, by securely sealing the centerboard well from below.

METHODS OF FISHING.

Besides a few small and unimportant hand nets, such as the "chaya" and the "bajia," there are only four or five types of nets in use. These are the "ataraya," or casting net; the "red derecha," or gill net; the "chinchorro," or beach hauling seine; the "anchobetera," and the "trasmalla."

The "trasmalla" (trammel-net) or "red de tres paños" (net of three cloths) is clearly an innovation, and is now found only where it has been directly introduced by the European fishermen, as at Callao and Mollendo. The others are doubtless indigenous to the country, although in some cases apparently modified by modern influences.

Where there are good beaches the fishermen wade into the surf to throw the ataraya, but, except when the valued lizas are abundant, the method is slow and profitless. (Fig. 4, pl. XIII.) The gill net, "red," or "red derecha," is essentially the same wherever found, though appearing under a variety of names, according to the size of the mesh and the kind of fish for which it is intended. Used at the surface or at the bottom, set straight or traplike, in the form of the letter S or of a figure 6, employed in the far off shore fishery for bonitos or in the treacherous surf on a steep shingle beach, it may have a mesh of any size from 1½ to 10 centimeters. Thus we find it as a "pejereyera" (1½ to 2 cm., bar measure), "cabinsera" (3 cm.), "lizera" (4 to 5 cm.), "bonitera" (5 to 7 cm.), "corbinera" (6½ to 9 cm.), "robalera" or "cazonera" (9 to 10 cm.), according as the net is designed for the capture of fishes of the sizes of peje-reys, cabinsas, lizas, robalos, cazones (large sharks), etc. The measures are always stated in "dedos" (fingers), one dedo being equivalent to about 2 centimeters, diagonal measure, and therefore the measure in dedos corresponds approximately to the bar measure in centimeters. The greatest part of the catch of the entire coast is taken by these nets.

The chinchorro is used where there are suitable beaches. It is a hauling seine, with a bag or bolsa about 7 fathoms deep by 2½ high. In the back or

[a] Chalanos, feluccas, and balandritas may be valued, approximately, at 200 soles, 400 soles, and 600 soles, or at $100, $200, and $300, respectively.

bottom portion for 2 fathoms it is of small mesh and strongly reenforced, while the outer portion is of larger mesh (about 8 centimeters). The long "brazos" (arms), or "bandas," extending out from each side of the mouth are 13 fathoms in length and 50 meshes (10 cm. each) in height. In making a haul, two canoas or balsas are used in putting the net, while it is drawn onto the beach by several men, often with two or three mules.

Perhaps the most characteristic net is the anchobetera, a modification of the chinchorro, used in taking the little anchobetas, which occur in such vast schools. The bolsa, or copa, is 4 or 5 meters in depth, and, when flattened, 9 or 10 meters wide (that is, 18 to 20 meters in circumference). The opening or mouth of the bolsa is surrounded by a sort of funnel, of four portions; the upper and lower "pechos" (breasts) with a mesh of 9-centimeter bar, and the right and left "sobacos" (armpits) with a mesh of 20-centimeter bar. From the sobacos the brazos, or arms, lead out on each side with a length of 5 or 6 fathoms, and a mesh of 40-centimeter bar (16 inches). In surrounding small schools of anchobetas, the net is worked from canoas or balsas. A larger net of the same type may be used for "sardinas," as referred to on page 342. It would be called a "sardinera" or a "red clara."[a]

In the way of line fishing, we find the simple still-fishing line, or "cordel," the trolling line, or "cordel bonitero," and the trawl-line or bait-line—the "espinel."

The espinel is of particular interest, as one of the most effective methods of fishing and as being the only method by which one of the very best fishes of the coast is taken in any abundance. As used at Callao, Chimbote, etc., the espinel carries 50 to 100 hooks on short lines attached at intervals of 1 to 2 meters, and it is worked in 20 to 30 fathoms of water. The espinel fishery, however, is best seen at Mollendo. Fishing in 46 fathoms at a trial on the usual fishing grounds, and using a line of 1,500 hooks, our fishermen took 256 congrios at one haul. As the hooks were attached (by 30-centimeter side lines) at intervals of 1 meter, the length of line fished was nearly 1 mile, but such a line is readily worked by one man with an assistant to control the boat. The line was set after 7 o'clock in the evening and taken up after midnight. The catch of about 400 pounds of the best fish, made at one haul of the line, was considered good, but not unusual, and the fishermen describe hauls of 700 pounds on 1,200 hooks kept in the water for four or five hours.

[a] The name "clara," it may be remarked here, is at first confusing, being applied to nets of very different types. The "clara" is the clear net—that is, the net which the smaller fish can pass through. Therefore, fishermen who speak of the anchobetera as "la red" (the net) would call the same form of net with larger mesh the "clara;" in another community, where the gill net for cabinsas was the net in most common use, and therefore spoken of as "la red," the "clara" would be a net of somewhat larger mesh, such as the "lizera" or the "bonitero." Thus in one community the "red clara" is a gill net, while in another community it is an entirely different type of net.

In this case only four fishes other than the congrios were taken (two sea basses and two rays), and it is significant that the congrio appears not to be taken in any numbers except by the use of the espinel. The congrio, eaten fresh, is considered an unsurpassed food fish, and, as will appear on a later page, it gives the best salt product prepared in Peru. It seems surprising, therefore, that the espinel is not more extensively used. The method is relatively laborious, but the yield is in proportion to the labor. Undoubtedly, the reluctance of the fishermen to use it is due, not so much to the amount of work involved, as to its relative intricacy, the necessity of much preparatory work in the securing of bait, the baiting of the many hooks, the arrangement of the lines in the tubs, and, finally, the constant care required in the manipulation of the line in order to avoid mischievous tangles.

At Callao the espinel is not often used, and then only in a small way, the fishermen preferring those methods which, however much actual labor they may involve, require the least forethought. The congrio is practically unknown to the market there. Even at Mollendo, where the effectiveness of the method is not infrequently demonstrated, it is not regularly used, the fishermen choosing rather to throw a shot of dynamite near the rocks and scoop the fish from the surface. Undoubtedly there are extensive fishing grounds which will become available only with the extension of the espinel fishery or by the introduction of the bottom trawl-net ("red barradera").

Dynamite must be mentioned as one of the common methods of fishing. This abuse is certainly working an incalculable damage, especially in certain regions. It is prohibited by the government, but the efforts to prevent its use have so far been ineffectual, and the practice is at present the most serious defect of the fishery.[a]

PRESERVATION OF FISHERY PRODUCTS.

Some of the methods of preservation employed are of especial interest, but before particular mention is made of these, a word may be said as to the significance of the fish-preservation industry to the country.

[a] A list of apparatus used for taking sea fish in Peru would be made nearly complete by adding the following to those that have been mentioned above: The dredge, or "rastra," employed in the scallop fishery, especially at Callao, and a rather better rastra formerly used in the abortive pearl fishery at Sechura and Paita; the net for turtles, or "tortugera;" the gig, or "fisga," for taking the flounders at Callao, a little oil being sometimes poured on the water to make the surface smooth; the "bolador," made of wood in the form of the dasher of an old-fashioned churn, which is thrust sharply into the water, making a loud sound to drive the fish into the gill net or the trammel net; the pole and hook ("gancho"), for taking gobies and devilfishes from the rocks; the lance ("harpón"), thrown at the larger fish from the shore, from a pier, or from the boat; the harpoons, as rarely used in the fishery of sword-fishes ("peje-espada") at Mollendo; and the ordinary harpoon and hand-lance outfit employed in the shore fishery of whales at Tumbes. We are not here concerned with the various baskets and hand nets with which the fresh-water shrimps are taken, or with the methods employed in the lake and river fisheries of the interior.

For want of convenient methods of transportation, it is only the people of the ports who can have the luxury of fresh fish, and even these may know it only as an occasional delicacy if the fishermen are accustomed to work at a considerable distance from the port. To the people of the interior only salt fish is ever available, and they prize it highly. Even this is a rare luxury in most parts of the country, however, on account of the rather unsatisfactory preservation of fish and the entire want of system in the marketing and distribution of the product. At some ports, in fact, neither fresh nor salt fish are regularly obtainable.[a]

At the island groups of Guañape, Lobos de Afuera, and Lobos de Tierra practically all the fish taken are preserved by salting or drying for the supply of the region of coast between Salaverry and Paita. Paita even boasts a small exportation of salt fish, since two balandritas convey annually about 50,000 fish ("sierras," "bonitoes," "caballas," "peje-blancos," and "meros") to Manta, in Ecuador, and other ports of the north.[b]

That preserved fish is not more available to the people of Peru is rather remarkable in view of the general occurrence of deposits of salt. In almost every part of the coast are found salt beds of greater or less purity. In some places, as near Pisco, cakes of almost pure salt can be picked up from the ground. The extraction, refining, and sale of salt are restricted, however, to the National Salt Company, and the common market price is exceedingly high. So far as I am aware, only the fishermen of one village, San Andres, near Pisco, have the privilege, especially granted them, of taking for themselves the comparatively good salt from the hillsides near the shores of Paracas, where they commonly fish for peje-reyes and other fishes. On the other hand, the Government, realizing the absolute necessity of cheap salt to the fishermen, has made special arrangements for their benefit. Each fisherman is entitled to receive monthly from the salt company 2 quintals (200 pounds) of salt at a nominal price, while for such further quantities as he may need the price is fixed very much below the regular market price. These arrangements would seem to be most satisfactory to the fishermen, at least; but the indigenous fisherman has an almost unconquerable prejudice against the purchase of salt, and will rarely go beyond the allowance, although often complaining of its inadequacy. In times of especial abundance, quantities of fish are therefore sold at small prices or allowed to spoil.

One of the expedients of the fishermen, resulting only in part from the inadequacy of the salt supply, is the use of what they call "salitre." The

[a] The importation of salt and canned fish in 1905 amounted to about £38,361 ($186,800), but the imported product does not reach a large proportion of the natives, who are without fish food of any kind.

[b] Sierra, *Scomberomorus sierra;* bonito, *Sarda chilensis;* caballa (mackerel), *Scomber japonicus;* peje-blanco, *Caulolatilus* sp.; mero, not identified.

word means saltpeter, but it is applied by them to what is merely a natural mixture of salt and sand and other impurities, which may be found near some of the villages. It is claimed by many of the Indian fishermen that the fish preserved with the so-called salitre will keep in better condition for eating than those preserved with pure salt.

The crude native methods of drying anchobetas have already been noted. Occasionally these little fishes are prepared in small quantities, by pickling, so as to make a very palatable food.

Generally speaking, no choice is exercised in the selection of fish for preservation; any fish that comes to hand and is regarded as edible will be packed away. There are certain forms of preservation, however, which seem to be worthy of further description.

Preservation methods at Mollendo.—The fisheries of Mollendo, though not extensive, would form a chapter in themselves. The markets of the port and of Arequipa, the second city of the country, display a variety of fish products not seen in the more northern markets.

On some accounts the most interesting fishery product of this region is the peculiar dry and tangled egg-mass which is found on the local markets as "cau-cau." This is the egg-mass of the "volador" or flying fish, which is collected in season and dried that it may be kept on the markets throughout the year. These eggs have an especial interest from the fact that, although flying-fish eggs have been known to science for nearly fifty years, they were, until quite recently, attributed erroneously to the little sargasso fish (*Pterophryne*) of supposed nest-building habits. A few years ago, after the discovery of the true eggs of *Pterophryne,* the identity of the eggs of the so-called "nests" with those of the flying fishes was soon established. The cau-cau appears to have been a product long familiar to the natives of this part of Peru, by whom the eggs have been attributed, and correctly as it seems, to the flying fishes.

Each egg is 2 millimeters in diameter, and its membrane is produced into a number of filaments, which, though rather scattered over the surface of the egg, have a tendency to a bipolar distribution. The filaments, though very fine, are quite long and the fibers of different eggs are thoroughly intertangled, to unite the many eggs into a closely woven mat. Sometimes the filaments are so twisted together as to give the appearance of a well-defined thread.

The cau-cau of the market, then, is a large number of the shrunken berries, entangled to form a shapeless mat. A mat may be a good double handful or more, and the filaments are so completely interwoven as to make it difficult to tear the mass into portions. When soaked in water the eggs will expand and take an appearance as if freshly laid. They are found in early summer, beginning with October, and are said often to be entangled with weed. My visit was in July (midwinter) and the cau-cau then on the market was quite free from

seaweed. Floating seaweed is, indeed, not common in the region, and the mat form of the large and otherwise shapeless masses suggests that they were formed while floating at the surface.

The most important preserved product of the region is the "charquecito," made from the congrio, a reference to the capture of which fish has already been made. The preparation was not observed, but as it was described the congrios are opened, cleaned, washed in salt water, and hung up to dry. Six or eight days later they are thrown into piles ready for the market. The drying and subsequent preservation must be watched with care to prevent heating or curling. The tail bends up in drying and must be pressed or bent out to preserve the desired appearance. The charquecito is the most highly esteemed preserved fish, but, like all fish products of the coast, it is rarely shipped to other ports. It brings a good price, 5 or 6 reals per pound (25 to 30 cents American).

Besides the charquecito and the cau-cau, a number of minor products are preserved. Dried seaweed is prepared by the simple process of putting the fresh weed into molds and pressing it into flat plates, which, after being dried in the sun, are folded and are then ready for sale. The seaweed used is called "uyos" or "cocho-uyos," but the species so dried is not the ordinary "cocho-uyos" that is eaten at other ports.

"Lapas" (fissurellids) and "barquillos" (chitons),[a] after being boiled and stripped of the shell, are dried and strung, and a "sarta" of two dozen of these "atados" (strings) is sold for the very small sum of 30 centavos, or about one-third the price of the fresh shellfish.

The "pincho de mar," a holothurian, is skinned and dried to make a crude trepang. "Ocoti," or "pota," is the sea anemone[b] stewed and stripped of the skin. It is sometimes dried. It is a custom for the Serranos, or inhabitants of the interior, coming down to the coast at Ilo, to take back with them the trepang, ocoti, etc., along with the cau-cau and charquecito.

In this connection it may be mentioned that, besides the characteristic methods of preservation practiced in this region, other fisheries are followed here that are rarely found in other ports. The capture of the swordfish ("peje-espada") is sometimes attempted, and at least one fisherman is well equipped with the necessary harpoons. The swordfishes are said to weigh 200 to 400 pounds and to bring 26 to 50 soles each ($13 to $25).

The prized "erizos" (porcupines), or sea urchins, are more commonly taken here than elsewhere. Ascidians, which bear the surprising name of "ciruelas" (cherries), are stripped of the test, so that the inner portion is taken out "como

[a] Lapas, *Fissurella costata* Lesson, *F. crassa* Lamarck; barquillos, *Chiton granosus* Trembly; *Enoplochiton niger* Barnes.

[b] *Phymacter clematis* (Dana) Milne-Edwards, as identified for the U. S. National Museum by Prof. J. Playfair McMurrich.

un huevo" (like an egg) and is eaten raw or in soups under the name of "cochizo" or "piuri."

Finally an allusion should be made to the taking of the abundant bogas, suchis, and peje-reyes (species of fresh-water fish) in Lake Titicaca. These fishes are considered delicacies and are brought down to Arequipa, the chief city of the region. Dried lake peje-reyes were observed on the market.

At Lobos de Tierra.—Reference has been made to the capture of selachians and flounders in the region of Lobos de Tierra. Many of these are preserved by sun drying and without the use of salt or other preservative. The process is of some interest, as the fishermen are peculiarly expert in preparing the fish.

On the return from the fishing trip, after the fish are thrown into piles on the beach, the first matter is the apportionment of the catch, since two or more fishermen have worked together. The division accomplished, they set to work individually to prepare the fishes for drying. Each man has beside him, when at work on the beach, an oar or a board sprinkled with sand and used for sharpening the knife. A short sharp sheath-knife is used and it is whetted by a stroke or two on the oar after almost every cut that is made. The "guitarra" (guitar-fish) is laid on the sand with the back up. Five cuts practically prepare the fish. The first splits the right and left sides incompletely apart, leaving the backbone in the left half; the second lays open the right side of the head; the third lays open the right side of the body; the fourth lays open the left side of the body; the fifth lays open the left side of the head. A few quick slashes to better expose the meat for salting, the removal of the entrails, and the making of a slit in the tail by which to hang the fish complete the process, and the fish is thrown aside for washing.

The "angelota" (angel-fish) must be cut a little differently, but the process is accomplished with hardly less dispatch. The outer parts of the outer fins are first removed. The first cut splits the fish; the second lays open the right side with the aid of a few additional slashes in the meat; the third and fourth lay open the left side. The head, gills, and entrails are then cut entirely away and the body of the fish is thrown aside to be washed.

The small boys assist by taking the opened fish, two at a time, into the water and washing them free of the sand, blood, and other dirt. The fish are then hung from poles by the slit in the tail. Two or three slender pieces of cane put crosswise keep the skin stretched, and the fish are thus left to dry in the sun. Four days is said to be sufficient for the curing if the weather is bright. Hanging in this way, they look like merely a series of skins, but the meat is all present as a thin layer on the skin. No salt or salitre whatever is used on them. They are strictly sun cured, as flat thin sheets of skin and meat.

"Tollos" (small sharks) and "cazones" (large sharks) are prepared in very much the same way as the angelotas.

The "rayas" (rays) are handled in an interesting way. The fish is laid on the back and two circular cuts are made. The first cuts away the lower wall of the mouth and gill cavity, leaving this wall hanging as a flap on the left side anteriorly; the second cuts away the lower wall of the abdominal cavity, leaving this as a flap on the left side posteriorly; the entrails are then removed; a vertical cut from above is made through the backbone from the head to the base of the tail and one or two short cuts may be made on each side of the thick base of the tail; a series of cuts are then made across the disk of the raya, which now looks like a circular gridiron. These crosscuts extend to the skin below.

When all the rayas are prepared, sand is rubbed well into the cuts of each, and the fish is laid in a hole in the ground. The hole is covered with boards or mats or by filling with sand, and the fish are thus left in the sand on the beach for a day to let the moist sand absorb the blood. They are then taken out, washed and salted, after which they are laid across poles or logs to dry in the sun. Three or four days are required for the drying.

With regard to the use of salt, the fishermen state that salt is never used on guitarras, but is always used on rayas; angelotas and tollos are prepared with or without the use of salt, according to preference or to the quantity of salt available. Salitre is used to some extent, but salt is considered much better.

The waste products in the preparation of the fishes are simply thrown on the beach and the "gaviotas," or gulls, gather in great numbers to eat them. The eggs of the guitarra are supposed to have a certain medicinal value, and are sometimes saved for this purpose.

On the mainland the dried fish bring from 10 to 60 centavos apiece, according to the demand. Practically all of the ordinary fish taken here are salted, but at the time of my visit few fish, other than the selachians mentioned and flounders and mackerel, were being taken.

Oils.—In the illustration (fig. 7, pl. XV), there is seen, below the drying fish, a turtle shell, into which has been thrown a quantity of turtle fat. Placed, as it is, in the sun, the shell is tilted so that the oil flows out into a can placed below the point of the shell, which serves as a spout. The oil is used medicinally, especially for dressing wounds of man or domestic animals, and also to take internally for troubles of the liver. Turtles were seen abundantly in this region. On one occasion I saw 10 heads of turtles thrust out of the water to breathe at one moment and within the space of a few yards. They were feeding on the abundant seaweed of these shores. In this part of Peru, however, the turtles are rarely used, as the meat is not valued. The only place where a turtle fishery was observed was in the south, at Pisco. The meat is there sold locally at 25

to 30 cents the quarter or less, but the real object of the fishery is the oil, which is valued for miners' lamps.

A net for turtles, or "tortugera," at Pisco may be about 80 fathoms long by 2 fathoms or a little more in depth. A net observed had a mesh of 30 centimeters (1 foot) bar. In the use of this net the fishermen, working near the shores, watch carefully, and when a turtle is seen, put the net out as quickly as possible. One to 5 or 6 may be taken at a time, or, when they are especially abundant, as many as 10 may be taken at one haul. Two fishermen, working together, may take as many as 80 turtles per week. January, February, and March are regarded as the best months in which to take them, because they are fattest in those months.[a] The fat is thrown into a big pot of 8 to 10 gallons capacity and slowly cooked, while the shells are used for fuel. The fishermen state that 80 or 90 turtles yield 16 to 20 tins of oil, selling at 3 soles (about $1.50). Computing from these figures, the oil yielded by an individual turtle would be worth from 27 to 38 cents, while the total catch of two fishermen in one week might be worth $24 to $30 for oil, besides the value of the meat.

The fishery for whales off the coast of Peru has been pursued by foreign vessels for more than a hundred years. After an English vessel, manned by American whalemen, made a most successful voyage around Cape Horn in 1788–1790, the coasts of Chile and Peru soon became favored whaling grounds for both English and American vessels. The agreeableness of the climate off the coast of Peru, the freedom from dangerous storms, the convenience of certain ports, the abundance of whales, all conspired to make it a favored cruising ground, and Callao, Paita, and Tumbes became places of common resort for refitting and provisioning. Peru derived a direct commercial benefit from this fishery. Tumbes gained more than this; for sometimes the crews were recruited with local sailors, and occasionally these native recruits, acquiring experience and skill, rose to the rank of officials of the boat crews. In this way the "Tumbeseños" learned the methods of the whale fishery, and the way was opened for a national fishery. For at least twenty years persons or companies of Tumbes have followed this fishery, employing the well-equipped whaleboats left behind by the foreign whalers. It is, however, a small fishery, 10 to 14 whales in a season being accounted a good catch. The season of 1907 was a very poor one, only 4 whales being captured, with a yield of about 6,500 gallons of oil, valued in Tumbes at about $1,300.

The coast has long been abandoned by all foreign whalers except a few Chilean boats, which are supposed to take about 150,000 gallons of oil each year. At the local valuation this would amount to approximately $30,000. The

[a] Turtles are not known to come on the beaches to lay in this region, nor so far as I know, south of the region of Tumbes, where it is said that the nests are made about September. The only common turtle of the coast is the Pacific green turtle. The tortoise-shell turtle is said to be found very rarely.

Chilean boats, which are said to use the whaling gun and explosive harpoon, probably take chiefly the sperm whales; while the native whalers confine their attention to the humpback whales found nearer the shore in the Gulf of Guayaquil, and employ only the harpoon and lance thrown by hand. The Gulf of Guayaquil is reputed to be a favored breeding ground of the humpback whale, and it is about at the bearing season (May, June, etc.) that the local fishery is pursued.

Except the preparation of oil from turtles at Pisco and the capture of whales at Tumbes, there is no fishery for oils in Peru.

For a time the sea lions ("lobos de mar") were taken for the oil and hides, but the government prohibited the continuance of the fishery, partly because of the use of dynamite and partly that an inquiry might first be made as to the relation of the sea lions to the guano-producing birds. It was a question whether the lobos were injurious to the birds, in the competition for food, or were of real assistance to them in so herding and demoralizing the surface fishes as to make them more available to the birds. It is probable now that the fishery will be resumed under proper regulations and restrictions.

The porpoises and dolphins seem never to have been sought; in fact, many of the fishermen have a peculiarly friendly feeling for these animals, believing that in some way they aid the Christians ("ayuda los Cristianos").

Fur seals, "lobos finos" or "lobos de dos pelos" (lobos of two coats), while undoubtedly occurring on the coast as far north as Paracas, are not abundant enough, nor perhaps of sufficient value, to support a fishery. The "gato de mar" (sea-cat), a species of river otter (*Lutra*) that lives in the sea, is not uncommon in some regions, but is never abundant. Its pelt when taken is regarded as of some value.[a]

FUTURE OF THE FISHERY INDUSTRY.

In spite of the antiquity of the fisheries of Peru, and notwithstanding the introduction of European fishermen with their improved boats and nets, the industry is now so inadequate and unsatisfactory that the larger part of the people of Peru are not supplied with a class of food which they peculiarly appreciate.

Some of the difficulties are inherent in the situation in a country whose industrial life in all its phases is relatively undeveloped, and many of these difficulties will disappear naturally as the country generally advances further in the path of industrial progress which it has so propitiously entered. Rapid and frequent transportation between ports is wanting, railroad rates are neces-

[a] We are not concerned with the preservation of the large fresh-water fishes by smoking and other methods which are practiced on the headwaters of the Amazon. I have been informed that this is such an extensive industry that smoked fish in that part of Peru is a more common food than beef.

sarily high, and ice is at present at almost prohibitive prices. The fishery industry everywhere is without that organization and specialization which marks the higher stage of development attained in many other countries. Each fisherman makes his own nets, conveys his catch to port, sells the fish fresh or preserves them by salting or drying for sale at a future time—everything in an individual way. Experience in other countries shows that economy is the result of systematization, and that the middleman, even if characterized as the "necessary evil," may not only keep the market more regularly supplied but also give the fisherman a better average profit and the consumer a lower average price. So in Peru we find the fish when unusually abundant thrown away or sold at a very low price, because the fisherman has not the means or lacks the energy to preserve a large catch, while the public complain of an irregular market and of an excessively high price in ordinary times. I have referred to the unusual appreciation of fish-food by Peruvians. Rarely is a meal served without fish where it is obtainable, yet to a large part of the people beyond the ports this much-prized luxury is seldom to be had.

Modernizing the fishery is not sought for itself, for many of the original Peruvian methods of capture are suited to the natural conditions and best adapted to the social nature, the abilities, and the wants of the people. Except in Callao and Mollendo, the fishermen are all native Peruvians but slightly touched by the wave of modern progress. In attempting to introduce new and larger methods, it would be unnecessary and unjust to hamper or antagonize a kindly people, poor in wealth but rich in contentment, who are working out a peaceful and honorable life after the bent of their nature. The caballito and the balsa, the chinchorro and the anchobetera, the camerone traps and other native nets may long continue to give satisfactory food to many Peruvians. Yet if the native fishermen may be taught to capture their fish more abundantly, and to salt and dry them more efficiently, their labors may be the more profitable and the more useful to them and to others. Furthermore, without prejudice to them, their fisheries may be supplemented by those who can pursue the industry in a larger way and with better organization; and this is clearly necessary if the larger part of the population of Peru is to obtain fish and to have it regularly and cheaply.

The abundant catches of the excellent congrios made with the espinel (trawl line or bait line) in the region of Mollendo and the success of this method when used in other parts show well that, although relatively laborious, it could be more extensively employed to great advantage. The deep bottom trawlnets, while not actually tested in Peruvian waters, would in strong probability prove successful, and it is much to be desired that experiments be made with them. The use of power boats will be necessary, and the introduction of these for quick conveyance of fish to market will enable the fishermen to

spend a greater proportion of their time upon the fishing places, increase the territory conveniently accessible for the markets of Callao and Lima, and open new fishing grounds. Finally, the opportunities are excellent for the proper preservation of several kinds of fish by various methods.

II. THE GUANO INDUSTRY.

The guano problem, which is perhaps the most important economic question confronting the nation of Peru to-day, has been included in the fishery studies partly because it is impossible entirely to dissociate the guano industry and the fisheries in protective and regulative measures. Strictly, indeed, we may consider guano a fishery product, for it is formed by the birds from the small fishes, which swim in such enormous schools along this coast. Chiefly for this reason, in fact, I have on a previous page referred to the anchobeta as the most important resource of the waters of Peru. It is, however, an inadequate statement of the relation of the guano and fishery industries to say that the existence of the guano-producing birds in Peru is dependent upon the presence of large schools of fish. One of the most important products of the fishery industry of the United States is the fish guano made by direct manufacture from the menhaden. In Peru a nearly equal value of guano is produced annually from the anchobetas through the agency of the birds. This guano is obtained far more cheaply than if the process of manufacture were depended upon, since it can be brought from the islands at little more than the cost of transportation. (Fig. 8, pl. xv.) It is a very significant practical question to what extent Peru should continue to depend upon the birds for the production of nitrogenous guano, or whether the direct manufacture of fertilizer from the fishes should be undertaken in order to supplement the present available supply. This question will not be specifically discussed at this time, but the matter here presented has a very direct relation to its solution.

Peru owes the importance of its guano deposits, not only to the abundance of the sea birds and the fishes upon which they feed, but in equal part to those natural conditions which have permitted the conservation of the nitrogenous parts of the guano. Had the coast been subject to rains, or were the climate more moist, the nitrogenous portion of the guano would have been converted into ammonia and lost by evaporation or drainage. There would have resulted then, at the best, a phosphatic guano of relatively low value. The guano consists, as is well known, of the excrement of birds and sea lions, with the other offal matter of the rookeries, consisting of bodies of birds and sea lions, birds' eggs, and fish. For our purposes the sea lions may be excluded from consideration. Undoubtedly they have lent considerable bulk to certain deposits of guano, but, from such information as can be gained, it seems practically sure

that apparent deposits of seal guano which have given a high analysis owe their chemical value in large measure to bird guano which has been formed with it.

THE PROBLEM.

It is difficult to overestimate the significance of the guano problem to Peru. It is not merely that the country is threatened with the loss of an exportation industry which has yielded important revenues; the sugar and cotton planters of the country have been coming more and more to recognize the value of the fertilizer for the production of their crops. In fact, with the relatively crude methods and the inefficient labor, combined with the necessary expense of irrigation, the profit from these crops is, to a considerable extent, dependent upon the availability of a cheap fertilizer. Even at this time the nation's agriculturists are estimated to require 40,000 tons annually, while, under existing conditions, they have been able to secure only about two-thirds of this amount. The guano deposits have been so mortgaged for the payment of the bonded debt that, under the present arrangements, the largest part of the guano must be exported. Thus, in 1907, of approximately 124,000 tons of guano extracted, only 26,000 tons were taken for the agriculture of Peru. Under a continuance of the present conditions, it is certain that even this proportion of the nation's requirement can not be obtained for more than a few years longer.

The exhaustion of the old deposits will soon be realized. It is true that there have been "false alarms" in the past in this regard. Islands which have been proclaimed exhausted have been revisited and have afforded new supplies of the fertilizer. This has been due only in a relatively small degree to the continued deposition of the birds; in part it is explained by the occasional discovery of new deposits of buried guano; but that the same island has been successively exhausted two or more times is chiefly accounted for by the fact that the term "exhaustion" has been used in a relative sense. At one time it was not profitable to extract guano lower than a certain grade, while at a later time the market would be content with a fertilizer of much lower nitrogen value. It would become profitable, then, to return to "exhausted" islands where the lower grades had remained.

At present the old guano supplies are reduced to the very lowest grades that it would be profitable to extract and transport to foreign markets, and the approximate amount of such guano being known, it is estimated that at the present rate of exportation all the available guano of old formation will be removed within four or five years. It is not probable that new deposits will be found of sufficient quantity to change the present outlook materially.

It is clear, therefore, that within a few years the guano industry will be dependent upon the yearly production of the birds. The amount of this new production can not be stated accurately, but it is fairly estimated to be between 20,000 and 30,000 tons. This amount, if divided as now between the export and the home trade, would be of comparatively little value to either. The estimated annual production is, indeed, less in number of tons than is actually required by Peru's agricultural industries alone; but since the new guano has a much higher average nitrogen value than the guano that is now used, and on which the estimated annual demand is based, it is probable that the yearly formation would meet the present demands of home agriculture. Furthermore, it is believed that with the adoption of the correct method of working the islands, and with the most thorough protection of the birds, there would result a material increase in the production of guano, sufficient to keep pace for a considerable time with the growing demand. It is even possible that there would be a surplus for exportation.

THE GUANO-PRODUCING BIRDS.

At least twenty-four species of birds frequent the islands, not including seven species observed at sea in proximity to the islands and coast. Twelve of these were observed nesting on the islands. From the commercial standpoint the chief birds are the cormorant, the pelican, and the gannet, the first and last mentioned being the most abundant birds on the coast.

THE CORMORANT.

The white-breast cormorant (*Phalacrocorax bougainvillei* Lesson), the paramount guano-producing bird, occurs along practically the entire coast, nesting on the level ground or the more gentle slopes, and always in closely crowded rookeries (fig. 9 and 10, pl. XVI). This cormorant, the "guanay," occurs most abundantly in the south, at the Ballestas and Chincha islands. The nests are closely crowded over great areas, where it may readily be ascertained that they average about three to the square meter. At the close of the season there may be allowed at least four birds to a nest, counting the parents and one pair of young. The population of a flock, after the young are raised, may therefore be estimated by multiplying by twelve the number of square meters covered by the rookery. On the Ballestas and Chincha islands in June, 1907, rookeries of 4,600, 10,000 to 12,000, and 60,000 square meters, respectively, were measured, and other smaller rookeries were observed. These flocks, then, must have contained 55,000, 120,000, and 720,000 birds, respectively. At a later time the last-mentioned flock, on the South Chincha Island, was so much increased, chiefly through recruits from the other flocks; that a million birds could have been only an underestimate of its population. The photograph (fig. 9, pl. XVI) shows but a very small portion of this immense aggregation of birds.

It may be of interest here to consider for a moment the potential commercial value of such flocks of birds. Let us assume that each of these birds leaves upon the island daily a single ounce of guano. This is actually an underestimate, as such a rate of deposition would not account for the quantity of guano actually extracted after a year's accumulation on a rookery; but on this assumption of 1 ounce a day for each bird, the deposit would grow daily by 1,000,000 ounces, 62,500 pounds, or 28 long tons. A million birds would then produce over 10,000 long tons of guano per year. Such an amount is probably not actually formed at this ground, for the reason that a million birds is a decided overestimate of the average number of birds on the rookery throughout the year. However, on the assumption of 1 ounce of guano per day per bird, it follows that 100 birds would produce 1 long ton of guano per year.

We may come more nearly to the actual conditions. From the various calculations I have made it appears that a rookery will yield about 1 long ton of guano per year for 28 nests. This guano of the "guanayes" is very high in nitrogen, giving an analysis of 12 to 14 per cent and higher, and we may value it at $40 per ton.[a] Twenty-eight nests, or 28 pairs of birds, have an annual producing value of $40. We give a fair idea of the commercial significance of these birds to Peru when we say that each brace of birds contributes annually $1.43 worth of guano, besides leaving a pair of offspring to continue its service. Is it not, then, of the greatest importance that the fullest protection should be extended the birds, and every possible precaution taken to insure that there may be the maximum number of birds at every rookery, and that these birds may remain upon the rookery the maximum amount of time?

Previous to making the above computation, from observations at other rookeries, I had estimated the number of nests on the south island of the Chinchas at 180,000, and, by an independent series of measurements of the deposits of guano at various places in the rookery after two years of accumulation, had estimated the amount of guano at between 12,000 and 15,000 tons. Making a new calculation on the basis of the figures just worked out—that is, 1 ton to 28 nests—the 180,000 nests would give 6,400 tons per year, which is in close agreement with the original computation from measures and weights taken on the rookery.

[a] The cost of guano to a Peruvian farmer can not be taken as a basis of valuation, since the government practically gives the guano to him, exacting a tax of only 1 sol (about 49 cents) the ton. The expense to the farmer is merely the cost of extraction and transportation. The cost of a ton of 9 per cent guano on the farm is, therefore, only $12 or $13 in American gold. This cost, however, does not at all represent the value of the guano, if the cost were based on the ordinary laws of supply and demand. The real value to the farmer can not be computed.

The guano for export was consigned to the exporting company many years ago by a process of adjustment, in return for the acceptance of certain obligations; so that it is not practicable, either, to calculate the value of the export guano on the ground.

However, considering the high selling value of guano of such excellent quality in foreign markets, and since the cost of extraction is less than $5, and the freight relatively low, it can not be considered unreasonable to assume that guano of this high anaylsis has a value to the world of $40 per ton.

THE PELICAN.

The second bird in importance is the "alcatraz," or pelican (*Pelecanus thagus* Molina), although it has not now nearly the rank of the cormorant. The pelican is not only far less abundant, but it appears that its guano is distinctly less in quantity and inferior in value to that of the cormorant. It can not be said in what degree this is due to an inherent difference in the birds, or to the fact that the cormorant breeds chiefly on the islands of the south, where the conditions are better for the preservation of the guano, while the pelican now breeds chiefly in the north where the atmosphere is more humid, and therefore deleterious in its effects on the deposits of guano.

There is one thing of especial importance for consideration in regard to this bird. The pelican, of all the useful birds, is the one which seems to be most affected by the disturbances incident to the extraction of guano, and therefore, of the three chief commercial birds, it is the one which has been most reduced in numbers. This may offer a reasonable basis of hope for the future. It does not appear that the breeding territory of the pelican was always confined as now to the northern regions. The islands of the south are smaller, so that the working of the islands is more directly disturbing to the birds. It is natural, therefore, that the rookeries of pelicans in this region should now be small and confined to the outlying and less accessible rocks. In the north, on the other hand, the islands of Lobos de Tierra and Lobos de Afuera are comparatively large, giving more opportunity to the birds to separate themselves from the guano workers. During recent years, too, the extraction in the north has usually been restricted to one group of islands, while the other was left to the undisturbed possession of the breeding birds. It is unfortunate that during the past two years both islands have been worked, with results which can not but be seriously injurious to the welfare of the pelicans.

In March, 1907, large pelican rookeries, with eggs and all stages of young, were observed to the eastward of the Lobos de Afuera islands and an islet just off the north end of this island. During the following winter, about August probably, the birds were entirely routed from these islands, and the rookeries were swept clean of guano. A new home was established on the westward island, where the photograph (fig. 11, pl. XVII) was taken in December, in the early part of the laying season. Not a single bird remained to make its nest on the islet, and only a few very small and scattered rookeries were found on the entire eastward island.

In March, 1907, there were probably about 80,000 flying birds (mature and immature pelicans, not counting the nestlings of every stage) using the Lobos de Afuera islands at night. In December, 1907, there were between 20,000 and 40,000 nesting birds on the same islands. The irregular nature of the rookeries

made it impossible to arrive at a more definite estimate. Probably by the following March, after the rearing of a brood of young, this number was nearly doubled, but it can hardly be supposed there were so many as in the preceding March.

It is believed that a proper consideration of the welfare of the pelican would promise much benefit to the country. It may be expected that with the most careful protection, the bird would increase materially in numbers in the north, and even more so in the south, so that in time the pelican would have a much higher value and would take a rank nearer to that of the cormorant.

THE GANNET.

The common "piquero," a species of gannet (*Sula variegata* Tschudi), which von Tschudi considered the most important bird (and this view seems to have been generally accepted), is still important, though of far less value than the other two species mentioned. However, on account of its habit of nesting on the cliffs and other comparatively inaccessible places, the great proportion of the guano is now lost in the sea, and it is doubtful whether the bird has ever had a commercial value comparable to the cormorant or the pelican. (Fig. 10, pl. XVI.) With the better systematization of the guano industry in future years, much of this guano now lost might be saved by the construction of shelves or other collectors at the bases of the cliffs.

Von Tschudi found that a single piquero in captivity would produce 3½ to 5 ounces of guano per day. If each bird leaves about its nest 2 ounces of guano daily, 1,000,000 piqueros would leave 20,000 tons per year. The piquero is so abundant and so generally distributed along the coast that 1,000,000 would seem a low estimate of the number of birds on even a portion of the coast. The piquero breeds throughout the year and the nests therefore are always in use.

THE PENGUIN AND THE PETREL.

Only two other species require particular mention. The penguin, or "pajaroniño" (*Spheniscus humboldti* Meyen), is now of almost negligible value, but was formerly so abundant as to be highly ranked by Raimondi. The rookeries are confined to the caverns, and the guano is considered very good, although there is little of it.

The "potoyunco," a species of petrel (*Halodroma garnoti* Lesson) of oceanic habit except for its nesting in subterranean homes, is still significant, but in relatively low degree. The nesting places are found on many islands, however, especially on the lofty San Gallan. Great areas of the surface of the ground, from the lower hillsides to the tops of the peaks that are usually capped with clouds, are undermined by nesting chambers of these birds. They will burrow indifferently through the hard crust of sand on the hillsides or beneath the

cloud-fed vegetation of the hilltops. The guano produced here must be of significant quantity, and it is reputed to be of high quality. It is remarkable to note that this little bird was given first rank by Raimondi.

The penguin and the potoyunco from their habits are the most helpless against ruthless destruction, and they seem undoubtedly to have been reduced from a condition when they possessed a much greater economic value than now. The exterminating process still continues, as both birds are frequently killed by the fishermen and the guano laborers. The potoyuncos especially are regularly sought by the fishermen. They can easily be captured at night in their underground nests, and quantities of them are taken to be salted and sold on the mainland. If adequate protection is extended to these two birds it seems reasonable to hope that they would increase in numbers toward the former condition of abundance and again take rank as important economic assets.

It is not within our province at present to speak of the other cormorants, another gannet, the gulls and terns, and the shore birds which are found on the island and coast. None of these species, individually, has a commercial importance, yet it must be remarked that, collectively, they may add materially to the total quantity of guano which may be swept from the ground.

EXTRACTION OF GUANO AND PROTECTION OF THE BIRDS.

Under the existing arrangement, all of the guano that is exported from the country is taken by a single corporation, which has offices in Lima, as well as in London, New York, and other cities. The corporation does not usually work the islands, but has the guano extracted by contract, paying to the contractor so much per ton delivered to the vessel. Often these contracts, involving only a few thousand tons, are given to native contractors. A large part of the export guano, however, is extracted by a single commercial company, which works now upon the northern islands. From this guano the government derives no present revenue, but the amount extracted is reported to the government and credited against the amount of guano which has been mortgaged to the corporation for obligations of the government previously taken over by the corporation.

The guano for the Peruvian agriculturists is extracted by a similar contract system, with the following method of procedure: The farmer who desires guano applies to one of the many individual contractors. A typical contract may be instanced. The contractor agrees to sell and the farmer to buy 600 metric tons of guano at 14 soles (about $7) the ton, the guano to give an analysis of 9 per cent of nitrogen. The contract further provides that if the average analysis is higher or lower the farmer will pay an additional price of 1 sol per ton for each unit of nitrogen above 9, while 2 soles the ton will be deducted from the

price for each unit below 9. Another type of contract might cover a larger quantity of guano, say 5,000 tons, to be delivered during four years, certain stated amounts to be made available each year. The contractor, having calculated the amount of guano necessary to fulfill his contracts for a given year, applies to the Ministerio de Hacienda (corresponding to our Department of the Treasury) for a concession to take such and such amounts of guano from stated islands, and, if the concession be awarded, the contractor pays to the government 1 sol for each ton conceded. In case of failure to obtain the amount asked for, and on which payment has been made, the government adjusts the matter equitably by continuing the balance of the concession to the following season or refunding the proportionate part of the payment.

This introduces one of the weakest points in the present method of extraction. It frequently happens that two or three or more concessionists are authorized to take guano from the same island. Only one who has lived on the islands while the working was in progress can appreciate the bitterness of competition that ensues. The disputes, the threats, and the personal violence which may arise are aside from the question. It is the effect upon the birds that is of vital moment.

Since it is understood that a concessionist establishes finally his claim to any deposit of guano by throwing this into piles, and since the best of the guano is found at the rookeries, disaster to the birds is inevitable. The first party to arrive, or the strongest, as the case may be, obtains possession of the rookery, and within a few days the entire breeding ground is torn up and the birds completely routed, without regard to the presence of immature birds or unhatched eggs. Under a better system a responsible contractor would at least allow the birds to use a portion of the ground, while, with as much consideration of them as possible, the guano was being extracted from the remainder. I should not omit to add that I have seen some concessionists working in this intelligent way where there was due opportunity. (Fig. 8, pl. xv.)

The government has not failed to recognize the necessity for protection of the birds. The destruction of birds or of eggs has been made a penal offense, and it is now practically stopped. It is a difficult matter to keep a thorough surveillance of a long coast, where the towns are widely removed, and of many islands, some of which are miles from the mainland. Hence there is still some violation of these laws, and the potoyunco, as has been mentioned, suffers especially from such depredation. At times, too, the eggs of more important birds may be taken, but the wholesale robbery of nests has been practically eliminated. Formerly the eggs were valued for food and for use of the albumen in clarifying wines, and it is said that enormous quantities were taken regularly.

That which most concerns the present government is how to regulate the working of the islands so that the necessary amount of guano may be taken

with as little detriment as possible to the birds. Two years ago a "closed" season of five months was established, to include the months of November to March, which constitute the height of the breeding season, and the writer was instructed to make a study of the habits of the birds, with reference to determining whether such a period was proper or adequate, or whether other methods of regulation were required. As a result of the studies made on various visits to the chief rookeries, it became apparent that the closed season adopted was inadequate, although it was a most significant step in the right direction and has undoubtedly already yielded results of value.

The pelican rookeries on the 1st of April were covered with eggs containing live embryos, and with all stages of young birds, immature and incompletely feathered. Young pelicans only partially feathered were to be found as late as June. Cormorants were feeding their young from mouth to mouth in June, while already the preliminary love plays and preparation of nests for the following season were in progress. By the end of July a large number of eggs were laid for the following season and a few even had hatched.

It follows, therefore, incontrovertibly, that there can be no season when the islands may be worked without disturbance of the birds. I believe the rookeries of pelicans and cormorants are never deserted voluntarily except for so long a period in the day as may be necessary to secure food. The breeding season of the gannet, as has been mentioned, is continuous throughout the year.

It becomes very clear, then, that only a very carefully and consistently followed plan of rotation in the working of the islands would insure the birds the best conditions for undisturbed breeding. For a period of at least five years certain islands in each region might be left as the unmolested abode of the birds, while the extraction of guano was being prosecuted on other islands. At the expiration of that period, certain other islands would be closed while the accumulations of guano on the previously closed islands would be available for extraction. The system might be worked out in such a way that each year certain islands would be opened, and a steady supply of guano be available each year.[a]

In partial adoption of a plan of rotation, the government has kept the south island of the Chinchas entirely closed during the past two open seasons, and it is estimated that by the expiration of the third year of closure there will have accumulated on this one island about 20,000 tons of guano of the highest grade. It is only fair to state that the government has enforced the closed season and kept this island closed in the midst of very serious difficul-

[a] The plan which the writer drafted in 1907 for the Chincha and Ballestas Islands and other points of the region (Boletín del Ministerio de Fomento, Junio, 1907) may be cited as an illustration. After further observation of the birds on the rookeries, I would modify this plan by using five-year instead of three-year periods, as was then suggested.

ties. We have seen that it has proved impossible to grant to the farmers of the country the full amount of the guano which they desire. However warmly and sincerely the principle of regulation may be indorsed, there must be faced a strong and not unreasonable cry from the many farmers for more fertilizer. Only by the opening of the middle, and later of the north, island of the Chinchas, which it had been intended to keep closed, and by the opening of the Lobos de Afuera Island, was it possible to give to the farmers the two-thirds portion of the guano which they required.

A large and important industry with exacting relations to creditors and to national agriculture can not be thrown upon a new basis in a moment; but the interests of all concerned are linked with the welfare of the industry, and it is believed that those on all sides who have power or influence are giving serious attention to the matter. It is probable that the proper solution of the question will not long be delayed, and we may confidently anticipate a brighter and far more satisfactory future for the guano industry, at least so far as the people of Peru are concerned.

CONCLUSION.

As a concluding word, it may be stated that the investigation of the fishery and guano industries was taken up a little less than two years ago. The first step has been the collation of data regarding the industries, the methods in use, and especially the conditions and the opportunities for development. The studies of the present writer conclude at this point. It is intended by the government to continue these studies and to adopt practical measures that will facilitate the development of the industries. It is evident that important economic results may be gained which will benefit both the fishing population and the country at large.

It is hoped also that arrangements may be made to investigate the fresh waters of the interior with reference to determining whether it is possible and profitable to introduce new species of fish into some of the lakes and rivers.

It is to be added that the government appreciates the ultimate necessity for an accurate knowledge of the marine fauna and flora, and desires to promote a knowledge of the natural history of the country. With this in view, the writer was instructed to collect the chief economic forms and others associated with these. The collections thus made will probably not include many new forms, except of the fishes, but it is intended that they shall serve as a basis for systematic reports illustrating the economic forms and epitomizing the present systematic information regarding the more important economic groups. To this end the collections will be intrusted to specialists in the various groups. It is believed that the reports will be of value to science and that they will be of especial service to those who may in future have the opportuinty to enlarge our knowledge of the natural history of a comparatively neglected region.

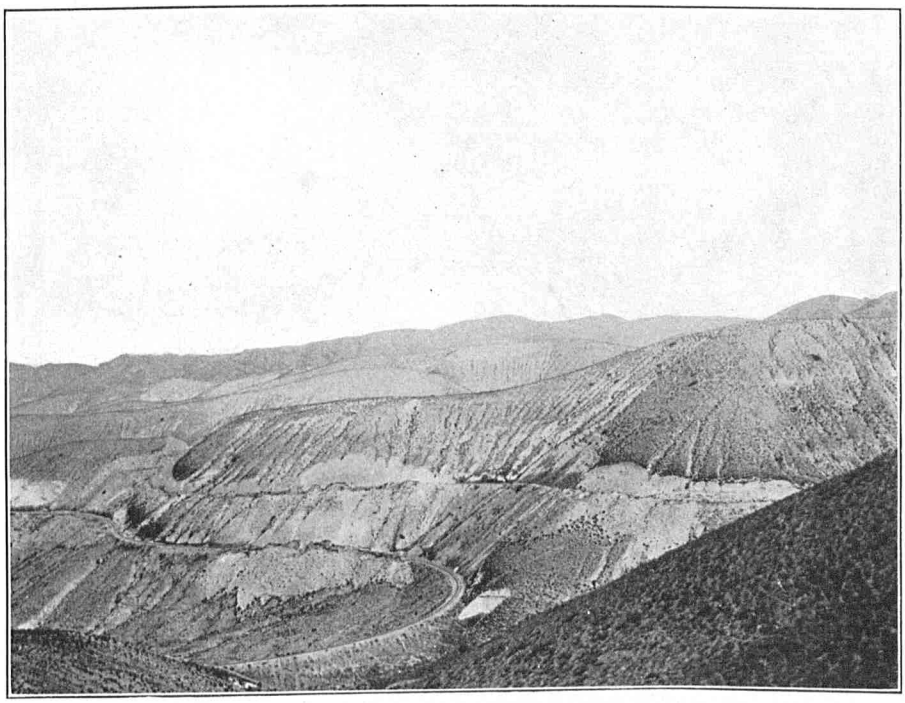

FIG. 1.—A characteristic scene on the coast desert, taken from the Southern Railroad between Arequipa and Juliaca.

FIG. 2.—Mouth of the River Rimac near Callao. On the left the ocean, on the right the lagoon formed by the river. The water of the lagoon escapes into the ocean by seeping through the natural dike of shingle.

FIG. 3.—Gathering oysters from the mangrove trees, Tumbes.

FIG. 4.—Native fisherman in the surf, throwing the ataraya (cast net).

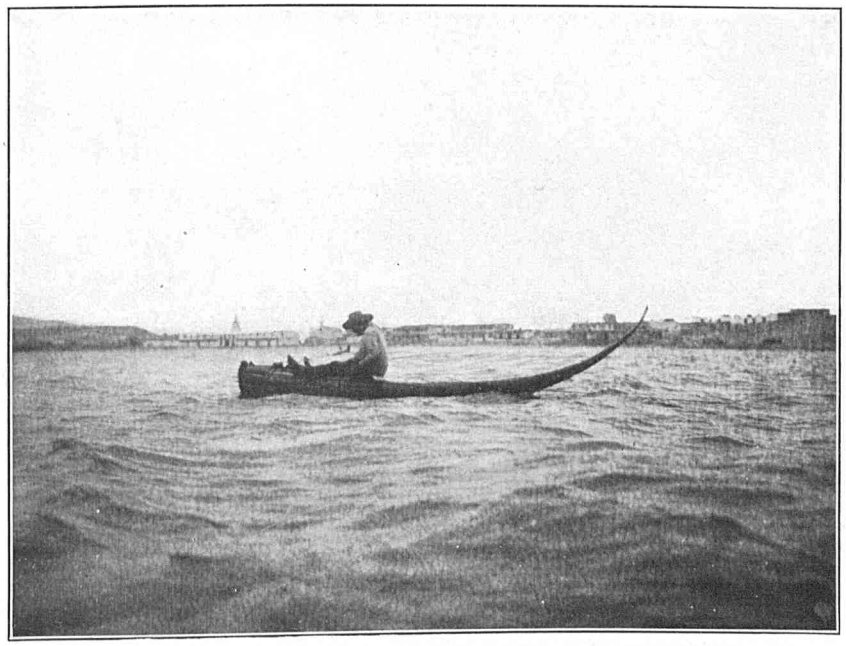

FIG. 5.—A Peruvian fishing with hook and line from a caballito, Pacasmayo.

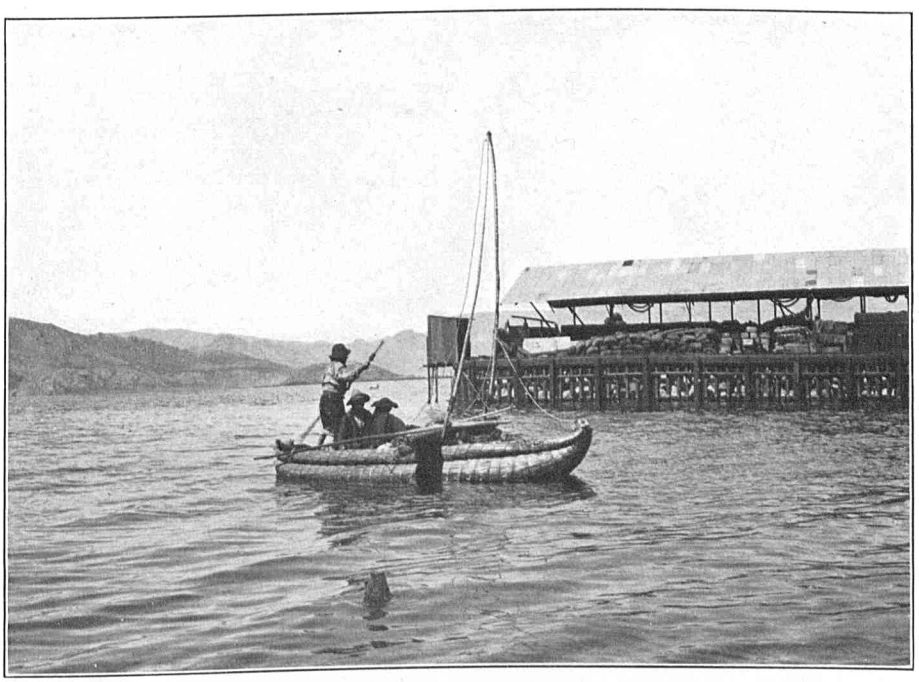

FIG. 6.—Balsa on Lake Titicaca. Made of reeds.

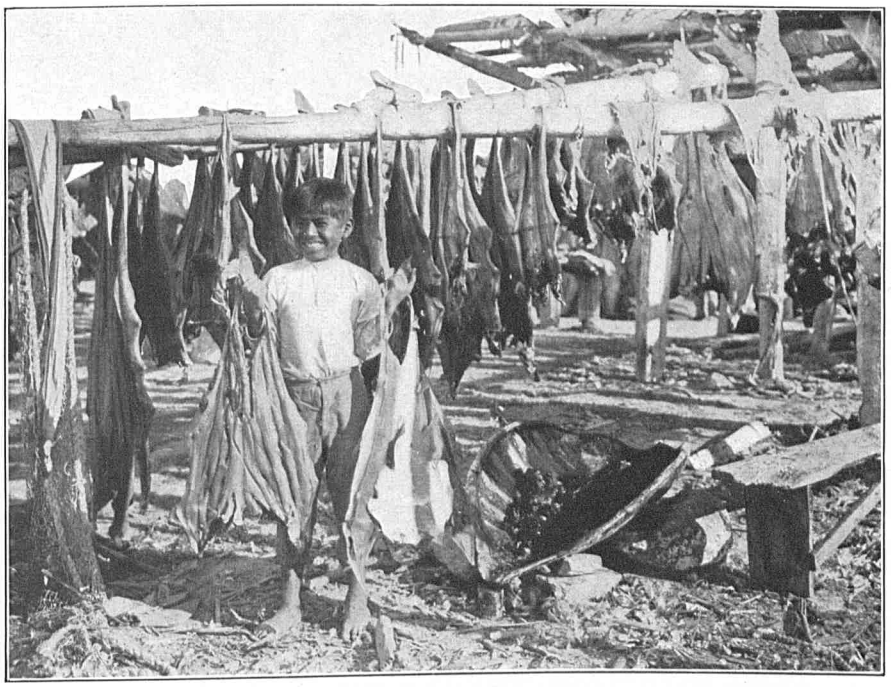

FIG. 7.—Drying sharks, guitar-fishes, etc., without the use of salt. Lobos de Tierra.

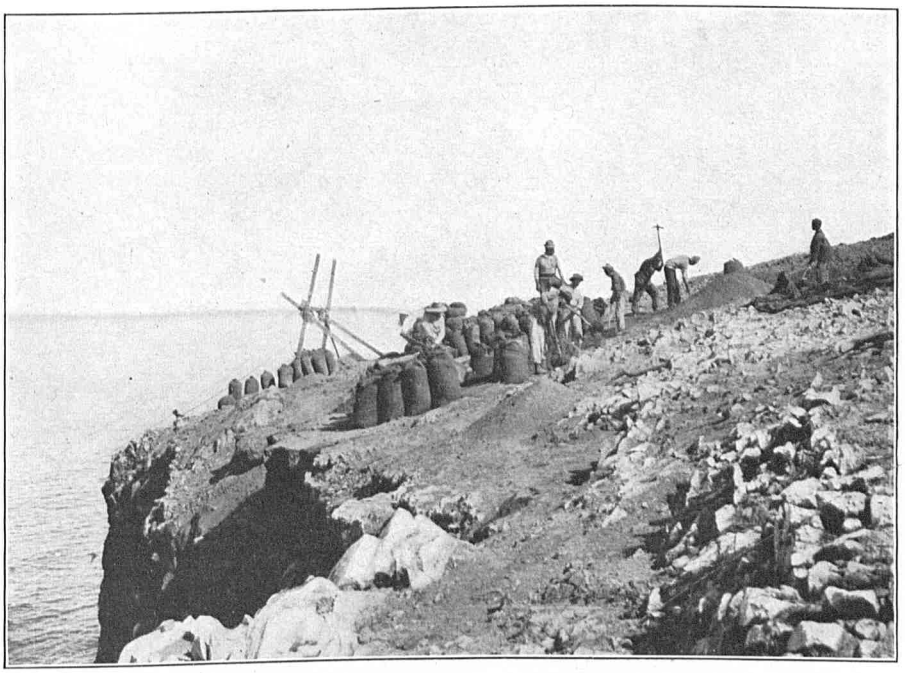

FIG. 8.—Sacking guano to be shipped by anda-rivel (automatic trolley), Ballestas Islands.

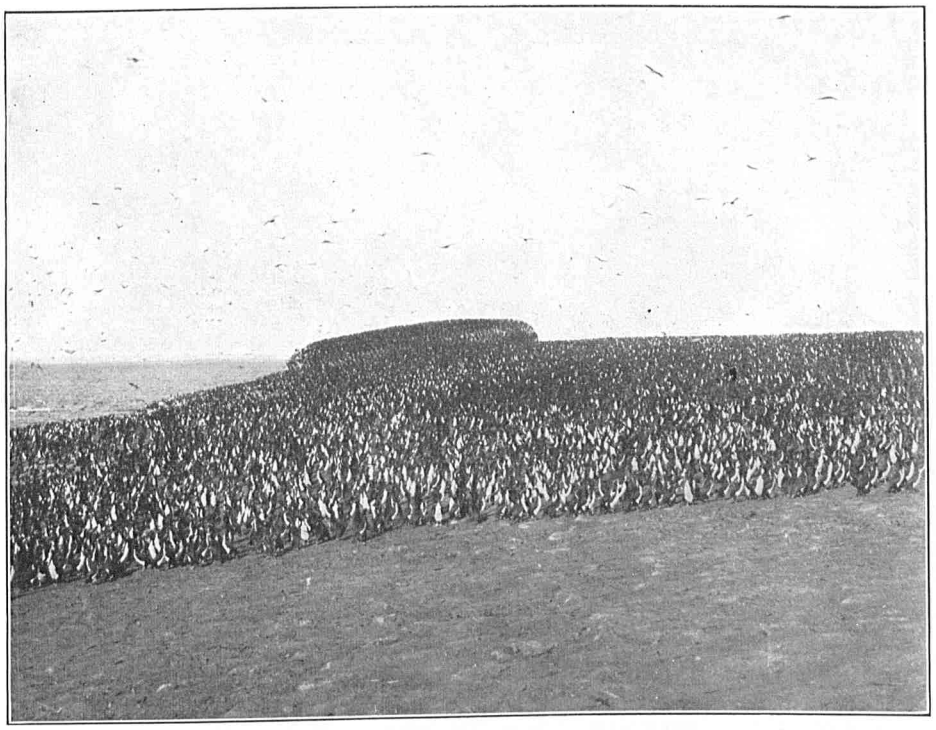

FIG. 9.—A very small portion of a flock of cormorants on the south island of the Chinchas.

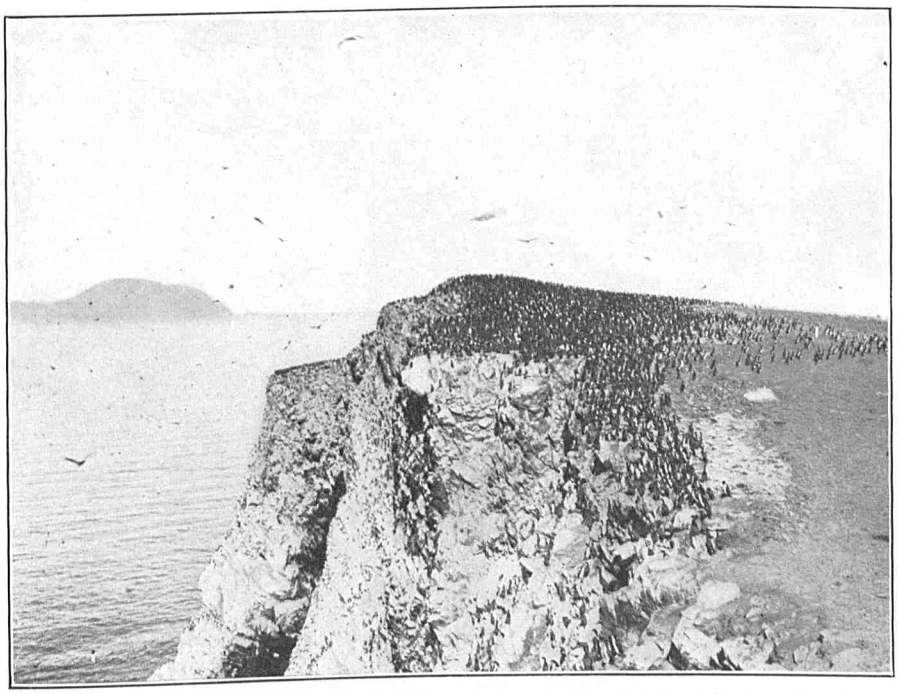

FIG. 10.—A small flock of cormorants on the top of the south island of the Ballestas. Gannets are barely distinguishable on the ledges.

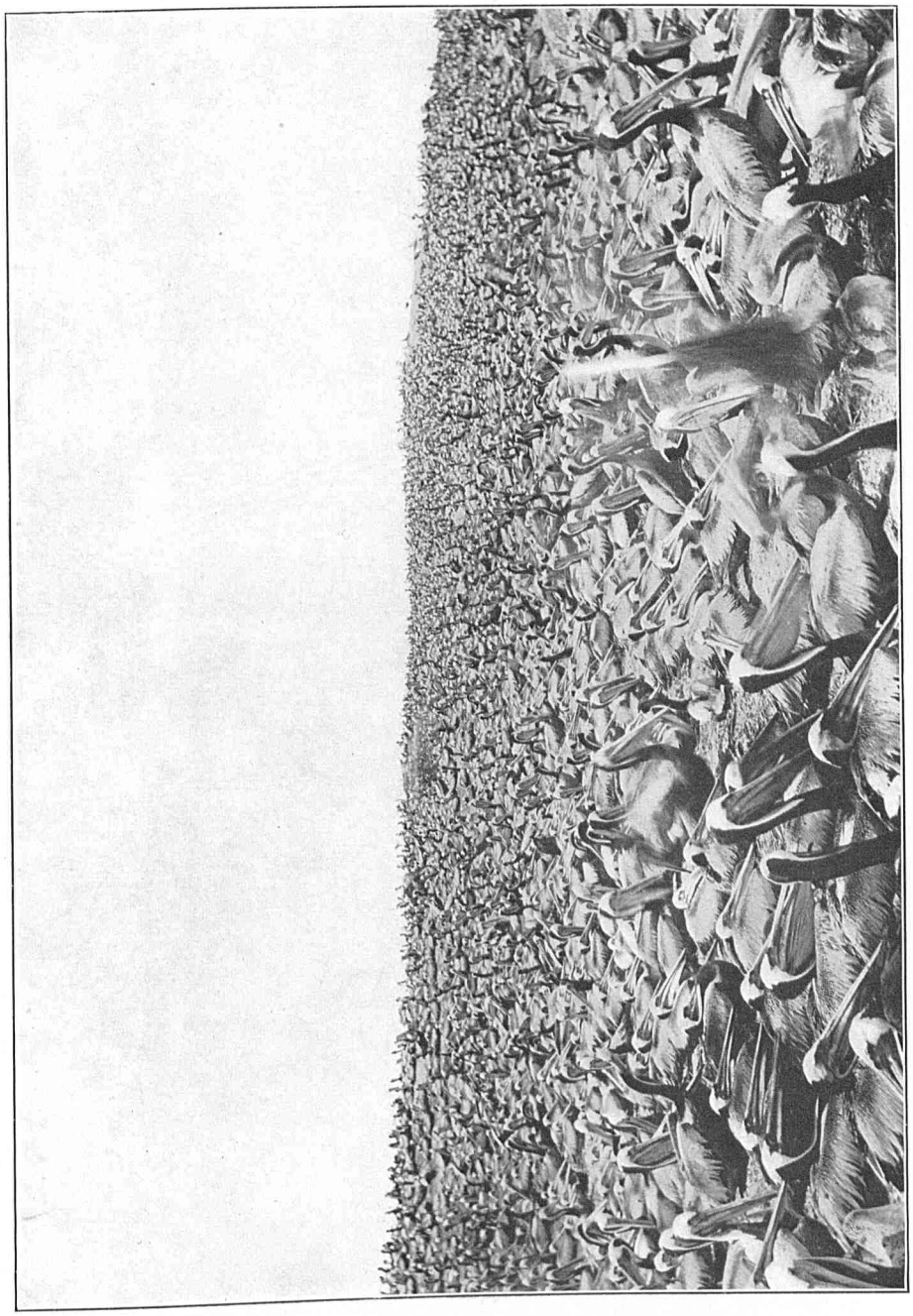

Fig. 11.—Pelicans on their nests, Lobos de Afuera.