1914.

NEW ZEALAND.

FISHERIES OF NEW ZEALAND

(PRELIMINARY REPORT ON THE) BY PROFESSOR PRINCE, COMMISSIONER OF FISHERIES FOR CANADA.

Laid on the Table of the House of Representatives by Leave.

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REPORT.

SIR, Wellington, 14th August, 1914.

I have now the honour to present my preliminary report upon the survey which I have made of the fisheries of the Dominion of New Zealand. This report embraces a series of recommendations bearing directly upon the objects set forth in your letter of the 22nd February, 1913, which letter resulted in my present visit to this Dominion with the sanction of the Government of the Dominion of Canada.

A full and detailed report will follow later; and the recommendations which I now make will be supported by extracts from letters and representations submitted to me by practical men, fishermen, fish-dealers, &c., and by anglers and sportsmen who have most willingly come forward at my various conferences and have given me a mass of evidence of the most valuable and interesting character.

My work began with the sea cruise round the Dominion in the Government steamer "Hinemoa," and it was followed by a land tour, in the course of which I visited the principal lakes, rivers, lagoons, and waters of New Zealand generally, occupying nearly four months in these investigations. My later report will include an ample exposition of the grounds upon which my recommendations are based. Not only have I received every help from the leading men engaged in the fishing industry and from the principal fishermen in each locality, but I have been greatly assisted by the kindly comments and suggestions which have been made in the more important newspapers of the Dominion, regardless of political colour. One important journal said, "The investigations which Professor Prince, of Canada, is at present making into the whole subject of our fisheries will have a rare value for New-Zealanders if they furnish further knowledge of this asset and cause the fishing industry to be conducted on a broader and more scientific basis than it has been hitherto." Another prominent journal stated, "We look forward with interest to the recommendations of Professor Prince upon sea-fishing"; and added that if the result was a better supply of fish "every city, town, and hamlet in New Zealand, when supplied with fresh and wholesome fish at prices which now appear ridiculously small, the community will realize that the seas, instead of being waste and barren, are seas which yield vast and ceaseless harvests to the toil of man." The most prominent newspaper in Southland, in a leading article, spoke as follows: "Professor Prince has had a wide experience of the habits of food-fishes and organization of the fishing industry in a latitude that corresponds more or less closely to our own, and his advice should be of the greatest possible service to the Marine Department as well as to the acclimatization societies which have done so much to advertise and popularize New Zealand by stocking our streams with trout and other fresh-water fish." And the same journal added that my views should have the beneficial effect of helping the general public to realize the enormous present and prospective value of the natural resources contained not only in our lakes and rivers, but in the seas that surround us. Further reference was made in another daily paper as follows: "If Professor Prince can put his finger upon the cause of the high prices which obtain, and outline a scheme which will give the public cheaper fish, he will lay New Zealand under a heavy debt." And a similar opinion was expressed by another newspaper, which said, "It is to be hoped that Professor Prince will be in a position to indicate the lines upon which measures to develop the industry and to secure a cheap and abundant supply of fish should succeed." Finally, an evening journal of prominence concluded a notice of my work by saying, "If his visit has no other result than to impress us with the necessity of taking steps which might have been taken years ago without outside advice it will be well worth its cost to the Dominion."

My work conveniently divided itself into three parts: Firstly, investigation of the sea-fishing grounds, including tests with the otter-trawl dredge, baited lines, &c.; secondly, visits to the principal lakes and rivers, and inspection of hatcheries and rearing-ponds; thirdly, conferences in all the principal fishing-ports with fishermen, fish-merchants, anglers, Government officers, and parties interested in fish and fisheries generally, and the inspection of fish-markets in inland towns, fish cold-storage establishments, fish-shops, and the like. I may add that I also visited the Marine Laboratory and Fish-hatchery at Portobello, near Port Chalmers, and saw the museums at Wellington, Christchurch, Auckland, Dunedin, and other centres where collections of fish are exhibited. The plan I followed was indeed precisely the same as that which I adopted when I first assumed the position of Dominion Commissioner of Fisheries in Canada over twenty years ago, and I was thus able to obtain a wider and more thorough knowledge of the great fishery resources of British North America than had ever been possible before, and probably not paralleled by that of any other official in the Canadian or any other fisheries service.

Upon my arrival on the 7th April, when I had the honour of being greeted by yourself, accompanied by Mr. Allport, Secretary, Marine Department, Mr. Ayson, Chief Inspector of Fisheries, Mr. Hislop, Under-Secretary, Department of Internal Affairs, and Mr. C. Ayson, Manager of the Government Salmon-hatcheries, I immediately commenced my coastal cruise, testing the sea-fishing areas of the shores of the North and South Islands, including Stewart Island.

It is not possible in this place to make proper allusion to the officials and gentlemen generally who have given me most valuable assistance in my work, and I shall make full reference in my later report; but I cannot forbear mentioning my indebtedness to Mr. George Allport, Secretary to the Department, and to Mr. L. F. Ayson, Chief Inspector, who had been detailed by yourself to accompany me throughout my tour, and of whose mass of practical knowledge and mastery of fishery methods and fish-culture I had every advantage, as Mr. Ayson was most anxious and willing to unsparingly assist me at every stage in my investigations. I have also to thank Captain Bollons, the experienced and

accomplished commander of the Government steamer "Hinemoa," of whose rare knowledge and enthusiasm in everything pertaining to fisheries it is unnecessary to speak. The services of Mr. Ayson and of Captain Bollons enabled me to more thoroughly carry out my work with a greater saving of valuable time than would have been otherwise possible. I may add that Mr. G. M. Thomson, M.P., accompanied me in the "Hinemoa" during part of the cruise; and Mr. T. Anderton, of the Marine Hatchery, efficiently attended to the routine and technical duties in preserving the specimens of fish. Also, I had the advantage of the presence of Professor Kirk during part of my tour; while Professors Benham, Chilton, and others in the colleges of the University of New Zealand afforded me kind advice in the course of my work. The acclimatization societies and their officers in various parts of the Dominion took a large amount of trouble to enable me to see over their districts and to gather information of an important nature.

In the course of my work the view was frequently expressed that my recommendations would have a minimum value because my experience was mainly in Canada and the fisheries in New Zealand had little in common with the Canadian fisheries; and it was pointed out to me—(1) The areas available for fishing, marine and fresh water, are so limited in New Zealand as compared with the vast expanse of sea, lakes, and rivers in British North America; (2) the population is comparatively small, and the demand for fish proportionately insignificant, affording limited scope for the fishing industry; (3) the kinds of fish are different, and do not include the principal food fishes of northern waters, such food fishes being the kinds most in request in the great markets of the world. The New Zealand food fishes, it is alleged, must be at a discount. I was even told that it was not possible for me to proceed on the assumption of any similarity in conditions or of commercial possibilities in the two countries, and that my recommendations, if made on that basis, must be misleading and to a serious extent erroneous. One authority declared that I could not, as a visitor, grasp the conditions existing in this country, and that I had at an early stage of my tour given evidence that I did not understand the conditions surrounding New Zealand fishery questions.

It is contrary to my practice to enter into argument with such objections in an official report, especially criticisms of my conclusions and recommendations publicly disseminated before such conclusions have been definitely reached by me and before any of my recommendations have been framed. But I will in this place refer to two criticisms—namely, the alleged limited domestic demand in New Zealand, and its isolated position geographically, which it is thought would prevent it from expanding to any large extent its fishing industry. My reply admits, I think, of no denial. A million people should, I claim, use annually one-eighth of the quantity of fish used by eight millions. New Zealand, according to information which has been furnished me, requires for domestic use at present between five and six million pounds of fish per annum, which is at the rate of over five pounds of fish per annum for every man, woman, and child; whereas Canada uses over 150 million pounds of fish—about twenty-five pounds per head. It will be seen, therefore, that the domestic demand for fish in New Zealand is certainly not one-fifth of that which it ought to be under normal conditions. The reason for this abnormally low demand will be dealt with in the body of my report. Nor is there any more force in the argument that geographical distances are too great for easy transportation of fish. In Canada, cities like Montreal, Toronto, and Winnipeg are situated 800, 1,000, and 2,100 miles respectively from the Atlantic coast, and yet they receive regular supplies of fish from the sea. Vancouver City, 3,600 miles from Nova Scotia, is supplied with smoked fillets of cod from the Bay of Fundy fishing-ports; and it is plain that no centre of population in New Zealand, and not even the Australian cities, are situated at distances comparable in any way with the vast distances just mentioned. Further, the cost per pound for transportation for long distances in Canada exceeds the small duty (1d. per pound) imposed on Dominion fish entering the Australian market, so that such small duty need be no barrier to the importation of New Zealand fish into New South Wales and other States.

Fishing-areas Available.

I estimate that New Zealand possesses about 20,000 square miles of inshore waters 10 to 30 fathoms deep; about 25,000 square miles 40 to 50 fathoms deep; and outside these areas a deeper water area extending ten to twenty miles from shore which descends to 300 and 400 fathoms. At a very moderate estimate the Dominion possesses 50,000 square miles of fishing-grounds available and accessible. It is interesting to compare this estimated area with the available sea-fishing areas on the east and west seaboard of Canada. Thus on the Atlantic coast of Canada it is estimated that 200,000 square miles, and on the Pacific coast 40,000 square miles, and on the great lakes 35,000 square miles are accessible to the Canadian fishermen, and yield a total annual catch which exceeds £7,000,000 in value. It is, of course, impossible to infer that because New Zealand has inshore waters somewhat greater probably than one-fifth those of Canada her fisheries should yield £1,000,000 to £1,500,000 value of fish. The argument would be legitimate as regards population and the possibilities of commercial development, but the fact cannot be ignored that the Atlantic herring, the smelt, the capelin, and other important species, which are the main food of the most valuable commercial fish, including the cod, haddock, Atlantic hake, &c., are absent from the South Pacific—or, rather, they are represented by fish less valuable and less abundant from the present point of view.

I have not been able to secure any very accurate data for an estimate of the total area of the inland waters—the larger and smaller lakes—but in all they must embrace a total fresh-water area of nearly 15,000 square miles, probably a little over 12,000 square miles in the South Island and about 2,500 square miles in the North Island. These estimates are, of course, far less vast than the estimates of the areas of the Canadian portions of the great lakes of North America: for in Canada are Lake Ontario, over 6,700 square miles; Lake Erie, 10,000 square miles; Lake Huron, 20,000 square miles; and Lake Superior, 31,000 square miles. About one-half of the total area of these lakes is within the Canadian

boundary, and the other half within the United States boundary. With such estimates and comparisons before us there is every ground for being optimistic in regard to the future of New Zealand fisheries. Their extent and possibilities have not been adequately realized.

Fisheries are a National Asset.

A mistaken view which is not uncommon in New Zealand, as in other countries, regarding fish resources lies in the assumption that the marine and fresh-water fisheries in local waters are the peculiar possession of the community living in that area. Fishermen and fish-merchants too often take this limited view, and resident anglers and sportsmen are prone to share in the same parochial feeling. I am familiar in Canada with this same mistaken view, though, thanks to the spread of Government reports and of enlightening information, the view is now largely a thing of the past. At one time, for instance, Nova Scotia fishermen regarded the lobsters in their own localities as their special property, and raised objection to taking protective measures, such as close seasons, &c., declaring that they wanted no such restrictions, and that if the lobsters were depleted it was "their own lookout." The fishermen were wont to reply to the argument—that unless protective laws were devised the lobsters would become depleted—by saying, "The lobsters are our fish, and if we destroy them it is no one's concern but ours." It was pointed out that Montreal, Ottawa, and even a distant city like Winnipeg, situated many thousand miles from the lobster-grounds, had a right to claim an interest in the lobster resources, and to insist that, being a national food-supply, the Federal Government was in duty bound to maintain the lobster resources of the country. The fishing population now have generally adopted the view that all Canada has a right to dictate how her fisheries—or, indeed, any other national resource of land or water—shall be treated. Dominion control is the only effective control, both for the whole country and for the local residents directly concerned. It has not been unusual for sportsmen in certain localities to argue that the rivers and their finny inhabitants were a local possession, in which New Zealand as a whole had no direct concern. Such parochialism involves a great danger; but it is not a danger confined to fisheries. I observed at a recent Farmers' Union conference in Wellington that representatives of the whole Dominion protested against this tendency to consider only narrow local interests, and one prominent speaker protested against making the conference develop into "a glorified provincial conference instead of a Dominion conference," and it was insisted that important questions should not be approached from a narrow provincial standpoint. I observed a similar protest voiced in parliamentary debate recently when the subject of education was under discussion, and it was emphatically declared in the House of Representatives that local interests should be subordinated in such an important matter, and parochial views should be deprecated.

High Cost of Living and Cheap Fish.

Fish in New Zealand is, in my opinion, high-priced. It should be cheaper, and thus encourage a vastly increased demand. Everywhere I find that my opinion is supported by intelligent citizens, with the exception of a few persons who still cling to the antiquated view that small supplies and high prices for fish products yield greater profits to those engaged in the fisheries. My opinion is that fish can be cheapened, to the benefit of all in the industry and to the great benefit of the public at large. Fish forms a good nutritious food and a popular food, and it should be a cheap food, because the finny tribes in the sea propagate and feed themselves, and are ready to be secured for the market without any trouble, care, or expense on the part of man—wholly unlike sheep and cattle, which demand infinite care and expense before they are ready for market. Yet it is a remarkable fact that this fish-food product provided free of cost by bountiful nature is as expensive as, usually more expensive than, beef and mutton. One correspondent wrote to me recently that the price of sea-fish at the present time is exorbitant. If the fishermen have a good haul, great quantities are consigned back to the briny ocean in order to keep up the price of this fish in the local markets.

Many reasons are urged for the prevailing high price of fish. Some blame the method of sale. As one fisherman in a printed letter stated, "Our catching-price for hapuka or groper is 1s. 5d. per fish irrespective of weight, and as the average run of this fish is 20 lb. or 30 lb., we do not get 2d. per pound from the dealers. If this fish were paid by weight and we got 1d. per pound for them we would be better satisfied." A prominent fish-dealer admits the rise in price. He says it is due to the fact that fishermen neglect the catching of blue cod, butterfish, &c., because hapuka and groper are plentiful and pay them better than any other fish. The neglected fish are consequently higher in price. It is claimed that Cook Strait fishermen will not catch blue cod and earn only £8 to £10 when they can with less trouble go out ten or twelve miles from Wellington Harbour and catch a hundred and fifty hapuka and earn over £20. Whatever the real reason may be, the price of fish to the public could, without loss to fishermen or dealers, be made far more reasonable; and I do not hesitate to say that one great reason for the high price is the fact that the catches are not always utilized or marketed, and there is consequently a great waste of fish.

Characteristic Features of the Fishes of New Zealand.

A survey of the fisheries of New Zealand and of the various important species inhabiting the Dominion waters emphasizes the contrast between the southern fish and fisheries and those of the north, especially the great fisheries of the North Atlantic. The various kinds of fish most abundant in New Zealand waters recall the species familiar in the markets of southern Europe. The great abundance of the spiny-finned fishes corresponds with the food fishes found off the Spanish and north African coast and along the shores of the Mediterranean. There is little resemblance between these fishes and those of the northern waters, such as the Canadian, British, or Norwegian fisheries. The most

important species in the great waters of the Northern Hemisphere are gadoids, such as cod, haddock, pollack, whiting, mackerel, halibut, turbot, &c.; whereas the principal species in New Zealand seas are spiny-finned fish like sea-perches, aparoids, bream, groper, mullet, gurnard, and the shark family. Most of these New Zealand species resemble very much the kinds which are seen in the markets of Lisbon, Genoa, Marseilles, and Naples. Most of them are exceedingly good food-fish, and, though not the staple kinds in the British and European markets generally, they could readily find large sale in some of the markets to which I refer in this report.

Large Importations of European and American Fish.

One startling fact presented by the fisheries of New Zealand is the comparatively large amount of fish products imported annually from Britain and other countries. For instance, in 1912 the value of dried, salted, and canned fish imported into New Zealand amounted to no less than £108,185. With the superabundance of fish in the waters along the coast-line and in the rivers and lakes there should be no necessity for importing any such quantity of fish products as stated. The harvest of the sea has been recognized as a source of food-supply for the people and a remunerative field for the employment of labour and capital; and, as the Chief Inspector of Fisheries in one of his reports points out, "to allow this great wealth to lie comparatively ungarnered at our doors seems to indicate a lack of enterprise and energy, and certainly a lack of appreciation of the great resources of the sea which are readily available." I have myself seen quantities of smoked cod, kippered herrings, boneless cod, cod fillets, and a great variety of canned herring, salmon, &c., in all the best shops in every New Zealand town. This implies a large sale of imported fish, whereas if the fishery resources of New Zealand were properly utilized, instead of importing fish, the Dominion could provide an abundant supply for domestic use and have an extensive export fish trade as well. Canada has developed a very large export trade to the West Indies, the Mediterranean, France, and other countries, and it has a large fish business even with Fiji and the Pacific islands within easy distance of New Zealand.

Suggested Territorial Limits.

Before I proceed to deal in detail with the suggestions which I have to make upon the fishery questions of the Dominion in their various aspects, I regard it as highly important that New Zealand should define the territorial limits which it regards as essential for the proper preservation of her fishery resources. New Zealand, in my opinion, occupies a very unique position. She has no foreign neighbours near at hand, and little risk of encroachment by alien fishermen; and she is not bound down, as many countries are, by treaties, conventions, and various formal agreements under which a definite limit of three miles, or some other distance, has been established and is generally recognized. Britain and most older countries have defined a three-mile limit, which it is now universally recognized is insufficient; and a common desire has been growing for a more extended territorial area on the seaboard. An impression prevails that by international law no country can claim more than three miles as its territorial boundary waters; but this is wrong.* Norway, by a new law passed five or six years ago, prohibits trawling within four miles from the coast, and this limit is now universally recognized and honoured by maritime nations. This extended territorial limit, to quote from the British Board of Trade warning, was established by "a new law rendering offenders liable to a penalty of 1,000 to 5,000 kroner, and confiscation of the vessel, catch, gear, tow-ropes, &c."† The United States for special purposes secured a sixty-mile zone round the Pribilof Islands; and by an international award Canada obtained in the Juan de Fuca Straits a territorial limit of from thirty to sixty miles—that is, from the mainland to the middle of the straits, the remaining half of the straits being United States territorial waters. A similar mid-boundary-line passes through the great lakes, giving Canada and the United States each much more extended territorial waters than three miles.

Most countries are bound by historic conventions, which they are not willing to ignore. New Zealand is in a different position, and might wisely proclaim a limit of eight or ten miles. She is bound by no conventions or treaties which define narrow territorial waters; and the sooner such a limit as suggested is established the better. Other countries will without doubt welcome such a step, for it is well known that Britain, France, the United States of America, and other Powers are awakening to the total inadequacy of the three-mile limit to which they have bound themselves. The matter of this limit has been canvassed at various international congresses and conferences, and fishery

* A three-mile limit is supposed to be recognized under international law; but as John Austin, an eminent authority on jurisprudence, says, "International laws are improperly termed 'laws,' being set and enforced merely by the opinion of an indeterminate body of men—*i.e.*, laws of honour, &c. Rules of this species constitute much of what is called international law." Austin further says, "The rules governing the conduct of independent political societies (say, nations) towards one another are laws set by public opinion, and, though receiving the name of 'international law,' would more properly be designated 'positive international morality.'" I am aware that Professor Sheldon Amos opposes Austin's opinion, though he admits that international law, owing to its ambiguity and indefiniteness, and "the scarcity and thinness of its materials," and owing to the absence of legislative authority by international Courts of justice, contrasts with a fully developed system of international law. Sir Henry Maine points out that law implies a lawgiver and a tribunal capable of enforcing it; but there is no lawgiver and no tribunal with power to bind sovereign States by decree or coerce them if they transgress. It is remarkable that the greatest maritime nation of the world, England, though for over a hundred years regarding a three-mile limit as established round the British Isles, realized that it was neither defined nor legally established even so late as 1878, for the British Parliament passed an Act to remove the existing uncertainty. By this Act the jurisdiction of English Courts was declared to extend, according to international rule, to three miles from the coast-line of England.

† *Vide* official notice from Marine Department, Board of Trade, London, November, 1908, signed "Walter J. Howell, Assistant Secretary," headed "Notice to Owners and Skippers of Trawlers.—Territorial Waters: The Board of Trade desires to call attention to the fact that the territorial waters of Norway are four English miles—not three miles."

authorities generally are fairly unanimous in their view that a five-, eight-, or ten-mile limit must ere long be adopted. New Zealand can lead the way by promulgating a regulation declaring larger territorial limits to be established round her shores.

Transportation Difficulty.

That the transportation difficulty in regard to fish should be easily solved is plain from the fact that beef or mutton, raised with great labour and at much expense, are actually transported by land and sea round two-thirds of the world's circumference, and sold in the most distant markets at a little greater price per pound than fish is sold in New Zealand towns fifty, twenty, or even two miles from the sea.

The Past and Future of the Acclimatization Societies.

There are, I understand, over thirty acclimatization societies in New Zealand, including one or two new societies recently organized; and the work accomplished by these societies has been of a most remarkable and fruitful character. For nearly fifty years members of these societies have zealously and enthusiastically carried on the acclimatization of sporting fish and of game. The success of the introduction into New Zealand of some of the best fresh-water fishes is widely recognized. Fishery authorities in all parts of the world have viewed with admiration the great work accomplished in the past. No really excellent species of game fish were found in the lakes and rivers of the Dominion, if we except the grayling. It is unnecessary to refer to the magnificent English or brown trout, rainbow trout, Loch Leven trout, and other varieties which have so flourished since their introduction into New Zealand as to far exceed in size and other qualities the original fish native to British and North American waters. In the early days a handful of enthusiasts, and, later, formal organizations, equally stimulated by zeal for fish and fishing, procured supplies of eggs and of young fish at considerable expense, and with infinite trouble initiated fish-culture in New Zealand. Such lakes as Wakatipu, Wanaka, Te Anau, Manapouri, Rotorua, and Taupo would not have contained the fine fish in which they have abounded but for these early efforts on the part of the acclimatization societies. The first trout introduced were brown trout, hatched in October, 1868, by the Otago Acclimatization Society; and since then more or less extensive importations of the various species mentioned have been made. (For details see Mr. L. F. Ayson's address to the Fourth International Fishery Congress, Washington, U.S.A., 1908.)

A review of the present work of the acclimatization societies, apart from the operations carried on in regard to game animals, demonstrates that the time has come for an important change. I shall treat in detail the work of these societies and of the reasons for my recommendations in my later report, and it must suffice to simply point out now—

(1.) These societies are voluntary associations not responsible to the Government, and are of the nature of fishing or recreation clubs from a strict point of view.

(2.) The scope and character of their work fluctuate and depend upon local funds and other conditions unrelated to the needs or the possibilities of each district.

(3.) Licenses are issued by these societies, which collect revenue of a public official nature with the cognizance of the Government.

(4.) They appoint fishery officers whose work corresponds to that of Government patrol officers in other countries.

(5.) They build and operate hatcheries more or less complete, but often very limited in their scope, and characterized by an erratic and desultory mode of carrying on fish-culture. Such operations in other countries are carried on extensively and most effectively under a Government Bureau or Department.

(6.) The work of each society is dictated by local members whose essential qualification is a contribution to the funds of such society or the payment of a fishing or shooting license fee (£1 1s. per annum). (The membership fees vary from 5s. to 10s. or more per annum.)

It is plain that these societies, so far as concerns fisheries, are in an anomalous position and have to a large extent outlived their original purpose and utility; and a proportion of the members, it must be granted, are not so enthusiastic and self-sacrificing as the fathers of acclimatization in New Zealand, of whom indeed very few now remain. All honour and credit must be freely given to the pioneer members of the acclimatization societies for the work, in some respects unexampled, which they have accomplished. These societies at present include a considerable number of active enthusiasts whose views and experience are of great value; and if any change is decided upon with respect to the status of these societies and the issuing of licenses and collecting of public revenue, it is desirable that nothing should be done to alienate the interest of these enthusiasts or deprive the country of the experience they have gained.

In my opinion it would be desirable to create an Advisory Board composed of representatives proportionate to the membership of the societies. These representatives should attend an annual conference in Wellington for the purpose of conferring with the chief fishery officers and laying before the Department at such conference suggestions and proposals which might be considered by the Department. An Advisory Board would not affect the responsibility of a Fishery Department such as I strongly recommend should be created for the administration and preservation of the fisheries, corresponding to the Government Fishery Departments of the leading countries of Europe and the American Continent. The Advisory Board would indeed correspond to the meeting of "representative authorities" in England, which includes twenty-one local Fishery Committees and Boards of Conservators as provided by the British Sea-fisheries Regulation of 1888. This representative body has no executive functions, but has done valuable work in discussing important fishery problems as they arose and conferring with the eight or nine Chief Fishery Inspectors, including the permanent head

of the Board of Agriculture and Fisheries in London. In this way the excellent work of the acclimatization societies would be fully recognized, and the Government would have the advantage of their knowledge and experience. But to continue the existing functions or confer new administrative powers upon such societies would impede that reform of the fisheries administration in New Zealand which is desired by all parties commercially interested, and by a majority, I am convinced, of the societies themselves, and certainly by the public generally. The responsibility should rest upon the chief of the Fisheries Department, acting directly under a responsible Minister of the Crown (Minister of Marine). But local knowledge and opinion would find voice; and the discussions arising at such conferences as I have suggested would enable expressions of opinion from the most remote parts of the Dominion to be made which would be of immense value to the officials. Centralization is, after all, a most effective method of economic public administration. A multiplication of local bodies serves no purpose which is not far better served by a Dominion Department. Money is wasted; energies are frittered away; there is no cohesion of uniformity in action; and the fish and fisheries suffer from a continuance of the present method of managing fisheries by means of local societies. It is stating a fact recognized by fishery authorities generally that the rival Fish Commissions in the various States in the United States and the activities of the local Fishery Councillors in Norway have really been a source of weakness and waste rather than advantage as compared with the unity of purpose, economy, and concentrated efficiency yielding the great results which have come from the work of such a Central Fisheries Bureau as that in Washington, U.S.A., or the Fisheries Department in Ottawa, Canada.

Systematic Survey of Fishing-grounds.

In the course of my cruise round the New Zealand shores I had abundant evidence that there are untried areas open for exploitation, many of which may be expected to yield abundant supplies of fine species of food fish. I cannot too strongly recommend that such survey-work as has already been carried on by the Department of Marine should be continued and extended. Indeed, the whole coast should be explored and surveyed section by section, so that every productive fishing-ground may be made known. In most countries, owing to the extensive fishing operations having continued for long periods of years, the available fishing-areas are well known and the fishing fleets proceed without loss of time to the most productive grounds. In New Zealand there are many unknown territories in the inshore and offshore waters; and several trials made during my cruise on the "Hinemoa," on grounds practically unfished, gave evidence of valuable resources that are little known and have not been exploited. If a special vessel for such prospecting fishery-work were provided, it would take several years to accomplish the whole survey, but the results would be of untold benefit to the country, and would reveal the hidden fish resources, which I do not hesitate to say are far more extensive and valuable than is realized even by those engaged at present in the fisheries. The work would be of immense practical value, and might afford also the opportunity for some valuable scientific exploration. Results, both practical and theoretical, of the highest importance would certainly be secured. I had the duty of being a member of the staff on the first Fisheries Survey around the coast of Ireland over twenty years ago; and the results of the work carried on by the steamship "Fingal" under the Irish Government auspices have been evidenced in the great development of the Irish fisheries since that time. A systematic survey in New Zealand would, I am confident, be even more valuable and productive.

Dominion Patrol System.

With the existence of a Dominion Fisheries Department there would be a uniform and universal patrol system for the supervision of the fish and fisheries in New Zealand, and all districts alike would receive adequate benefit therefrom. At present, waters in the district of a wealthy acclimatization society receive more effective supervision and benefit than a larger district under an acclimatization society whose funds are meagre. There are at present probably under twenty fishery wardens who are in any way compensated by acclimatization societies for the serious work of discouraging poaching, and aiding in the improvement of the fish-supply. This implies that, were the existing staff stationed fairly evenly over New Zealand, each would have about 10,000 square miles of territory under his supervision. The present system is therefore an inefficient and absurd one. In Canada the whole country is divided up into inspectors' districts, each province having usually three or four Chief Inspectors with defined areas over which they keep a general supervision. They have under them a staff of sub-inspectors called Fishery Overseers, who have a limited number of rivers, adjacent sea-coast, and portions of lakes to look after. Both these classes of officers receive fairly substantial salaries. Each Chief Inspector devotes all his time to his official duties, and is provided with a central office and usually with one or more assistants, stenographers, &c. He receives a salary of from £200 to £600 per annum and travelling-expenses, or a *per diem* rate in some cases. Both the Chief Inspectors and the Fishery Overseers are appointed by Order in Council and cannot be removed except by the same authority, such Order in Council constituting them Magistrates or Justices of the Peace for the purposes of the Fishery Act. This system acts most effectively and enables offences to be dealt with promptly and efficiently; while it acts as a most potent deterrent to violations of the law. Under the Overseers, a large staff of temporary fishery guardians at 5s. to 10s. per day are employed during special fishing seasons, and especially during the spawning seasons of fish. All these officers (including the guardians when temporarily employed) submit monthly diaries to the nearest officer of higher rank. Printed forms are supplied to all these officers, in which are filled the details of the daily patrol performed by each, with space for making any remarks or recommendations. The third class of officers (guardians) report violations of the fishery regulations, giving details of the offence (name, &c.), and they have power to seize any gear illegally used. Such confiscated gear must be transferred to the Fishery Overseer or Inspector, who

has the authority of a J.P. All these officers assist in the collection of statistics in the localities in which they act, with the result that the fisheries statistics in Canada are probably more complete, and approximately more accurate, than those of any other country. Professor Brown Goode, an eminent United States fishing authority, publicly declared his opinion that the Canadian system is the simplest and best in operation in any country; and the statistics accumulated, which are due to this universal system of supervision and patrol, are recognized as approaching accuracy as near as fishery statistics can be. It must be recognized that there are large catches of fish made by wandering tribes of Indians and by remote Eskimo communities which it is difficult to record; but the Royal North-west Mounted Police have aided most actively in getting statistics, and indeed in carrying out fishery supervision in the most distant waters of the Canadian Arctic regions. An organization of the character indicated, acting under a central Fishery Department, would accomplish admirable results in the most economical way.

Fishery Publications.

A Fisheries Department would be able to prepare and issue publications of value to the fishermen and to the public. Various Governments have found the issue of hand-books of great help in the development of the fisheries. Thus there can be no doubt that the issue by the Government of Canada of a special handbook entitled "Fish and How to Cook it" has done a great deal in some Canadian cities to increase the demand for fish. Much ignorance exists generally as to the best methods of cleaning and cooking fish for the table; and the circulation of a small handbook of nine or ten pages such as that issued in Canada, furnishing probably a hundred different methods of preparing appetizing fish dishes, would be generally appreciated. Other books such as that issued by the Irish Fisheries Department in Dublin, explaining methods of curing mackerel and of handling fish for the market, have also been of great help. In Norway and Germany similar publications have given a great stimulus to the fisheries. There is no reason why in New Zealand those engaged in the fish business should not have the best and most recent information in handy printed forms, and New Zealand housewives be furnished with the best information as to the preparation of fish food in the house.

Acclimatization of the True Herring.

While the New Zealand waters produce several fish which are called "herring" and resemble herring—I myself saw vast quantities of these small fish at Nelson in April—they differ from the true herring in several important points. Both from a fishery and a food standpoint the true herring has qualities of greater commercial importance. The texture of the flesh and the nature of the skeleton or bones in the true herring as well as the flavour are peculiar, and the markets will not take a substitute. Further, abundance of sea-herring, which is an inshore species, attracts the schools of valuable large fish into inshore waters; and it has been observed in Canada that the decline of sea-herring along any portion of the shore usually results in the disappearance of cod and valuable deep-sea species.

In order to provide a new food and to encourage a new and valuable industry, as well as to induce the schools of large commercial fish to remain in the inshore waters, it seems to me desirable that extensive experiments should be made to establish the sea-herring in our waters. If success followed and New Zealand could create a herring industry comparable with that of Scotland or Norway, it would be a source of considerable wealth. The interesting experiments which have been made with much trouble and labour to bring eggs of herring from England were almost successful, but owing to special circumstances the eggs did not reach New Zealand alive. The officers in charge did their best, and the plan adopted was admirable in every way. In my opinion it would be a great advantage to bring a supply of eggs from waters nearer than those of Britain. British Columbia has a herring which from a commercial standpoint is equal to the British herring, and it abounds in incredible quantities, so much so that certain harbours on Vancouver Island and Queen Charlotte Island are in some seasons practically a solid mass of fish, and owing to their crowded condition they often suffocate and die in vast numbers. I myself have seen bodies of dead herring extending for two or three miles, through which steamers have to make their way in crossing the Straits of Georgia. The Indian tribes have been accustomed to depend on herring-spawn for a not inconsiderable part of their food, and for centuries have practised a system of laying branches of trees along large portions of the coast where the herring spawn. On lifting these branches out of the water they were coated with the eggs of herring, which the Indians dried, and which they considered a great dainty as well as a nutritious food. From the first week in March to nearly the end of the month is the main herring-spawning period; and any quantity of herring-spawn can be got, which by properly arranged apparatus could be kept alive until it reached New Zealand, the voyage occupying about half the time occupied by the voyage from Britain. A prominent fisherman in British Columbia wrote me not long ago that in every bay along the coast for over a hundred miles he had noticed the herring spawning in immense schools, and the Indians were going down with sacks to gather it up and dry it. He said, "The numbers were such, to express it to a person not seeing the sight he would be very apt to doubt the truth, as I have always looked on it as an Indian yarn, but there must have been hundreds of thousand of tons of spawn."

Larger Fishing-craft.

The fishing operations carried on hitherto have on the whole been somewhat local in their character, and not to be compared with the fishing trips made by fishermen in other countries. For instance, the Scotch liners make trips of fifty to a hundred and fifty miles from shore, and secure some of their best catches out on the more distant grounds. Even the herring-fishing in Scotland, which is regarded as an inshore fishery, is largely conducted many miles from the coast; and the steam-vessels, both liners and trawlers, going out from British ports make trips of from twenty-five to thirty-five days, extending to distances of one thousand to one thousand five hundred miles. They are specially fitted for these

trips, and carry supplies of ice and provisions for lengthy trips. Large wells are provided in addition to fish cold-storage rooms, so that the catches are kept cool and fresh, and arrive in a sweet and firm condition as though they had just been caught. In operating, the steam liners use from five to seven miles of gear baited with herring, and steam four or five miles per hour, operating in 100 to 150 fathoms, and they haul up their catch very rapidly by means of steam hauling-gear. The best Canadian boats fishing from Nova Scotia ports are fine craft suitable for long trips to the fishing-banks. They are from 80 to 100 tons and over, and usually carry eight dories or small boats, and many of them have specially built gasolene dories or boats in which the men fish on the banks and convey their catches to the schooner. The fishing trip lasts many months, some vessels being five or six months absent from port. Their catches on the Atlantic banks are cleaned and salted on board the vessel, and undergo the drying process after the termination of the voyage.

Grants or Bounties for Fishing.

In various countries it has been found beneficial to the fishing industries and a stimulus to their development to carry out a scheme of loans, grants, or bounties to parties engaging in fishing—(1) by improving fishing-boats and means of fishing; (2) by increasing the catches through the exploitation of new and, it may be, more distant fishing-grounds than those generally worked; (3) by encouraging the tinning, curing, and commercial preparation of fish foods on an extensive scale; (4) by rebates on the cost of transporting fish by rail or boat, and on ice, salt, and other necessaries for fish preservation and curing; (5) by a system of insurance of fishing-boats and gear.

In many countries such a system of pecuniary encouragement from the public funds has been tried spasmodically, and indeed a permanent system of loans or bounties does not appear necessary, for new fishery enterprises soon would put themselves on such a paying basis as to render Government aid unnecessary. There is no doubt that the French deep-sea-fishing operations on the great cod-banks off Canada and Newfoundland have been maintained by Government bounties. But for such bounties the competition between Canada, United States, and Newfoundland fishermen, and the vast distances to be traversed from the French ports to the banks and back—six thousand miles—would have discouraged the fishery and probably brought it to an end long ago. It still continues, as it has done for over a century, a large and flourishing enterprise. The fishing bounties granted in Canada, amounting to £30,000 annually, differ from usual fishing bounties, inasmuch as the amount is really the interest on an indemnity paid by the United States as a result of the Halifax Fishery Award, 1883, and it cannot be truly said that it has adequately stimulated deep-sea fisheries. The development of the industry at important fishing centres such as Lunenburg, Canso, and Digby, Nova Scotia, especially seen in the improvement of the fishing-boats, is due less to the bounty than to the business enterprise of merchants and owners and to the rivalry between Canadian and United States fishermen.

In Britain loans or bounties have at times been granted for encouraging fisheries. The Scotch herring industry, it has been claimed, rose to prominence through bounties originally granted; and in recent years the British Treasury has made advances to various fishing localities for the purpose of improving fishery methods. Thus the sum of £4,000 was granted by the Imperial Government from the "Development Fund," as it is called, at a rate of 3 per cent. per annum, on the security arranged by fishermen's societies, subject to the approval of an administrative committee locally appointed by the Cornwall Sea-fisheries Committee. It was recently stated in the House of Commons, London, that much of this grant would be devoted to installing mechanical power in fishing-vessels; and a similar grant, amounting to about £2,000, was made to the Devon Sea-fisheries Committee for the purpose of making experiments with motors in trawlers, and with types of boats used inshore where fishing is carried on from open boats. The grants from this British Development Fund have done much to stimulate the industry in certain localities.

There is a feeling in various localities in New Zealand in favour of fishery grants or advances on terms similar to those provided in the Advances to Settlers Act.

Japan affords a good illustration of the benefits of Government grants, and has with great success distributed over £40,000 (200,000 yen) annually in loans at low rates of interest to—(1) fishermen or companies of three years' standing; (2) fishermen or companies recommended by the local officers. The Japanese grants are expended in building improved boats, making tackle, erecting fish storehouses, wharves, and any public utility connected with the fisheries.

The agricultural progress of New Zealand during the last twenty years has been largely ascribed to the Government encouragement in the shape of advances to settlers, according to prominent authorities, and I am strongly of opinion that certain new lines of fishery business and improvement in the size and character of fishing-craft would be rapidly accomplished by a system of Government grants or bounties. It is, of course, impossible to ignore the fact that individual fishermen can do much for themselves; and there is every evidence that an active and able fisherman can make good wages. There is therefore less urgency for Government assistance in providing boats and gear. I have been supplied with accurate returns of the earnings of fishermen in various parts of New Zealand, and it has been demonstrated to me that an able fisherman can make very ample earnings.

Objections to Duty on Fishermen's Gear.

During my tour I had on many occasions strong representations made to me respecting the 20-per-cent. duty imposed on imported lines and fishing-gear. It was pointed out to me that farmers were treated more generously, and that machinery for agricultural purposes was admitted free from England. There is, I think, every ground for aiding the fishermen in their precarious and dangerous occupation, by enabling them to procure their fishing outfits at the lowest price, and they certainly

have, for manifest reasons, as much claim to generous consideration in this respect as the agricultural population.

Size-limit of Fish.

There has been some dissatisfaction at the limits imposed by law on certain speci s of fish caught for market; but no one who realizes the harm done by destroying undersized fish can doubt the wisdom of such a size-limit. Professor D'Arcy Thompson has shown that the extra-small flat fish of the North Sea, less in dimension than the smallest of the three commercial grades—large, medium, and small—though brought to such markets as Aberdeen in great quantities, and forming 8 or 9 per cent. of the total weight of fish brought there, really amounted to over 32 per cent. of the total *in number*. Thus, of the fish referred to, though forming one-third of the catch, these small undersized fish formed barely one-twelfth of the total weight. Hence their capture and sale is harmful to the fish-supply, detrimental to the industry, and yields no adequate benefit to the trade or to the man handling the fish. I have in my visits to the fish-markets and fish-stores noticed far too many undersized fish, but a great majority of them no doubt are of legal size. The minimum size-limits, therefore, are certainly not too large in many species, and might be increased with advantage. It is impossible to avoid catching some small fish, but by arranging a properly meshed net the capture of these immature fish could be reduced. Such fish if allowed to remain in the sea would readily grow to a large marketable size. With respect to fish which apppear erratically and whose movements are not known, such as the warehou, if seems to me that a size-limit is really not necessary. Their case is quite unlike that of the fish whose resorts are regularly known, and the supplies of which are fairly regular. The protection of the young of such local schools rapidly and directly benefits the fishermen by way of the resulting improvement in the average size. I understand that Mr. Ayson, the Chief Inspector of Fisheries, has expressed the view that the size-limits now in force for such fish as warehou and similar fish of a wandering nature might with advantage be abolished.

Stalling or Blocking Tidal Inlets.

The question as to the desirability of legalizing stalling, or the use of staked nets in the estuaries and tidal inlets of the Auckland District was brought before me on several occasions. Strong representations were urged that it should be permitted; but I am convinced that it is a method which is very harmful to the inshore fisheries generally. Large numbers of undersized immature fish are taken in this manner, their capture being unavoidable. I was informed that large numbers of small fish are left stranded as the tide recedes, and the waste of fish is disproportionately large. The capture of flat fish and of other inshore species can be effectively carried on without the adoption of this method, and I would strongly report against its being permitted. The detailed grounds for my strong and unfavourable views are set out fully in my subsequent report.

Effective Penalties, Confiscation, etc., for Fishery Violations.

The great object of all fishery regulations is the discouragement of illegal methods of fishing; and the more effective the deterrents are, the greater are the benefits to the fisheries and to the public generally. Hence no step should be left untaken which would directly deter wilful violation of fishery laws. There is no more effective method than the seizure and confiscation of boats and gear used in illegal fishing. The imposition of fines is often futile, as illegal catches of fish may yield such ample returns as to make poaching a profitable pursuit despite the fines. If, however, an offender is deprived of his means of carrying on illegal fishing, such violations of the laws inevitably come to an end. The seizure and confiscation of such gear may appear severe, but that is a consideration which poachers should well weigh before engaging in illegal operations.

I had on many occasions reported to me the fact that illegal oyster-fishing is at times carried on in Hauraki Gulf and the Bay of Islands, in spite of the very energetic and able efforts of the local fishery officers. I was assured that in many cases owners of yachts, who were men of means and who would be considered men of position in the community, descended to the level of the common poacher and marauded valuable oyster-beds. No consideration should be shown to the owners of private yachts who thus try to evade the fishery officers and violate fishery regulations. A poor man to whom the taking of oysters or of other fish may mean the securing of the necessities of life may be regarded leniently; but the well-to-do owners of yachts and prosperous picnickers merit no consideration, the only punishment of serious moment to them being not a pecuniary fine, but, on conviction of illegal fishing, the seizure and confiscation of craft and gear.

The Canadian Fisheries Act contains a distinct clause providing for the confiscation of boats, nets, and gear for fishery violations; and in the fishery laws in most countries such confiscation is an essential provision and punishment.

Technical Instruction to Fishermen.

The experiment has been found very successful in Britain of providing courses of instruction for fishermen, dealing with the life-history of fishes, their food, habits, &c., as well as methods of handling, freezing, curing, and caring for fish. In some localities the fishing population have shown great interest in this work, and it is claimed to have been of great benefit, arousing the interest of fishermen to an increased extent in their calling, enabling them to make observations and to add to our information on fish and fisheries, and to carry on their operations with greater efficiency and intelligence. Many years ago courses of lectures were given in Berwickshire and along the border coast of the south of Scotland. These were the first lectures given in Britain on the subject, and they proved of great interest to the fishing population. Later, the University of Aberdeen founded a fishery lectureship; and in the north of Scotland courses of instruction are provided for a selected number of fishermen.

Professor Herdman, in Lancashire, has done the same, and in Glasgow and Edinburgh some fishery instruction has been arranged at intervals. In St. Andrew's, Professor MacIntosh has always given prominence to fish-life and fishery matters in the university, and has established the finest existing national fisheries museum, including a very large collection of eggs, larvæ, and various stages of fish, as well as the food of the young and adult. Fishermen who visit this national fishery collection of Scotland's oldest university are enabled to learn a great deal about the inhabitants of the sea.

Such technical instruction as I have suggested should include not only a popular account of the eggs and growth of fish, but might also include instruction by some experienced man selected by the Government to demonstrate the most up-to-date methods of treating the fish after being caught. In Ireland the Department of Fisheries and Agriculture arranged for an expert to give tutorial instruction in the curing and grading of Irish mackerel. The Department offered, free of charge, such instruction at the various fishing-ports, so that the whole trade might benefit by new and improved methods of curing and packing fish. Canada adopted the same methods in regard to herring, and for some years carried out a course of instruction and demonstration in the pickling and packing of herring, a Scottish expert being brought out to Canada with a staff of herring-girls and a cooper experienced in the making of the best barrels. On the Atlantic and Pacific coasts this staff put up some of the finest herrings ever prepared in North America. The scheme also included new methods of fishing for herring by means of a steam drifter. Great interest was aroused amongst the fishing population, and abundant proof was afforded that the Canadian herring, Atlantic and Pacific, which had been alleged to be inferior in quality to the Scotch herring, were really prime herring, and when cured by the expert staff proved to be equal to the best herring put up in Scotland or Norway. Several firms in Canada have continued to pack herring as a private enterprise on the lines demonstrated by this system of technical instruction under Dominion auspices.

Fish Driers and Refrigerators.

It is important for the future development of the fisheries that better facilities for the cold storage of fish and the preparation of chilled and dried fish should be provided. The Dominion of Canada has found it to be a most valuable aid to the fishing industry to initiate artificial fish-drying establishments on the Atlantic coast. A system of fish-drying known as the "Whitnan system" was adopted with success, and it provided three special advantages: first, the control of the degree of dryness suitable for different foreign markets; second, increase in the rapidity of the preparation of dried fish; and, third, independence of rain and weather changes. The first fish-drier built in Canada on Prince Edward Island cost £500 or £600 to erect, and was capable of drying from 800 to 1,000 quintals per day at a cost of about three-eighths of that of the usual sun-drying process. I am satisfied that a number of fish for which there is no great demand now could be dried and converted into a commodity that would readily sell in some of the South American markets, to which Canada sends large quantities of dried fish.

The necessity of providing cold storage for catches of fish, especially when the catches are large and there is a considerable surplus, requires little argument; and if the fruit industry receives encouragement, and advances up to £3,000 can be made for erecting cold stores for fruit under the Fruit-preserving Industry Act, 1913—an amount which I understand it is proposed to increase to £9,000—there is every reason why the fish industry should receive similar encouragement, and cold storage be provided for fish in order to avoid the waste which at present occurs frequently. There are some less accessible fishing-ports where initial cold-storage establishments might be started; and I was specially struck by the position at Half-moon Bay, Stewart Island. At this place a fleet of fishing-boats operates continually, and fine catches of excellent fish are made, which for various reasons, such as bad weather or limitation imposed by the fish-merchants, cannot be fully utilized. I had evidence when visiting Stewart Island that very serious waste of fish occurs when large catches are made. This could be avoided by the erection of a cold-storage establishment in which the fish could be preserved until the weather or the market-conditions allowed of their being sent to the markets. I was also struck by the suitability of Nelson as a central fishing-port, and feel convinced that a well-managed cold-storage establishment there would be of great assistance to the fishing fleets which operate in Tasman and Golden Bays and other fine fishing-grounds in that locality.

It is of the highest importance that fish should not be exposed even for a few hours beyond the time absolutely unavoidable, as they fall off in condition and lose flavour by such exposure. Much of the fish which reaches our markets at present has altogether lost its fresh and excellent qualities owing to a few hours' exposure on boats, wharves, or steamers; whereas had it been put into cold storage as soon after capture as possible its condition would have been prime. The d mand for fish, indeed, is largely influenced by its condition, and the public will not buy fish to such a large extent if it has lost its fresh and sweet qualities by exposure to the atmosphere and to the sun or by rough handling. By being properly placed in cold storage immediately after capture the fish retain these qualities for a length of time. A fish that has deteriorated in condition by exposure, &c., cannot be made into a good fish by being placed in cold storage, so that it is necessary for the fishermen to realize that their catches must be packed in crushed ice and transferred to cold storage unless marketed immediately.

Frozen versus Chilled Fish.

An impression prevails in the public mind that frozen fish is very inferior to fresh fish, and this opinion is well founded. The method of freezing fish solid so that they resemble a stone or a block of wood is found in the case of most fishes to destroy the flavour and the texture of the fish to such an extent as to make them very inferior for table use. Freezing hard, which is the method that has been adopted for a great many years, is a bad method of treating fish. As a man of unusually large

experience in New Zealand remarked, "Freezing simply spoils fish." On the other hand, if fish are placed in crushed ice, especially if wrapped first in clean paper, they will keep for weeks in that clean chilled condition; and that being so, fish stored in a chilled condition will be found both useful for the table as fresh fish or for smoking, especially in the case of blue cod. What is called "bone taint" is one of the troubles in freezing fish, and it is held to be due to the animal heat which remains within the fish after its death. If fish as soon as possible after being caught are placed in a temperature of 37° F. and gradually cooled down to 32° F. the interior flesh is reduced to the same temperature as the exterior, and the qualities are retained. As is well known, there is a difference between frozen meat and chilled meat, frozen meat being that stored below freezing-point for an indefinite time, while chilled meat is not frozen and can be kept quite wholesome for many weeks at a low temperature. It is claimed that chilled products will not keep more than six weeks, otherwise they must be frozen; but this is a matter for experiment. As chilled beef is found to be quite equal in every respect to fresh beef for table use, a proper method of preparing and storing chilled fish should also be equally successful. Even the Scotch cured herring are shipped in cold storage in order to keep their piquancy and delicate flavour, which would otherwise disappear. The Russian and German markets take immense quantities of Scotch herring and accept readily this chilled fish kept in a cool atmosphere. Official tests have demonstrated that these fish show no sign of deterioration even when stored for upwards of twelve months. There is evidence that the different kinds of fish vary in their keeping-qualities in a cool atmosphere; and such a scientific bureau as New Zealand should possess would be able to experiment with the various species of fish in the Dominion and determine which fish are the best for storage as chilled fish.

Unutilized Fish.

I found in the course of my tour quite a number of desirable fish and fish products which seemed to be little appreciated and of practically no value. I am satisfied that many of these fish could be made valuable. I heard continually that fishermen make catches of various kinds for which there was no demand in the market. At one place the shores were stated to be strewn with *tarakihi* which had been caught in large numbers and for which there was no market. Ling also I was informed were often a drug in the market. It seems to me that if such excess catches could be chilled and conveyed to some central tinning or curing establishment these excess catches could be made into products that would find a ready market. All fish, of course, cannot be treated in the same way; and it is still a matter of experiment as to which fish in New Zealand are the best for converting into smoked or filleted fish, and which are the most suitable for being tinned or made into fish-paste, and possibly in some cases coloured to make them more appetizing. One of the largest fruit-canners in the United States told me that he could not sell yellow Indian corn tinned though of the very best quality, but it all had to be subjected to a bleaching process and converted into white corn. This bleaching did not improve the table quality at all, but rather removed some of its excellence. The public, however, demanded corn of a certain colour, and he supplied it. The same principle applies to fish, and there is no reason why fish which are not at present esteemed because they are white should not be given a pink or reddish trout colour to make them more acceptable.

The warehou abounds over a very large area on the New Zealand shores and ought to be convertible into a good fish product. It is related to genera which include some of the most important food fishes, such as the yellowtails and the cavalas of North America. It is stated that they smoke exceptionally well, and some authorities have declared that they ought to rank as a valuable fish. But they are somewhat erratic in their movements and occurrence, and it would be a matter well worth investigation as to what the movements of the warehou are, and where they can be found, at the various periods of the year. In New South Wales the warehou occurs in large numbers at times, but the authorities there confess that little is known of its distribution.

The large quantity of elephant-fish occurring in the inshore waters suggests the proposition that these should be experimented with, and the exceedingly fine, firm flesh utilized, either by smoking or by some other method, and turned into a good marketable product. Parties who have tried some fillets of elephant-fish have declared that it is equal to the groper, and in the colour and the texture of the flesh not inferior but rather superior.

Nova Scotia has within the last ten years developed an enormous business in the smoked fillets of so-called cod and haddock. These fillets almost without exception, are not cod or haddock, and I see no reason why so fine and abundant a fish as the elephant-fish should not be converted into very superior smoked fillets, and a market found for them. So great is the demand for filleted smoked fish produced in Nova Scotia that the firms preparing these fish have found it difficult to secure sufficient supplies of fresh material. The Canadian fishermen supplied all that they could, but the shortage had to be made up by importing fish from the United States fishermen. The field is therefore open for enterprise in New Zealand as the demand is increasing.

It was with some surprise that I learned how common was the waste of red cod. It is a fish, when properly cured and smoked, of very good quality, although somewhat soft when in a fresh condition. Even the fresh fish, however, if properly treated is found to be an exceedingly good table-fish. Such considerable quantities of this fish are captured and so large an amount thrown away every season that I would strongly urge their utilization by being converted into fish-flour under such a scheme as I have elsewhere suggested, if the demand for the smoked fish is found to use only a portion of the annual catches. Thus the present waste would be avoided.

Immense quantities of gurnard are continually brought into the markets, but vast numbers are returned dead to the sea owing to the limited demand and the lack of popularity of this fish. It must be admitted that it is not equal to some of the more popular fish, but smoked gurnard is quite a palat-

able product, and if a general scheme of utilizing all kinds of edible fish be devised and carried out the gurnard is a species which could be turned to considerable commercial account.

Another important fish, already mentioned, the value of which has not been realized, is the eel. Eels have a high reputation in some countries, and large buyers in England, the United States, and Germany import great quantities either in fresh chilled condition or smoked; and the demand is so great that there ought to be a good market for eels shipped from New Zealand. Canada has a very considerable export of eels, but has the advantage of great markets only from twelve to thirty hours by rail, and eels can therefore be sent frozen or even alive to New York, Boston, Chicago, &c. Ireland has great eel-fisheries, one fishery alone yielding £2,000 per annum. But the most valuable eel-fishery is one in Canada, which brings in about £3,000 per annum. I am strongly of opinion that if eel-fishing were carried on in practically every river in New Zealand and in some of the lakes which abound in this fish, an important industry could be created. It might, indeed, be worth while offering a bounty of so-much per ton to encourage fishermen to enter into this business, and to bind themselves under a sworn undertaking to return alive any trout or other fish that might be taken and to capture and transport eels only. The following objects would be gained by an extensive eel industry in New Zealand: First, it would clean out or reduce the number of eels, which is at present excessive; second, it would concentrate attention upon eel-fishing in the waters where they occur.

On several occasions I was urged to recommend that experiments should be carried on with the canning of eels and the shipping of them to Europe, especially to England, where it was claimed they would bring a high commercial return, and thus the eels would be kept under control and salmon and trout would benefit thereby. Canned eels I think could not be made a very large industry, and their utilization would, I opine, be on other lines. Smoked eels especially are in demand; and I am strongly of opinion that the flesh removed from the bones and made into a paste, and possibly, by means of pressure through a sieve-like apparatus, converted into small cylindrical particles about the size of whitebait, might be cooked in such a manner as to readily resemble whitebait, and canned in that form would be a delicious and I think popular product. What name might be given to such shredded eel-meat is worth consideration. I have in another place dealt with the whole vexed question of the names attached to fish products, and have shown that it is quite rare for fish to be sold under their proper names. Even a British Columbia salmon is not, strictly speaking, a true salmon at all; and the canned Cape lobster is really not a lobster. There is therefore no reason why New Zealand fish products should not be marketed under advantageous names.

I understand that hapuka or groper are often captured in such quantities as to be difficult to market; but as Sir James Hector said forty years ago, it is a fish well adapted for pickling, and there should be an opening in Italy for this excellent fish, inasmuch as the large tunny is pickled and is in great demand in that and other Mediterranean countries. Through a proper fish agency it should be possible to establish a good demand for such pickled fish from New Zealand.

The crayfish is abundant over very large areas, and the quantity at present utilized is insignificant in comparison with the supplies available. Canned crayfish would readily secure a big market. The lobster in Canada is tinned on a very extensive scale. About five hundred canneries on the Atlantic coast put up this valuable product, but the demand is greater as a rule than the supply, and the price is becoming prohibitive. France and England require more than even the Canadian canneries can pack. The crayfish, it must be confessed, is not quite equal to the true lobster; but under the present conditions it would be an admirable and successful substitute. I understand that the crayfish is marketed under the name of "canned lobster." An essential feature in the tin containing lobster is the large claws; and buyers as a rule when inspecting canned goods open the tin to see how much claw-meat there is in it, and the price very often depends on that feature. The white meat of the crayfish corresponds to what is called the "tail-meat" only of the lobster; and it appears to me quite feasible that New Zealand might put up in large tins, of from 2 lb. to 4 lb., the white meat, to be utilized by Canadian canneries along with the lobster-meat, so that the tin of lobster would contain part of the white meat of a crayfish and the claws and part of the white meat of the lobster. In this way it would reach the great markets of Europe under more advantageous conditions. The objection might be raised to such a course as I suggest that the tin would not contain lobster meat solely; but I need hardly point out that in most food products there is this combination of various materials. For instance, we know that the exceedingly good preserved fruits and jams sold on such an extensive scale at present are mainly compounds of several fruits in one jar. I may also say that whole crayfish is in great demand in the United States, and I observe a recent quotation for this fish in California is 12 to 15 cents per pound, wholesale.

Trepang: Sea-cucumbers, which abound in many of these regions on the New Zealand coast, are really the raw material for preparing the esteemed trepang, which is a most important food product in the Japanese fisheries. Over 10,000 tons of trepang are shipped from one port, Hakodate, in the course of the year, the value of which is over £22,000. The squid also is abundant, and dried squid or cuttlefish is in great demand in China. By a little enterprise I am satisfied that trepang and dried squid could be prepared in New Zealand and shipped to China.

Seaweed products: The Japanese utilize also the various seaweeds for good purposes; and a project, therefore, for utilizing seaweeds in New Zealand I think might be made remunerative. The seaweed is utilized in various ways, either as a material for making soup or for producing iodine and other products. Even oil has been made from seaweeds, and recently Professor Lewes stated that a ton of common *Fucus* yields over 6½ gallons of valuable oil by distillation. The value of seaweed for the manufacture of iodine is being largely recognized; and on the Californian coast a very large firm has been organized for the utilization of kelp and other seaweeds, and the company is producing iodine, potassium, sodium, carbon, and other materials, the kelp being burned to an ash in a special type of

incinerator, then subjected to various processes for the extraction of these valuable materials. Japan has long conducted an important seaweed industry, mostly for food purposes in China, 14,000 or 15,000 tons, valued at nearly £30,000, being shipped from Hakodate in a single year. The production of fish fertilizers and fish-oil I deal with on another page; but there are other products which might be instanced, and which I shall give in detail in my larger report.

New Markets for Fish.

There is abundant evidence that a much larger demand for New Zealand fish could be easily created by such steps as those which I am now about to suggest. The home markets could be vastly increased by better transportation and marketing facilities; but it is the export market, after all, on which a large fishing industry in the Dominion would depend. There are five different methods of putting up fish for the export market which are well worth consideration:—

(1.) Dried fish-powder: This can be readily prepared; and for this class of fish product there is an unlimited market in Japan and China and the East generally. Fish regarded as inferior for table use can be utilized for this fish-powder, which consists of the solid meat removed from the bones, the water extracted, and the dry material ground up by special machinery in the form of a fine powder.

(2.) Boneless fish either in the shape of dry bricks or smoked fillets: Such fish as the ling, which are at present wasted to a large extent and which are fish of large size and thick solid flesh, could be readily made into boneless cod; and, as I suggested, there are other fish, such as elephant-fish, with which experiments might be made in this direction.

(3.) Salt dried fish: There are a number of species of fish in New Zealand waters which it is found can be dried in the manner of the salt cod of the North Atlantic and Pacific. Canada exports great quantities of dried salt fish to the Mediterranean, the West Indies, and to some of the Pacific islands. It is quite possible, therefore, to develop an industry in the preparation and marketing of such fish.

(4.) Chilled fish: I have pointed out elsewhere in this report that fish when properly handled and chilled and kept in cool chambers at a steady temperature slightly above freezing-point can be kept for long periods in a condition which is practically that of fresh fish. I am convinced that eels, if properly treated by the removal of the slime, &c., and chilled immediately, and kept under cool conditions, can be shipped at a profit to some of the great European markets. Apart from London, which takes an immense supply, eels are in demand in Germany, Italy, and other countries, and many American cities, such as New York, will take an unlimited quantity of eels and pay a good price for them. I refer to this subject under another heading.

(5.) Tinned fish, fish-paste, &c.: New Zealand has a great many very excellent fish which would make capital tinned fish, or which might be worked up into fish-paste with very little labour. Eels, hapuka, crayfish, and other kinds make excellent paste, which when canned will keep for a long time. Some of the fish which could be tinned might, I think, be coloured so as to resemble trout or salmon. The use of aniline or other harmless dyes would doubtless improve the appearance of some of the white-fleshed fish, and they could be marketed not as salmon, but as "table fish-paste," or some such general name. I myself have seen hundreds of cases of the poorest kind of Pacific salmon landed on the Fiji Islands, and am convinced that tinned fish slightly coloured and shipped to Fiji would be as much in demand as the somewhat poor class of salmon shipped in great quantities from North America to these Pacific communities. Any one acquainted with the Norwegian fisheries will be aware of the large number of different kinds of tinned fish products which are prepared, many of them from fish of inferior quality, but so well prepared that they make capital food. I regard the eel, which is super-abundant in so many New Zealand rivers and lakes, as a very promising fish for experiments of this nature. It is not esteemed by British people generally, excepting in London and some of the other large cities, but it is rightly regarded in such countries as Italy as one of the prime fish, and if prepared by proper cooking or by curing and smoking, or being made into a fish-paste, can be made a most appetizing and important dish for the table.

The taste of the public in different parts of the world is certainly most peculiar and erratic, and a famous Chinese authority connected with the Embassy at Washington, D.C., once told me that the deep-sea fishes which are so highly esteemed by most nations cannot be sold in China at any price, as the Chinese more highly esteem perch, carp, jellyfish, cuttlefish, sharks' fins, and other edibles, which they regard as of a very superior character.

New Zealand Fish Agents necessary.

My experience has been that it is impossible to gain entrance to some of the best markets in the world through the ordinary trade channels. The finest qualities of fish will be discounted and shipments excluded unless judicious steps are adopted. For example, it was found impossible to place chilled, frozen, or smoked British Columbia salmon on the London market owing to fishery rules and regulations and the prejudice of the trade. It was only after some very strong reports, which I prepared for the Canadian Government, and after strenuous efforts by Sir Charles Tupper, the High Commissioner in London, that such Canadian salmon found entrance. After the preliminary obstruction had been overcome a very large trade rapidly developed, and this has continued for many years with great advantage to the Canadian shippers. It would seem necessary, therefore, that if shipments are to be sent to London, or even to Sydney, or to any other large cities in other countries, the task of looking after the New Zealand shipments should be undertaken by some recognized agent or officer: possibly the High Commissioner for New Zealand in London might act in this way. Otherwise the ordinary fish firms shipping in the usual channels would probably find that their products were treated most unjustly. Business is established on certain lines, and the large fish firms are accustomed to handling only the products of certain countries. For instance, Scotch salmon and

Norwegian salmon will find ready access when salmon from Canada or the United States would probably be impeded and might even not find sale at all. Denmark has for many years adopted the plan which I suggest, and through a very able agent in London has been able to build up a large business in fish. This agent takes pains to see that the Danish shippers and fishermen receive the full benefit of the products which they send to London. The trade agents which I refer to should have some special knowledge of the fish business, and should be men of some ability who can readily overcome trade prejudices and any obstruction to the entrance of new fish products.

Improved Public Fish-markets.

I have not seen in my tour through New Zealand any fish-market in the cities visited to which very serious objection may not be taken. In some cases the accommodation where the main shipments of fish are received from the nearest fishing-port or from the fishing-boats is very objectionable. The fish-carts arrive, in the case of one fish-market, at an open platform with roof overhead in the midst of a busy railway shunting-yard, and exposed to the dust, smoke, and soot from locomotive engines and moving trains. A dustier and dirtier place could hardly be selected for exposing fish freshly brought in from the sea. At this place the groups of buyers assemble at 7 or 8 o'clock in the morning to purchase their supplies. No special pavement for washing or cleaning fish is provided, and the place strikes a visitor as more suitable for receiving town refuse than for fish intended for food. Another fish-market is a very small crowded place hidden away close by busy wharves, and not suggesting in any way the purpose for which it was built—namely, for distributing a valuable food product. The conditions are somewhat better in an important city in the South Island which I visited. Here concrete floors and abundance of water are provided. The place is fairly central, but its approach is bad, and the piles of fish are roughly thrown upon the floor and present a very undesirable appearance. Public fish-markets in New Zealand are in great contrast to those provided in other countries. Thus no one who has visited the splendid fish-market in Aberdeen, or those in Leeds, Manchester, and other large provincial cities of Britain, can question the absolute necessity of New Zealand being provided with modern adequate fish-markets.

Several points must be borne in mind in erecting a fish-market: Firstly, its location or position must be central and accessible; and the case of Sydney might be instanced in proof of this. Sydney some years ago was provided with an exceedingly good market building, but the public refused to use it, and the scheme lapsed. The main reason which prominent citizens gave for the lack of public support was the inconvenience of its position. The Chief Inspector of Fisheries in a report stated that there was no reason to suppose that such a market placed in a central position would not be remuneratively patronized. Secondly, white-tiled tables and compartments are essential where the fish can be exposed to the best advantage, and there should be an abundance of water at hand to keep them clean and free from slime, dirt, and other sources of offensive fishy odours. Cool chambers for keeping chilled fish are also a desirable feature in such public fish-markets.

In my opinion such modern fish-markets should be under some form of Government supervision, and erected with the aid of subsidies and possibly an annual grant to provide for a qualified market superintendent. Whether the fish-market should be built by a City Council, or a special local fishery corporation, or by the Dominion Government is a matter for consideration. My important point is that such markets should be provided under the initiation of the Dominion Government in every centre of population where there is a prospect of commercial success. The details as to hours and methods of sale depend very much upon local conditions, and it would be quite easy for the officials of a Fishery Department, after conference with the Advisory Board, to decide upon the best methods of conducting such fish-markets.

Supplies of Ice.

An ample supply of ice is of great importance to the fishing industry. In Canada vast quantities of ice are harvested in winter by cutting blocks of it from the frozen lakes and rivers. In New Zealand reliance must be placed largely at present on artificial ice, and it is only supplied at a cost which is a considerable burden on those engaged in fishing and in the fish business. Provision should be made, in my opinion, by the Government to enable supplies of ice to be obtained by fishermen and others at a very low cost. It has occurred to me that perhaps some of the icefields on some of the mountain-ranges might be utilized; but I am not sufficiently familiar with the physical features of the mountain-ranges to know whether any glaciers or icefields in the North or South Island are sufficiently accessible to allow of ice being cut and the blocks being conveyed by light tramways from the lower portions of the icefields to the plains below. It is possible that ice might be obtained in this way from glaciers within reach of existing railways. Were natural ice thus obtainable, it would certainly enable large supplies of the product to be obtained at a very low cost.

Trade Names for Fish-food Products.

An impression prevails that the public know what they are eating and that there is some reliability in bills of fare at restaurants and hotels. But all trades have conventional terms, and the fish trade has perhaps more misnomers than most trades. Attempts have been made in the United States by pure-food laws to ensure that the public shall get really what they pay for, but as a matter of fact in no country are foods sold under more misleading names than in that country. Much of the "cod" handled in the American fish business is really hake. The delicious catfish of muddy streams and ponds appears at the hotels as "trout." So-called "sardines" are really herring, and the names "black bass," "halibut," "flounder," "sole," usually mean anything in the way of fish, and a variety of species are served to the public under those names. French names on menu cards add to the difficulty. Happily all are good food, and in some cases better than the genuine article. In England the same state of

affairs exists, and some of the best "cod" sold in London are really sea-cat, frog-fish, and other delicious but despised species. Recently a Newcastle firm was fined for selling as "sardines" the small sprat. The Judge declared that "sardine" is a French name for the young pilchard, and the Norwegian "sardines" were really brisling, retailed as "kipper sardine," "Norwegian sardine," &c. The term "sardine," however, has been applied to a great variety of preserved immature members of the herring family. The immense sardine business in the State of Maine has never in all its history put up a single sardine, the raw material consisting of small herring.

Inasmuch as the names in use for important food fishes in various countries are so contradictory it is hopeless to look for any uniformity or reliability; and the main point for the public is as to the palatable and nutritious character of the fish. This is important for New Zealand fish, as groper, schnapper, and other species in various preserved forms if sent to some of the markets would certainly find no sale under their proper names. Just as the dogfish of the North Atlantic has been tinned under the name of "ocean whitefish," so it is justifiable to adopt more acceptable names for fish which it is desired to introduce to new markets abroad.

Fish-transportation.

Reference has already been made to the necessity of better transportation facilities in order that the public may obtain ample supplies in the best possible condition, and the fishermen receive proper returns for their catches. As an Irish authority expresses it, "The effective transporting of fish from the ports and their quick conveyance from the water to the table would revolutionize the whole fish business." Fishermen ought to be able to rely on their catches being delivered in perfect condition. The first preliminary is of course the handling of the fish on the boats by the fishermen and their proper delivery at the landing-wharves. Great carelessness is often seen on board the fishing-boats, and if a fish is bruised and in bad condition when brought ashore no quick transportation or efficient methods of shipping can make a bad fish into a good one. Indeed, it would be to the great advantage of the fishermen themselves and the merchants if all fish were placed in boxes and handled carefully, as they are in other countries; the use of ice might also be encouraged, so that fish at all times might have a little ice upon them and be kept cool. It is too much to expect that the fish could be wrapped in paper, although with salmon and trout this would be worth while, as even cod and sea-fish keep their qualities far longer if individually wrapped in paper on board the fishing-boats. In Norway this has been done to a large extent. The use of fish-boxes, however, would improve matters very much.

Three things are necessary to improve the transportation of fish: First, refrigerator cars, which should be attached to quick trains; second, rapid unloading and distribution of fish which have been shipped; and, third, low rates. In Ireland some years ago arrangements were made to have a refrigerator car attached to every train leaving such ports as Ardglass, Howth, Kinsale, &c.; and it would be just as easy in New Zealand to carry out a system of transportation by quick trains in refrigerator cars. In the same way, the steamers carrying fish should be required by the strictest regulations to handle shipments of fish expeditiously and carefully. There has been considerable pressure brought to bear by the exporters of dairy-produce to get low rates for shipping long distances and to improve the methods of handling all kinds of farm-produce, frozen meat, &c.; and at a conference of farmers held recently complaints were strongly expressed of the damage done through obsolete methods employed at New Zealand ports, and the Harbour Boards were urged to remedy the state of affairs as soon as possible. If farmers complain, how much stronger ground is there for fishermen and fish merchants to be dissatisfied with the rough and obsolete methods of handling such delicate food products as fish! Better train facilities from such places as the Bluff to Christchurch, and from various ports to Wellington, might with very little difficulty be afforded. The earliest trains, it might be arranged, should take fish along with them, and collect the shipments at various points, so that the fish should reach the large centres of population without delay. Even after arrival at the terminus fish are often handled in the most absurd manner, especially shipments brought by steamer. These shipments, after arriving at the wharves, may be delayed for many hours, exposed to the sun and to the worst weather-conditions, before they are allowed to be taken ashore or to the fish-markets. Many cases came to my notice of fish arriving before daylight which were not removed until 8 o'clock in the morning, and remained for hours exposed to heat and weather-conditions, flies, &c., so that they presented a very undesirable appearance and were in bad condition when the shipments were actually carried ashore. Respecting the rates for carrying fish: Many complaints were brought to my notice, and it appears that there is not a strict uniformity as to the rates charged for packages of fish, a statement being published in the newspapers recently that 2s. was charged for carrying 18 lb. of fish a distance of thirty-two miles. In Canada the Government has made arrangements with the express companies that a rebate shall be paid upon all shipments* of fish sent by quick express, and the result has been that the fish business has advanced by leaps and bounds, and many towns which had difficulty in securing supplies are now well provided with fish in exceedingly good condition.

Labour Difficulty in Fish Industry.

I have been frequently met by a serious objection when urging that new modes of preserving fish and manufacturing fish products should be initiated in New Zealand, and that is the high cost and great scarcity of labour. The preparation of such products involves labour, and I realize that some difficulty actually exists with regard to that. But I know from my thorough acquaintance with the British Columbian fishing industries and with the commercial utilization of fish products in eastern Canada (Nova Scotia, &c.) that the labour difficulty is great in Canada. Labour is not abundant, and is highly paid. By the adoption of mechanical appliances and modern machinery, however, these difficulties

* The cost to shippers or consignees has been reduced to one-third the usual rate.

can be readily overcome. There is no reason why in New Zealand such mechanical methods and machinery should not be adopted.

Sea-fish Angling.

Few sportsmen have realized that New Zealand offers the finest sea-fishing such as is greatly sought after in other countries, especially California, Florida, and Cape Breton, where the tunny or tuna, the albacore, the bonito, and other large members of the mackerel tribe occur and can be fished for with baited line or even with spoon and rod and line. The kingfish, especially in the Bay of Plenty and Hauraki Gulf, are becoming famous; and the pretty town of Russell is resorted to each season by kingfish-anglers, who obtain splendid sport. But a still more exciting form of angling can be obtained there, as well as on other parts of the coast, in the shape of shark-fishing. For example, last season a visitor, an elderly gentleman, while enjoying fishing for kingfish, reports that he was playing one of these fish for three-quarters of an hour when suddenly his line slacked. He reeled up, to find that his line was taut, and it seemed as if he had caught foul on a sunken rock. Soon he felt a very heavy pull, and was afraid he had hooked a kingfish, to use his own words, "as big as New Zealand." After three hours' exciting play he was at last able to reel in his fish, and found that he had hooked a fine "moko" shark, 9½ ft. long, weighing 200 lb. The captor was completely exhausted with his four hours' exciting fishing. He was interested to find out how the shark had been hooked. It appeared the fish had at first bitten off the head of the kingfish and left the rest of the fish. Then it returned and swallowed the remaining part of the fish, with the hook, the latter passing right through the chamber of the stomach, while the head of the kingfish was pushed half a yard up the snood, but as the snood was of piano-wire the shark could not sever it. Such royal sport can be obtained in the Bay of Plenty and other New Zealand waters, and needs only to be known to attract anglers from all parts of the world.

Fresh-water Game Fish.

New Zealand has long had a high reputation for its magnificent trout-angling. The wonderful growth of its trout, especially brown and rainbow trout, has made the lakes and rivers of the Dominion an anglers' paradise. Yet there are two or three considerations which are worth noting in respect to angling: (1.) Excessively large fish, 20 lb. to 30 lb. in weight, are less desirable than the smaller fish, because they destroy a proportionately large amount of smaller trout. (2.) These overgrown giants, while affording good sport, are often stupid and heavy, and on the whole are not game fish proportionate to their size, nor do they provide as excellent food for the table as smaller fish. (3.) Their excessive size and probably resulting scarcity of food reduce their condition and they become favourable prey for parasites. (4.) Smaller less overgrown trout are more desirable as making less demand upon the food-supply and as affording a considerably larger amount of sport.

The brown trout, it is well known, has proved most successful in the southern rivers and lakes, while the rainbow trout has shown the greatest success in the waters of the North Island. In both Islands each species has reached a size and weight far in excess of that reached in its own native waters. But it is probable that there is a cycle in these matters, and that the trout, which have attained an enormous size since their introduction, will now become more reduced in dimensions and assume their normal weight and reduced size. As pointed out, this is not to be deplored. Similarly, the epidemic disease which has affected the trout so seriously in the Rotorua and Taupo waters has probably reached its maximum, and there are signs already that it is on the decline. As I point out elsewhere, measures should not be relaxed for getting rid of the conditions under which this disease spreads. That the trouble is on the decline I had evidence; and a similar decline in the fungus trouble has been observed in Lake Wakatipu, as seven or eight years ago the fish in that lake, I am informed, fell off very seriously in quality and a great number were affected by fungus, but during the last six years they had improved.

There should be a more systematic announcement of the splendid fishing New Zealand affords in such papers as the English *Field* and American sporting journals, in order to encourage the best class of anglers to come to New Zealand. I am of opinion that some of the anglers who have come in past years were somewhat of the nature of pothunters, whose ambition was to see how many tons of trout they could boast of capturing in a few weeks' stay. Some of these so-called sportsmen stated that they had captured some 7 or 8 tons of trout in a stay of twelve weeks - that is, over a ton and a half a week, or, say, thirty fish per day for five days in the week. Such men are not desirable; and the true sportsmen should be encouraged. Canada has been fortunate in attracting large numbers of the best class of sportsmen, and yet has had no giant trout to offer visitors. What is really wanted is an improvement in the food-supply in many of the lakes and rivers, and a far more extensive planting of fry than has been possible hitherto. In another part of this report I recommend a very largely extended system of fish-culture under Dominion arrangement.

Decline of Fish in Lakes, etc.

The decline in the quantity of fish in some localities which has been reported to me I do not regard as very serious, and with a system of crayfish-culture, or the introduction of some non-predaceous food fish of small size, such as the American smelt, the supply of trout could be maintained without difficulty. All salmon and trout waters are subject to fluctuations, and ten or twelve years ago it was a matter of common knowledge that the salmon rivers in the British Isles had shown a marked decline, and in rivers which had not been netted at all this decline had been as marked as in rivers in which netting had been carried on. This decline continued for seven or eight years, and formed the subject of a Viceregal Commission in Ireland and similar Commissions in England and Scotland;

but it is difficult to decide upon the real cause. In most cases a decline in the supply of fish and a decline in quality are due to some temporary scarcity of food.

That it is important to attract tourist anglers needs no argument; and it is stated that the angling facilities offered in such regions as the lakes and rivers of Quebec, in Canada, bring in annually nearly £1,000,000 to that part of the country, on account of the anglers who travel from all parts of the world to fish in these well-stocked trout and salmon waters.

Disease Epidemic among Trout.

I have already referred to the parasitic epidemic which has so seriously affected the trout in the Taupo and Rotorua waters, and it was clearly proved to me by the researches carried on by Dr. Reakes and Mr. Kerrigan, with the assistance of officials of the Tourist Department, that the parasite is a nematode worm which has long existed in the native fish and certain native birds. It is beyond question that the shag is the original host, and that the intermediate host is the cock-a-bully, and probably one or two other species, including the toitoi. On the introduction of the brown and rainbow trout these fish did not seem to be affected by the parasite, but after some years the decrease in food and the falling-off in robust condition resulted in the trout becoming a prey to these parasites, and eventually the internal organs and even the muscles of the fish becoming more or less seriously infested with the parasite in the intermediate stage. Two measures are essential for the extirpation of such a parasite: they are (1) the extermination of the original host, the shag, and (2) the destruction as far as possible of all fish in poor condition and infested with the parasite. Both these steps have been actively pursued; but even greater benefit would have resulted had the recommendation of the Chief Fishery Inspector, Mr. Ayson, been carried out years ago. Steps were taken very late and after much delay by the two Departments which at present share responsibility for these fisheries. Great benefit is, however, apparent from the steps taken thus late. All the "shaggeries" or nesting resorts of the shag should be destroyed, and shag shot on these interior waters whenever seen. A systematic destruction could be carried out by a small staff of Government officials, as it is hopeless to rely upon private individual efforts, even with the stimulus of a bounty. Netting of the poor or emaciated infested fish should be actively carried on for some time to come. I think, however, that the importation of a new strain of brown and rainbow trout would increase the resisting-power of the fish; and this, combined with the destruction as far as possible of the original cause, would enable the spread of this trouble to be controlled. The native fish have always been stated to have been infested with this parasite, and such fish have formed a large part of the food of native tribes without any apparent harm. Even the large trout infested with the parasite form quite acceptable food, provided the intestines and internal organs are carefully removed and any parasites in the flesh also taken out.

Waste of Netted Trout.

I was astonished, at Taupo and Rotorua, to find that tons of fine trout had been captured and buried instead of being cleaned and utilized for food. A quantity were cured and smoked, and found a ready sale; but at Lake Taupo fifteen thousand fish were destroyed annually. Inasmuch as all could not be cured, the canning of this fish might have been adopted, and tinned trout could have been sold in all parts of New Zealand. The overcooking which is necessary in putting up tinned fish, as in the case of British Columbia salmon, should render any parasites not removed quite innocuous. All fish have parasites, and the eating of such fish has not in general any evil results. Many private parties have applied to me in my tour asking if they would be allowed to buy these netted trout and put them up in tins in the event of their erecting a small cannery in an appropriate position where these netted trout could be secured with facility.

Limitation of Trout-supply in some New Zealand Waters.

Such lakes as Lake Wakatipu and others, on account of the comparatively narrow shallow portions and the immense area of extremely deep water are undoubtedly limited in the extent of trout resorts and limited in the possibility of affording angling; but all such lakes are well provided with tributary streams and creeks. In some of these streams which are lacking in pools suitable for fly fishing steps might be taken to create such pools by the erection of weirs at suitable points. This would create more still water in rapid rivers and streams. The example of one fine angling river on Vancouver Island might be cited—namely, Cowichan River—where fine fishing-pools have been artificially created by the erection of barriers composed of boulders and gravel and by excavating some portions of the river. Not only have fine fishing-pools thus been created, but the upper parts of these pools are found to increase the spawning-area for fish. The limitation in the capacity of certain lakes for fish depends upon various circumstances, especially the lack of oxygen. The surface waters, where wind and wave action are effective, become charged with dissolved oxygen, but in the greater depths, which are cold and dark and not stirred by superficial agitation, there is a lack of oxygen. This is one reason why fish do not spawn in such depths, as the eggs need oxygen. It is well known also that as the temperature of water rises its power of absorbing oxygen decreases. Professor Dittmar long ago showed that water near the surface, owing to radiation, was often colder than at a slightly greater depth, but he found a serious deficiency of oxygen below 250 ft. or 300 ft. The angling, therefore, in a great many New Zealand lakes must of necessity be confined largely to the mouths of tributaries and to tributary streams, and every effort should be made to improve and to extend these. There are many instances in which this could be easily done. One of these is the small stream which runs through Queenstown, situated on the shores of Lake Wakatipu. This fine little stream is at present merely a drain for the houses along it banks, and tin cans and old rubbish of all kinds are thrown into it, although the stream

is a favourite resort for fine trout. I myself saw in the course of a twenty minutes' walk along the banks of this stream over sixty trout. The local authorities could readily prevent this stream from being a mere drain for domestic refuse, and by widening it in some places, especially where it passes through the public gardens, could make it into a fine series of pools or small lakes which would provide splendid fishing for tourists and townspeople. With little expense and trouble the whole stream could be made into an admirable spawning and fishing area. The only step taken was a somewhat mistaken one, and one which has caused very deep dissatisfaction. I refer to the erection of a dam by the Tourist Department, which has not improved the stream in any way, and forms a barrier for the ascent of fish, although many succeed in getting over it. All such streams as this—and there are many—should be regarded as national property, and their improvement and extension for trout-fishing purposes made part of a national fish-culture scheme to attract visitors and to afford the local population the finest kind of recreation.

Atlantic Salmon: Reasons of Failure.

I have been frequently asked why the attempts to establish the Atlantic salmon in New Zealand waters do not seem to have met with success. I am convinced that success could be secured by a systematic planting of an adequate supply of fry over a series of years, as was strongly urged by Mr. L. F. Ayson. I cannot resist the conclusion that the failure of past efforts has been due to various causes such as (1.) Inadequate quantities of fry. If insufficient numbers of young fish are planted there can be no result, because these few fish are subjected to all the numerous enemies which decimate even large schools of immature fish. (2.) The fry in some cases have been planted too low down, and in one important river they were placed upon gravelly banks which in my opinion were affected by sea-water. Sea-water is most fatal to newly hatched salmon; and no results from such planting could be expected. (3.) Eels are so abundant in most of the rivers that the salmon-fry have no doubt been destroyed in vast numbers by them. (4.) The large numbers of shags which are noticed on many important rivers of New Zealand must have picked up vast numbers of these young salmon. (5.) The Atlantic salmon does not show quite the same regularity as some of the Pacific species in returning to its own river. Indeed, a recent authority in a research at Manchester University goes so far as to assert that there is no definite law governing the migrations of the Atlantic salmon, which fish is a law unto itself, living its own independent life and travelling about wherever it pleases. Hence a shoal of salmon returning to a river does not consist of a number of fish hatched and reared together and of a similar age, but is merely a crowd of fish that have congregated haphazard, of various ages, and approached the river together. Possibly the temperature of the water being a determining factor in regard to the migration of salmon may have influenced the fish and deterred them from reascending, or in leaving the river they have got too far away in search of feeding-grounds in the sea to find their way back. Occasionally, Atlantic salmon have been reported as having been taken on the sea-coast; but there is no doubt that the attempt to stock rivers has not been a success. The proper course, therefore, would be to secure for five or six years an ample annual supply of Atlantic-salmon eggs and to adopt the "intensive" system of planting them in the same river year after year until they are thoroughly established.

Introduction of New Species.

While New Zealand waters abound in fish of which a great number are excellent food, there is a great opportunity for introducing some new species which would be of account both from a commercial and a sporting point of view.

Striped Bass.—One of the finest of food fishes, and an important game fish, is the striped bass of the Atlantic shores of Canada and the United States. It is a handsome fish, and ranges from 5 lb. to 30 lb. or 40 lb. in weight. Its table qualities could not be surpassed, and it is a fine sporting fish. It spawns in rivers, and in Canada spends a large part of the winter in brackish water; but its usual habitat is in the inshore waters along the coast. The success which has attended its acclimatization on the Californian coast has been such that I am satisfied the New Zealand waters offer a great opportunity for the introduction of this fish. On the Californian coast it has been so successful that striped bass are sold in San Francisco at a less price per pound than on the Atlantic coast, its original home. There would be no difficulty in procuring quantities of small bass and transporting them to this Dominion. The eggs would be more difficult to handle, as they are very small and delicate, and the young fry hatch out in such a short time.

Rocky Mountain or Cut-throat Trout.—In size and other features this fine species of trout varies greatly in different waters. In some of the Californian lakes its weight is recorded as 12 lb. or 15 lb.; while in British Columbia I have noticed that they usually range from ¾ lb. to 3 lb. or 4 lb. I notice that the Chief Inspector of Fisheries, Mr. Ayson, has in several of his reports strongly urged the introduction of this species, and specially recommended the Lake Tahoe kind, which is a fine fish reaching a considerable size. No doubt supplies of eggs of this fine fish could be readily obtained from Californian authorities.

Gourami.—The gourami is a valuable fresh-water fish, native to the streams and ponds of Java, Mauritius, &c., and is well worth experimental trial in New Zealand, both on account of its furnishing food for trout, and its usefulness as a table fish owing to its exquisite flavour. It ranges up to 20 in. in length and 10 lb. to 15 lb. in weight. It is a non-predaceous insect-eating fish, and is a great consumer of mosquito-larvæ. The rearing of gourami is a very easy task; and as it constructs a nest in which it deposits its eggs, and the male acts as defender, it is a fish that would readily establish itself. In rearing the young ones (4 in. to 6 in. in length) worms, boiled rice, and raw liver have been used, but it really feeds naturally upon aquatic plants and insect-larvæ. I understand that it has been introduced into Ceylon with success, and it has long been known in Europe as an aquarian fish.

With respect to the *turbot*, the true *lobster*, and the English *crab* it is not necessary for me to say anything in this place. I can only express a very favourable opinion as to the methods which have been adopted in New Zealand for the acclimatization of these three valuable species. The success in transporting young turbot and rearing them at the Portobello Marine Hatchery is certainly a feat which is almost unique in the annals of acclimatization.

Special mention must be made of the splendid success which has been obtained by Mr. Ayson, Chief Inspector of Fisheries, in establishing the valuable *quinnat salmon* in New Zealand waters. This fish is the finest of the Pacific salmon. It is not only the best of table fish, but, especially in its young stages, is an important game fish. After the grilse stage is passed they usually take the fly with avidity, and have been fished for in British Columbia rivers, especially on Vancouver Island, with great success. When they reach a weight of 20 lb. to 40 lb.—specimens over 80 lb. in weight have been caught in British Columbia—they provide royal sport by trolling with spoon-bait in the sea. Several rivers on Vancouver Island provide in their estuaries the finest quinnat-fishing, and sportsmen from all parts of the world visit these rivers, especially Campbell River, for the purpose of capturing this giant salmon. Mr. Ayson has succeeded in thoroughly establishing this salmon in the Hakataramea River, and he is adopting an admirable plan in the attempt to establish it likewise in some of the rivers of Westland.

Sockeye Salmon.—The most important commercial salmon on the Pacific coast is the sockeye or red salmon, sometimes called blueback salmon. It is not a very good table fish, and absolutely without sporting qualities, but it increases so rapidly, and ascends rivers in such immense schools, that the salmon-tinning industry depends upon this species. Owing to its deep red colour it has put out of the market practically the fine Columbia River and other pale-fleshed fish. There are several rivers on the coast of New Zealand which seem to provide admirable conditions for the introduction of this valuable species with a view to creating a commercial salmon industry. Experts have come to the conclusion that sockeye salmon will only do well in rivers which have lakes at their headwaters. This fish, almost without exception, in its native rivers, ascends to the upper waters, migrates through the lakes there, and spawns in the remoter tributaries. This is the notable feature characteristic of the sockeye salmon.

Steelhead.—The steelhead of British Columbia very closely resembles the Atlantic salmon. It is a good sporting fish and takes the fly readily. It reaches a considerable size—20 lb. or 30 lb.—and possesses good table qualities. It is stated to have been already introduced into New Zealand waters; and the statement has been made that the first shipment of so-called rainbow-trout eggs to New Zealand was not rainbow but steelhead ova. One authority in 1909 wrote that twenty-five years ago a shipment of steelhead-trout eggs from California was sent by the late Thomas Russell. The eggs were obtained from Mr. Lamotte and were secured from steelhead taken in Sonoma Creek. If this shipment did consist of steelhead eggs they have not been a very great success, as the true rainbow trout abounds in many New Zealand rivers and lakes, whereas an authentic capture of a steelhead has not come to my notice. Occasionally, specimens of what are called "blue salmon" are stated to have been captured, and it is possible that these may be steelhead, but they are few in number and unimportant. I do not recommend the planting of steelhead, as it is a very predaceous species, and, unlike the Atlantic salmon and most of the Pacific salmon, it feeds very voraciously in fresh water. One well-known Canadian angler actually took seventy-three small trout from the stomach of a large steelhead.

Alberta Grayling.—There is one species which I understand has never been tried in New Zealand waters—namely, the Alberta grayling or Williamson's whitefish—which is a very active and beautiful species, of a silvery appearance, ranging from 2 lb. to 3 lb. or more in weight, and possessed of extremely fine sporting qualities. It occurs in the eastern and western Rocky Mountain streams, and affords splendid fly fishing. It belongs to the whitefish family, but has more of the qualities of a grayling or trout than of a lake whitefish. It resembles very much the native grayling of New Zealand, and sportsmen who have had any experience of fishing for it in Canada are loud in its praise.

Landlocked Salmon, or Ouananiche.—I am strongly of opinion that were a supply of the eggs of this fine game fish secured and the fry planted in such lakes as Manapouri or Te Anau the result would be most satisfactory. These waters are cold and pure, and have in every case swift running inlets and outlets which are of importance in regard to this fish. In lakes known to me in Quebec and New Brunswick, Canada, these landlocked salmon, though able to descend to the sea, do not do so excepting accidentally. In view of the high esteem in which this fish is held by anglers, and the certainty of success in New Zealand waters, arrangements might be made, and I advise should be made, to procure supplies of eggs in order to establish these species in such waters as I have referred to.

Terrapin.—The terrapin or diamond-back turtle is one of the most valuable aquatic animals, and it is in such demand in the United States that the supply is totally inadequate and the price has become exorbitant, £7 10s. per dozen being paid for these turtles; and on the bills of fare in New York, Boston, or Washington, 8s. or 9s. is usually charged for a dish of terrapin. There is no difficulty in establishing terrapin in tidal brackish lagoons where the temperature is not too severe. There are some lagoons in New Zealand in which the temperature of the water, so far as I have been able to observe, most resembles that of waters of North or South Carolina and Chesapeake Bay, where terrapin abound. Small bays of quiet water with soft mud and sandy shores, and fenced off in such a way as to admit the tidal influx and outflow, are suitable. During the winter the terrapin burrows into the mud, and only during the warmer months of the year is active and requires feeding. As many as two thousand or three thousand may be cared for in a half-acre enclosure, and they will flourish on crabs, fish-fragments, cabbages, turnips, cornmeal, &c. In May or June the female deposits eight or nine eggs or more in a hole which she digs with her hind feet to a depth of 7 in. or 8 in., and then leaves them to hatch out, which they do early in September. In ten or twelve weeks the young emerge, and measure about 1 in. in length. They are transferred to rearing-tanks covered with wire netting

to prevent their escaping, as they are fond of climbing. They require to be fed three times daily, and they grow about 1 in. a year. The female is always larger than the male, and is in chief demand in the market. In the fourth year the female terrapin may be 4 in. or 5 in. long, and is considered ready for sale; but in the fifth year all terrapin reach a marketable condition. It might be added that the male is usually not marketed, and a few only are used for breeding purposes. The demand for this turtle is so great in the United States that a paying industry could be created in New Zealand and terrapin exported, if inshore lagoons prove to provide suitable conditions. The experiment is one which I strongly recommend as worth trying.

Frog-culture.—It has seemed to me that there are many marshy areas which I have seen in the course of my travels where the bull-frog would be worth cultivating. Frogs' legs are becoming expensive on account of the growing scarcity in North America, and I am confident that the introduction of the large bull-frog, the legs of which are in chief demand and realize quite a high price, would result in the setting-up of a paying industry. Enclosures could be made in which the frogs would be placed in order to prevent them spreading, as there would be some danger to young fish if bull-frogs made their way into waters stocked with trout. The danger is not a very serious one, as evidenced by the conditions in Canada, where bull-frogs abound and trout are also abundant. But they are very voracious creatures, and the areas for bull-frog culture should be effectually enclosed by wire netting. I deal with this subject more fully in my later report.

Pearl-oysters.—In view of the great demand for shell materials used in the manufacture of pearl buttons, it seems to me that experiments are most desirable with the pearl-oyster. This shell-fish not only produces pearls of great value, but the shell itself, on account of its flat pearly interior surface, is very valuable for commercial purposes, and realizes £40 to £100, or as much as £200, a ton. They live normally in waters between 25° and 26° south latitude. The northern waters of New Zealand are between 15° and 36° south latitude; but warm currents wash the Bay of Islands and the waters between North Cape and the Great Barrier Island, and experimental transplanting of the pearl-oyster is well worth trying. In Western Australia acclimatization experiments were carried out at Shark's Bay, near Geraldton. In the experiment living shell-fish were transplanted from warmer waters further north, in special tanks through which a flow of water was maintained, and they were transferred to wooden boxes open above and below and covered with wire netting to retain the shell-fish. These experiments were attended with considerable success. If it were found that they flourished and successfully bred in some of the warmer bays of New Zealand, a valuable industry might be created.

Oyster-fishery.

There are three important points respecting the oyster-fishery which I would briefly refer to—

First, submarine beds of oysters, similar to the famous Foveaux Strait beds, occur all along the coast of New Zealand at intervals. In my trawling and dredging experiments evidences of oyster-beds were brought up almost at every haul, usually dead shells and more rarely living oysters. Many of the localities have never been fished for oysters at all. From the outer west shore of Foveaux Strait east and north up to Cook Strait oysters occur at various points; and at Tasman and Golden Bays, near Nelson, living oysters were brought up. These areas and the well-known Foveaux Strait grounds should be surveyed, and the beds on which living oysters occur should be mapped out.

Second, recognized beds with very little trouble can be extended by the return to the beds of undersized oysters brought in by the fishermen. Adventure Bay oysters might be used for this purpose, as they are said to be of finer quality and flavour than those in Foveaux Strait. Generally in the same way rock-oysters can be extended and new beds started on suitable shores—*e.g.*, Queen Charlotte, Pelorus, and other sounds at the north end of the South Island. The existing beds in Hauraki Gulf and Bay of Plenty would furnish abundance of seed for creating new beds in other localities, and information was given me at times of the occurrence of limited rock-oyster areas where they are not at present utilized. Some of the lagoons of a tidal nature which occur on both Islands might be valuable for oyster-culture experiments. It is possible that oysters might flourish in such waters as Lake Ellesmere, Awarua Bay, and Waituna Lagoon, and these might be considered for test experiments. Great quantities of what are called mangrove-oysters, which are not generally esteemed in New Zealand, though they sell well in Sydney, could be transplanted to other areas, and would certainly improve in quality were they so transferred.

Third, existing Government management of oyster-beds. I had every reason when visiting the northern oyster-beds to conclude that the system of Government supervision carried out in Hauraki Gulf and Bay of Islands has been the best system possible. It has saved these beds from destruction, otherwise they would by this time have probably been entirely cleaned out. Two main objects have been thus accomplished—namely, the beds have not only been preserved but rendered far more productive; and, secondly, the public have been able to obtain ample supplies at a reasonable rate, and the average size has been most satisfactory.

There is some feeling prevailing that the bed-oysters in Foveaux Strait might be brought also under Government supervision, and the matter is one well worth considering. Under the present system the tendency is, owing to the rivalry amongst the fishermen, for each individual to clean as thoroughly as possible any area upon which he is working. There I found with surprise that the fishing is entirely free and unrestricted, the only protection being the existing four months' close season from the 1st November to the end of February. My experimental dredging in the strait clearly showed that in some areas the oysters are becoming scarce, and I would suggest two steps which seem to me to be desirable before the Foveaux Strait supply becomes endangered: First, that a system of special oyster licenses should be inaugurated; and, second, that areas should be laid off each season on which no fishing should take place, in order to seed the surrounding areas. This method of establishing

temporary reserves and fishing the areas on a system of alternation has been proved most effective in maintaining a permanent supply. If the system adopted on the rock-oyster beds of the north was applied to the Foveaux Strait and other beds it would certainly be the best safeguard for the future. Even a licensed fisherman is anxious to get all he can in as short a time as possible. The Department wisely limits each northern fisherman employed to three sacks per tide, and this limitation ensures an ample supply for the present demand, the picking of the best marketable-sized oysters, and the saving of the smaller and the breeding oysters, which thus maintain the future supply. The public certainly benefit by the present Government method of employing men at stated pay, and insisting upon the picking of good marketable oysters. The price charged is very reasonable—namely, 13s. 6d. per sack, containing on an average 90 to 100 dozen oysters, and in retail quantities equal to 3d. per dozen, as compared with the price for oysters of less delicate and delicious flavour in England—viz., 3s. to 5s. per dozen; in the United States, 1s. 6d. to 3s. per dozen; and in Canada, 1s. to 2s. per dozen.

Leases.—I cannot regard the leasing of oyster areas in New Zealand favourably, in view of the benefit to the public of the successful conservation on the North Island secured under present conditions. Leasing usually implies the granting to a company or to private individuals the right to take oysters on a definite area to the exclusion of everybody else. This is a private monopoly, and has not been found to work well in other countries. Canada has tried both leasing and annual licenses, and the result has been practically the destruction of the fine oyster-beds of Prince Edward Island, New Brunswick, and British Columbia. Endless conflict and complaint arose from the existence of leases, and the public got no benefit, as the oysters became more scarce and prices became almost prohibitive. I do not propose in this place to speak of the export of oysters; but London and New York and even some of the large Canadian cities such as Montreal would pay a high price for such oysters as New Zealand produces, and it might be worth while to experiment with various methods of keeping shell-oysters for long periods in cool conditions, or of preserving them in such a way as to maintain their full and appetizing appearance when placed on the table after being kept for many weeks or even months.

Toheroa-beds.

This shell-fish, from which a most delicious soup is made, appears to be rather local in its occurrence, though there are many beds not generally known, some of which I visited during my tour. In view of the limited nature of these beds the question arises as to what is the best method of utilizing them in the public interest. It seems to me that if all the areas continue to be open to the public this delicious shell-fish will rapidly become exterminated. The best course, therefore, would be to lay off some of the recognized areas and lease them to parties prepared to erect a cannery and tin these valuable molluscs. There are one or two such canneries already in operation, and it would be a desirable step to grant a lease for nine or fifteen years covering an area of, say, five miles of shore from which all other firms should be excluded. Such a lease would justify the carrying-on of an up-to-date tinning establishment. More extensive leases either in area or time to single firms or parties would establish a monopoly, but it is quite feasible to leave certain areas open to the public and to lease areas to firms prepared to tin the toheroa. An essential part of a system of reserving for lessees and for the public definite beach areas is the laying-off annually of some portion of these areas for seeding purposes. I do not think that the life-history of this shell-fish has been studied; but it no doubt resembles *Mya arenaria*, a species of clam which is forming the subject of research at marine biological stations in Canada and the United States. The egg is no doubt cast out in the spawning-time into the sea, and develops into a swimming larva, which in a few weeks sinks from the surface waters into the shallow sandy areas, where it buries itself and grows into the adult stage. By-laying off areas which are fished alternately, and thus providing spawning reserves, the floating eggs and young are produced in immense quantities, and carried by the currents and tide over the whole shore. In this way a permanent supply of these shell-fish is secured, and at the same time areas are thrown open every season for utilization by the public or by lessees authorized by the Government.

Whitebait Industry.

There is very little to be said in regard to the whitebait question, as the fish still come up in immense numbers season by season and form a delicious addition to the bill of fare in hotels and private homes. I examined some specimens of whitebait on the West Coast and found that they certainly were not what many parties supposed them to be—the young of the smelt. They appear indeed to be a species which reach an adult condition and spawn without being transformed into any of the larger recognized species. It may be that, like *Crystallogobius*, they are a transparent fish all though life. But, on the other hand, it is just possible that the life-history of this fish is a peculiar and interesting one, and that further studies may show it to have two breeding-stages—one an early stage which in other fishes would be regarded as immature, and at a second stage later in life it may develop into some well-known recognized species. Its movements are so peculiar, and so far as is known its habits so unusual, that the life-history of whitebait is well worth systematic study by some of the New Zealand biologists.

Whaling.

New Zealand has long had a reputation throughout the world for its splendid whaling resources; but I regret to find that these resources even now are being most wastefully handled. It was found necessary in Canada to require parties entering upon the whale industry to obey a system of regulations with a view to preventing the waste of valuable whale products and to prevent the industry being a nuisance in the localities in which it is carried on. No parties should be allowed to kill whales unless they are able to handle and properly use the creatures when captured. I have every evidence during

my short stay in New Zealand that parties utterly unprepared to handle whale products properly have entered upon this pursuit, with the result frequently that wounded whales escape and die, their bodies decaying at sea, and in many cases being thrown up on the shore in a putrefied condition. Such a waste of these enormous creatures, which are capable of yielding such valuable products, is a national wrong, and a serious menace to public health. All parties engaging in whaling should have the necessary capital to put up a proper whale-reduction works where the oil can be extracted and the waste materials fully utilized in the shape of manure or other products. Modern methods of whaling are so efficient that the escape of a whale has become almost an impossibility, and every ounce of the huge carcase is turned into valuable material. Why should New Zealand allow these animals to be destroyed and wasted and the valuable by-products utterly unutilized? No more profitable industry can be carried on than the modern method of whaling and the utilizing of whale products in reduction factories.

Fur-seals and other Seals.

While making my cruise on the "Hinemoa" I had several opportunities of seeing the last remnants of the great seal herds which once abounded on a number of rookeries in the southern waters of the Dominion. It is stated that between 1816 and 1826 one hundred sealers were permanently settled in New Zealand; and the annual takes of valuable fur-seals were enormous, from one southern island alone during 1814 and 1815 no less than four hundred thousand skins being obtained and taken to London. The sealing-vessel "Pegasus" took to London one hundred thousand of these, but they were so badly handled that they heated during the voyage and were ruined, so that they had to be dug out of the hold and sold as manure—a frightful waste of valuable skins. The methods of killing were of a most cruel, indiscriminate, and wasteful character, and the result is that the New Zealand seal-rookeries, which should be yielding enormous annual returns, are practically of no value or importance so far as their production is concerned. The establishment of sealing prohibitions in recent years has not had the effect of restoring the numbers of this valuable animal; but this is explained by the fact that no patrol is maintained, and the destruction of seals goes on undetected, thereby defeating the object of the prohibitions. A few score seals are all that remain on some of the rocky ledges which I visited and which once abounded with the fur-seal. The sealers in former days carried on their pursuit like madmen, using no discretion, and simply slaughtering right and left, old and young, males and females. The numbers killed were sometimes so great that a great many passed into a state of putrefaction without either being skinned or utilized.

No intelligent person can doubt that this reckless destruction carried on without any supervision or control by sealing crews from all parts of the world, but chiefly from Britain and the United States, has been a great mistake. The example of the United States shows what a valuable asset fur-seal rookeries are if properly protected and supervised. It is well known that the fur-seal industry of Alaska has yielded to the United States Government an enormous revenue, and, with the fishery returns, has paid many times over the price which secured from Russia this arctic territory.

New Zealand can still restore her fur-seal industry by the following measures: (1) A prohibition for a number of years of all seal-killing and handling of seal-skins; (2) a regular patrol around the shores and islands frequented by seals; (3) the prohibition of all sealing operations excepting under a license issued by the Dominion Government.

There is no force in the argument which has been urged that fur-seals are reducing the supply of fish in the neighbourhood of the rookeries. Fur-seals feed largely on inferior species which are of no marketable value; and, as is well known, in Behring Sea the presence of enormous herds of fur-seals has had no effect on the great abundance of the valuable fish required for commercial purposes.

While thus strongly recommending the protection of the fur-seal rookeries and the taking of steps for restoring them to plenitude, I make no reference to the various species of hair-seal, such as the sea-leopard and harbour-seal. The harm done by these seals I am of opinion is exaggerated; and scientific evidence does not support the contention that schools of hair-seals seriously affect the supply of fish in the sea.

It might be possible to utilize such a vessel as the training-ship "Amokura" in the work of patrolling the fur-seal areas; and were the penalty of violation made very heavy and include confiscation of vessel and gear, the effort would, without doubt, be completely successful.

Fish-culture.

Under a Dominion Fisheries Department a centralized system of fish-culture could be readily carried out, to the benefit of the whole country. No country has a greater opportunity for doing splendid work in this way; and the success which has attended the work of Mr. Ayson, and the operations carried on by acclimatization societies, under a great many disadvantages and limitations, shows what a fully organized fish-culture scheme under Government auspices would accomplish. The United States spends nearly £70,000 per annum on fish-culture work, and operates forty-four permanent and 102 sub-hatchery and planting stations. Canada spends nearly £60,000 annually on fifty-one hatcheries, and has four new hatcheries and supplementary salmon and lobster ponds in course of construction. While the Act of 1912, providing for the encouragement of trout-cultivation by private parties in New Zealand, has no doubt stimulated worthy efforts, the countries in which the rivers and lakes have been most effectively stocked are those in which a large inclusive scheme has been economically conducted by the Federal Government. It is probable that the acclimatization societies at present spend between £2,000 and £3,000 per annum on fish-culture, and it is therefore easy to be seen that the Dominion Government spending £10,000 to £20,000 could confer immensely more benefit and the whole of the population would receive the advantage. In addition, there would be an influx of tourists and visitors on account of the increase in the supply of sporting fish.

Fish-hatching is carried on now under a divided and confusing system—namely, somewhat erratic efforts by the various local societies, and some hatching operations carried on by the Tourist and Marine Departments. The work of importing and hatching fish under the Marine Department is doing at present only a fraction of the work, not altogether ineffectively, which could be done with greater advantage and with immensely greater results under a central and uniform system of Dominion fish-culture. The hatching of sea-fish would come under a Dominion scheme. While it must be admitted that the Portobello Marine Hatchery has been doing splendid work, and accomplishing some remarkable results in the acclimatization of such fish as the turbot, the lobster, &c., the operations are too limited to be of great benefit to the fisheries. Such an institution would come under the scheme which I suggest, as also would a proposed marine hatchery for the North Island. At very little expense the hatching and rearing accommodation could be extended fifty-fold, and the culture of valuable marine fishes carried on for the purpose of benefiting the inshore waters by way of increasing the flat fishes and other species on a large scale.

The culture of mullet, though not without difficulty, could be included. The mullet is a highly esteemed fish, and there have been several mullet-tinning factories operated. I understand, however, that in some localities the supply of this fish has considerably fallen off. On the other hand, I was informed by a reliable authority that immense quantities of mullet still frequent the west coast of the North Island and some of the shores north of the Bay of Islands. It might, I think, be advisable to try some experimental hatching of this fish by procuring spawn when the fish approach the shores for breeding purposes. The depleted areas could then be restocked by this highly desirable fish.

The Transportation of Eggs and Young Fish.

The present annual shipments of eggs and young fish to various localities from central hatching establishments seem to me to be capable of considerable improvement. With a small staff and with the lack of a general Government scheme great dangers are incurred when valuable eggs and fry are sent long distances. In Canada no shipments of salmon, trout, or other fish eggs are made unless accompanied by a qualified officer. Such shipments are regarded as of great value and importance, and worth every protective measure when in transit by rail or steamer. It is impossible in New Zealand under the present system, or lack of system, to have this always done, and serious results, in my opinion, often arise from rough and improper treatment of the shipments of eggs and fish *en route* from one hatchery to another. They are subjected at times to the roughest handling, and are often turned upside down in spite of large official labels, "Handle with great care," and "Keep this side up." They may be placed near odorous oil, or casks of dangerous materials, or close to stoves or hot pipes, often with the risk of fatal results, and not infrequently they are unnecessarily delayed. In one case which came to my notice a case of valuable trout-eggs was turned up on end and used for some time as a desk by a wharf tally-clerk. Four cases had been shipped, but only three arrived at their destination, the missing case being subsequently discovered doing service as a desk, as stated above. In other cases, eggs directed to be sent by rapid steamer were found to have been forwarded by slow freight-boats. With a proper staff under a Dominion Fish-culture Branch a trustworthy and qualified official would attend such shipments, and thus avoid the dangers which at present attend eggs in transit—eggs which, after many months of care and labour, are ruined at the last stage by rough handling *en route*, and the efforts of hatchery officers thereby nullified and practically thrown away. I am also convinced that many of the parties who plant the fish, under the present system, or lack of system, do not take the precautions which qualified officials would take. Sudden changes from the water of the hatchery-tanks or of the transportation-cans into lakes or rivers several degrees colder or warmer are generally fatal. I have been asked on many occasions why no results followed the planting, year after year, of quantities of fish, and in numerous cases the answer must be that the cans of fish were planted with such lack of knowledge and absence of necessary precaution as to render any good results impossible.

Injuries by River-pollution.

Many fine rivers, such as the Taieri, with fine banks, splendid scenery, and perfect angling-pools, have been utterly ruined by gold-mining pollution. Apparently there is no cure for this, but while New Zealand cannot help the loss of such fine fishing-waters, there are a number of rivers into which pollution is being poured where steps should be taken to prevent it. There are a few cases of sawdust pollution which should be most rigorously dealt with. There is no reason why sawdust or mill-refuse should be poured into any streams suitable for fish, especially as sawdust and such refuse can be now utilized as indicated in another portion of my report. The use of cyanide of potassium in quartz gold-mining, which is likely to largely increase in the future, is also a source of great danger to fish and all aquatic life, owing to the deadly effect of this cyanide on such life. The most effective steps should be insisted upon in order to prevent this waste going directly into public waters. In North America such mining operations have in every case been permitted only on the condition that the cyanide pollution is conveyed over certain waste areas where by a natural system of filtration it ultimately reaches the rivers or streams deprived of its most serious poisonous qualities. That sawdust and mining pollution has been effectively dealt with in other countries is a proof that stringent measures would be successful in New Zealand.

Waste Fishery Products.

I have observed that in New Zealand practically none of the waste products resulting from the fish industry are utilized, and the surplus catches of fish which are not marketed are usually consigned to the sea or to municipal destructors. Most valuable commercial products can be made of such

wasted materials; and just as the Canadian sawmills discovered a few years ago that sawdust, which they had been throwing into rivers, could be made into valuable commercial materials, so fish-waste could be turned to account. Recently, in reference to sawdust, it has been found that about £8 per ton can be realized for this material for the purpose of making gas, which it is reported can be sold for lighting and heating purposes at 5d. per thousand feet. A Baltimore chemist has devised a process of extracting gas from sawdust. Large quantities also are used in Canada for making wood-alcohol; and in Austria it has been utilized for making a fuel by mixing it with tar materials and moulding it into small briquettes, of which one Austrian factory alone produces 7,000,000 a year.

The readiest method of utilizing waste fish and fish-offal is by the manufacture of manure of an extremely valuable character. Fish-skins also, if separated and dried, are in great demand for the manufacture of fish-glue; while oil extracted from fish-waste is of importance as being specially suited for certain paints used for painting ironwork. It is superior to linseed-oil in the manufacture of leather products and printing-ink, and good prices are paid for refined fish-oil, of which many New Zealand fish contain considerable quantities. Following the example of Grimsby and other European fishing-ports, Canada has encouraged the erection of fish-reduction works where oil is extracted and manure manufactured. Owing to its richness in nitrogen fish fertilizer is of extreme value for agricultural purposes. It therefore does seem absurd that New Zealand should import 100,000 tons of land-fertilizing materials annually when far more valuable materials are being thrown away in the shape of fish-waste. In my detailed report I shall furnish full particulars of the methods of handling fish-waste, and tables showing the superiority of fish fertilizer over the materials at present being purchased by New Zealand farmers.

The immense amount of fish-waste produced annually, and the vast quantity of fish thrown back into the sea and not utilized, or, if brought ashore, sent to the incinerator and destroyed, is a source of serious loss to the country, especially in view of the fact that at least 20,000 tons of superphosphates for fertilizing the land are imported annually by New Zealand. It is stated that 60,000 tons of this land-fertilizer are imported from Europe to Australasia, and of this New Zealand gets about one-third, apart from other large importations of guano and other manure material of which the chemical constituents are less rich and available than in the fertilizers made from fish-waste and unutilized fish, the total imports last year being no less than 102,925 tons, of the enormous value of £377,422.

Fish-oils and their Utilization.

The livers of most fishes caught in New Zealand contain valuable oil, and some of them, such as the electric ray or torpedo-fish, yield an oil which is of exceptional medicinal importance. The waste of fish-livers implies an enormous loss of revenue annually, for all fish-oil is of value, and, as is well-known, the supply of codfish-oil in the markets has in recent years been far less than the demand. Codfish-oil is really not merely the oil from cod-livers: it is largely oil extracted from the livers of various species of fish. Indeed, the dogfish-oil, when properly refined, is said to be superior to cod-liver oil, and is sold in the markets under that name.

I might mention that fish-oil for medicinal purposes can be prepared as follows: (1.) Clean the fresh liver from skin, gall-sac, blood, &c., and wash in two or three waters. (2.) Cook over a fire in a metal pot fitting into a larger pot with a space of 2 in. or 3 in. between, filled with water; boil at 165° F. for forty-five minutes. (3.) Allow to cool. (4.) Draw off floating oil. (5.) Filter through strainers of canvas, and finally moleskin. (6.) Bleach by exposing in shallow pans to sun's rays for one hour. (7.) Extract dark oil by pressing the sediment or lower stratum: this dark oil is of special value to curriers. (8.) The final solid refuse can be made into a good fertilizer.

With respect to the dogfish-livers: the extracted oil is richer in iodine, and has much less stearin than codfish-oil. 2½ gallons of liver usually yield 1¼ gallons of oil, which may sell at 1s. 8d. or 2s. per gallon.

In Norway the livers are cooked in steam-jacket vessels provided with mechanical stirring-devices inside, and a stream of carbonic-acid gas surrounds it so that no oxidation takes place. Oxidation due to exposure to air causes an unpleasant taste in medicinal oil.

Utilization of Fish-roe.

Large quantities of fine fish are captured in New Zealand in which the roes or egg-bags are very large and could be converted into fine food products, or utilized for other purposes of commercial importance. The roes of the hapuka or groper have now attained some repute in the market, and I understand in some towns bring no less than 1s. per pair, a pair of ovaries weighing about 1 lb. They are a delicious food when properly prepared and fried, and, as is well known, the roes of some fishes are extremely valuable as an epicure's dish. Thus the roes of the shad, a fish abundant in Canada and the United States, appear on hotel bills-of-fare at a very high price, no less than 1 dollar being paid for a dish of shad-roe, which is really only half a roe. Caviare, which is a most valuable fish product, could also be made of the roes of such fish; but it requires some skill in curing and preparing, and "white" eggs may require to be coloured in order to imitate the true caviare. There is a great demand for slated roe in France. It is called "rogue," and is used as bait in the sardine fisheries. The eggs of hake and cod, &c., have been largely used. It is prepared by soaking for some days in brine, and is then packed in strong, tight casks holding about 25 gallons. Each cask brings from £2 10s. to £6 according to its quality. There should be no waste of fishes' roes in view of the great demand for salted roes in the French sardine industry at such high prices.

Fish-food in Dominion Waters.

During my coast cruise I saw every evidence that abundant food exists all along the New Zealand shores, and I saw great quantities of floating food, especially the red whale-feed, extending for many

miles, and at times, I was told, it is so abundant as to be thrown upon the sea-beach for many miles 12 in. or 15 in. deep. The introduction of the sea-herring would, I think, be attended with success, and without any harm, in view of the superabundance of floating food in the sea. While dredging I obtained evidence of abundance of molluscs, hermit-crabs, sea-worms, sand-stars, &c.—all good fish-food.

With respect to the food in fresh waters, there seems to be evidence that in a great many lakes and rivers the total amount of food is decreasing as compared with the amount observed years ago. The whitebait and the inanga, while still very plentiful, are not, I was informed, so enormously abundant as formerly; and the fresh-water crayfish, or koura, in some localities is stated to have fallen off very seriously. Certainly the large trout of 10 lb. to 25 lb. in weight must destroy a large amount of this food, and I cannot resist the conclusion that they have decreased the total amount of such food just referred to.

At Taupo species of carp were introduced with the object of providing food, but I think this was not a wise step. Small carp are not eagerly devoured by trout, and they destroy a quantity of small food on which more desirable young fish and crustaceans live. The introduction of the small minnows of Britain or North America has been suggested, and Japanese minnows have also been urged. I found some evidence that the native food had not fallen off in some places; and on Lake Tarawera crayfish, or koura, were stated to be as plentiful as ever. The Marine Department has already been recommended by Mr. Ayson to make an extensive planting of lake whitefish and the lesser whitefish, or so-called lake herring, and these with the small North American smelt would, I think, provide ample trout-food in the lakes and streams where there has been any decline. The three species mentioned are entirely innocuous, can do no harm, and in their younger stages afford abundant and most nutritious food for sporting fish.

I also think that on a good many rivers and lakes there are arms or tributaries in which water-cress and certain water-plants abound; and steps might be taken to cultivate the crayfish, or koura, on a large scale, and the smaller crustaceans, such as daphnia, cyclops, &c., after the methods which have been detailed in certain American and Japanese reports. The officers in charge of hatcheries could do this work without much loss of time. Were these food-culture reserves separated from the main streams or lakes by gates, the gates could be opened at intervals to liberate the cultivated feed, especially at times when the young trout, after the yolk-sac is absorbed, are taking food readily. In some streams the amount of minute feed suitable for young fry may not be very abundant, although I was much pleased to find on examining the bottom of some waters that there was an abundance of food in the shape of larvæ of the caddis and isopods or stone-lice, shell-fish, and various other organisms upon which trout feed and fatten rapidly.

The Steam-trawling Question.

I am an advocate of steam trawling as the most effective, rapid, and reliable means of supplying the public with fish. My early work in Scotland thirty years ago was connected with the great trawling controversy, and my researches carried on under Professor MacIntosh, of St. Andrew's, Scotland, proved the allegations against steam trawling to be on the whole erroneous and baseless. Several objections to trawling were made, and are still repeated, which I proved to be unfounded. These objections are—(1) Spawn or valuable fish are crushed, destroyed, or brought up in quantities from the bottom of the sea: (2) vast numbers of immature fish are captured; (3) feeding-grounds are denuded and ruined; (4) the schools of fish are decimated and rapidly destroyed.

None of these contentions were established, for the following reasons:—

(1.) No spawn is crushed or captured on the bottom: it floats on the top of the water. Cod, haddock, flat fishes such as sole, turbot, brill, &c., all produce floating spawn, the only exception being the herring, which attaches its spawn to rocks and weed. It has, however, never been alleged that herring-spawn is brought up in tons by the trawl, being indeed deposited on rocky ground as a rule unsuitable for trawling.

(2.) Undersized fish are not taken to any serious extent—indeed, less so than by drag-seines, nets, &c., or even baited lines used inshore in shallow water. Great numbers of undersized flat fish are taken by these nets, and many immature fish are captured on baited lines.

(3.) Marine fishes feed very largely about rocky ledges and rock bottom, or on floating food which abounds near the surface, and the trawl does not injure such food. Comparatively little of the food of important fishes gets into the cod-end or bag of the trawl. Dogfish, skate, and large numbers of the enemies of young fish and of fish-spawn are destroyed by the trawl.

(4.) Trawling has not cleaned out the North Sea, though it has been carried on there for over seventy years incessantly. The vast fish-supply of Britain is greater than ever, and 50 per cent. of it still comes from the North Sea, only 20 per cent. from Iceland, 2 per cent. from the arctic seas, Lapland, Spitzbergen, &c., 2 per cent. from the Irish Sea, and 7 per cent. from the west coast of Scotland.

The importance of steam trawling in Britain may be judged from the fact that England has thirteen hundred steam trawlers, Scotland three hundred, and the rest of North Europe four hundred. In addition, there are over eleven hundred steam fishing-boats, mostly herring drifters, and of these England has five or six hundred. Seventy or eighty years ago there was not one fishing-boat on the coast of Scotland more than 30 ft. in length, and none of them were operated otherwise than by sails.

I am of opinion that the New Zealand coast is such that trawling can only be carried on in certain areas, and a large part of the fishing-grounds must be exploited by liners and by purse-seines or other nets. The shallow areas (10 to 30 or 40 fathoms) are limited, and the schools of such fish as schnapper, blue cod, groper, mullet, &c., might be seriously disturbed were steam trawling extensively carried on in partly enclosed bays and other sheltered waters. Hence I regard as a wise precaution such limits

as those established in Hauraki Gulf, &c., where steam trawling is prohibited. The smaller fishermen, especially the line and net fishermen, have a claim to special treatment, as they can supply the local markets abundantly from areas close at hand, and steam trawlers, if of the right tonnage and with up-to-date gear, can work grounds farther out. Indeed, such restrictions will probably stimulate the building of larger trawling-vessels, enabling fishing to be carried on at greater distances, remaining out longer, and returning to market more speedily with their catches.

The question of Government or of municipal trawlers I shall deal with more fully in my later report. I do not regard such proposals with favour. The Government of New South Wales, I am aware, is entering on an experiment with a Government trawler; and it is estimated that a trawler costing £12,000 will yield a profit of £4,000 or £5,000 a year, the gross earnings being estimated at over £11,000 and the working-expenses at £6,000, the profit being based on a selling-price wholesale of 4d. per pound. In this enterprise of steam trawling I am satisfied that private firms can operate more economically and more effectively than vessels carrying on the fish business under Government or municipal auspices.

Government or Municipal Steam Trawlers.

While I recommend and strongly favour the operation of a steam-vessel by the Government for the purpose of prospecting new fishing-grounds and determining the productiveness and capabilities of grounds already worked, I do not favour the participation of Government or of public corporate bodies in commercial fishing. The Government vessel would, however, in the course of the operations mentioned, make catches of fish by trawl and hook and line, to be disposed of commercially, and the proceeds set off against the expenses of the vessel. Considerable enterprise has been shown by private firms in this industry, and much private capital has been sunk in boats, freezers, gear, &c. If facilities for receiving the catches and distributing them to the public are provided by the Government or aided by Government subsidy, the actual fishing operations, it seems to me, can be very well left to private enterprise, as at present. Private enterprise, if encouraged and given the facilities I speak of, could go much further than it does at present; and, indeed, the limitation of operations, the limitation of catches, and the waste of fish, involving high prices to the public, are mainly due, in my opinion, to antiquated methods of marketing the fish and to deficient transportation facilities.

Organization of Fisheries Urgent.

Lack of organization no doubt is responsible for much of the existing difficulty in regard to fish-supply and prices. The fishery operations are at present most irregular; the prices received by the fishermen uncertain; the methods of wholesale marketing inferior and not to be compared with the methods adopted in the fruit and other businesses; while rail and steamer transportation, and the system of retailing now in vogue, are all at fault, and demand effective remedies such as I suggest in my present report. The whole fish business needs to be reorganized, and this can be best done by the establishment of an effective Fisheries Department, with a proper official service, such as Canada and other countries possess. Under a Government Department with experienced chief officers, a staff of technical investigators into fishery problems, the supervision of fishery methods, the improvement of fish resources by hatcheries, and by protective and preservative means, and especially by the encouragement of fishery enterprises on modern lines, the development of the industry would be hastened in every way; and the public would receive vastly increased benefits, just as such benefits have accrued to the farmers, fruitgrowers, and the whole country from the proper organization of agricultural, fruit, and forestry branches of the Government service.

In my opinion there should be more co-operation amongst the fishermen themselves, so that they may reap more adequately the benefit of their labours; and fishery societies might, in my opinion, be founded at the various ports. The fruitgrowers in some districts, I observe, are already forming co-operative associations with the view of securing better distribution of fruit products, the purchase of orchard requisites, the establishing of cool storage, and of canning-factories, and the building-up of an export trade which will ultimately lead, without doubt, to the establishing of central packing and grading houses. In Denmark, the phenomenal success of the farmers who supply European markets with eggs is due to the Farmers' Egg Association, which consists of about forty thousand peasant members, who co-operate in their egg business, so that it now amounts to over one and a half million pounds per annum, small organizations in the villages being in constant communication with a central body in Copenhagen. The quick transport of products from producer to consumer is accomplished now more effectively than ever before. Only perfectly fresh eggs are marketed, so that the public can rely on the very best quality when purchasing under this system. It need hardly be pointed out that if the Government were disposed to assist the fishing industry by loans or grants, the best results would be accomplished by such loans or grants being made to associations or fishery societies rather than to individuals.

Scientific Fisheries Bureau.

An important section of the work of the Fisheries Department would fall under this head. It is recognized universally that fishery laws are of greater value when based upon accurate scientific information. Such information can only be secured by appropriate marine and fresh-water investigations. A qualified scientific expert is a necessary adjunct to a Fisheries Department; and in Canada three biological stations have been founded, on the lines of similar stations in the United States, Britain, and other countries, with the special object of aiding in such fishery investigations. The Portobello Hatchery and Marine Station in the South Island has great capabilities of useful work, but a similar institution is urgently required for the North Island. It appears to me also that the biological departments of the four colleges of the University of New Zealand could, by arrangement

with the Professors of Biology in each college, be utilized in the fishery investigations suggested. No field of biological investigation is more interesting and, from a public point of view, more valuable than fishery researches. Hitherto, gifted students with special powers of observation and special qualifications for original research have had little opportunity for exercising their abilities. In a Fishery Department a programme of work could be carried out in the various biological laboratories mentioned which would be of great aid to such marine hatcheries and biological stations as have been referred to for the North and South Islands. I make reference elsewhere to the desirability of a steamer specially fitted for fishery investigations and prospecting for new fishing-grounds, and which should be solely at the disposal of the chief of the fisheries staff. It is not necessary in this place to give details of the programme of work which would be carried out under such a scheme of investigation by Government steamer, biological stations, and college laboratories, but it would embrace the physical and biological exploration of the Dominion's fishing-grounds; a study of the food, habits, and movements of important food fishes; an inquiry into the fluctuations of fish, having special reference to the number of fishing boats and steamers, methods of fishing, and climatic and other conditions; also the conducting of experiments with respect to such fluctuations, and suggested remedies, by—(*a*) Artificial culture of fish; (*b*) protection of young and immature fish; (*c*) increase of any food; (*d*) destruction of enemies; (*e*) legislation as to times or places of fishing and methods of capturing fish. The work would also include inquiry into the parasites and diseases of fish, especially with relation to trout, the Salmonidae, and fresh-water fish generally.

Divided Authority over Angling-waters.

I found in my tour that in the Rotorua and Taupo regions considerable dissatisfaction prevailed owing to the divided authority exercised over the fish and fish-culture in Lakes Rotorua and Taupo and adjacent waters. The acclimatization societies most concerned unanimously complained that there could be no satisfactory results either in the management of these fisheries or in the methods of fish-culture unless they were under a single authority, and managed by officials specially trained and with long experience and capable of satisfactorily handling the whole matter. One prominent individual, a banker, charged one of the Departments with serious lack of knowledge and with mistaken methods, especially in dealing with the public. "It would be a waste of time," he says, "to suggest anything under the present management." While credit must be given to the Tourist Department and the Department of Internal Affairs for zeal and a desire to do their best, it was plain to me that practically every measure taken showed a lack of experience in the fisheries and wasteful and mistaken methods. A large amount of money has been really wasted which, if expended by men of special knowledge and experience in fish, would have yielded far better results. Indeed, I found that a great many erroneous methods had been at first adopted, and only after waste of time and money had the recommendations of methods which experience dictated been followed. No doubt some of the zealous officials of the two Departments who are experienced in handling big game, roads, and tourist matters have done their best; but the whole of the management of these trout-fisheries and of trout-culture should be embraced in a general Dominion Fisheries service. Otherwise Departments and officials are at cross purposes, and the public and the fisheries lose thereby.

I strongly recommend that the whole of this work and the control of these waters be transferred to a Fisheries Department and included in the general fisheries administration of the Department. The continuance of the present system means confusion in the work, dissatisfaction on the part of the public, and results that are wholly inadequate to the expenditure and the labour involved. I found the leading men in Auckland, members of the acclimatization society there, especially aggrieved at the policy at present adopted. They pointed out that, as the pioneers in stocking the lakes referred to, their expenditure and efforts for many years had been totally ignored, and the fisheries ruthlessly taken from them without any consideration or compensation. Not only this, but when the society desired eggs from the waters which they had stocked, the Tourist Department absolutely refused to allow it to utilize the fishery, and charged them 2s. per thousand for the right to take eggs; and the Department of Internal Affairs has followed the same policy. Parent trout have been netted by this Department in waters close by the Auckland society's hatchery without even consulting the society, and the fish taken away to Lake Rotorua. The fact that the society had borne all the expense originally of introducing these trout and stocking these waters was wholly ignored, the Government stepping in and appropriating everything. The existing dissatisfaction with regard to the divided authority referred to has thus been accentuated by such methods as these. The whole trouble could be readily adjusted and complete satisfaction on the part of the societies established by transferring these fishery matters to a Department specially versed in such work.

All the existing widespread dissatisfaction, the waste of energy owing to the duplication of staffs of officers engaged in the same duties, and the inadequte results following from the various organizations being at cross purposes, and having no united or uniform system, seem to me to be unjust to the great interests involved. In the course of my tour this widespread dissatisfaction was expressed to me everywhere by prominent gentlemen and practical authorities. There should be one licensing system under a central authority, one policy of protection by means of a uniform Dominion system of patrol, and one fish-culture organization which would be able to stock waters in any district which urgently needed it, and not, as at present, a method resulting in the neglect of remoter lakes and rivers, and the overstocking of waters near large cities or in the districts of acclimatization societies with ample funds. There should be one undivided fishery administration and management; and divided departmental superintendence and inadequate local organization should be done away with, and give place to a large, active, efficient, national system of management and extension.

The Title of Chief Fisheries Officer.

If the Fisheries service be so organized that a Fisheries Branch be established, as I have urged, it would be desirable for the responsible head to be called "Director of the Fisheries Branch." In most countries—Canada, United States, and some European countries—the chief Fishery officer, who acts under the Minister in charge of Fishery Affairs, is named "Commissioner of Fisheries." It might be an advantage, if my suggestion be favoured, that the same title should be given to the principal Fisheries official in the Dominion. Uniformity in the title of the principal officer charged with the fisheries administration facilitates communication with other countries and ensures an exchange of information and of courtesies which the adoption of a less widely recognized title does not facilitate.

Conclusion.

I am aware that in the foregoing preliminary report a number of suggestions and recommendations require fuller elucidation, but I present them in this abbreviated form for the reason that my full detailed report will take some time in preparation, and I feel it due to the New Zealand Government that I should state some of my conclusions on reaching the end of my actual survey of the fisheries. I shall have many supplementary suggestions to make in my subsequent report, and shall furnish a full scheme of what I regard as a desirable organization for administering and for expanding the fisheries of New Zealand. No visitor from other parts of the world who sees anything of this beautiful and fertile Dominion doubts that agriculture, forestry, and other great industries are capable of vast development, and in the immediate future there will be no doubt great expansion of these. The land, a recent distinguished visitor said, could be made to produce for the markets of the world a vastly increased amount of animal and vegetable food for the more populous regions of the world. But the waters of New Zealand are capable of a parallel development. I think it important to call attention to the fact that the resources of the sea, unlike cattle, wheat, and other food resources produced on the land, are not endangered in time of war and national and international trouble. A nation with well-developed sea-fisheries is never in danger of starvation. The vast schools of fish in the sea, unlike the resources of the land, are available at practically all times, and can be most economically and reliably utilized. Great international crises and the dangers of war do not affect the inhabitants of the deep, which do not demand constant human labour to cultivate. Agriculture, stock-raising, &c., demand such constant labour and large investment of capital that in time of trouble the utilization of these land resources may be seriously interfered with, farms and fields being laid waste, and the activities essential to their cultivation and utilization being turned to military duties or to other purposes. It is not too much to say, therefore, that the fish resources are amongst the most valuable and most lasting of all national resources.

A well-organized Fisheries Department with full administrative powers, an extended system of fish-culture, and the adoption, experimentally or otherwise, of the most recent methods of utilizing and turning to account every product of the fisheries, I do not hesitate to say, are steps which must be of benefit and advantage to every citizen of the Dominion. The fisheries of New Zealand have perhaps not been encouraged or advanced so rapidly as those of some other countries, notably Canada; but I have endeavoured to indicate the lines on which progress may be most rapid and certain. By the adoption of some of these methods the future prosperity and expansion of the New Zealand fisheries may be assured.

I have, &c.,

EDWARD E. PRINCE, D.Sc., LL.D., F.R.S.C., &c.,
Commissioner of Fisheries for Canada.

The Hon. F. M. B. Fisher, Minister of Marine, Wellington.

APPENDICES.

APPENDIX 1.—ANALYSES OF FISH-WASTE MANURE.

THE following analyses are given to indicate how valuable is fish-waste as an aid to agriculture. For example, a fish guano, composed largely of dogfish, skate, and other species of little value as food, prepared at a reduction-works at British Columbia, showed the following results:—

Water	12·65
Oil	1·55
Organic matter rich in nitrogen	77·45
Phosphoric acid	3·40
Lime	1·76
Alkalies	3·09
Earthy matter	0·10
	100·00

The analysis is that of Dr. Hughes, District Agricultural Chemist for Herefordshire, and Consulting Chemist to the Ceylon Coffee-planters' Association. This authority says that the sample proved to be very free from oil, and contained twice as much nitrogen as ordinary guano, and was worth in the markets probably £7 or £8 per ton.

Another analysis of salmon-waste from salmon-canning establishments in British Columbia showed the following results:

Water	5·19
Organic matter	46·99
Mineral matter	47·82
	100·00

(NOTE.—In the organic matter the nitrogen amounted to 3·47; and in the potash phosphoric acid amounted to 17·60.)

Professor Shutt, of Ottawa Central Experimental Farm, Canada, stated that it was a very valuable manure, especially for wheat and other grain crops, or for application to soils poor in nitrogen and phosphoric acid. He estimated its value at about £7 per ton, the nitrogen-contents being valued at about £2 3s. 6d. in the ton, and phosphoric acid being nearly £4 15s. 6d. in the ton.

Such analyses indicate how desirable it is that fish-waste should be converted into materials of which the agriculturist is so greatly in need.

APPENDIX 2.—PROCESS OF CANNING FISH.

The details of cooking methods, &c., vary with different species of fish, but the following particulars as to the methods of handling salmon in British Columbia indicate some features of the process:—

1. The fish are first lifted from the wharf on to the cleaning-tables, where, either by an automatic machine or the knife of a gutter, the head, tail, and back and under-fins are cut off, the fish ripped open, and the entrails removed.

2. The gutted fish is then washed in a tank of running water and the blood and clinging inside membranes removed. A second washing and cleaning process is usually adopted, and the fish is passed into a rotating knife wheel which severs an average-sized fish into four slices.*

3. Empty cans are then filled by hand or by a plunger machine.

4. The sealed cans are subjected to the first boiling at 212° F.

5. The cooked cans are removed from the retort or kettle and pierced to allow the air to escape. They are then resealed.

6. The cans are subjected to a second cooking in a retort or large kettle, the water in which rises to a temperature of 240° F.

By this process it will be seen that Pacific salmon are really overcooked: and it is this that increases the tenderness and table qualities of the fish, the principal species of which are in a fresh condition rather hard and dry. No doubt many New Zealand fish could be subjected to a similar process and thereby improved. Delicate oily fish and fish of the nature of whitebait, however, must be subjected to a less intense temperature.

* The principal commercial salmon in British Columbia (the sockeye) is from 4 lb. to 6 lb.

APPENDIX 3.

I do not regard it as my task to add to my recommendation regarding the organization of a Fisheries Administration Department any suggestions as to the position of executive head of such a Department. But in selecting a principal officer I think it of the highest importance that he should be an official thoroughly well acquainted with the fisheries of New Zealand, the kinds of fish, methods of fishing, and the various localities in which fishing operations are carried on, and have a thorough knowledge of the lakes and rivers of the Dominion. If such a complete acquaintance with the fishery resources and possibilities of the country are combined with a knowledge of the fisheries of other countries, especially of the market-conditions, fish-culture operations, and the general system of handling British and foreign fisheries, such qualifications would be of immense importance in ensuring the success of a general reorganization. The Dominion Government has indeed an official possessed of these precise qualifications in an exceptional degree; and from personal knowledge acquired in my extensive tour round the coast and the interior waters of New Zealand I found confidence very generally expressed in the exceptional knowledge and ability of Mr. Ayson, the Chief Inspector of Fisheries. He certainly has the confidence of the practical fishermen, fish-merchants, anglers, and acclimatization societies. In my later report I shall possibly quote from the opinions as to the exceptional qualifications of Mr. Ayson expressed by these various parties. In his several trips to Europe, the United States, and Canada, Mr. Ayson has acquired an unusually profound acquaintance with all the details of the fishing industry and with the methods of fish-culture in the various parts of the British Empire and in foreign lands. It would be difficult to find an official with such rare qualifications, and one who has the zeal and earnestness essential to success in fisheries supervision and administration.

It would be of great aid to such official duties if a technical assistant or deputy were appointed. Such a technical officer would have the special scientific knowledge of fish and fisheries and all the conditions for successful fish-culture which would secure the adoption of the most modern methods in vogue in other countries. But a scientific specialist would not be qualified to act as the executive head, as no appointee could be found with the supremely important qualification added of a wide practical knowledge of the fisheries, fishing-grounds, and commercial aspects of the fish business.

APPENDIX 4.—EXTRACT FROM CANADIAN FISHERIES ACT.

The following clauses from the Canadian Fisheries Act at present in force are quoted in order to demonstrate how important the confiscation of illegally used boats, gear, &c., is regarded in the work of protecting and maintaining the fishery resources of that Dominion:—

Clause 92. "All vessels, boats, canoes, rafts, vehicles of any description, nets, fishing gear, materials, implements, or appliances used in violation of this Act or any regulation under it, and any fish or other marine animal taken, caught, killed, conveyed, bought, sold, or had in possession in violation of this Act or any regulation under it, and all other fish, shell-fish, or marine animals otherwise legally taken, caught, killed, conveyed, bought, sold, or had in possession, and of whatever size and description, which are intermixed therewith, shall be confiscated to His Majesty, and may be seized and confiscated, on view, by any fishery officer, or taken and removed by any person for delivery to any fishery officer or Justice of the Peace."

"93. Should any nets, seines, or other fishing-apparatus be set or used in violation of this Act or any regulation thereunder for more than one day, then each day during which such seines, nets, or other fishing-apparatus shall remain so set or used shall constitute a separate offence, and may be punished accordingly; and should any other violation of this Act, or of any regulation thereunder, continue for more than one day, then each day during which such violation continues shall constitute a separate offence, and may be punished as such."

APPENDIX 5.—EXHIBITION OF PREPARED FISH AND FISH PRODUCTS, ETC.

It may be of interest to quote the following from the preface to the "Monthly Bulletin of Sea-fishery Statistics," issued by the Canadian Government, having reference to the desirability of awakening public attention to the variety of fish products available for table use.

In addition to rapid transportation and proper care of fish in transit, it is desirable to press upon the attention of the public the many fine fish-food products, of which they are not as a rule aware. The New Zealand Government might, indeed, help the fisheries a great deal by arranging an exhibit of prepared fish and fishery products, as well as specimens of fish, at the numerous shows held annually by the agricultural and pastoral associations, and also at the larger exhibitions in great centres of population.

(From Fisheries Bulletin, March, 1913, Ottawa, Canada.)

"While the assistance the Department has been giving during the past few years in the transportation of fresh fish has resulted in a very rapid development in the trade, there is room for a still more rapid expansion and extension of the business. There is no question that people in the interior portions of Canada could, with advantage to themselves physically and financially, consume much larger quantities of fish than they are doing. No doubt the reason for the present condition is that fresh fish has not been brought to their attention in an attractive form, notwithstanding that with the express and cold-storage services now available it is possible to place such fish in excellent condition and at moderate prices in practically all the markets of Canada. Much could be done to expand the demand by suitable exhibits of fish at the more important exhibitions in the interior of the country; but it is realized that such exhibits would cost more than individual persons or firms would care to expend. . . .

"The Department will be glad to receive suggestions from those interested in the industry as to the arrangements, special features, &c., of the exhibit."

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