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Canada. Dept. of Fisheries
Report on fish culture

1889

PART II.

REPORT

ON

FISH BREEDING OPERATIONS

IN THE

DOMINION OF CANADA

1889.

PRINTED BY ORDER OF PARLIAMENT.

OTTAWA:
PRINTED BY BROWN CHAMBERLIN, PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY.
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REPORT

OF MR. S. WILMOT, SUPERINTENDENT OF FISH CULTURE FOR THE DOMINION OF CANADA, FOR THE YEAR 1889.

The Honorable CHARLES H. TUPPER,
Minister of Marine and Fisheries,
Ottawa.

SIR,—I beg to submit the annual report on fish-breeding operations in the Dominion of Canada for the year 1889, in which will be given the particular transactions which relate to each of the hatcheries, especially as to the number of fish-eggs which have been laid down in each nursery, and the young fish of various species which have been bred and turned out of the several establishments during the past year; a summary of the work performed at, the wants required for, and the general standing of each nursery will be included.

There will also be found appended to this general report, the individual reports of the several officers in charge of their respective institutions in the several Provinces. In these, fuller details will be given, descriptive of the varied operations of capturing parent fish, hatching the ova, and distributing the several species of young fish in the waters of the various sections of the country.

The output of fry during the past year has been under that of former years, by reason of the reduced supplies of ova that were obtained in the season of 1888. Great success, however, has attended the collecting of eggs during the autumn just closed. The gross number amounting to upwards of 136,000,000, or an increase of some 37,000,000 over the previous year.

Taking the work as a whole the year's operations are of the most satisfactory character, and judging from the numerous applications which are being continually made by individuals, and public bodies throughout almost every section of the country, for fry bred at these nurseries to stock waters which are failing, or have become depleted of their former supplies of fish, but one conclusion can be arrived at, namely:—the growing popularity of the work of fish culture and the undoubted benefits which have been, and are to be derived from a judicious application of it as a supplementary aid to the natural method of producing from the waters of the country more plentiful supplies of fish-food for the inhabitants generally, and for enlarging commercial traffic in fish.

It may not be considered as inappropriate to briefly refer here, to the views entertained by two of the adjoining countries regarding the importance for extending in the one,—and introducing into the other, the work of fish culture, with a view to improve their former extensive, but now somewhat declining fisheries.

The Federal Government of the United States, and the Government of our own sister colony of Newfoundland are both making strenuous efforts to foster the fishing industry of their separate countries. The former by enlarging its fish cultural operations which have been already so successfully carried on by the United States Fish Commission at Washington, and its friendly co-operation with individual State Fish Commissioners for the erection of Federal Hatcheries and the taking over, and working some of the fish nurseries which were built by these individual States; thus relieving them from carrying on an industry which the Federal Government considers to be of such general benefit to the whole Union, that the expenditure in erecting these establishments and maintaining them should be borne from federal grants alone.

Newfoundland hitherto occupying the position of one of the leading fish countries of the world and desirous of maintaining that distinction in the future, has also just acknowledged fish culture to be a means by which to recuperate, and sustain her cod, and lobster fisheries.

The Government of that Island has secured the services of an expert in lobster breeding from Norway, Mr. Adolph Neilsen, who has already fitted up on Dildo Island, Trinity Bay, a fish hatchery of considerable magnitude for the propagation of codfish and lobsters; his success in breeding the latter during the past season has been very encouraging, and his convictions are that he will be enabled to turn out the coming season vast numbers of the young of the cod, and the lobster, to supplement the natural product of these valuable fish in the waters of Newfoundland.

In a further reference to the growing popularity of artificial fish culture in Canada, and in corroboration of the statement, it may be mentioned that applications are being made for enlarging some of the present hatcheries, and for building several additional fish nurseries:—The Fraser River hatchery in British Columbia, by the almost unanimous voice of the salmon canners there, who are a very important, wealthy, and influential class of persons, with one accord, give credit, in a great degree, for the enormous catch of salmon in the Fraser River the past season to the output of fry from that institution into the tributaries of that river. These practical men, all largely engaged in the fishing industry of British Columbia, almost without a dissenting voice, now earnestly ask that fish culture may be extended by the enlargement of the present hatchery, and for the construction of additional ones. A series of letters, under the signatures of these canners, expressing their views and faith in the results of artificial salmon culture on the Fraser River, will be found embodied in this report, and will repay a careful perusal by all persons who may feel interested in the maintenance of the fisheries of the country.

Manitoba and the North-West Territories, though but lately and sparsely settled, find that in some waters a decline is being felt already in the fish crop, and they now ask as a remedy to avert the disastrous results to their fisheries which have been so sadly experienced in the older settled Provinces, that artificial fish culture be introduced at once, and that one or more establishments be erected there to aid in maintaining the whitefish industry in Lakes Manitoba, Winnipeg, and other waters in the North-West.

In Prince Edward Island, where a salmon hatchery had been in operation for some time, but from an unforeseen accident by a freshet in the river, it became seriously damaged, and its operations have been stopped for the past two years. The inhabitants, noticing the benefits which have accrued from it in several streams, now apply for its renovation, and that it should be placed in a position for active work next season.

In the the city of Ottawa a fish hatchery has been fitted up, and will be in full operation during the approaching Session of Parliament, having a capacity to hatch several millions of young fish, of different species, annually. This nursery is on the lower flat of the present Fishery Exhibition building, and being at the seat of Government, will, no doubt, add materially to still further popularize the science by making this an educator on fish cultural matters for the numerous visitors coming to the Capital. In addition, this establishment will afford an opportunity to members of Parliament and others for obtaining, both ocular and practical, demonstrations of the *modus operandi* of propagating and rearing fish by the artificial methods.

GENERAL STATEMENT OF WORK PERFORMED AT THE SEVERAL HATCHERIES IN 1889.

The gross output of young fish of all kinds from the hatcheries in 1889 amounted to sixty-eight millions seven hundred thousand (68,700,000) and were of the following species, namely:

Atlantic salmon (*Salmo salar*)	7,254,500
Pacific salmon (saw-quai) (*Oncorhynchus nerka*)	4,419,000
Salmon trout (Great Lakes) (*Namaycush*)	5,140,000
Brook trout (speckled trout) (*Salmo fontinalis*)	206,500
Whitefish (Lake region) (*Coregonus albus*)	30,600,000
Pickerel, doré (Wall Eyed Pike) (*Lucioperca*)	21,000,000
Black bass (small mouth) (*Micropterus dolemei*)	80,000
Total	68,700,000

The following table will show the number of young fish, and semi-hatched eggs turned out from each of the hatcheries in the Dominion in 1889. The reports from the several officers in charge are of the most satisfactory description, regarding the healthy state of the fry when planted in the waters; and of the soundness of the eyed-eggs which were obtained from the Ontario hatcheries, and deposited in the Quebec, New Brunswick, and Nova Scotia nurseries. The particular lakes, rivers, and streams and their localities in the several Provinces, will be found minutely described in the individual reports of the several officers in charge of hatcheries, in the appendices hereto attached:

SCHEDULE showing Number of Fry and Eyed-eggs turned out from each Hatchery in 1889.

Number.	Hatchery.	Province.	Fry put out.	Eyed-eggs sent to other Hatcheries.	Eyed-eggs received from other Hatcheries.	Species.
1	Fraser River	British Columbia	4,419,000	.....	.....	Salmon (*Nerka*).
2	Sydney	Nova Scotia	2,034,500	.....	.....	do (*Salar*).
3	Bedford	do	900,000	.....	.....	do do
	do	do	450,000	.....	500,000	Salmon trout (*Namaycush*).
	do	do	2,500,000	.....	3,000,000	Whitefish (*Coregonus*).
4	Dunk River	P. E. Island	Not in operation.			
5	St. John River	New Brunswick.	140,000	.....	150,000	Salmon (*Salar*).
	do	do	830,000	.....	1,000,000	Salmon trout (*Namaycush*).
	do	do	2,600,000	.....	3,060,000	Whitefish (*Coregonus*).
6	Miramichi	do	850,000	.....	50,000	Salmon (*Salar*).
7	Restigouche	Quebec	1,280,000	200,000	.....	do do
8	Gaspé	do	450,000	.....	.....	do do
9	Tadoussac	do	1,600,000	.....	.....	do do
10	Magog	do	1,000,000	.....	1,200,000	Salmon trout (*Namaycush*).
	do	do	1,700,000	.....	2,000,000	Whitefish (*Coregonus*).
11	Newcastle	Ontario	2,760,000	2,700,000	.....	Salmon trout (*Namaycush*).
	do	do	206,500	.....	.....	Brook trout (*Fontinalis*).
	do	do	2,800,000	.....	3,000,000	Whitefish (*Coregonus*).
	do	do	80,000	.....	.....	Black bass (small mouth).
12	Sandwich	do	21,000,000	11,000,000	.....	Whitefish (*Coregonus*).
	do	do	21,000,000	.....	.....	Pickerel, doré (*Lucioperca*).
	Total	.....	68,700,000	13,900,000	13,900,000	

FISH EGGS COLLECTED AND LAID DOWN IN THE HATCHERIES IN 1889.

The following table will show the numbers and descriptions of ova collected and laid down in the hatching troughs and incubators of the several breeding establishments in the Dominion. No eggs were procured by the Magog and St. John River hatcheries in their own localities, but supplies of semi-hatched eggs will be transferred to the Magog establishment from Newcastle and Sandwich in Ontario; and to the St. John River nursery from the Ontario and Restigouche hatcheries. The total number of eggs collected for the year amounts to 136,122,000, and judging from the weekly reports which are regularly sent in by the officers in charge, the loss of eggs so far has been very small, and their present general appearance would indicate a satisfactory yield of fry for the coming season of 1890.

The following will give the eggs collected in 1889, the name of the hatchery and Province, and the species.

No.	Hatchery.	Province.	No. of Eggs.	Species.
1	Fraser River	British Columbia	9,233,000	Salmon (*Nerka*).
2	Sydney	Nova Scotia	2,540,000	do (*Salar*).
3	Bedford	do	2,300,000	do do
4	Dunk River	Prince Edward Island.		
5	St. John River	New Brunswick		
6	Miramichi	do	1,100,000	do do
7	Restigouche	Quebec	3,022,000	do do
8	Gaspé	do	820,000	do do
9	Tadoussac	do	2,557,000	do do
10	Magog	do		
11	Newcastle	Ontario	11,150,000	Salmon Trout (*Namaycush*)
	do	do	300,000	Brook Trout (*Fontinalis*).
	do	do	3,000,000	Whitefish (*Coregonus*).
	do	do	100,000	Black Bass (Small Mouth).
12	Sandwich	do	30,000,000	Pickerel, doré (*Lucioperca*).
	do	do	70,000,000	Whitefish (*Coregonus*)
13	Ottawa	do		
	Total Eggs, 1889		136,122,000	

NOTE—The St. John River, Magog and Ottawa hatcheries will be supplied with eggs later on from other nurseries.

GRAND TOTAL OF YOUNG FISH OF ALL KINDS WHICH HAVE BEEN TURNED OUT OF THE CANADIAN HATCHERIES FROM THE COMMENCEMENT OF FISH BREEDING AT EACH HATCHERY.

The following table will exhibit the gross out-put of fry of every description. Separate columns will give the names of the Provinces, and hatcheries, and quantities of fry bred at each nursery, and the year of the establishment, making in the whole a grand total of 705,544,900; consisting of Atlantic salmon, Pacific salmon, salmon trout of the Great Lakes, speckled trout of the rivers and streams, whitefish, lake pickerel or doré, and black bass.

STATEMENT showing the Places where, and the Years in which the several Fish Hatcheries have been erected; also the number of Fry distributed from each Establishment, annually, since they were built.

Year.	Ontario.		Quebec.				New Brunswick.		Nova Scotia.		Prince Edward Island.	British Columbia	Totals.
	Newcastle.	Sandwich.	Magog.	Tadoussac.	Gaspé.	Restigouche.	Miramichi.	St. John River.	Bedford.	Sydney.	Dunk River.	Fraser River.	
	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.	Fry.
1868-1873	1,070,000	..											1,070,000
1874	350,000			..	.....	100,000	60,000	..				.....	510,000
1875	650,000	.....		60,000	110,000	600,000	150,000						1,570,000
1876	700,000	8,000,000		150,000	50,000	300,000	60,000	..	395,000				9,655,000
1877	1,300,000	8,000,000		1,180,000	1,051,000	600,000	320,000		1,000,000				13,451,000
1878	2,605,000	20,000,000	.....	707,000	650,000	1,015,000	665,000	.....	1,400,000	.....	.....	.....	27,042,000
1879	2,602,700	12,000,000		1,250,000	1,597,000	1,470,000	1,025,000		1,740,000				21,684,700
1880	1,923,000	13,500,000		1,455,000	730,000	1,500,000	805,000	170,600	730,000		500,000		21,013,600
1881	3,300,000	16,000,000	200,000	331,000	500,000	740,000	770,000	50,000	680,000	.....	375,000	.....	22,949,000
1882	4,841,000	44,000,000	975,000	600,000	530,000	1,400,000	640,000	588,000	850,000	315,000	1,060,000		55,799,000
1883	6,053,000	72,000,000	250,000	995,000	520,000	300,000	925,000	72,600	800,000	659,000	1,210,000		83,784,600
1884	8,800,000	37,000,000	100,000	985,000	859,000	940,000	795,000	811,000	1,000,000	853,000	1,000,000		53,143,000
1885	5,700,000	68,000,000	300,000	720,000	290,000	650,000	900,000	155,000	670,000	772,000	1,100,000	1,800,000	81,067,000
1886	6,451,000	57,000,000	1,400,000	1,627,000	576,000	1,380,000	945,000	2,181,000	960,000	1,179,000	400,000	2,625,000	76,724,000
1887	5,130,000	56,500,000	675,000	900,000	630,000	1,500,000	900,000	2,179,000	1,230,000	1,415,000	500,000	4,414,000	79,273,000
1888	8,076,000	56,000,000	3,475,000	850,000	800,000	1,720,000	1,290,000	1,142,000	4,390,000	1,559,000		5,807,000	88,109,000
1889	5,846,500	21,000,000	2,800,000	1,600,000	450,000	1,280,000	850,000	3,570,000	3,850,000	2,034,500	..	4,419,000	68,700,000
Totals	65,398,200	489,000,000	10,175,000	13,113,000	9,343,000	15,505,000	11,100,000	14,210,200	22,695,000	8,786,500	6,145,000	19,065,000	705,544,900

NOTE. The particular descriptions of Fry above enumerated were as follows:

Salmonidae	Atlantic and Pacific salmon, salmon trout of the Great Lakes, and speckled trout of the Streams	176,079,000
do	Whitefish (*Coregonus*) of the Great Lake region	335,250,000
Percidae	Pickerel, or Dore (*Lucioperca*) and Black Bass	194,215,900
	Grand Total of all kinds	705,544,900

PROPOSED CULTIVATION OF THE LOBSTER.

Regarding the contemplated action of your Department to erect one or more establishments for the artificial propagation of lobsters, I desire to state that, as lobster hatching has proved to be a successful undertaking in the United States and in Newfoundland, as well as in several of the European countries, there can be no reason whatever to doubt its applicability to the waters of the Maritime Provinces of Canada.

From the information obtained on this subject by correspondence with Colonel Macdonald, Commissioner of Fish and Fisheries for the United States, and with Mr. Neilson, Superintendent of Fish Culture for Newfoundland, there will be little difficulty experienced either in the erection of properly arranged lobster hatcheries or in carrying on the work, and turning out millions of young lobsters annually.

Our Maritime Provinces are, perhaps, in a position better calculated to make lobster hatching more successful than is found to be the case in the United States, from the fact of the parent lobster being yet found in many localities along the coasts quite numerously, and consequently giving greater facilities for securing almost unlimited supplies of eggs; and whilst this enterprise has been successful in the United States, in so far as the hatching of the young fish is concerned, yet a difficulty arises with that country in procuring adequate numbers of lobsters to supply them with eggs. I here quote Colonel Macdonald's words: "I am well satisfied, however, that if it were practicable in any locality to obtain all the fertilized eggs from the female lobsters which are taken for market, hatch them out and return them to the waters, the result of this work pursued systematically would make it possible to maintain the supply without imposing any unreasonable restrictions upon the catch. As a matter of fact, however, the exhaustion of the fisheries in the vicinity of Wood's Holl has gone so far that it is very difficult to obtain eggs in any number.

"We find no difficulty in hatching the eggs in any quantities that can be obtained, and with a very moderate percentage of loss. * * * The number of young lobsters hatched and planted last year in the vicinity of Vineyard Sound amounted to about a million and a-half. The apparatus used by us in lobster hatching is the automatic hatching jar employed in hatching shad and whitefish."

From the above it would appear that no difficulty presents itself to the artificial propagation of lobsters in Canada, and that the obstacle of not getting sufficient supplies of parent lobsters, referred to by Colonel Macdonald, would be overcome in the Maritime Provinces, as there are many localities where abundant supplies of the parent fish and their eggs could be readily got.

I also quote here a few paragraphs from Mr. Neilson's letters, who is engaged with the Newfoundland Government in lobster hatching. He came from Norway, where he was previously employed as an expert in lobster breeding. He says:

"A hatching station is built on Dildo Island, Trinity Bay, dimensions 75 x 45 x 20, with hatching room on first floor, dwelling above. A steam pump is used, capable of throwing 200 gallons of water per minute, and drawing the water from the sea at five fathoms depth, in order to procure water of great specific gravity, and keep an even temperature, which is of the utmost importance in hatching lobsters. * * * The apparatus used here is the automotic jar; it does not work as well as the apparatus I used in Norway, but still I hatch out about 50 per cent. I collect all my eggs from the lobster factories, and thus save a large amount of eggs from destruction, and that otherwise would be cooked. The time of hatching from the eggs depends upon the state of the ova when taken from the parent lobster, and the temperature of the water. I prefer to take them when they will hatch in about three weeks. From the 19th July I have collected 2,600,000 lobster ova. * * * We collect our eggs in Placentia Bay and carry them across the country, which is troublesome; but we intend to put up a new hatchery in Placentia Bay."

From the above statements of Mr. Neilson, I should say that equal facilities are obtainable at many points in Nova Scotia, New Brunswick and Prince Edward Island for carrying on the work of lobster hatching successfully.

Again, I will quote from a letter of Prof. Gilbert V. Bourne, of the Marine Biological Association of Great Britain, who, in his concluding remarks, says:

"In conclusion, I would say that, in our opinion, the rearing of lobsters is perfectly possible, and that after the first installation it could be carried on at no great expense, and should the Government of Canada wish to know of a competent person to undertake the matter on their behalf, I could with the greatest confidence recommend one."

Prof. Bourne's views would indicate that, after building and furnishing an establishment with all necessary appliances, lobster breeding could be successfully carried on.

In Norway, where lobster hatching has been entered upon somewhat largely, Capt. G. M. Dannevig, an authority on the subject in that country, says:

"My opinion, as far as regards the coasts of Norway, where the lobster, practically speaking, is on the point of being exterminated, is that artificial hatching of all the eggs that can be had from the fishermen and exporters, and which of course are doomed to destruction, will prove to be of great benefit, but that the young ones at present, at least, must be liberated shortly after their birth, as their voracity leads them to kill and eat one another when crowded in the apparatus in large numbers."

It would therefore appear from all of the above practical statements, which are given by prominent persons actually engaged in the work of lobster culture, that there are no insuperable difficulties in the way of commmencing the enterprise in Canada, and that the present falling off of the lobster fisheries in parts of the Maritime Provinces calls for some effort to be put forth by your Department to stay, if possible, so great a calamity as the extinction of the lobster fisheries in those Provinces."

I beg to add here one more extract from Prof. Neilson's letters regarding his experiments. He says:—"I closed the hatchery the 12th November for this season (1889). Of 7,995,400 collected lobster ova, 3,956,400 were rejected, and 4,039,000 hatched and planted out in good condition. This gives me 50½ per cent., which I consider good, when considered that I collected all this ova from lobsters brought to the factories for canning purposes, and handled very roughly, too."

From the foregoing, lobster hatching can be readily carried on. Information on three important points in connection with the work will be asked, viz.:—Where to locate the hatcheries? and the cost of the necessary buildings and apparatus? and the maintenance of the establishments afterwards.

In reply to the first, as to location, I would say that it would be necessary to locate the establishments near to where an ample supply of parent lobsters could be readily got, for it would be almost useless to commence artificial breeding unless upon a very large scale, and an important point in the location must be that the sea water should be pure and strongly saline in quality, and of low temperature.

In the matter of cost of necessary buildings and apparatus, it will be extremely difficult for me to give a very clear estimate, but I should judge from the statement given by Col. Macdonald and Mr. Neilson that the building should be somewhat extensive in size and appliances, in order to carry on the work up to a standard of a producing power that would give ultimate success and satisfaction with the undertaking. In this view I would say that a building fitted up similar to the Sandwich hatchery, where the water is supplied by steam power, and the automatic glass incubators are used, would cost between $4,000 and $5,000. The average cost of the maintenance of the Sandwich hatchery during the past three years has been about $3,000 per annum—and I would conclude that a less sum than this could not be expected to run a lobster hatchery.

It may be asked, why not utilise some of the present fish hatcheries in the Lower Provinces, and combine salmon and lobster hatching together. This, I fear, could not be done, for the following reasons. Lobster hatching requires the purest saline water: salmon hatching the purest fresh water. The sea water for lobster breeding would necessarily have to be drawn from a depth of four or five fathoms, to give it the requisite purity, density and temperature. The water for salmon breeding is taken from running streams of fresh water. The location of a lobster establishment should,

of necessity to procure adequate supplies of eggs, be at or near some extensive lobster packing establishment, or where they could be taken in great numbers on the coast adjacent to the hatchery. None of the present salmon hatcheries are so situated.

In selecting a proper location, having the necessary conveniences for a lobster hatchery, another essential point must be held in view, namely: facilities for transporting the fry to other places where it may be found desirable to plant them. Nothing is said in any of the correspondence had with the authorities already referred to regarding the transport of the young lobsters, but I should conclude that with the facilities which are afforded by the lines of railways running along the coasts of the lower Provinces that no difficulty would arise on account of the safe carriage of the young lobsters to almost any point necessary for their distribution. When young salmon, salmon trout, and whitefish are transported hundreds of miles by railway and waggons without any appreciable losses, I would conclude that the same means could be applied for the safe carriage of the young lobster to almost any point if the location of the hatchery or hatcheries were in the first place made somewhat central.

In order, then, to make successful the enterprise of lobster hatching, locations as just described must be obtained, commodious buildings erected, and the best known apparatus placed in it, with the view that their capacity for producing should be counted by tens of millions, so that their output of fry should somewhat approximate to the natural production of these valuable crustaceans.

SAWDUST—ITS INJURIOUS EFFECTS UPON FISH-LIFE IN THE WATERS OF THE COUNTRY.

The specialty of artificial fish culture, to which the undersigned has closely applied himself for many years, has necessarily given him particular opportunities for observing from a practical standpoint fish-life in its varied forms, from the egg to the adult stage. The fish culturist from his calling, therefore, should be enabled to form a better idea than most others regarding the character, habits, nature and wants of fishes; and that which may be most beneficial for them at their critical periods of spawning, and the necessity also that exists for the river, stream and other waters where fish resort to spawn being kept as nearly as possible in their normal state, devoid of deleterious or polluted matter of all kinds.

The following conclusions regarding the destructive effects upon fish-life from mill-dams, and the casting of sawdust, mill refuse and other deleterious substances into waters frequented by fish (at their spawning times more especially), are based upon information derived, and facts personally obtained, during nearly half a century of close observations and practical knowledge in relation to the subject:

The poisonous effects of sawdust, when allowed to pass into rivers and streams, are so manifold and self-evident to the rational or practical observer that it would appear almost needless, in the present enlightened state of the world, to require any special pleas or arguments to convince even the most skeptical person of its disastrous workings upon all aquatic life, of an animal or vegetable character, found in the tidal, lacustrine or fluvial waters of any country. Wherever mill-dams have been built across streams, and where sawdust, mill rubbish and other deleterious substances have been cast into the water from saw-mills and other manufactories, fish-life and vegetation of all kinds have been greatly lessened, and in many instances wholly destroyed. This is particularly noticeable amongst the higher order of fishes,

ESPECIALLY THE SALMON FAMILY,

which are largely of a migratory nature, many of them ascending rivers and other streams for breeding purposes. These waters are usually of the purest, coldest and most limpid description, and therefore best adapted for the propagation of the

salmon species. These fish at the time of the first settlements of Canada were found frequenting almost every river and stream emptying into the sea, and the great lakes also. So plentiful were they in many of our waters, before the lumbering industry took such a strong hold in the erection of dams and saw-mills, with the consequent injurious effects from them upon fish-life, that fish of all kinds were in great abundance. They were freely used by the inhabitants generally for domestic purposes, and also produced a large amount of traffic and commercial wealth for the country. But as the saw-mills and mill-dams increased in numbers with greater capacity for their work, the mill-dams formed impassable barriers to the ascent of salmon and other fishes to their natural spawning grounds above—and then the hurtful and pernicious effects arising from the sawdust and mill rubbish being constantly cast into the streams poisoned the spawning beds below, and stayed the growth of all vegetation, thus driving away insect life, which is the principal sustenance for fish in their younger stages of existence. As this improvident work of the mills increased in magnitude, so did the yield of all kinds of fish decrease in these waters until it has been found in some cases that, after stripping the neighborhoods of all lumbering material and

DESTROYING ALL FISH-LIFE,

these mills have gone into ruin and decay, leaving sorrowful mementos only of their destructive workings in the waters of the country for the inhabitants who follow after. It is, therefore, of the greatest importance that any law which provides "that sawdust or mill rubbish shall not be drifted or thrown into any streams or other waters frequented by fish," should be maintained and strictly enforced wherever the continuance of fish life is held to be of any benefit to the people. By a strict and impartial application of a law for regulating mill-dams for the easy ascent of salmon, shad and all other migratory fishes to their proper spawning grounds; by the enforcement of any statute forbidding sawdust, mill rubbish and other deleterious substances being drifted or thrown into the streams and other waters; by the due observance of a proper close time; by a stoppage of the deadly torch and spear, and the accursed use of dynamite for killing fish; by judicious regulations regarding the use and setting of nets of all kinds, and by increasing the supplementary aid to be obtained from artificial culture, it is believed that only a few years would pass before an increase would be experienced in the catch of salmon and all other fishes throughout the whole extent of the Dominion. There are yet to be found sufficient numbers of fish, natives of the rivers and other waters, left, from which, by proper protection and good husbandry, an immense supply of fish food and commercial wealth would be readily obtained for the general benefit of the inhabitants of the several sections of the country. Sawdust, as previously stated, is manifold in its range of destruction when allowed to be cast into waters to which fish are indigenous, or where animal or vegetable life is to be sustained. It is an artificial product, alien to and engendering latent diseases of various kinds, with fatal results in all waters where fish life exists. Its introduction into streams and other waters through the improvident agency of mankind has so changed their purity and fouled their beds as to

RUINOUSLY OPERATE AGAINST

the many natural requirements indispensably necessary for the production and growth of the better descriptions of fish. Sawdust in its locomotion, when drifted from mills, becomes water soaked, and settles upon the gravel beds and other places where fish resort for depositing their eggs. These coming in contact with this extraneous matter become infected: impregnation is prevented, vitality is destroyed, and they die. Should the ova escape contact with the sawdust or the foul matter from it during the earlier stages of incubation the same direful effects will be brought about later on, in the embryo state, and also when hatched into fry. In this last-mentioned stage death is almost certain, from the total absence of vegetable growth, the nuclei for insectivora, crustacea, and other insect tribes upon which the young

fish largely exist in early life. Sawdust, from its resinous nature, becomes almost indestructible, even on land or in the water, and wherever it takes lodgment to any extent, must sooner or later destroy all animal or vegetable life. In certain cases it becomes intermixed with sedimentary matter and alluvial deposits, when partial decomposition sets in, and gaseous explosions of a fetid and noxious character are thrown up over large areas, and with such violence as to cause upheavals of this putrid matter through ice and water surfaces hundreds of yards in extent; and in some rivers these explosions are found to be extremely dangerous to life, property and navigation.

A NOTABLE CASE IN POINT

is the Ottawa River. In order to comprehend the desolating influences of sawdust and mill rubbish even on the land, an inspection of one of the many mill yards, where acres in extent are covered with this refuse at establishments now in operation, as well as at places where the mills have long since gone to ruin and decay, and the spectacle presented to the eye is but a barren, death-like waste of all vegetation; not a blade of grass, nor an evidence of any growth whatever is to be found on these deposits of sawdust. Here, if nature's laws for giving growth to all things could have been carried out, something having life, or showing vitality in some manner, would be produced during long years. But no; it is still an inanimate mass of rubbish stricken with death, annihilated for growing anything. Who, then, would cover his garden, or his lands with this non-producing, desolating substance, in the expectation that vegetation would come forth, or that animal life of any kind could be sustained from it? The ruinous effects of this sawdust scourge when deposited in the waters of the country are still greater than when cast upon the land. Its floatability at first gives it more widespread areas in which to work out its blasting influences; even passing down in some instances till it reaches the estuaries of streams and the small inlets and bays along the coasts of the sea and shores of lakes. Here, it likewise

KILLS THE SOURCES WHICH GIVE LIFE.

and food for the smaller races of insects and other marine animals, whose absence from these secluded nurseries of fish-life turns away from the adjacent shores the more important commercial fishes that formerly resorted to these places for prey. Settling here and there in its course down the streams, it forms a compact mass of pollution all along the bottoms and margins of the rivers and inlets, filling up the crevices on the gravel beds, and among stones, where aquatic life is invariable produced and fed. It becomes a fixed, imperishable foreign matter, and adheres to the beds of streams and other waters, and forms a long, continuous mantle of death, and constitutes an endless graveyard to the innumerable colonies of insect life which inhabited these former well-adapted natural abodes for their existence. These, then, are only some of the pestilential effects produced by sawdust and mill rubbish in the waters of the country on fish-life; and independant of its evil influences, from a sanitary point of view on human life and its damaging effects by seriously impeding navigation on many waters. Then why should the few, for self-aggrandisement only, be permitted to continue this

WICKED DEVASTATING WORK,

for depleting the waters of their legitimate supplies of food, originally provided by an All-wise Providence for the use of mankind? And why should the many suffer for the few who still pursue and unscrupulously advocate a continuance of this insidious and direful proceeding for entailing ruin upon the fisheries of our country?

The following extracts, taken from official reports and other public documents, relative to the evil effects of sawdust, mill refuse and mill-dams upon fish-life, are hereto given in corroboration of the foregoing remarks:—

Extract from a report prepared for the Vienna Exposition, on the decrease of Food Fishes:

"The basis on which a rational system of pisciculture is founded is very simple, and can be limited to the following rules:

"Preserve the natural condition of those places where the fish spawn, conditions which favor the spawning process and tend to preserve the spawn and protect the first development of the eggs; thus, everything which diminishes the supply of fresh water; everything which changes the quality of the water or the character of the bottom; everything which hinders the growth of aquatic plants; in fact, everything which, at its very source, can destroy the health of fish of a whole basin. * * * Leave a free passage for the fish to pass to the places which are favorable for spawning. * * * Protect the young generation, so that it can arrive at the age of maturity and contribute its share towards the increase of its species."—*U. S. F. R.*, 1874.

Prof. J. W. Milner, of the United States Fish Commission, in reporting on pollution of lake waters from sawdust, said:

"The refuse from the saw-mills, slabs, sidings and sawdust is thrown into the streams in immense quantities, to float out and sink into the lake. It is having a very injurious effect upon the fisheries. The water-logged slabs, tilted on the bottom and moved by currents, tear and carry away the nets. The sawdust covers the feeding and breeding grounds of the fish, and is so obnoxious to them that, in the vicinity of numerous mills, the fisheries become greatly reduced in numbers and success.

"Observations have discovered the salmon ova, diseased and decaying, with particles of sawdust adhering. Its contaminating effects extend far and wide from the vicinity of the mills, as the contents of a dredge, from one hundred fathoms depth, in Grand Taverse Bay, contained numerous blackened and decaying particles of sawdust.

"The gradual deposit of water-logged sawdust, an inert substance in the water, with occasional slabs, forms nuclei for sand-bars in the mouths of the rivers, and in some of them will contribute to an injury to navigation, as it has to a considerable extent in rivers of Wisconsin and Michigan.

"In the Sault Ste. Marie River, and in the Detroit River, in the fall of the year whitefish congregate in great numbers for the purpose of spawning. In a number of rivers the whitefish was formerly taken in abundance in the spawning season; saw-mills are numerous on all of these streams at the present day, and the great quantity of sawdust in the streams is offensive to the fish, and has caused them to abandon them.

"As everywhere civilized man disturbs the balance of nature, and becomes the great enemy of all forms of life that do not conform to his artificial methods for their protection. Not only by the hundreds of artifices for the capture of the fish, but in the foul drainage from the cities, and manufactories, and in quantities of sawdust from the mills, they are driven from their favorite haunts and spawning grounds, and their food destroyed by waters tainted with fatal chemical combinations."

In the seventh report of the Fish Commissioner for the State of Michigan, 1886, when alluding to fouling of the waters with sawdust, &c., it is stated:

"There are some places, nevertheless, where the practice of running sawdust and edgings into the water has become not only an intolerable nuisance from a sanitary point of view, but a great annoyance to navigators of steam craft, and utterly destructive of fishing grounds which, before, were the natural spawning resorts of the whitefish. Particularly is this state of facts true in several places on the north shore of Lake Michigan, and Muskegon, and other places on the east shore of the same lake. The surface of the water for miles around each of the places named is covered with this stuff, and both vessel men and fishermen report that the natural formation of the bottom has been completely covered by the rotting sawdust deposited there. This unnecessary destruction of the feeding and spawning grounds of the fish should have been prevented long ago, but even at this late day there is

no good reason why early legislative action should not intervene to prevent the few mill men who still persist in this practice from so using the waters of the great lakes and the streams emptying therein as to subvert the rights of every other class."

In the New Hampshire Fishery Commissioner's Report, 1885, the following passage occurs :—

"Another method of securing an increase of fish consists in taking the necessary measures to prevent the introduction of foul waste, such as will kill or injure the adult fish, or young, or interfere with the development of the eggs, such as paper and dying establishments, &c., &c., and refuse of saw-mills, the sawdust getting into the gills of the parent fish, or covering up the spawning beds. Many a fine stream has been ruined by saw-mills which have allowed the sawdust to pollute the water. Dams near the mouth of a stream often obstruct the water, so that fish cannot reach a suitable place to deposit fertilized eggs. At the end of two or three years there will be a continued lessening of the run of fish. At the end of this time, when all of the fish born in that stream have been caught, or destroyed, the run ceases. Although the obstruction be removed the stream will remain barren of fish until restocked by human agencies."

Extract from the Michigan State Laws, Section 10 :—

"No person shall put in any of the waters bordering land where fish are taken by the legal owners, or occupants thereof, any ship's ballast, stone, sand, ashes, slabs, sawdust or filth of any other description * * * shall be subject to a fine not exceeding $50."

Extract from a report of Chief Inspector of Fisheries to the Imperial Board of Trade :—

"The ascent of salmon in the rivers is considerably impeded by a number of small weirs, many of which have been built or raised since 1861, and are without the required fish-pass. I have drawn the attention of the Fishery Board to these cases, and also to the introduction of sawdust into the rivers, which is deadly to fish from its choking their gills, and of the refuse from slate grinding, which fills up the spawning beds."

The National Fish Cultural Association Journal, April, 1887, states :—

"Another impediment to the rapid accomplishment of the desired result (for increasing the supply of valuable fishes, and other aquatic forms,), is the absence of concurrent protective legislation of a sufficiently stringent character to prevent unnecessary waste of the fish during the critical period of spawning; and the erection and maintenance of impediments to their movements in reaching the spawning grounds. This is especially the case with the shad and the salmon."

Extract from report of Fish and Game Commissioner for the State of New Hampshire, U.S.A., for 1889 :—

"The Commissioners call the attention of the Governor and Council to the great injury done to many of our trout streams by sawdust and mill refuse being dumped into the streams. A great deal of this is done by portable steam mills that move from place to place, and generally locate so as to run the refuse into the stream to avoid the trouble of taking care of it. The extent of this evil will be understood when we consider that for every thousand feet of lumber sawed forty bushels of sawdust go into the stream. The greatest injury to our streams by mill refuse is the distruction of the spawning beds and young fry. The clear, gravelly eddies just below rapids are the places that are selected by the fish for spawning

purposes, and unfortunately these are the places in which the sawdust accumulates, and the bottom is no longer clear sand and gravel, but a foul mass of decomposing vegetable matter, capable, if present in large quantities, of generating heat enough to emit gas."

Another extract is here given from the report of the Fish Commissioners for the State of Michigan for 1887-88:—

"At Manistee, Seedington, Muskegon, Grand Haven, Pentwater and Montague, while whitefish are scarce in consequence of the depositing of refuse from saw-mills, yet the fishermen believe in artificial propagation, and that planting would be a success if the water was free from that refuse."

Extract from a letter of the late Professor Baird, United States Fishery Commissioner to the Commissioner of Fisheries of the State of Maine:—

"My opinion is asked as to the probable cause of the rapid diminution of the supply of food fishes on the coast of New England, and especially of Maine. The fact as stated needs no question: it is too patent to the experience of every man who has been interested in the fisheries, whether as a matter of business, or as an amateur. An examination of the early records of the country, in which the subject is referred to, cannot fail to convince even the most skeptical.

"We are all very well aware that fifty or more years ago the streams and rivers of New England emptying into the ocean were crowded, and almost blockaded at certain seasons, by the numbers of shad, salmon and alewives seeking to ascend for the purpose of depositing their spawn, and that even after these parent fish had returned to the ocean their progeny swarmed to an almost inconceivable extent in the same localities, and later in the year descended to the sea in immense shoals. It was during this period that the deep-sea fisheries of the coast were also of great value and extent. Cod, halibut, haddock, and the line fish generally, occupied the fishing grounds close to the shore, and could be caught from small open boats—ample fares being readily taken within short distances of the fishermen's abodes, without the necessity of resorting to distant seas. Now, however, the state of things is entirely different. The erection of impassable dams upon the waters of the New England States, and especially of the State of Maine, has prevented the upward course of the anadromous fishes referred to, and their numbers have dwindled away, until at present they are almost unknown in many otherwise most favorable localities. The fact has been observed, too, that with the decrease of these fish there has been a corresponding diminution in the numbers of cod, and other deep sea fishes near our coast; but it was not until quite recently that the relationship between two series of phenomena were appreciated as those of cause and effect."

The following is copied from the annual report of the Commissioners of Fisheries and Game of the State of Maine for 1886, viz.:—

"It is a fact that the State of Maine has the most rigid and best enforced code of laws for the protection of game and game fish of any State in the Union.

"Moosehead Lake is evidently to be the grand fish pond of the Union. * * * The waters are forever protected by law from such deposits of mills or factories as would drive away the fish.

"The diminished volume of water in our rivers, caused by the demands of our industries, and ravages of fire, the obstruction of our watercourses by milling enterprises, the throwing into our our streams of sawdust and waste of our sawmills, the poisonous washings from our various factories, all have tended to destroy our fishes. * * * A great portion of the spawning grounds of our salmon has been destroyed by being covered with sawdust and waste from our thousands of manufactories, compelling our migratory fishes to seek other spawning beds, or leave their ova to be poisoned, or its young to be starved.

"The future of Maine is artificial hatching and planting, or the entire extinction of salmon in our rivers. For the last decade the work of the Commission, in yearly planting young salmon fry in the Penobscot, has alone preserved the salmon to our

river. Had the Commission not yearly supplied hundreds of thousands of young salmon to stock the great rivers of Maine the salmon would now be a thing of the past and extinct."

EXTRACT FROM THE REPORT OF THE SELECT COMMITTEE OF THE SENATE OF CANADA, FOR ENQUIRING INTO THE EXPEDIENCY FOR PREVENTING SAWDUST AND OTHER REFUSE BEING CAST IN THE OTTAWA RIVER.

(ABBREVIATED.)

"Your Committee are of opinion that it is established beyond question, that extensive deposits of sawdust and other mill refuse exists in the river * * *, and that these constitute a very serious and steadily increasing interference with public rights of navigation, which has already become seriously obstructed, and must at no distant period, if immediate measures are not taken to arrest the evil, become irretrievably destroyed. That sawdust, and other refuse of sawmills, can be economically utilized, and that, the destruction thereof is successfully accomplished in at least one mill on the Ottawa, and in many others in Canada, and in the United States of America. * * * That these large deposits of decaying vegetable matter constitute at times a dangerous menace, if not a positive injury to health."

"Your Committee accordingly recommend that the provisions of the Act (Chap. 91, R. S. C.) 'To prevent sawdust or sawmill rubbish from being thrown into navigable waters' be stringently enforced."

The following are abridgments of the evidence given before the above named commission, showing the destructive effects of sawdust and mill rubbish, when thrown into rivers:—

1. *Jno. R. Arnoldi,* Chief Mechanical Engineer of Public Works, said:—

"Before retiring I want to put in something, as one of the most important facts against the sawdust nuisance that has yet been brought to notice. I live right over the cliff, and can see the barges, and cribs, and sawdust coming down the river. The most serious thing is the danger arising from sawdust deposits. These piles of sawdust in the bottom of the river generate a gas which produces explosions by which the steamer 'Peerless' might be broken to atoms. I have seen three explosions a week in front of my house: I have seen a barge thrown clear up on top of the water by one of these explosions. One explosion blew up about two acres of solid ice a couple of feet thick—the broken ice froze together again, and within a week or ten days it blew up again in the same place. This was right in the track of the steamer when coming in with passengers. The obstruction of the river is a commercial loss, but the danger of life is still more serious."

2. *Henry A. Gray,* Assistant Chief Engineer, said:—

"It is no common occurrence for explosions to take place in the gas generated from sawdust. In January last an explosion took place opposite the Rideau River, and broke up the ice, bringing from the bottom of the river a large amount of mill refuse. Another explosion took place and ice 14 inches thick, covering an area of 1,500 feet, was thrown up and broken into small pieces. Decomposing sawdust will not float; it sinks; it never rots. The smell is very obnoxious, and injurious to health. The sickening smell made me ill and also some of the men. At Spanish River, Byng Inlet, the men after going there took typhoid fever, which the doctors said was attributable to the gases arising from the decomposed sawdust. I have no doubt if the steamer 'Peerless' was passing over at the time of one of these explosions it would destroy her."

3. *Robert Surtees,* C.E., of Ottawa, said:—

"We have had difficulty in connection with the recent epidemic of typhoid fever, and the analysts all agree that it came from pollution of the water by organic matter, bark, sawdust and sewage. About twenty-eight years ago there was good

fishing in the river; about five years ago I fished and did not get any then. I used often to get a dozen in the evening before. The sawdust could be burnt as it comes from the mills without incurring vast expense. Three mills now make steam with the sawdust. An explosion occurred one night and blew up 50 or 60 square feet of the ice, right on the road. If any teams had been there they would have been lost."

4. *William P. Lett*, City Clerk of Ottawa, said:—

"I used to fish in the river in my early days and it was one of the best rivers for fish that I know of. Every eddy was full of fish. The fish was a matter of some importance, though they are of little consideration now. There was no salmon, but there were pickerel pike, black bass, and a great many mascalonge. I could catch any number of fish I wanted; now you might fish a week and would not catch two. The bottom of the river is covered with sawdust, and the pickerel, which is a ground fish, could not remain; it has disappeared; it must have sand, earth or gravel. There were fifty thousand people besides the children, and the fish they caught and were benefited by were worth $2.00 each adult, for the year, over and above what it is now, when the river was in good condition. This is a loss of $100,000 a year alone, although it is the smallest consideration in this matter."

5. *A. L. Dunning*, of Ottawa, being examined, said:—

"I have been backward and forwards here for forty years. In those days there was no sawdust to be seen, the shores were perfectly clear, the bays were clean, and there was any depth of water, where now they are filled with sawdust. There were lots of fish in those days, any quantity of them, but not so many now; they are a good deal scarcer."

6. *Dr. Robillard*, of Ottawa, was examined, and said:—

"I have lived here fifty years; the river, when I first knew it, was a free, unobstructed stream, where game and fish used to abound. There was no accumulation of sawdust at that time; the bays and creeks were free from sawdust and mill refuse. The condition now is, that it is obstructed by sawdust, and mill refuse from the mills, all along the coves, and creeks; portions of the river are choked up altogether. I am quite aware of the fact that the river is much obstructed by sawdust, and is a great injury to navigation, and may be an injury to the health of parties on the lower parts of the river. There is no doubt that it is the principal cause for the disappearance of fish from the Ottawa River."

7. *T. C. Keefer, C.E.*, Ottawa, examined, says:—

"I have resided here since 1864. The shores were then entirely clean, rock, sand, and gravel, and the beach sandy and gravelly. The water was all depths, beginning at the shore, it went out to 40 feet. Ten years ago I examined it, and there was a deposit of several acres of sawdust, and the outer edge of it was steeper than an ordinary sand-bank and 40 feet in depth. There are acres and acres of a rotten mass of sawdust. In the early days fish were very plentiful: I do not think any respectable fish would come up here now; the shad used to come in my early days to within eighteen miles of Ottawa. I know that fish are very scarce—we cannot get any now."

7. *John Stewart*, of Ottawa, being examined, said:—

"Sawdust covers the spawning beds of fish, and it gets into the gills of the fish, and of course they will not come up the river. The gas that comes from it is the same as that which comes from the swamps of ague malarial districts; it is also explosive. I do not think that the majority of lumbermen are against the utilisation of sawdust; the thing is to get them all harmonious, of one mind."

8. *Hon. Mr. Dever*, examined, said:—

"I found at the harbor of St. John, N.B., and on the river also, that numerous mills of the same kind as at Ottawa throw their sawdust and mill refuse into the river and harbor. The practice was so injurious to the waters of the harbor,

destroying the fish, &c., that we deemed it necessary to prevent it, and we did prevent it by by-law. They have also to dispose of their slabs, and bark, and refuse of all kinds. They burn it; in our primitive state this was not done, but we were compelled to prevent it because our harbor and fish pools would have been filled up with this decomposing matter. It became ruinous to the fish, destroying their spawning grounds and lessening the supply of fish generally."

9. *John Mather*, engaged in lumbering at Keewatin, was examined, and said:

"I am engaged in water and steam mills, principally water mills; at Keewatin we do not let any sawdust in; that is a water mill; we keep all sawdust out; we catch it as it falls and take it out with carriers and then cart it away. The mills are driven with waterwheels and belts on the wheels; it is the same action as the steam mills."

10. *Hon. Senator Glasier*, examined, said:—

"There are seven or eight mills at the St. John, N.B., harbor, all steam mills; they burn all their sawdust and a large portion of slabs. They have worked thirty and forty years with no accidents from fire, though they are in the middle of the place. Right in the city of Fredericton, on the St. John River, there is a mill which has been running for twenty years, and they burn their sawdust; there are other mills along the river; they all cart their sawdust and refuse out and burn it. The only mill on the river that does not consume its sawdust and refuse is Gibsons. By arrangement with the Government he is allowed to put his sawdust in the river, but he burns his slabs right alongside his mill. A channel has been dug through the sawdust half a mile long and 10 feet deep; sawdust is ruining the fish in the river.

"The salmon have decreased where the sawmills are located. The streams are comparatively ruined for fishing. The Nashwauk River, where Gibson's mill is situated, used to be a good salmon river, but they are now completely gone. The salmon used to spawn there; I have taken seventy in a day right on the shore, below Fredericton. The shad, the gaspereaux and the salmon and sturgeon were then in large quantities; now they are diminished very greatly. The salmon that we now get are mostly from the north shore, Baie des Chaleurs and Miramichi. A considerable number of salmon are still in the St. John harbor and around the bays. The obstruction to the river is a very serious thing, and if Gibson is allowed to put sawdust and refuse in the river a few years longer without check it will be worse. I have been in the lumber business sixty years, on the River St. John and its tributaries."

From the "American Angler and Hook and Line":—

* * * "In considering this question as briefly as possible, it is quite superfluous to enquire to what family or particular genus river fish belong. All fresh water river fish demand similar conditions of the water upon the spawning beds for the vivification of the spawn, the health of the ova and the prosperity of the fry. It is known to be essential that the milt and spawn admix in a clear state, and that if any acid or gas should come in contact with spawn and be absorbed at this critical stage, the result would be disastrous, and simply cured by experience. The absorption of oxygen is necessary for the development of the embryo, and should this be contaminated by other acids or soluble gas than the natural hydrogen found in pure water death is inevitable.

"Now it is known that sawdust, being greatly composed of coniferous woods, combines with its resinous properties chemical agents capable, under certain conditions of heat, of generating deadly quantities of carbonic acid gas, humic acid and others, all of which are factors in the destruction of fish life. If sawdust is advantageous to the healthy state of the ova, why do not those favoring it employ sawdust, instead of carefully boiled gravel in the tanks of their hatching houses? It is quite impossible that in waters where sawdust accumulates, or even passes in its descent over the beds, that the ova are not corrupted, or that algæ or rust will not

settle upon them, and it is too well known that one dead egg will soon contaminate others in its vicinity. * * * *

"But why is it that all fish seek running water, if it is not from a natural instinct to get oxygenated waters, untainted by anything like muric acid or like gases? To say that salmon seek clear water, and yet are not inconvenienced by waters wherein decayed vegetable matter gains admission, is a contradiction. But again, the aromatic odor emenating from coniferous wood is sufficient to decide fish to vacate its vicinity, even if it could furnish an unperceptible quantity of food. There is certainly no reason to conclude that fish do not die from sawdust because their dead bodies are not found, because the fact is they die before maturity, and that it is the ova and the fry which suffer, not the adult.

"Is the heat occasioned by the fermentation of decaying sawdust not calculated to render noxious any water where this may take place? As to sawdust not collecting upon spawning beds, that plea is exploded, for it cannot be contradicted that waterlogged sawdust becomes little less heavier than light gravel, or sand, its specific gravity little less, and that it can accumulate in quite appreciable quantities in every small depression or inequality of the bottom of a stream whose speed attains four miles an hour. To say that fish can escape from taking through their mouths certain quantities of sawdust is equally absurd, for they do, and cannot help it. Hence we must suppose they must suffer by this fact alone. That vegetable matter in a state of decay, as given out from the sawmills, is not beneficial to fish, but on the other hand entirely adverse to their propagation, with all respect to those holding opposite views we cannot conclude otherwise."—*G.B.*

SAWDUST IN COLORADO.

"The sawmills of Colorado, as a general rule, cut pine lumber, and anyone who has seen a bank of pine sawdust extending into a stream has noticed, if he has been in the least observing, the turpentine and resinous oils exuding from the sawdust and spreading abroad upon the surface of the water in all the gaudy colours of the rainbow. The deep pools in such a stream for miles below, instead of offering to its finny inhabitants healthful bottoms of sand and gravel, are cased and lined with sawdust. In Colorado sawdust kills and drives out fish. The experience of thirty years has taught the people this, not as as a theory, but as a fact."—*Sports Afield.*

SAWDUST ON LAHAVE RIVER, NOVA SCOTIA.

EXTRACT from a Report made by Mr. S. Wilmot to the Department of Fisheries in 1884, regarding Sawmills and Sawdust on the Lahave River.

"It is advanced by the mill-owners and other parties interested with them that should they be restricted from allowing the sawdust made at their mills to pass into the river they would be obliged to shut down their mills, and thus stop a large industry in the country. These, to my mind, fallacious and irrational statements, need only to be considered and investigated by the reasonable and dispassionate mind to show how futile is the plea, and why it is put forth for self-aggrandisement only, whilst the public generally are the sufferers. Not only in the fishing industry of the country is it found that many valuable fish-producing waters have been almost wholly deprived of fish-life from the noxious and wide-spreading evil influences produced from sawdust deposits, but also in many instances navigation has become seriously impeded by the operations of this too long practised habit which is forbidden in the statute books of this and almost every other civilized country where the safety of the fishing and navigable interests are considered worthy of legislative protection.

"One of the largest water mills with a double gang of saws is situated on the estuary waters of the Lahave River below Bridgewater. It is driven by water power alone; it has been running for about six months in the year during the past thirteen years. The river is navigable for vessels to come to the mill for the lumber made in it. But no sawdust is cast into the water; it is all carried into a ravine a short distance from the mill, the owners preferring to do this, which they admit entails

but little expense, rather than throw it into the water, where it would obstruct the passage of vessels coming to the mill to carry the lumber away. Now, here is a case which, taken from a navigable point of view, shows clearly the interest of the mill owner for his own preservation in the course he should pursue for economically carrying on his milling business, and not injuring the navigation of the river by depositing the sawdust in it. The whole of the sawdust and mill rubbish here is caught as it falls from the large gang-saws, by a simple and cheap appliance of carriers, and dumped into carts and conveyed to the ravine: here, during thirteen years or rather six and a half years of the actual working of this mill, a mountain of sawdust has been found covering a surface area of about six acres, with an average depth of about 40 feet; one side of the ravine, from information obtained from the manager of the mill, was originally about 60 feet deep, the other side about 20, giving an average depth of 40 feet; it is therefore mere matter of calculation to show the extent of river bottom this vast quantity of sawdust would cover, and the injury that would necessarily result to the navigation of the river, independent of the fully greater calamity to be produced on fish-life from the noxious gasses arising from it by its partial decomposition on the bed of the river.

"This mill is the only one of the many on the Lahave River that does not allow this refuse matter to pass into the streams; and it is a deplorable fact that nearly every mill owner throughout Nova Scotia pursues the pernicious course of putting sawdust into the streams, rather than otherwise disposing of it. In the one case referred to, it is got rid of for self-interest, to prevent blocking the passage of vessels to the mill for carrying the lumber away. In the other cases it is disposed of likewise from selfish motives, by allowing it to pass into the streams without labor or expense, to the detriment of every other interest of the inhabitants below them.

"It may then be asked, how is it that this one very extensive saw-mill on the Lahave River, manufacturing, as it does, ten and twenty times more lumber than many of the other mills on the same river, finds no difficulty in catching and carrying its sawdust away on the land for convenience and financial benefits in the transaction of its large business, while the other mill-owners, from other interested motives, and to hoodwink and deceive the fishery authorities and the public, declare that if compelled to carry out the law by 'not allowing their sawdust or mill refuse to be cast into the streams,' they would have to close their mills, which would seriously affect the lumber trade of the country. The great wonder is, that the public and fishery authorities should have so long countenanced the violation of the law which 'forbids sawdust and mill refuse being cast into streams frequented by fish.'

"With every saw-mill examined, and they have been very numerous, I have not yet found a single case where the sawdust, by a little ingenuity, and with small expense, could not be readily caught when falling from the saws and carried away, in like manner as at this large gang-mill on the Lahave River. But so long as the mill owners are permitted to cast sawdust and mill refuse into the streams, contrary to the provisions of the law, and with the sanction of the fishery officers, just so long will this destructive agency to fish-life be continued, and the prospects for maintaining the fisheries of the country be overthrown and eventually ruined."

EXTRACT FROM REPORT MADE TO THE DEPARTMENT OF FISHERIES, REGARDING SAWDUST AND MILL REFUSE IN THE OTONABEE RIVER, ONTARIO, BY MR. S. WILMOT, 1889.

"That the statements put forth by the mill-owners on the Otonabee River 'That all sawdust and mill refuse which they can reasonably be supposed to keep out of the river is kept out; and that their mills are so constructed as to render it impossible to entirely prevent sawdust from falling into the river; and that to enforce the provisions of the 'Fisheries and Navigable Streams Acts' would result in a stoppage of their work, and the throwing out of employment of some six hundred men.'

"The above statements are not only incorrect, but also untenable, from the simple fact that two out of the four of these mill-owners are, at the present time, by

a simple and comparatively inexpensive appliance in their mills, preventing sawdust from going into the river; and this same remedial measure is equally applicable to the other mills worked on this river, or in fact anywhere else in the country.

"That any concessions made to sawmill owners by which they may be allowed to let all sawdust, made from gang or other saws, pass through the pitman holes into the river, is tantamount to exempting that mill from the operations of the 'Fisheries and Navigable Streams Act,' relating to sawdust, &c., for in the manufacturing of ordinary lumber from ordinary logs it is held that about one-fifth of the log is made into sawdust, and that fully seven-eights (or it may be said all) of the sawdust will necessarily drop through the pitman holes into the water below unless otherwise prevented.

"That all sawdust can, by the exercise of some small ingenuity, and by the application of comparatively inexpensive machinery, be conveyed out of nearly every sawmill in the country, when it can be dumped into fire pits, to be consumed, or otherwise disposed of.

"This is practically illustrated in a very great measure at the upper mills on the Otonabee River, where nearly the whole of the sawdust from the large gangs of saws is kept out of the river, and where it can also be easily seen that, by some further simple appliance, the whole of the sawdust could be carried from the pitman holes, leaving none whatever to drop into the river. Sawdust can be conveyed out of all sawmills in like manner, by means of properly constructed carriers, quite as readily as grain and offal are carried from place to place throughout the ordinary grain mills of the country, and would be so disposed of, if the owners of all saw-mills of every class were compelled without fear, favor, or distinction, to obey the restrictions relating to sawdust and mill refuse, so wisely embodied in the 'Fisheries and Navigable Rivers Acts' of the Statutes of Canada."

SUMMARY OF OPERATIONS AT EACH OF THE HATCHERIES IN THE DOMINION DURING THE SEASON OF 1889.

1. *Fraser River Hatchery, British Columbia.*—During the past year this hatchery planted in the Fraser River and its tributaries and other streams 4,419,500 salmon fry of the saw-quai (*Nerka*) species. Very few eggs of the quinnat (*Chouicha*) family were obtained the previous autumn of 1888. The fry were planted in good condition in rivers well adapted for their aftergrowth, and that were found to be most accessible at the proper time for distribution. About 373,000 of the above number were put out, in the egg state, just previous to hatching; these were quinnat eggs. The loss of eggs during incubation was generally much less than formerly. No fry were planted in Vancouver waters last season. Experience went to show that fry kept in the nursery until the sac was wholly absorbed were safer to transport and more able to take care of themselves when turned out in the streams.

The officer in charge again recommends the introduction of shad in the British Columbia waters. He reports some of these fish were caught in the Columbia River, and at Puget Sound, and along the Vancouver coast, but none in the Fraser River. Applications are made for Ontario whitefish for British Columbia waters. Those which are native to British Columbia lakes are inferior, and cannot be obtained on account of the remoteness of the lakes inland. The gross number of salmon put out of the hatchery since commencement is 19,065,500, from which it is said unmistakable evidences of success are shown. In the Harrison the increase is most marked. The Indians were at first unbelievers in fish culture; they are converts now, after seeing the masses of fish in the streams supplied with young from the hatchery. Satisfactory certificates from canners regarding the general improvement of the fisheries, which they attribute in a great degree to this hatchery, will be found appended to the general report.

The number of ova collected in the fall of 1889 was very large, double that of 1888. Some 9,233,000 were laid down, all Saw-quai eggs; the quinnat are not taken

at the same time as the saw-quai. The latter are most valuable for canning purposes. These eggs are at present in the best of condition.

Repairs, to a considerable extent, must be made upon the hatchery another year. Foundations require renewing; new hatching troughs must be had; the upper floor should be fitted up for hatching purposes; the roof is leaking; the present water flume is absolutely unsafe and must be made anew to avoid the total stoppage of the water supply another year.

2. *Sydney Hatchery, Cape Breton, Province of Nova Scotia.*—There were turned out of this nursery into the waters of Cape Breton Island, in 1889, 2,034,500 young salmon. The yield from eggs laid down in 1888 was very fair—about 76 per cent. No less than seventeen of the principal streams of the island received their quota of fry. They were reported to be planted out in the best possible condition.

The catch of parent salmon the present season of 1889 was very good in the rivers where the operation of capturing them was carried on; the streams were largely filled with salmon, but it was noticeable that they were uniformly smaller in size—many grilse were also taken, a circumstance hardly hitherto known in these waters; the rivers were actually teeming with young salmon. This increase is pretty unanimously attributed to the work from the Sydney hatchery.

The number of parent salmon caught this season was 631. They were taken in the Margaree, Middle, Lower Middle, Sydney and Salmon rivers—the greater portion, or 280, of these fish were captured in the Margaree. Of the whole lot, 379 were females from which were collected 2,540,000 eggs, an average of about 6,700 to each: these eggs are now undergoing incubation, and a large crop of fry is expected from them. But slight repairs of any kind or improvements were made at the hatchery during 1889. A new floor will be required another year for the hatching room; also a coating of paint for the whole building—in other ways the establishment is in very good condition. A request is made for a supply of land-locked salmon to stock a number of fresh-water lakes in Cape Breton, which are said to be well adapted for these fish.

3. *Bedford Hatchery, Province of Nova Scotia.*—A large number of salmon-trout and whitefish eggs were received by this hatchery from the Ontario nurseries —about 3,000,000 of whitefish eggs from Sandwich, and 500,000 salmon-trout from Newcastle. These were transferred during the winter in the semi-hatched state. Upon their arrival about 1,200,000 of these were sent on from Bedford to temporary auxilliary hatching huts at Antigonish, Queen's, Yarmouth, Halifax and King's counties. These small temporary hatcheries have been found to answer the purpose admirably, from an economic standpoint, as well as insuring greater certainty of success in the planting of the fry in the localities proposed to be supplied. It would be found almost impossible to transport the fry from the Bedford establishment at these long distances in the spring of the year without very great loss, whereas in the egg state they can be readily conveyed any time during the winter to these auxiliary hatcheries, which are built near to where the fry are required, so that when hatched the little fish can be planted in the waters at comparatively trifling expense, and with a much greater certainty against loss.

The planting of the salmon and whitefish was performed satisfactorily; some losses took place with the salmon trout. The officer in charge of the Bedford hatchery advises the continuance of this work of stocking the numerous inland lakes of Nova Scotia with the salmon-trout and whitefish of Ontario. He also advocates the erection of one of these small auxiliary hatcheries in each of the counties as the best means for accomplishing this end. The number of salmon fry distributed in the several counties of this Province was 900,000; of salmon-trout fry 450,000 were put out, and of whitefish fry 2,500,000, making a total of 3,850,000 fry of the salmon family that were planted in the waters of Nova Scotia from the Bedford institution during 1889. Mention is made of a marked increase in the salmon fisheries of Nova Scotia since the introduction of artificial fish culture, which should warrant the work to be carried on upon a much more extended scale.

The success attending the capturing of parent salmon, and collecting of eggs during the past season, was very satisfactory. At Musquodoboit River 270 were taken, and at West River 67, were netted in all 337 salmon. Of these, 231 were females, which gave 2,300,000 eggs, an average of about 9,950 to each female fish. These eggs at the present time are showing the embryo fish within them and the prospects of a successful crop of fry at the coming spring is confidently expected. The establishment throughout is reported to be in good condition.

4. *Dunk River Hatchery, Province of Prince Edward Island.*—This hatchery has not been in operation during the past two years, by reason of the breakage of the dam which gave the water supply to the breeding troughs. It will be put in order for general fish-breeding purposes during the coming season of 1890. Beneficial effects have been felt from its former operations in many of the streams of the Island.

Mr. Hackett, Inspector of Fisheries for Prince Edward Island, says:—"Salmon was reported as being plentiful in all the principal rivers of the Province this season, and in many small rivers where they have not been seen for years numbers have been seen this fall. This is, no doubt, the result of the fry placed in the rivers a few years ago.

"If the work of hatching and distributing fry were continued, and better protection given the rivers than that afforded them of late years, I am convinced that salmon would become most abundant in our coast waters, and instead of being practically of no account, as at present, the salmon fishery would in a few years become a valuable industry."

5. *St. John River Hatchery, Province of New Brunswick.*—A series of misfortunes has befallen this hatchery with regard to getting parent fish for supplying it with eggs. numerous trials have been made to capture salmon on the Tobique, a branch of the St. John River; some seasons moderate success has attended the work, but upon the whole failures have prevailed. The past season not a fish was taken, and supplies of eggs for this hatchery will have to be got from the Ontario hatcheries and from the Restigouche establishment. The recommendation of the officer in charge for procuring parent salmon at the St. John Harbor fisheries in like manner as at Restigouche, Gaspé and Tadoussac, should be carried out, as sufficient numbers of salmon are taken in the harbor weirs to warrant full supplies of ova for this nursery, and at less cost than has attended the fruitless trials on the Tobique. The supply of ova for the St. John hatchery for the season of 1889 was obtained as follows—3,000,000 whitefish and 1,000,000 salmon-trout eggs were transferred from Sandwich and Newcastle, in Ontario, and 150,000 salmon eggs were got from the Restigouche hatchery. These were safely transported in the semi-hatched state, and duly hatched out in the spring of 1889, and planted in many of the lakes and rivers of New Brunswick, in the following proportions of fry—2,600,000 whitefish, 830,000 salmon-trout, and 140,000 salmon. Mention is made of whitefish and salmon trout being caught in some localities where the fry had been planted from this hatchery in previous years, and where they were not formerly known to inhabit. These evidences of practical results from the introduction of salmon-trout and whitefish into New Brunswick waters are encouraging, and should be continued on a much larger scale.

Some repairs are required to give permanency to portions of the building, and should be carried out next season.

6. *Miramichi Hatchery, New Brunswick.*—This hatchery produced 800,000 fry from Miramichi River salmon eggs, and 50,000 from ova obtained from the Restigouche hatchery. These were all successfully planted in the Miramichi River and its branches. They were in accordance with instructions, put far up into the head waters of the stream.

A request is made by the officer for a supply of white fish eggs to stock a lake a short distance from the hatchery, in order to introduce this fish into that section of New Brunswick. The lake is well adapted for the experiment. Evidence is given of the certainty of the growth of the salmon fry to "parrs" and "smolts," where these young salmon were found in great numbers in small streams in which fry from the

hatchery were planted, and where parent salmon could not get to lay their eggs. This fact, with so many others previously known, must disprove the theory of many skeptics in that section who assert that all fry put out of the Miramichi hatchery die, or are eaten up by other fish. The officer in charge reports that salmon fishing in that section was just as remunerative last season as for any previous five or six years; and that the majority of the fishermen give credit for this steady catch to the supplementary aid received from the great number of young fry put in the river from the hatchery. They say in fact, that if there were no other source of supply than the natural one the salmon fisheries on the Miramichi would soon become a failure. A well-drawn comparison is made by citing the almost complete extermination of the bass fishery on that river, where their natural reproduction is the only means for keeping up the bass fisheries. The smelt fisheries of that river are also given in proof of the fact that some other than the present method of protection, and natural propagation, must be resorted to, to save this fishery from total destruction in a few years. With these facts of the bass and smelt fisheries rapidly declining, and the salmon fisheries increasing their yield from former years, positive evidence must be drawn that some strong factor is at work to produce this result; and why should not the many millions of artificially bred fry put into these rivers annually, which otherwise would not exist, be entitled to a reasonable share of credit for this improvement of the salmon fisheries, whilst without this aid the bass and smelt fisheries, especially the former, are fast declining.

The fall run of the salmon was late in entering the river. It was remarked that many of them were very large fish. Some fishermen advance the idea that these larger salmon were the product of the Restigouche fry previously put in the river. Grilse were very abundant in the river; as many as a hundred were taken at a single sweep of the net in some pools when seining for the parent salmon. Fishermen now seem to generally admit that the aid from the hatchery has shown itself to be the surest safe-guard against the depletion of salmon in the Miramichi.

The gathering of eggs last autumn was more successful than for years previous notwithstanding a heavy freshet prevented the taking of many more parent fish. The statement is made that poachers held full sway and destroyed great numbers of breeding fish during the close time, on account of the guardians not being appointed at the proper time. The number of parent salmon captured on the different branches of the river was 293, of these 153; were females, from which were taken 1,100,000 eggs or an average of some 7,190 from each. This high average of eggs from each female is proof of the larger life of the salmon this year, as only an average of 5,530 ova were got from each fish last year.

The hatchery and its appliance generally are in good working order, and the eggs, from present appearances give prospects of a larger crop of fry.

7. *Restigouche River Hatchery, Province of Quebec.*—This hatchery turned out 1,280,000 young salmon, and transferred 200,000 semi-hatched eggs to other nurseries; 100,000 of the fry were put in the Métis River; the balance were planted in the Restigouche and its principal tributaries, namely the Kedgewick, Upsalquitch, Patapedia, Metapedia River and lake, and the several brooks entering the Restigouche. The method of planting the fry is admirable; they are towed up in scows, so constructed that the little fish escape gradually through openings, and are seeded so to speak all along the extent of the river, where they immediately hide amongst the gravel and stones in the shallow water, along the edge of the stream. In locations where scows cannot be towed the fry are carried in cans in canoes to their destination. The distribution was perfect, and safe throughout.

Greater success than usual attended the capture of parent salmon; 584 were procured in May, June and July; 475 of these were taken in the Departmental net at the reservoir; 30 in the other Government net at Mission Point, and only 79 purchased from fishermen. The daily catch is shown in official report, Appendix No. 7. A small number were injured in the nets; those not likely to recover were sold on account; 259 females were spawned, and gave 3,022,000 eggs, an average of 11,667 ova to each female. The impregnated ova were carried some fifteen miles up

river to the hatchery. It will be necessary to transfer some of these eggs to other hatcheries, as their number would be too great and cause overcrowding and loss of fry at the hatching time if not thinned out. It is proposed to supply the St. John River hatchery from this stock of eggs. Important repairs will be needed at the salmon pen or reservoir before another season, by building substantial block piers for strengthening the wire-work or casing of the pond to prevent the escape of the parent salmon. Great precaution is required to make this enclosure perfectly safe, otherwise the whole season's catch of parent salmon might escape, and a year's operations of the hatchery would be lost. These piers, and additional wire fencing, are absolutely necessary to insure safety for the reservoir next season. Some new twine netting for repairing the salmon nets must be procured also.

The officer in charge reports the first run of salmon to have been a fortnight sooner than usual, caused by the very early spring, which opened up the river long in advance of former years, before the netters were prepared to set their nets, thereby losing the benefit of this first run. Yet the general catch of salmon in the estuary and bay was good, and the anglers also did well. Certificates are hereto appended from most intelligent fishermen and proprietors up river, giving conclusive evidence of the healthy state of the salmon fisheries of the Restigouche and the bay, which they attribute in a great degree to the continual annual supply of young salmon put into the river from the hatchery. Parrs and young salmon were very plentiful in the river the past season. The river guardians of the Kedgewick and of the main river also, and scowmen traversing the river, make statements that the spawning beds and bars all along these rivers were literally covered with salmon in the act of spawning last autumn. It is also reported that a great deal of poaching was practised by drifting and otherwise during the past season.

8. *Gaspé Hatchery, Province of Quebec.*—By the death of the late officer in charge of this hatchery, Mr. P. Vibert, another appointment was made in June last, of Mr. Henry Davis, who reports having captured 110 parent salmon in the Dartmouth River; of these 65 were females, and gave 820,000 eggs, making an average of 12,600 ova from each. Not one parent fish was lost from confinement in the reservoir from May till late in November, when they were turned out quite healthy. The planting out of fry commenced in June: 450,000 were distributed: 250,000 were put above the falls on the Dartmouth, 100,000 below the falls, and 100,000 in the York River. The building is in good repair, but requires painting outside. The apparatus, generally speaking, is in good condition. A pleasing circumstance in connection with this hatchery is that its beneficial effects have been felt in giving an increased average weight to the salmon caught in the adjoining River St. John which empties in the Gaspé Bay. The young fry bred from eggs of the larger salmon, natives of the Dartmouth River have, for many years been planted in the St. John River, where native salmon were formerly of a much less size than the Dartmouth fish. The average weight of the salmon taken in the St. John in 1889 was 22 lbs. The account given by an old reliable fisherman is that, from 1870 up to 1880, the average was 12 to 15 lbs. This increased till 1887-88, when it reached 18 and 19 lbs., and in 1889 reached 22 lbs. Some individual fish were taken at 30 lbs. The canoe men and fishermen assert that this extra size of the salmon is to be attributed to the operation of the hatchery in planting the fry bred from Dartmouth salmon in the St. John River. Reports go to show that great number of young salmon parrs and smolts were observable in the upper waters, and the estuaries of the Gaspé Rivers.

9. *Tadoussac Hatchery, Province of Quebec.*—There were successfully bred at this establishment during 1889, 1,600,000 salmon fry, and safely planted in the principal tributary streams to the Saguenay River. It has been found that the fry put in the small lakes Mowats a short distance from the hatchery have thriven in a most satisfactory manner. Distribution in these waters will be continued, as the facilities offered for their ready growth, and passage to the sea are very great. A suggestion is made to discontinue the planting of fry in the St. Margaret and Little Saguenay rivers, as they are so largely filled with trout, and that additional supplies should be given to the extreme upper waters of the Main Saguenay, as salmon have

already been taken above Chicoutimi, where they were not previously known, and where fry were planted from the Tadoussac hatchery.

It has been somewhat difficult to obtain full supplies of parent salmon for this hatchery. The improvement this year has been very marked as a surplus, of 249 salmon were turned out of the net, over and above the number required to fill the hatchery with eggs. A total of 559 salmon were taken in the Departmental net; 249 were let loose again keeping 310 of the largest for hatchery purposes. The perfection of the mode of retaining parent salmon in the salt water reservoir from early in June till November, is shown by the loss of only two fish. There were 206 females spawned, from which 2,557,000 eggs were obtained, with an average of 12,400 ova to each, thus showing the fish to be of very large size. Spawning commenced 21st October, and terminated 9th November. The fish, when turned into the Saguenay, were perfectly sound and active, and gave the utmost satisfaction to numerous leading visitors who came to see their liberation.

The increase of salmon taken by netters was shown to be very good in 1888; an increase of 50 per cent. has been shown this year over that of last year, and the catch this year is nearly 300 per cent. over that of 1886, and with the same number of nets; an evidence of success which is substantiated by the letters of leading persons, who state that salmon were caught in the river Shipshaw and other streams above the town of Chicoutimi for the first time, which they consider to be the result from fry planted from Tadoussac hatchery. The officer in charge reports the hatchery to be in a dangerous state. It stands upon a pier of slabs which is badly decayed, and the building also is showing signs of decay, and either a large outlay for repairing or building anew must be done. A better and safer site can be obtained close by the small pond, from which the water could be run directly into the building, and thus save the expenditure and precarious nature of the long dall or raceway which conveys water to the present hatchery. It is urgent that something should be done during next summer to put the Tadoussac hatchery in a safe and proper working condition.

10. *Magog Hatchery, Province of Quebec.*—From this institution 1,700,000 whitefish fry were planted in Oxford, Massawippi, Megantic and Memphremagog lakes, in the Eastern Townships. There were also bred in this hatchery 1,100,000 salmon-trout from eggs from Newcastle, which were planted in the lakes of the counties of Brome, Sherbrooke, Megantic, Stanstead and Beauce. Both trout and whitefish were put out in good condition, and with very slight loss. The officer in charge reports again, as previously, that whitefish are seen in considerable numbers in some of the above lakes since being put there from the Magog hatchery; and that they were not known in these water previously. Netting and spearing being prohibited in these waters, few whitefiish can be taken.

Salmon-trout and black bass are still increasing, the spawning grounds were largely covered by these fish the past season. Illegal fishing is practised in these waters, and the reduction of means for guarding the shoals at the spawning time has given an impetus to the poacher to extend his illegal work. Necessary repairs to the floors are in progress and when complete the establishment will be in first class condition. The usual quota of salmon-trout and whitefish eggs in the semi-hatched state, will be transferred from Newcastle and Sandwich hatcheries to Magog at the proper time.

11. *Newcastle Hatchery, Province of Ontario.*—There was a very large output of fry and semi-hatched eggs of various kinds from this hatchery during 1889, forming a grand total of 8,566,000, consisting of salmon-trout, whitefish, speckled-trout and black bass. Their distribution was spread over numerous sections of the country; salmon-trout and whitefish were planted in many of the lakes of Quebec, Nova Scotia, New Brunswick and Ontario. The speckled trout were widely disposed of in localities where the numerous applicants desired them.

From the satisfactory acknowledgments received concerning the distribution generally, the eggs and fry were received at their destination in the most healthy condition; and the fry were liberated to the satisfaction of all concerned.

The officer in charge reports the necessity for procuring larger supplies of speckled trout ova, in order to fill the numerous and increasing demands which are being made by individuals to re-stock various streams of the county, which, in many cases, from improvidence, have become very much exhausted.

The system adopted the past season for procuring supplies of salmon trout eggs was eminently satisfactory. By the selection of certain fishing stations in Colpoy's Bay, at Wiarton, and working them with Departmental nets, under the supervision of Mr. Charles Wilmot, officer in charge of the Newcastle hatchery, the success in getting full supplies of ova within a shorter period of time, and at less cost, was very gratifying, showing that 11,000,000 of eggs were collected during sixteen days in November, as against 5,000,000 during the whole of November in 1888, under the then system of employing nets and fishing gear of all kinds from pound net fishermen. With the nets and fishing plant now owned by the Department, it may be safely concluded that the expenditure connected with gathering salmon-trout eggs for the several Dominion hatcheries requiring them will be considerably lessened in the future.

Appended to the Newcastle report is a schedule giving the numbers of fish netted, the quantities of eggs, and the dates in which they were collected. From this diary, and those of former years similarly kept, the most indisputable evidence is brought out, proving the wisdom of selecting the month of November as the proper close time for the protection of salmon-trout at their spawning time. It is asserted, however, by interested parties, that November is not the true spawning time for salmon-trout. The practical work of the fish cultural service after many years experience has shown that the eggs of the salmon trout are principally shed during November. If taken at an earlier period they are, in the majority of cases, not sufficiently mature to be susceptible of proper impregnation. This evidence should suffice to show that the present close season of the month of November is the correct one for salmon-trout.

The condition of the ova in the Newcastle nursery is very satisfactory. They are, however, somewhat overcrowded by the increased numbers now on hand. Relief must be given shortly, by transferring large quantities to Magog, St. John River, Bedford and Ottawa hatcheries.

With the now increasing demands from the Maritime Provinces for supplies of eggs of the commercial fishes of the great lakes, for introduction into their waters, it will be necessary to increase the hatching capacity of the parent establishment at Newcastle. Repairs of certain descriptions are, however, requisite, and will demand consideration the ensuing summer.

12. *Sandwich Hatchery, Province of Ontario.*—From the supply of eggs collected in 1888 there were turned out of this hatchery 21,000,000 of whitefish fry and 11,000,000 of semi-hatched ova; the former were planted in many of the principal lakes of Ontario, and the eyed eggs were transferred to hatcheries in Quebec, New Brunswick and Nova Scotia. The work of distributing the fry and transferring the eggs was satisfactorily carried out. When the work of whitefish hatching had been completed, operations commenced in collecting the ova of the pickerel, (doré), when 30,000,000 were obtained in Lake Huron; about 21,000,000, or 70 per cent. of these were hatched and planted in various places in Lakes Huron, St. Clair and Erie, and in the Detroit River. These fish are reported by the fishermen to be considerably on the increase through the agency of the hatchery.

The collection of whitefish during the past fall has been most satisfactory, nearly doubling the quantities of former years. This success is due to the means adopted by the Department in operating the Bois Blanc fishery by its own employés and fishing apparatus, together with the enforcement of a regulation that, fishermen who we permitted to fish during November should allow the eggs to be taken from the fish for hatchery purposes. The result was that 70,000,000 of ova were placed in the Sandwich nursery and in addition about 4,000,000 eggs were impregnated and scattered here and there in the Detroit River. Whitefish fishing on the river the past season was generally speaking much better than the previous year. It will be found neces-

sary to erect a temporary breakwater at Bois Blanc fishing station, to prevent injury to the fish put in the pens caused by the receding of the water from the effects of strong winds; $100 would make this provision.

The officer in charge says necessity exists for erecting another wind-mill, where the pickerel are caught in Lake Huron, in order to supply more water for the tanks in which the parent pickerel are kept till ripe for spawning.

The hatching capacity of the Sandwich hatchery must be enlarged: its growing importance demands this. The present deposit of 70,000,000 eggs in it causes great anxiety for their safety, by overcrowding; only half of the floor area is at present utilized for hatching purposes, the other half being used for dwelling purposes by the officer in charge and his family; outside provision should be made for the officer in charge, and the wholefloor area supplied with additional apparatus. In this way hatching room would be obtained for 150,000,000 whitefish eggs.

APPLICATION FOR YOUNG FISH.

From the numerous applications which are continually coming in from all parts of the country, it has been considered expedient to issue the following form of application and directions so that all parties desirous of obtaining fry of any kind from any of the hatcheries can be furnished with this blank form of application and directions which when duly filled in by the applicant and returned, will enable the fish cultural branch of the Fishery Department to form a more intelligent idea regarding the adaptability of the waters for the growth of the fish, where they are proposed to be planted.

DEPARTMENT OF FISHERIES,
FISH CULTURAL BRANCH, OTTAWA.

In consequence of the increasing number of applications for young fish, and for the distribution of fry from the Government hatcheries, the following regulations have been made by the Department: —

Hereafter no application can be entertained unless these regulations are strictly adhered to, and the application made at the time specified.

All applications must be made upon a blank form, a specimen of which is hereto appended. These forms may be obtained on application to the Superintendent of Fisheulture, Ottawa, or from the various inspectors of fisheries and officers in charge of hatcheries throughout Canada.

DIRECTIONS.

The appended form of application for procuring young fish, and directions for planting them, is given to all persons who are desirous of applying for fry of such description as are bred at the several Government hatcheries.

It is requisite that the appended blank form shall be intelligibly filled in, and the directions strictly adhered to by all applicants, in order to insure successful results from the action of the Government and from such persons as are desirous of replenishing the waters of the country with increased supplies of fishes.

All applications for fry, or ova, of any description, must be made in writing on or before the 1st day of February of the year in which they may be required, addressed to the Department of Fisheries, Fish Cultural Branch, at Ottawa. If not made upon the appended form, one will be forthwith sent to the applicant, which must be promptly returned, duly filled up, when in due time the applicant will be notified of the quantity of fry that may be allotted to him, and the time when and the manner in which the young fish are to be obtained by him.

Special attention must be given by all persons receiving young fish to their being carefully and properly planted. They must not be thrown out by the pails full, so to speak, in one spot, but spread thinly over long areas, in well selected parts of rivers, lakes, streams or other waters.

Salmon fry (*Salmo Salar*) must be carefully distributed on the gravelly beds of rivers and streams, far up and near their sources as possible, where the water is pure and cold, with a temperature not exceeding 60 or 65 degrees.

Salmon Trout and *White fish* fry, in order to thrive well, should be planted out on the shoals and reefs of deep lakes, having pure, cold water of a temperature ranging under 65 degrees.

Speckled-trout should be put in the pure, cold rapid parts of brooks or larger streams, on gravel beds, in sheltered places. Ponds and lakes fed by springs are also well adapted for them. They will not thrive well in waters of a temperature above 60 degrees.

Pickerel (Doré) and *Black Bass* may be planted in waters more sluggish, warmer, and less pure in their nature than is required for the salmonoid species previously mentioned.

Special attention must be given by all applicants to the foregoing directions.

SAMUEL WILMOT,
Superintendent of Fish Culture for Canada.

Ottawa, October, 1889.

Note.—This page page of directions is to be kept by the applicant for his information when forwarding the appended application for fry.

FORM OF APPLICATION.

The undersigned applies for of the species

which are to be planted in the public or private waters hereinafter described, to be procured from the Newcastle hatchery, Ontario, or from such other nursery as may be nearest and most convenient to the waters to be stocked.

1. Name of stream, pond or lake.

2. Name of Province, county, township or town.

3. Approximate size of stream or other water.

4. What kinds of fish have been, or are now, native to it?

5. What is the nature of surrounding country? Is it wild or cultivated?

6. If a lake, stream or pond, what is its character as to temperature, depth, bottom and purity?

7. What constitutes the ordinary food for fish in the water to be stocked?

8. Have the fish hitherto found in this water thriven well?

9. What is the sentiment of the inhabitants in the locality regarding protective laws for fish?

10. Are the fishery laws well enforced? Give the name of the nearest fishery officer.

11. Give the name of the railway and station nearest to the water to be stocked.

12. If for a public water, what provision will be made upon arrival at station to carry fry to their destination? Give the distance, description of road and conveyance to be had.

13. If for private waters, give similar information as for question 12, but all expenses connected with transport and planting of young fish must be paid by the applicant. If convenient, an expert will be supplied from the nursery to perform this work, whose expenses must be prepaid.

14. Applicants will give the most direct route by land or water by which the fry can be most safely and speedily transported to their destination.

15. Applicants for speckled trout fry will be charged a moderate price per thousand to cover cost of eggs and hatching.

Prompt and complete answers to the foregoing queries will enable the Department to act intelligently on the application.

Date of Application, Name of Applicant,

P. O. Address,

EVIDENCE OF THE PRACTICAL RESULTS FROM ARTIFICIAL FISH BREEDING IN CANADA.

The following letters from reliable sources are herewith given, in evidence of some of the benefits which have been experienced from the planting of fry in certain localities, which were bred in the hatcheries :—

BRITISH COLUMBIA.

New Westminster, B.C., 23rd August, 1889.

Sir,—At a meeting of the Board of Trade, held last night, the following resolution was unanimously carried:—

"That this Board of Trade has every reason to believe that the Fraser River hatchery has been productive of much good, and the experience of this and last season proves beyond doubt that the numbers of fish coming into the river has greatly increased; therefore, this Board is of opinion that it would be mistaken economy to close said hatchery, and that the fishing interests of the Province are such as to make it desirable that the efficiency of the hatchery should be increased rather than decreased, and that an additional hatchery should be established at Harrison River, or some other suitable point."

Yours truly,

D. ROBSON, *Secretary.*

DEN'S ISLAND, 19th August, 1889.

SIR,—In reply to yours of 12th August, referring to the fisheries service, &c., I think by all means the hatchery should be kept up and the output increased. I also think some means ought to be taken to protect the natural spawning beds.

I remain, yours sincerely,

H. KIRKLAND,
Fraser River Fishery, Den's Island.

(*Extract.*)

NEW WESTMINSTER, B.C., 7th August, 1889.

"In regard to the Fraser River hatchery, I think I am able to speak more correctly on its work than any fisherman on the river. For over thirty years I have fished salmon on the river, and therefore know what should be expected from the various years as they came along. Last year and this I have caught many more spring salmon than ever before, and very many of these fish were under the usual size—a fact which convinces me that they are the product of the hatchery. My thirty years' experience teaches me that the large number of these small fish is not the result of accident.

"The unprecedented run of 'sockeyes' this year brings with it a phenomenon never before observed on the Fraser, viz., a great run of 'sockeyes,' averaging from 3½ to 4½ pounds in weight each. This has never happened before in my thirty years' experience, and I attribute it solely to the work of the hatchery. Last year there was a small run of these fish also.

"On the whole, I consider the hatchery a very important factor in maintaining the fisheries of the Fraser, and the removal of the hatchery, in my opinion, would be a genuine calamity. I trust the Fisheries Department will do nothing rashly in this matter, and in conclusion I would urge a strict maintenance of the efficiency now prevailing.

"I am, Sir, your obedient servant,

"WM. H. VINCENT."

LADNERS' LANDING, 19th August, 1889.

SIR,—Replying to your letter asking for my opinion regarding the utility of the hatchery, I would state that it is favorable. The fact that fish have been propagated in rivers to which they were previously unknown is evidence that their numbers may, by similar methods, be increased in their native waters. This has actually been done at Rogue River, Oregon, where Mr. R. D. Hume erected a salmon cannery and a hatchery some twelve years ago. The hatchery since its establishment has increased the supply of salmon three-fold.

I believe further that the hatchery under your supervision on this (Fraser) river has been of great benefit this year. The "sockeye" run is not ended, yet there are already more fish packed on the Fraser than were ever before put up in the whole Province during an entire season. Each and every cannery on the river has exceeded its greatest previous packs made on this run. The increased number of canneries this year partially accounts for the large aggregate output, but not for the uniformly greater pack of individual canneries.

To discontinue work at the hatchery would be a mistake which the Province cannot afford to have made.

Yours truly,

E. A. WADHAMS.

CANOE PASS, 15th August, 1889.

DEAR SIR.—I am in receipt of yours of the 12th inst., and in answer would say that in the matter of the hatchery it is my firm opinion that the big run of salmon this year is to be attributed to a great extent from the output of the hatchery, and it is to be hoped that the Government, instead of curtailing the expenses on the existing one, will establish another in some suitable place on the Fraser River. The salmon industry on this river has been a great success, and a great source of revenue to the Province this year, and will always continue to be so as long as it is fostered and protected by the Government. How any one (unless it could be through prejudice) can say but that the great sources of fish supply this season can be attributed to any cause outside the hatchery I cannot see. You can take, for instance, the supply of salmon for the year 1885, when there were only six canneries running, and it did not nearly average to each boat as much as they did this with sixteen canneries running.

I would strongly recommend that the hatchery should be continued and for the next three years let it prove its value, and I think it will convince the most bitterly prejudiced of these parties that may write against it.

I might quote instances of the great success of hatcheries, such as Rogue River, and also the hatchery of shad on this coast, but you of course are thoroughly conversant on these subjects, and I will not occupy your time in doing so.

I will conclude by strongly recommending that the hatchery should be continued.

Yours very truly,

THOS. E. LADNER.

LADNER'S LANDING, 16th August, 1889.

SIR.—We learn that the Department has been informed that the hatchery has been of no benefit to the river. How any one could make such a statement and give reasons for it greatly surprises us, and we can only think that there must be some other reason than the welfare of the country has made them do so.

Till this year the hatchery could not prove itself according to the accepted four year return. This year the run has been the best that we ever saw on the river when the hatchery had a chance to make returns, and we have no doubt in following years will greatly add to the output of the river, and be a source of revenue to the country at large, very much in excess of the present expenditure, and we think it would be a very great mistake if the Department should curtail or hamper the hatchery in the least.

Had they spoken of increasing its capacity instead of diminishing it, at least till it had a fair trial, it would have been much more reasonable, and we consider when the Department pays a much larger subsidy to eastern Provinces that do not turn out one-tenth of the returns of the Fraser, it would be very unjust to British Columbia. That the hatchery has not shown much return till now is not strange. You would not plant fruit trees and, unless they bore fruit in two or three years, dull them up. But that, in our opinion, would be the action of the Department should it decrease the capacity of the hatchery at this time.

We think the hatchery should be continued for at least three years longer, in order to see whether or not it improves the poor years, as otherwise it would not have been in operation long enough to prove its usefulness.

We remain, dear Sir,

Very truly yours,

LAIDLAW & CO.,
Delta Canning Co.

CANOE PASS, B.C., 15th August, 1889.

In answer to yours *re* hatchery on Fraser River, beg to state that, judging by the results this year, my opinion is that the salmon hatchery established on the Fraser River has increased the salmon run enormously.

I have the honor to be, Sir,
Your obedient servant,

D. DRYSDALE,
Manager Canoe Pass Canning Co.

LULU ISLAND, B.C., 16th August, 1889.

SIR,—I should say by all means maintain the salmon hatcheries. It has already done good, and we are just beginning to see the result. There is no doubt, in my mind, but that it will eventually fill up the off years, so that we will see no difference in the seasons, which at present are, as you know, very marked. There can be no doubt but that the salmon hatchery will be attended with the same good results as other fish hatcheries have on this coast. I have no doubt of the success of propagating, both for increasing numbers and improving quality. It is so in vegetable—why not in animal life?

We all know there were no shad on this coast until they were hatched and planted here.

I will respectfully recommend this to the Department. Do not protect trout in the rivers carrying large amounts of salmon, or the tributaries thereto, as they are the salmon's greatest enemy. I would rather encourage their destruction.

Trusting the hatchery will be maintained at any cost.

I am,
Yours very respectfully,

M. M. ENGLISH.

ANNISVILLE, 16th August, 1889.

SIR,—I am in receipt of yours asking my opinion on the utility of the fish hatchery. I beg to say, that I wish others engaged in the canning business advocated and petitioned the Minister of Fisheries to establish a hatchery on this river. Since its establishment I am more confirmed in my opinion that it was a wise step in the interest of the fish industry, and I think it would be a most serious mistake should the Government consider it necessary to discontinue such a useful establishment.

I am, dear Sir,
Yours respectfully,

PETER BURELL,
British Columbia Packing Co.

BON ACCORD CANNERY, 15th August, 1889.

SIR,—In reply to yours, I may say that I am certainly in favor of continuing hatchery operations for a time at least. I do not think sufficient time has elapsed from date of its inception until the present to decide its results as a failure or success.

Spring salmon, I believe, take longer to mature than the "sockeye," and I understand very few of the latter were hatched until the run of 1886. I feel satisfied that we need not look for these until next year. From my view the hatchery on this river is but an experiment yet, and for that reason would continue it until results are proved beyond a doubt.

Aiding and protecting the natural spawning grounds, however, is something I would advocate most strongly. You, perhaps, know my views on this matter

already; and anyway I have not time to write them here; but as settlement and development on the river banks continue, correspondingly should efforts be made to maintain by all means the safest source of supply of salmon for the Fraser River, the natural spawning grounds.

To do this, if your Department cannot afford to expend anything in this direction, apart from the hatchery expenses, something worth while, I would suggest that the amount be equally divided with a natural spawning ground protective service until such time as the hatchery results are proved conclusively.

Yours respectfully,

D. T. MANN,
Manager.

Victoria, B.C., 13th August, 1889.

Sir,—We had always been under the impression that the hatchery has been beneficial towards increasing, or at least maintaining, the supply of salmon in the Fraser River, and this impression was gained from remarks made by fishermen.

Our own knowledge on such matters is very imperfect, and an opinion is therefore not of much value, but we beg to submit the following for consideration of the Department:—

Has the hatchery been in operation for a length of time sufficient to afford a practical test of its efficiency in increasing the supply of fish? If not, should it not be continued until a practical test has been made?

We presume you are the best judges as to whether any results have been obtained or not.

We remain, yours faithfully,

FINLAY, DURHAM & BRODIE.

San Francisco, 1st February, 1889.

Dear Sir,—Your favor of 4th ultimo has been forwarded from Ellensburg, and in reply will say that I have been operating a hatchery on Rogue River with some success for the past twelve years.

Being only an amateur at the business, have had many difficulties to overcome, but am gradually improving, and can see evidences of its benefits.

The pack at Rogue River the season of 1877 was 3,500 cases; spring of 1878, about 14,000 cases. The season of 1878 I turned out 350,000 salmon fry, and four years later packed 15,000 cases spring fish.

We have until this season only propagated "salmo quinnat," what are called "Chinook." This year we have also spawned "silversides." The ova is from fifty to sixty days hatching, according to temperature of the water. We kept the young alewives in troughs until umbilical sack is absorbed, and they are ready to feed. My hatchery has a capacity of 3,500,000 eggs. Owing to its situation, the cost of working is comparatively light. I think outside of repairs and improvements can operate for $1,500 per annum. I have not the figures at hand, but am sure it would come inside that amount. Trusting that I have answered clearly on the various points, I can assure you it will be no trouble to answer any further enquiries you may wish to make, although I may be rather slow in answering, as I am very busy, but would like to take leisure time to write up the matter more fully.

Yours truly,

R. D. HUME.

ASTORIA, OREGON, 14th September, 1889.

DEAR SIR,—Your favor of the 4th inst. is at hand, and contents noted. In answer will say that the pack of salmon for the Columbia River the past season is 320,000 cases, as near as I have been able to ascertain. The pack on the Sacramento is not far from 75,000 cases. The small streams along our coast are just commencing their fall pack, which will not be very large. I think it will not exceed 100,000, if it reaches that figure.

We turned out from the Clackamas hatchery this spring 5,500,000 fry, and have a good prospect of obtaining enough ova for that amount the coming season. The United States Fishery Commission still operate the Clackamas Station, in conjunction with the State Commission.

The shad are gaining very rapidly in the Columbia River; indeed, many have been taken and sent to market this season; some have been taken to weigh as high as five and six pounds, and the fish is far ahead of the Atlantic shad, being much fatter and of better flavor, and in a few years will be a source of revenue to our country.

Your reports came to hand with the letter, for which accept thanks. I have none of our reports for 1887–88 at hand, but will try and find one for you.

I have found a few copies of 1887–88, and will forward them with this. Your pack on Fraser River exceeds all expectations, and must go far to convince the most skeptical that artifical hatching can be made a success. I believe in the near future that all our streams will be restocked with an abundant supply of food fish by means of artificial propagation.

Yours truly,

F. C. REED.

ELLENSBURG, CURRY CO., OR., 17 September, 1889.

DEAR SIR,—Your favor of 23rd August received. The pack on this river has been greater so far this season than ever before, although of modest proportions as compared with Fraser. However, it is a small river in comparison. The benefits of the hatchery are conclusively shown, when we compare the conditions with other streams on the coast. This river has increased its pack every year since the hatchery was established, while the other streams have decreased, and as Rogue River is a very easy stream to fish, and has been done very closely, it seems as strong evidence that our work has been a great benefit.

The spring pack will be about 16,000 cases, about five times as much as was packed in a season before the hatchery was started.

I do not consider that we are fairly started at the hatching business yet, as we have in the past labored under many difficulties, which are now about overcome, and in future think we will be able to make a fair showing.

Yours truly,

R. D. HUME.

WESTMINSTER JUNCTION, 27th November, 1889.

SIR,—In regard to "sockeyes" salmon running up the Coquitlam River: I have lived here, and have fished in the Coquitlam River for the last eight years, and this is the first year that I have seen "sockeyes" salmon ascending the Coquitlam, which they did in considerable quantities for about six weeks this fall, showing clearly that they are the young salmon deposited in the stream from the hatchery. But the upper portion of the river is badly obstructed by log dams, preventing the fish from reaching the lake, and consequently a large spawning ground. If the the river was cleared of obstruction, which a few thousand dollars would do, it would be a good investment for the country.

Respectfully yours,

R. B. KELLY.

HALL'S PRAIRIE, SURREY, B.C., 30th November, 1889.

DEAR SIR,—In reply to your inquiry dated 19th November, relating to the salmon fry distributed by you in the Nicomekle River last spring, I have the pleasure and satisfaction of being in a position to inform you that the young fish here have done remarkably well, and that large numbers of them may be seen 6 inches and upwards in length. I think the experiment so far has been very satisfactory, so much so that the Council of the Corporation of the District of Surrey at their last meeting adopted the enclosed memorial (which please forward to the proper authorities), requesting that the waters of the Serpentine, Nicomekle and Campbell Rivers may all be stocked with salmon and shad fry. Thanking you for your willingness to place the fish in our river, and believing you will be perfectly satisfied with the results.

Respectfully yours,

HENRY T. THRIFT,
Clerk Municipal Council.

MEMORIAL *RE* SALMON AND SHAD FRY FOR SURREY RIVERS.

On motion of Councillor Armstrong, seconded by Councillor Shannon:

That whereas the waters of the Nicomekle, Serpentine and Campbell Rivers, in the opinion of this Council, are well adapted for the propagation and development of several species of food fish, which if introduced therein would soon be a source of profit to the residents of the neighborhood and a great benefit to the cities and towns of the mainland;

And whereas the salmon fry distributed in the Nicomekle River last spring by the officer in charge of the Government fish hatchery have so far exceeded our expectations, many of the young fish being 6 inches and upwards in length;

And whereas this Council believing that were the Government to undertake to stock the waters of the above named rivers with salmon and shad fry, it would be the means of inducing a most desirable class of settlers to locate on the Government lands near the rivers, besides proving a great attraction for tourists, etc., and furnishing settlers with a constant supply of those excellent fresh food fish;

Be it therefore resolved:

That the clerk prepare a memorial addressed to to the Minister of Marine and Fisheries, directing the attention of the Department to the above facts and requesting that action may be taken immediately, with a view to depositing a number of both kinds of young fish in the above named rivers in the coming spring.

Carried unanimously.

HENRY T. THRIFT,
Clerk of Municipal Council.

NANAIMO, B.C., 20th November, 1889.

SIR,—The "sockeye" salmon, or a trout-like fish which I believe must have been the "sockeye," were seen in great number in the spring, and the Indians remarked that they never saw so many trout in the river before. Since the spring I have not heard of or seen any strange fish in Nanaimo River.

I am, Sir,
Your obedient servant,

LOUIS A. GOOD.

QUAMICHAN, B.C., 20th November, 1889.

SIR,—I have the honor to report that the "sockeye" fry and eyed ova placed in the Cowichan River are now showing good results; a great number of fish of this species have been taken during the year, and when I was at the head of the Cowichan Lake last month we saw shoals of them from four and a-half to six pounds in weight. They seemed to be waiting to get up the mountain streams.

The Indians say that they have never been seen here before, and they now have faith in your fish culture, which before, when they assisted in placing the ova in the river, they thought would prove fruitless. Congratulating you on the result.

I have the honor to be, Sir,
Your obedient servant,

W. THOMAS,
Fishery Guardian.

NEW BRUNSWICK, MIRAMICHI HATCHERY.

SOUTH ESK, 16th December, 1889.

Jared Tozer, Esq., says: "Salmon were as plentiful this season as they have been for the past four or five years, some nets having taken even more than a uniform catch, while others have not done so well. Those nets which were in readiness to take the June run of fish, which entered our river this season about the middle of May, made good catches, while those which did not get to work before the usual commencement of the fishing season show a slight falling off."

John McColm, Esq., says: "My nets have taken more salmon this season than for any during the past five years. Our June run of salmon entered the river in May, on account of the early spring, and some fishermen complain of poor catches, but this is simply because they had not their nets in readiness to take this first run. Altogether, salmon do not show the slightest signs of decreasing in our waters during the past six years. This is, I think, greatly due to the benefits derived from artificial breeding, without which our supply of salmon would run short in a very few years."

Patrick Gillis, fisherman, says: "I have fished a set of nets near the head of the tide for past ten years, and I am of the opinion that salmon have been on the increase for the past six years. Certainly the catches of fish by nets in this vicinity do not show any falling off, and one would almost think it impossible for ten salmon out of one thousand to reach here when the way in which the river and bay is obstructed with netting below this point is considered, of which one-fifth was not in operation eight or ten years ago. Grilse have been very plentiful during the past summer. It is my opinion that artificial breeding is an almost incalculable benefit to our rivers, in keeping up the suply.

RESTIGOUCHE HATCHERY.

CAMPBELLTON, N.B., 9th December, 1889.

DEAR SIR,—In answer to your enquiry as to the state of the salmon fisheries at present, in comparison to what they were years ago, I beg to say I am the owner of a fishing station situated some two miles above Campbellton. I have been engaged in the salmon fishery for twenty years, and I believe, notwithstanding all the anglers and the great increase of nets in the bay and on the coast of late years, the salmon are more plentiful than they were years ago, the catch each year is more uniform, and the fish were larger this last season than I ever saw them before. I certainly believe these results are largely due to the planting of the millions of fry from the hatchery.

I am, yours truly,

WILLIAM PRATT.

METAPEDIA, 15th December, 1889.

DEAR SIR,—In reply to yours of the 10th inst., I can say I have been living on the Restigouche for forty years. I am the owner and still retain my angling privilege, some eighty rods fronting on one side of the river. I leased it last season to some sporting gentleman of New York for $100, it being the second year it was possible to lease it. The R. S. Club refused to lease, saying there was no fishing on it, but two years ago some thirty fish were caught, and last season twenty-five fish taken, averaging over 20 lbs. It is only of late years, and since the fish began to increase, that the anglers could be persuaded to fish in the long reaches of the river. I actually believe there are ten fish in the river now to where there was one twenty years ago, and the fishery has enhanced in value 500 per cent. It is reported by all parties that the river is full of fish. I have no doubt but what the hatchery, combined with protection, has been the main factor of bringing about this result.

I am, yours very truly,

NATHANIEL MOORES.

RUNNEYMEDE P.O., METAPEDIA, 16th December, 1889.

DEAR SIR,—In reply to your inquiry respecting the benefits (if any) of the Restigouche hatchery to the river, would say, my opinion is, owing to the increased numbers of nets on the coast and estuary since 1872 and the increase of anglers since 1880, that only for the hatchery the salmon would be nearly extinct, and the great increase of nets above referred to plainly shows that there must have been a corresponding increase of the fish.

I own over 480 rods of frontage on the river. I formerly set a salmon net thereon and never took, or caught, over four barrels per annum. Since 1880 I have only fished with my rod and have regularly leased my fishery to anglers, at an average of $200 per annum, and I attribute the extra benefits and regular annual supply to the Restigouche hatchery, which is no doubt also supplemented by the better protection afforded by the lessees. I may say, when properly angled by those who know how, my fishery averages from forty to fifty salmon yearly.

I am, Sir, your obedient servant,

JAS. H. MOORES.

TIDE HEAD, 13th December, 1889.

DEAR SIR.—In reply to your letter of the 10th inst. asking my views on the state of the salmon fisheries and the benefits of the hatchery: I have, as you know, been in the employ of the Restigouche Salmon Club, acting as guardian of the river around Tide Head for the last three years. I am the owner of a net fishery, but as it is in the boom limits and the great number of logs coming down annually has completely spoiled it. But some of my neighbors, who are more favorably situated, and also in the boom limits, made a very good fishing last season, the best for a number of years, and I am positive there was a very large run of salmon. I heard of some good catches among the net fishermen. Of course, there is a falling off in the estuary, but I think this is very easy accounted for when it is taken into consideration that the nets on the coast have increased of late years 50 per cent. The catch has also increased accordingly, and the fish that do escape the multitude of nets below, by the time they have reached the estuary they become by instinct so cautious as to avoid the nets, that they will not go into these only when the water is dirty, or the wind is blowing strong. The fishermen say they are so shy that they will not even mesh when in the pounds. They have to be hooked out with the gaff.

In going over my beat at night I have often seen the fish running in all directions over the shallow bars and places, and I believe there are ten fish in the river now to where there was one twenty years ago. I have noticed the young "smolts" playing about at the Tide Head in schools like smelts on their way out to sea. From what I have seen and read about artificial fish breeding, I believe the hatchery is

justly entitled to be credited with a large share of the preservation and healthy condition of the salmon fisheries as they now exist on the Restigouche and Bay des Chaleurs.

I am, yours very truly,

ROBT. D. GERRARD.

BROADLANDS, QUE., 9th December, 1889.

The Honorable

The Minister of Marine and Fisheries.

SIR,—In reply to your request for my opinion of the value of the hatcheries on the catch of salmon on the Restigouche River, I beg leave to say that, in my opinion, it is a very difficult, I may say impossible question to answer, as so many other things have to be considered.

It is a well known fact that for several years after Confederation, when spearing salmon was prohibited, and drifting in a great measure stopped, the salmon increased very rapidly until the year 1878, when the catch reached its highest point. But, since the year 1888, though the number of nets in the river above Campbellton has been reduced one-third, the catch has fallen off at least one-half on an average in the estuary.

I would account for this falling off in the catch partly by the great increase in the number of nets in the Bay des Chaleurs, and the trap nets which are used there, and partly to the excessive angling on the spawning grounds on the Restigouche and its tributaries.

From what I have read of the beneficial results of fish-breeding in other places, and what I would suppose should be the result here, I would say that the placing of young salmon in the different streams must be of great benefit. The only thing is that the number placed has been too small.

As I cannot give a more positive answer to your question,

I have the honour to be, Sir,

Your obedient servant,

MELVIN ADAMS.

CAMPBELLTON, 20th August, 1889.

DEAR SIR,—Being always in favor of pisciculture and of salmon breeding in particular, since it was first started in this place, I feel much pleased with the statements of overseers and guardians on the River Restigouche, of the immense numbers of salmon in the pools and on the spawning beds this season, since all fishing has ceased. In my opinion no better proof could be given of the success of your efforts in artificial breeding. From 1850 until 1860 there were but few stands of nets comparatively in the Bay des Chaleurs and River Restigouche, and although only the most choice spots were occupied it was only in exceptional years they were considered remunerative. My business led me to be on the river towing and otherwise for thirty to forty years, and I can truly say it was a rare thing to see salmon anywhere in the stream after the 1st of August in any year within that time. What a change now! The pools in places are crowded with them, and they can be seen after the 20th October almost anywhere on the bars from the First Islands to the head of the river, in the act of spawning. Although the complaint may be true that there has not been so many salmon taken from Dalhousie up to the First Islands in the last seven years, on an average, as there was in the preceding seven years, it can be accounted for by the great number of new stands placed along the Bay des Chaleurs shores, and the great improvement in the mode of fishing in late years. I may also state in my experience I find the salmon much more wary of late than they used to be, and shun the nets in calm weather. I think I am not wrong in stating that the breeding establishment has been a good thing for all concerned on Bay des Chaleurs and Restigouche Rivers.

I am, Sir, Yours truly,

ALEX. R. CHAMBERLIN.

After that portion of this report dealing with the subject of sawdust (from page 12 to page 23) was in print, other letters of importance treating upon the effects of sawdust on fish life, came to hand, namely, from Commissioner Stillwell from Maine, and Mr. Cheney from Glen's Falls, New York State. Extracts from these letters are hereto added as follows:—

Extract from letter of Henry O. Stanly, Fish Commissioner, State of Maine, *in re* sawdust:

"In regard to the disposition of mill waste in this country, would say the only method (except that of turning it into the stream) at present is by burning. Large quantities of sawdust and other waste are thrown into the Penobscot, Kennebec and other rivers. The coarser parts, such as edgings, bark, &c., which is not used for fire-wood for domestic purposes, is in part burned on the premises, in a receptacle for that purpose, but much of it finds its way into the rivers, and in many places fills the rivers to a great extent and damages the navigation very much.

"It does not seem to have injured the salmon so much as any one would be likely to suppose. The reason (in my opinion) is that the mills are located low down on the river below the natural spawning or breeding haunts of the salmon. The fish when they come into the mouths of the rivers stop but a short time, but run up past the mills, escaping the injurious effects of the sawdust, &c., &c. I think the most injury is done by its filling the beds of the rivers and obstructing navigation.

"I have no doubt it has a very injurious effect on other kinds of fish which do not run far up rivers, such as the alewife, shad, &c. Where the sawdust and other *débris* cover the bottom of spawning grounds I think they are ruined. What we fear much at the present time is the waste and chemicals from the pulp mills which are now being built on every stream in this country. It is death to every living thing in the water in the vicinity where the waste is turned into the river. Unless a remedy for the evil is soon solved the salmon fisheries in Maine will be a thing of the past."

Extract from letter of A. N. Cheney, Esq., editor *Fishing and Shooting:*

"Saw-mills on the upper Hudson are water-mills, and since the first one was built it has been the custom of the mill-owners to dump the sawdust into the river. It has been the custom also to throw edgings and other woodwaste into the river; but it ceased a short time ago, when the edgings, etc., were sawed into stove wood. Only during the last winter have the saw-mills at this place arranged to save the sawdust that it may be used as fuel in a paper-mill near at hand. Tight boxes with sloping bottoms are built under all the saws, gangs, slabbers, butting, stave, heading and lath saws. The sloping bottoms of the boxes conduct the sawdust to a wooden trough through which passes an endless belt of leather, on which are fastened iron cups or buckets (similar to the buckets used in flour-mills for raising flour) that draw the sawdust through the trough to a storing pit, from which it is carted to the paper-mills. As this storing pit is at the bottom of the mill, the sawdust is lifted to the ground floor by another series of iron cups or buckets on an endless chain. These are called conveyors, and are placed horizontally under the mill floor, and all lead from the different saws to the storing pit. *The manner of saving the sawdust is simplicity itself, and as it requires no hand labor it is inexpensive.* * * * * That sawdust in one way does do injury to the fish there is no question in my mind, for it covers the spawning beds, smothering eggs and young, and except in very swift water it leaves no place after a time for a fish to make a decent spawning bed.

"How much poison comes from the tons of hemlock sawdust deposited annually in the river I cannot say, but I believe the Pharmacopœia says that it takes only eight pounds of hemlock to make one ounce of the oil, and as Socrates came to his death from hemlock water, it does not seem that our fishes should be able to withstand what proved to be the undoing of the Grecian Sage, unless modern fishes are tougher than the ancient Greek. Nor can I say what poisonous gasses are generated by the rotting of the masses of sawdust which covers the river bed and lines the rivers banks, partly in the sun and air, and partly in the water, a soggy offensive

sight if not a breeder of disease. The tannin in oak troughs, and the turpentine in pine troughs will kill young fish, if the troughs are not covered with tar or asbestos, as it has done in hatcheries where these precautions have been neglected. Why then should not hemlock and pine sawdust under some conditions be injurious to older fishes ?"

CONCLUSION.

Having submitted the various matters relative to the operations of artificial fish culture in Canada during the past year, as related above, it will be unnecessary to add more, but simply draw the attention of your Department to the importance of extending its operation, so that all parts of the country may be enabled to partake of the benefits of an industry which has now become world-wide in its operations.

In the appendices hereto will be found the reports of the several fishery officers in charge of the hatcheries of the Dominion.

All of which is respectfully submitted,

SAMUEL WILMOT,
Superintendent of Fish Culture for Canada.

FISH CULTURE.

1889.

APPENDICES.

REPORTS FROM THE SEVERAL OFFICERS IN CHARGE OF FISH-BREEDING ESTABLISHMENTS IN THE SEVERAL PROVINCES OF CANADA FOR 1889.

1.—FRASER RIVER HATCHERY.

PROVINCE OF BRITISH COLUMBIA.

Report of the Officer in Charge of the Fraser River Hatchery for 1889.

I have the honor to submit the sixth annual report of this hatchery, together with a statement of the distribution of fry and collection of eggs during the season of 1889.

From the eggs laid down in the hatchery during the fall of 1888 the following numbers of fry were distributed on the dates and at the places here mentioned, namely:—

Saw-quay Salmon (Nerka.)

February	13, 1889,	Pitt Lake	200,000
do	20, 1889,	do	425,000
do	28, 1889,	Harrison River	600,000
March	6, 1889,	Sumas Lake	400,000
do	14, 1889,	Pitt Lake	600,950
do	21, 1889,	Chilawheck Rapids	600,000
do	23, 1889,	Harrison River	600,000
do	26, 1889,	do do	550,000
April	3, 1889,	Silver Creek	223,000
do	11, 1889,	Nicklemockel	60,000
do	13, 1889,	Coquitlam	161,000
Total			4,419,500

Included in the above number were 373,000 fry of the quinnat salmon (chouicha), which were put in the Fraser and Harrison Rivers. Of these the percentage of loss was much greater than the "Nerka," on account of the fish having been caught by gill nets and kept in floating cribs, which caused bruises that developed fungus and unhealthiness of the fish. At the time these salmon were caught and stripped there was only one experienced man in charge of operations, the caretaker being at Okanagan, and Mr. McNish at River's Inlet, where each were doing duty as fishery guardians. The "quinnat" fish were no doubt roughly handled by the Indian fishermen, for it was impossible for one man to be up day and night watching them. They were also the first eggs laid in the hatchery, and as the season was very mild

and the water warm, fungus had a better chance of developing. But notwithstanding the loss on the "quinnat" salmon ova, taking the whole number laid in the nursery, the rate of mortality was nearly one-half less than in any previous season. This success is attributed to the fact that the parent fish last season were handled by men who had had experience and a knowledge of the business, and that my orders in stripping fish were strictly adhered to, which was that only three fish should be stripped at a time, and that it should be done under the shade of a tent or tree, so that the sun's rays would not strike on the eggs, and that only a portion of the eggs should be taken from a fish at a time, and if the slightest disease was noticeable the fish were to be rejected.

The eggs were laid in wire baskets as soon as they reached the hatchery, in place of being left on the trays, so that sedimentary matter had less chance of collecting on them and fungoid growth was less likely to prevail.

There was no fry distributed in the rivers on Vancouver Island last season, as the capacity of the hatchery was capable of hatching the quantity of eggs laid in, and as the intention of the hatchery was to keep up the supply of fish in the Fraser, it was thought best to distribute them in it and its tributaries.

Owing to the lateness of instructions and the difficulty to obtain suitable steamers at the proper time, the fish were held in the nursery until the sack was absorbed and many of them were taking food before leaving the troughs. The cost of distributing them at this age came to a little more than in previous years, as there could not be so many put in the distributing scows at once, which caused a greater number of trips with the steamers. But from this year's experience I have learned that it is better to keep the fry in the nursery until the sack is all absorbed. They are then more active and better fitted to protect themselves.

No shad were caught in the Fraser this season to my knowledge, but a good many were caught in the Columbia River, Puget Sound, and along the Vancouver Island coast. I would again recommend, as in previous years, that some shad fry be secured and put in the Fraser and other streams in this Province.

Whitefish have not yet been introduced in any of these waters from Ontario, although enquiries still continue to be made for them. The lakes that produce native whitefish are so isolated that they can not be got to market without heavy cost, and even then the quality of the fish is quite inferior to those of the east.

The quantities of salmon fry distributed from the hatchery since its erection are as follows:—

The year	1885	1,800,000
do	1886	2,625,000
do	1887	4,414,000
do	1888	5,807,000
do	1889	4,149,500
	Grand Total	19,065,500

From this output of fry there has been unmistakably a great deal of benefit derived, as will be seen by the enclosed certificates from the canners of the Fraser River, the fishery guardians of Nanaimo and Cowichan River, the corporation of the municipality of Surrey, and Mr. Robert Kelly, of Coquitlam. From my own experience on the Harrison River I must say that, I think the fish have increased tenfold, as in the year of 1885–86 we could hardly secure any parent fish in the Morris Creek, where we now catch them numerously. Formerly they had to be swept from the lake with a net, and only a few hundred entered our traps the first two seasons. Last year the fish were in greater numbers than before, but of a smaller size. I believe the large run in Morris Creek in the year 1888 was caused by the output of fry from this nursery and the extraordinary masses of "suckeye" salmon that ascended all the streams of the Harrison, but more particularly the Morris Creek were also due to the output of fry from this establishment. It would be almost im-

possible for me to attempt to describe the quantities of fish that were in some of those streams, so I enclose with this report two photographs, one showing the fish in the stream ascending it to the traps, and the other showing the masses of fish that were crowded into the pens during the spawning season.

The Indians living on the Harrison, where the parent fish are captured, were previous to this season unbelievers as to the benefits from the hatchery. But now they are decided to a man that the enormous swarms of fish seen this season were caused by the fry put into this hatchery.

I enclose also for publication, in addition to the canner's certificates, a letter from the State Fish Commissioners of Oregon, United States, which gives their views on the success of the Clackamas hatchery; and a letter from R. W. Hume, of Ellensburg, who operated at his own expense a hatchery on Rogue River, State of Oregon.

Collection of Ova.

The number of eggs laid in the hatchery this fall amounted to 233,000, all of the "suckeye salmon" (Nerka). Operations were commenced on 23rd September and ended on 7th November. There were no "quinnat" salmon eggs taken this season, as the fish are not procurable in traps at the points where the "suckeye" salmon are captured. The "quinnat" have to be caght by gill nets, which is more expensive, and so injures the fish that they give unhealthy eggs. In any case the "suckeye" salmon are considered of better color, and of more value to the general trade.

There was no count kept of the fish captured, or that passed through our traps; in fact, it could hardly be done by any other means than a salmon register, as you will notice by the enclosed photo, that our pens were crowded all the time. We therefore only selected the healthiest and strongest salmon, allowing the others to pass up the stream by the opening of a slide gate in the trap. However, the suckeye salmon will not average over 5,000 eggs to the fish, and from the majority of the fish stripped this season there was seldom more than 3,000 eggs taken from them.

Repairs.

This establishment has now run six years without any repairs, and a building of this kind soon goes to wreck. During the month of April or May next it should be fitted with a new gutter pipe, as the old one has fallen off. New hatching troughs are necessary to replace some that are very leaky. The foundations of the building under the water tank requires re-blocking, as the old ones are quite rotten. The upper part of the building should be fitted with a new races and troughs, in order to increase the capacity of the hatchery. The roof of the building should be repaired, as it is leaking in places. The grounds should be put in new shape, and the entire building should have a coat of paint. A new and larger flume for conveying the water supply is absolutely necessary, as the one used now is unsafe and may at any time break down, causing the destruction of all the eggs or fry in the hatchery.

I have the honor to be, Sir,

Your obedient servant,

THOS. MOWAT,
Officer in Charge.

2.—SYDNEY HATCHERY.

PROVINCE OF NOVA SCOTIA.

Report of the Officer in Charge of Sydney Hatchery, 1889.

SIR,—I have the honor herewith to submit my annual report upon the work done at this hatchery during the past year.

As stated in a former report, I laid down in the hatching troughs in the fall of 1888, 2,678,000 ova; of these, 2,034,500 fry were hatched and distributed in the best possible condition in the following streams, viz.:—

Margaree River (Inverness Co.)	200,000
Shubenacadie River (Cape Breton Co.)	50,000
Sydney River do	350,000
Ball's Creek do	150,000
Trout Brook do	150,000
Black Brook do	134,000
Grand Lake do	100,000
Eskasoni River do	50,000
Salmon River do	100,000
George's River do	150,000
Leitch's Creek do	50,000
McLean's Brook do	150,000
Middle River (Victoria Co.)	150,000
Baddeck River do	150,000
Grand River (Richmond Co.)	50,000
Iron River do	50,000
Hatching Brook (Cape Breton Co.)	50,000
Total	2,034,500

The following table shows the number of parent salmon caught this season and the rivers in which they were caught, also the number of ova laid down in the hatching troughs this season.

Name of River.	Males.	Females.	Total.	No. of Ova.
Margaree River	76	204	280	1,470,000
Middle River	60	50	110	254,000
Lower Middle River	55	45	100	236,000
Sydney River	30	50	80	400,000
Salmon River	21	30	51	180,000
Total	242	379	621	2,540,000

The above is not strictly correct as to numbers of male and female, it being almost impossible to make an accurate count at Margaree and Middle Rivers. The number of ova is taken from the actual condition of the trays; after they were laid down and all the ova picked out that were affected by transportation from the different spawning places.

In the waters of this Island it is hard to show an increase in the salmon fisheries. The rivers stocked from the hatchery were in years gone by good salmon rivers, and if to-day a goodly number of salmon were caught, the artificial means employed would not be fully credited for its assistance. This season all our fish seem to have left us; even the cod, mackerel and herring deserted our shores; the catch of salmon was also below the average. There must be some general cause for this. If we look back over the last ten or fifteen years we find that every year is not equally prosperous with fishermen; some years they reap a goodly harvest, while perhaps the

next year they are disappointed, and the fisherie is a failure. This is true of all kinds of fish, particularly salmon. Does not this lead us to believe that salmon do very frequently break the law and stray to other waters, the law governing their actions being the supply of food. Last season our salmon fishery during the open season was, if anything, above the average; this year it was below, but during the months of September, October and November they were as plenty as usual in the river and the average high. There was one thing very noticeable in the fish handled this season: they were small and of a uniform size; we have handled more fish from 7 to 9 pounds than ever before. We also handled some female grilse which we never saw in these waters before. Our rivers are teeming with young salmon, their increase being unanimously attributed to the work of this hatchery.

The improvements done about the place this year were not great. As reported last year, the floor of the hatchery room required thorough repairing—in fact, a new floor. I received no instructions to proceed with the placing of a new floor, and consequently confined myself to the repairing of it. I found it in a very bad condition. Two pieces of joist had to be removed and new ones put in. About one-quarter of the whole floor had also to be replaced. The remainder is scarcely good enough to do for the winter. The whole floor will require to be taken out next summer and a new one put in. I also did some work to the outhouses. One required some shingling and roof boarding. Everything in and about the hatchery now is in thorough condition, except the floor already mentioned. The outside of the house also is sorely in need of paint. I would recommend that the painting be attended to as early as possible in the spring. The flooring can be done any time during the summer.

We have in this Island some of the finest fresh water lakes in the world, and it seems now the time has come when we should get a supply of land-locked salmon for them. With the facilities we have now of conveying fry and ova from the other Provinces to this most easterly part of the Dominion, there is no reason why we should not have these fish introduced here. I understand that strong efforts are to be made this season to secure some of these fish for our lakes. I hope you will favor the scheme and give us at least enough for our lakes.

All of which is respectfully submitted.

I have the honor to be, Sir,

Your obedient servant,

C. A. FARQUHARSON.

3.—BEDFORD HATCHERY.

PROVINCE OF NOVA SCOTIA.

Report of the Officer in Charge of the Bedford Hatchery for 1889.

SIR,—I have the honor herewith to submit my report upon the operations at this hatchery during the past year.

As previously reported, the number of salmon ova laid down last year was 1,100,000. To this number was subsequently added 3,000,000 whitefish, 500,000 salmon-trout ova, making a total of 4,600,000.

Shortly after the arrival of the whitefish and salmon trout ova from Ontario, I received instructions to distribute portions of them amongst the several small auxiliary hatcheries located in different parts of this Province.

This distribution was as follows:—

Lochaber,	Antigonish	County,	Salmon-trout	ova.....	120,000
do	do	do	Whitefish	"	300,000
Kempt,	Queen's	do	Salmon trout	"	100,000
do	do	do	Whitefish	"	500,000
Tusket,	Yarmouth	do	Salmon-trout	"	60,000
Sheet Harbor,	Halifax	do	do	"	60,000
Kentville,	King's	do	do	"	70,000
					1,210,000

Making a total of 1,210,000 semi-hatched ova disposed of in the month of April. At the same time I conveyed to these hatcheries their usual supplies of partially hatched salmon, as follows: Lochaber, 100,000; Tusket, 40,000; Sheet Harbor, 40,000—or a total distribution at that date of 1,390,000 ova, leaving the balance of 3,720,000 in the troughs of this establishment.

With the salmon and whitefish ova the most satisfactory success was met with in their hatching; and while at Lochaber, Sheet Harbor and Kentville the percentage of salmon trout hatched was fully up to the average, some losses were met with at Kempt, Tusket, and at this hatchery.

I have as yet been unable to solve the difficulty heretofore experienced in hatching the ova of the salmon trout in the water with which this hatchery is supplied, but from the results obtained at the different temporary hatcheries, and noting the temperature and condition of the waters at these points, I am led to believe that in some way to those features the loss is attributable. During the next season I propose instituting such observations at these small temporary hatcheries as will be likely to throw some light on the subject.

Notwithstanding the partial failures to which I have alluded, I would respectfully urge upon your Department the advisability of continuing the effort to stock the numerous lakes of this Province with these fish. Considering the number and extent of these inland waters and their apparent adaptability for supporting fish life, the extent, magnitude and commercial importance of which this prospective fishery is capable, a much more decided effort in future would be warranted, and to this end each of the counties in the western portion of this Province should be provided with an auxiliary hatchery. These could be built at but slight expense; being used only during the spring months they need not be so substantially constructed as this building, and the cost of working them would not exceed $100 per year. They could be so arranged that a considerable number of whitefish could be hatched at the same time, and they could also accommodate a number of salmon ova, and thus materially assist in the economical prosecution and extension of the work to which this institution has been particularly devoted. Such hatcheries as I refer to, capable of hatching 4,000,000 or 5,000,000 of whitefish, 200,000 salmon-trout, and a similar number of salmon ova, could be erected at a cost not exceeding $600.

Distribution of Fry.

The distribution of fry from this hatchery for the past year, including the semi-hatched ova already mentioned, was as follows:—

Salmon Fry.

Musquodoboit River,		Halifax County	40,000
Sackville	do	do	20,000
Nine Mile	do	do	40,000
Pennant	do	do	20,000
Little Salmon	do	do	20,000
Ecum Secum	do	do	40,000
Salmon	do	Colchester County	40,000
Stewiacke	do	do	40,000
Wallace	do	Cumberland County	40,000
Philip	do	do	40,000
West	do	Pictou County	40,000
East	do	do	40,000
Middle	do	do	40,000
Gaspereau	do	King's County	40,000
Cornwallis	do	do	40,000
La Have	do	Lunenburg County	40,000
Gold River,		Lunenburg County	20,000
Middle	do	do	20,000
East	do	do	40,000

Annapolis River,		Annapolis County		40,000
Round Hill	do	do	do	40,000
Tusket	do	Yarmouth	do	40,000
Lochaber	do	Antigonish	do	100,000
Roseway	do	Shelburne	do	20,000
Total salmon fry				900,000

Salmon-Trout Fry.

Lochaber Lake,		Antigonish County		120,000
Gaspereau	do	King's	do	70,000
Little River Lake,		do	do	20,000
Rossignol	do	Queen's	do	100,000
Tusket	do	Yarmouth	do	60,000
Sheet Harbor	do	Halifax	do	60,000
Hubley's	do	do	do	20,000
Total salmon-trout fry				450,000

Whitefish Fry.

Grand Lake,		Halifax County		500,000
Hubley's	do	do		200,000
Williams' Lake		do		200,000
Governor's	do	do		200,000
Sandy	do	do		200,000
Lochaber	do	Antigonish County		300,000
Rossignol	do	Queen's	do	500,000
Gaspereau	do	King's	do	200,000
Milford	do	Annapolis	do	200,000
Total whitefish fry				2,500,000

Totals.

Salmon	900,000
Salmon trout	450,000
Whitefish	2,500,000
Grand total	3,850,000

I am able to report that this work was performed with almost perfect success, no loss being met with, except among one lot, which I was ordered to take to the Roseway River, in Shelburne County. Knowing the difficulties to be encountered on such a long journey by steamer I took every possible precaution to avoid loss. I provided six large casks of water, and so arranged the barrels containing the young fish that a stream of water could be kept passing through them. Owing to rough weather and detention by fog, Shelburne was not reached until the following morning, over twenty hours after leaving Halifax, and my supply of ice and fresh water being exhausted, I met with considerable loss of fry.

I would respectfully suggest that if any further attempts to stock the rivers of Shelburne County be contemplated by your Department that a small auxiliary hatchery be erected at Shelburne town, to which the ova could be taken some time before hatching with perfect safety, and from which the young fry could be readily conveyed to the different rivers. The rivers of Lunenburg County, which I have been endeavoring to re-stock for some years past, owing to their great distance by road from this hatchery, have not been served as generously or successfully as their

importance would warrant, and I would suggest that a small hatchery be erected at some central point in that county. The same plan should also be adopted in Digby and Annapolis counties. The very marked increase in the salmon fisheries of this Province since the introduction of fish culture, as shown by the fishery statistics, and which I endeavored to demonstrate to your Department in my annual report of last year, should warrant the work being undertaken on a much larger scale than at present.

It can be justly claimed that fish culture has passed through the experimental stage, and has established itself as a practical art, upon which any expenditure made will give satisfaction and highly remunerative returns. The continual decline in the salmon fisheries of the Province up to the year 1882 clearly demonstrates the fact that in the present condition of our rivers the natural reproduction is quite insufficient to maintain the supply, and that to retain our present stock in the presence of the continuously increasing demand, more hatcheries are necessary, and all parts of our coast should receive a bountiful supply of young fry annually.

The almost universally expressed desire of those of the inhabitants of the western counties of this Province with whom I have come in contact for the extension of the fish cultural operations of your Department prompts me to respectfully urge upon you compliance with their requests, and the introduction of such appliances as will enable us to produce such a number of young fry as will bear a reasonable proportion to the natural reproduction of past years.

If I might be permitted to offer a suggestion in reference to the extension of fish cultural operations, I would say that probably the most economical manner in which an increased output would be effected would be to enlarge the hatching capacity of this institution to the desired extent, make this the general depôt from which the auxiliary hatcheries located in such counties as are beyond the scope of this establishment, could receive their supplies of semi-hatched ova each spring.

The work of collecting the ova for this larger institution and the necessary care to be given them during the winter months would be obtained at very little over the cost of the present work, while the final hatching and the distribution of the fry from these points could be performed by the overseers or wardens of the districts at a cost not exceeding $100 per year.

Collection of Ova.

In the work of capturing a supply of parent fish from which to procure a stock of ova for this season's operations I was very successful. Having obtained permission from your Department to operate on the Musquodoboit River, on the 1st September I engaged the fishermen and put them in charge of the trap, which had been placed in the natural pass around the dam at the mouth of the stream. Very dry weather having set in about that time the river became so low that no fish could enter—in fact, during the greater part of September no water passed through the ladder. In the mean time large numbers of salmon congregated in the pools below the dam, and early in October, when the first freshet occurred, they commenced to ascend the pass, where they were captured in the trap. In this way a large number were taken, but as the water fell off again rendering this trap useless, I was obliged to resort to setting a net in the pools below. Altogether 270 salmon were taken from this river and conveyed by means of water-tight boxes to a raceway about one mile distant, where a tank and spawning shed was provided. Here they were eventually shipped and returned to their native stream. Permission was also obtained from your Department to operate upon the West River, in Pictou County, but at this point it was not as successful as in former years.

As in the Musquodoboit River, low water also prevailed during the season when salmon usually enter this river, and the fish were obliged to remain in the tidal waters, where I have reason to believe large numbers were caught by the inhabitants. The catch by the fishermen amounted to 67 fish in all at the West River.

The total catch from these two rivers amounted 337 fish, as follows: Musquoboit River, 82 males, 188 females; West River, 24 males and 43 females. Of these 231 were females, producing about 2,300,000 ova. The loss up to the present time has not exceeded the usual percentage, and as the embryos are now visible in the greater portion of them, the prospects of a successful hatching are favorable.

I beg to report that the hatchery and all its appliances are in good condition, and no extraordinary outlay will be required during the next year.

I have the honor to be, Sir,

Your obedient servant,

A. B. WILMOT,
Officer in Charge.

4.—DUNK RIVER HATCHERY.

PROVINCE OF PRINCE EDWARD ISLAND.

Not running in 1889. *See* summary (4).

5.—ST. JOHN RIVER HATCHERY.

PROVINCE OF NEW BRUNSWICK.

Report of the Officer in Charge of the St. John River Hatchery, 1889.

SIR,—I have the honor to make the following report on the operations of the St. John River fish hatchery for the present year.

In order to give an intelligent account of the work it will be necessary for me to state that in the autumn of 1888 I was informed by the Deputy Minister of Fisheries that it was not the intention of the Department to take any parent salmon on the Tobique River that year, but that this hatchery would be supplied with ova from the Restigouche nursery; consequently, there were no eggs put in this house the first part of the hatching season. However, in the month of March I received from the Newcastle and Sandwich hatcheries, in Ontario, by the hands of Mr. Charles Wilmot, 3,000,000 whitefish and 1,000,000 salmon-trout eggs; and on the first day of May I got another consignment of 150,000 Restigouche salmon eggs from Mr. Alexander Mowat, making in all 4,150,000 fish eggs of the different species above named. They were all received in fair condition. The only loss sustained was with a few of the Restigouche eggs, which hatched out prematurely, on account of the lateness of the season when they were transferred. With this exception the different classes of eggs did very well and a large percentage hatched out.

On the 5th of April I commenced the distribution of whitefish fry, a labor that is fraught with a great deal of hardship, owing to the very bad state of the roads at that season of the year. On the 5th of June I started to distribute the salmon-trout and salmon fry, and finished planting the entire lot on the 4th day of July. The work was successfully performed, without any appreciable loss of young fish, notwithstanding the long distances that the majority of them are carried. They were apportioned amongst the Counties of Victoria, Carlton, York, Sunbury, Queen's King's and Charlotte. Below I give a tabulated statement of the several localities in which I planted the different kinds of fry, the quantity put into each, the name of the river, lake or stream, and the distance in miles that each lot was carried, and the mode of conveyance.

Whitefish Fry Planted and Distance from the Hatchery.

	No.	By rail.	By waggon.	Miles.
Magaguadavic Lake, York Co.	350,000	....	...	128
Harvey do do	350,000	....	...	138
Oromocto do do	350,000	138	10	148
Lakeville Lake, Carleton Co.	350,000	46	13	59
Skiff do do	350,000	97	7	104
Foster do Charlotte do	350,000	145	...	145
Portage do Victoria do	200,900	....	7	7
Long do do do	300,000	....	9	9
Total.....	2,600,000			738

Salmon-Trout Fry Planted and Distance from the Hatchery.

Lakeville Lake, Carleton Co.	106,000	46	13	59
Skiff do York Co.....	140,000	97	7	104
Harvey do do	150,000	138	...	138
Chamcook do Charlotte Co.	150,000	157	...	157
Foster do do	120,000	145	...	145
Long do Victoria Co.	90,000	...	9	9
To a Mr. Thompson, Woodstock, Carleton County.....	36,000	...	...	...
To Fishery Overseer Burt, Hartland, Carleton Co.....	30,000	...	...	...
Run out at the Hatchery about	8,000	..	...	...
Total.....	830,000			612

Salmon Fry planted and Distance from the Hatchery.

Lake Alva, Kings Co.....	30,000	By rail	190	Waggon	7	197
Washademoak River, Queen's Co.....	25,000	do	210	Steamer	65	275
Salmon River, Queen's Co.	25,000	do	210	do	70	280
Oromocto, North Branch Sunbury Co.....	25,000	do	135	Waggon	10	148
St. Croix River, Charlotte Co.....	25,000	do	132	Boat	2	134
St. John River, Victoria Co	10,000		....		..	....
	140,000					1,034

Recapitulation—

Whitefish fry.....	2,600,000	Miles travelled.	738
Salmon Trout.....	830,000	do	612
Grand total.....	3,570,000	do	2,384

I respectfully desire to inform you that in transporting the young fry such long distances as I am compelled to entails a vast amount of care and necessitates a heavy expenditure to perform the work in compliance with my instructions.

There is a redeeming feature in connection with the work, that the applicants are delighted to get the young fry; but there is a special preference for the salmon fry, particularly for waters where sport is the object in view, but where the fish are required for food purposes the people are well pleased to see the salmon trout and whitefish introduced in the lakes, although they know very little about this class of

fish; but I have endeavored to explain to them their quality and usefulness as a food fish. Some very fine specimens of the salmon trout were caught by Doctor Gove and another gentleman from St. Andrew's, in Chamcook Lake last summer, weighing from three to seven pounds. I was also informed that salmon trout were taken by some of the New Brunswick railroad employés in Williamstown lakes, and no doubt both salmon-trout and whitefish were caught in other lakes. Some of these lakes are held by lessees, who will not permit outsiders to fish them, nor will the proprietors allow net fishing. It is, therefore, difficult to ascertain what quantity of these fish have matured in these waters.

Last autumn I got instructions by your Department to proceed up the Tobique and Serpentine rivers, with the view of capturing parent salmon to stock the nursery. When I arrived at the spawning grounds on the Serpentine I found scarcely any salmon there. I caught a few, but they had already spawned. I then abandoned the work and returned at once, in order to avoid expenses, being fully convinced that it was useless to spend time so late in the season.

I was not unprepared to find the salmon scarce on the Serpentine, for on my way up I was informed that the lumber drive on that river was kept back last spring for the want of water to take it down; consequently, I was satisfied that if there was not water enough to float the lumber down there would not be sufficient water for the fish to get over the falls, as no salmon can ascend the several falls that are upon it except in the hight freshet in the spring. I learned from all the information that I could gather that the salmon are slaughtered by every conceivable means that the poachers could invent, even to dynamite. There seems to have been no protection for the salmon on the Tobique waters last summer, and if some authority does not take the matter in hand to protect this river the salmon will soon be as scarce on the Tobique and its tributaries as they were before the artificially hatched fry were first planted in them.

Parent Salmon.

It is much to be regretted that your Department does not come to a final conclusion to have the parent salmon for this hatchery taken in the St. John harbor. I cannot see any valid objections against the scheme, but on the contrary there is good reasons for adopting it. In the first place, a sufficient number of fish would be caught every year; in the second place, it would be the most certain and economical plan; and in the third place, it would be the most prudent system for the improvement of the St. John River fisheries. The eggs taken from the salmon now caught in the harbor for food purposes would be saved and hatched in the nursery, for the benefit of our waters, and the parent salmon would also be saved and liberated alive, whereas at present both the salmon and their eggs are wholly lost to the river.

I understand that some objections have been raised by certain parties against using the Carleton Pond, in St. John, as a safe resevoir for the salmon until they became ripe for spawning. The Superintendent of Fish Culture should be good authority on this point, and his opinion is that the pond in question could be made suitable at trifling expense for the purpose named. At any rate, some convenient place above or below the falls at Indiantown (St. John) should be provided, so that salmon when caught in the harbor could be put into scows and carried to the place and then safely kept till the spawning time, the same as is done at the Restigouche, Miramichi and Tadoussac hatcheries. At Bucksport, below Bangor, in the State of Maine, the Americans tow their parent fish from 6 to 8 miles with row boats from their nets to the shore; they are then taken some distance up a river to their reservoir. I would respectfully request your Department to give this your serious consideration, as it is absolutely necessary that some such scheme should be adopted for supplying this nursery with salmon ova in the future. Both salmon and speckled trout fry are in great demand by the people here and in the adjoining counties, and I have to request your Department of Fisheries to make full provision to supply these wants of the inhabitants. Very little repairs have been made about the house the past summer, although some were much needed, but the frequent admonitions not to incur expenses

coming from the Departments has deterred me from making necessary repairs. The floor of the hatchery where the tanks are placed is in a bad condition. It is now 9 or 10 years old, and being constantly exposed to wet and dry weather, decay has set in. The platform outside the door is also in a most dilapidated condition, and the plaster on the walls requires repairing. These and other minor matters must be attended to next summer.

Respectfully submitted,

CHAS. McCLUSKEY,
Officer in Charge of St. John River Hatchery.

6.—MIRAMICHI HATCHERY.

PROVINCE OF NEW BRUNSWICK.

Report of the Officer in Charge of the Miramichi Hatchery for 1889.

I herewith submit my annual report upon the operations in connection with this hatchery for the past year. The eggs laid down in the hatching troughs on the 1st December, 1888, received the closest attention during the winter months, and I am pleased to state a very small loss was met with. In addition to the ova collected from parent salmon on this river, I received 50,000 "eyed eggs" from the Restigouche hatchery. Every exertion was made to have the young salmon hatched from these eggs planted as far up the streams as possible, and on the grounds best adapted for them to grow.

Following is a list of the rivers, with the numbers of fry planted in each, viz.:—

North-West Miramichi (native fry)	400,000
do (Restigouche fry)	30,000
Stony Brook (Restigouche fry)	20,000
South-West Miramichi (native fry)	50,000
Little South-West Miramichi (native fry)	240,000
Sevogle (native fry)	100,000
Stewart Brook	10,000
Total	850,000

I was very successful in the work of distribution this season, the weather being cool and favorable. Thirty thousand of the Restigouche fry were planted at the request of the Hon. Mr. Adams on the North-West Miramichi, a distance of about 45 miles up river by the road and nearly 75 by the river. The upper 22 miles of this road is only a portage, and required the greatest care to be taken in the carrying of the fry safely to this destination.

The remaining portion of the Restigouche fry, along with the 800,000 native fish, were planted as far as possible up the streams to which access was most easily gained.

I would here respectfully ask that a quantity of whitefish eggs be forwarded from some of the Ontario hatcheries to this nursery, the product of which I propose planting in the lake about seven miles distant from this establishment. I am of the opinion that this body of water would be well suited for this fresh-water fish. This lake is now almost destitute of fish of any kind, except some perch and a few lake trout. If the hatching and planting were successful, and as the growth of fish could easily be ascertained from time to time, it would be the means of introducing another valuable fish now altogether unknown in our waters.

In order to illustrate the benefits which must be derived from artificially-bred fry being planted in small streams which empty into the large rivers, and to refute other statements that are sometimes made by persons who decry the worth of fish culture, let us take the small stream which runs into the Miramichi River and supplies this hatchery as an example.

Previous to the erection of this hatchery not a salmon, smolt, or parr was to found in it, and what do we find now? Towards the latter part of August and 1st of September it was literally alive with young salmon, which are the results of planting in it eight or ten thousand fry every season. The small pools swarm with these young salmon, and hundreds could be taken with hook and line. When this result is obtained in this small brook (where any one can satisfy himself of the fact if he desires it) in which trout and other fish are also plentiful, and where the temperature and quality of the water does not differ materially from the up-river streams in which the fry are annually planted from this hatchery, then why should not this one simple fact give the strongest evidence of similar success attending the planting of the many thousands of fry from this hatchery into all the branches of the Miramichi for years past? But then there are designing persons who always oppose any progressive work, and who are so closely set in their own opinions that they will neither fairly consider nor inspect the workings of these *public* institutions, but prefer to circulate misleading statements and reports, which have no foundation whatever but in enmity. Look at the senseless fabrication which appeared some time ago in the columns of one of the local papers: "That thousands upon thousands of young salmon fry were found dead along the shores of the river." And this was sixty miles below the place where they were planted. When the successful results that I have pointed out can be attained in this little stream, why should it not be the same in similar streams up river? Where is the supply coming from if the product of naturally-deposited ova is not greatly augmented by these artificial means? Even the salmon, that may reach the spawning grounds, after having passed poachers' nets and other difficulties, will deposit their ova where ice, freshets, frost, and all the other elements may make war upon them. What has become of the ova naturally deposited this season, and what return can be expected from these eggs after 3,000,000 feet of lumber has been driven over the beds, besides two heavy freshets, accompanied each time by running ice? This occurs nearly every season in our rivers, and surely must destroy the greater number of naturally-laid ova. But still the salmon are not decreasing in the waters, although the fishermen are enlarging their operations and employing all the means they can to exhaust them. Nets are placed upon nearly every available stand upon the river, and salmon fishing was just as remunerative during the past season as for any time during the previous five or six years. The majority of fishermen believe this to be the beneficial results of artificial breeding. These fishermen and dealers—who take an interest in keeping the supply equal to the demand—plainly see that if there was no other resource besides the natural one their business would soon be a failure, and the enterprise and activity which this industry now creates would have to be directed into other channels in order to be remunerative.

Why is our striped bass fishery completely exhausted; and why is our smelt fishery yearly decreasing? The answer is plain—the natural supply cannot equal the enormous drain that is put upon it year by year,—alongside of the startling facts that the bass fishery is depleted, and the smelt fishery yearly decreasing—how favorably can the salmon fishing be compared, when it is known that it was better this season just passed than it was six years ago. Some of the fishermen in tidal waters say they have not taken as great a number of salmon this season as others, but they account for this falling off in the following manner: springtime set in about three weeks earlier than usual, and naturally the salmon entered the rivers at a much earlier date than other seasons—so early, in fact, that but very few fishermen had their nets or rigging in readiness to take the first run—while those men who owned fishing stands further up river, and who had their nets set before the run reached them—claim that, they caught more fish by the last of May than they would, other seasons, up to the last of June.

The fall run of salmon did not enter the rivers until October. There were some very large fish, and some of the fishermen are of the opinion that these large fish are the results of planting Restigouche fry in these head waters. Grilse were also very

plentiful, some of the up-river pools being literally alive with them about the latter days in September and first of October. Then the fishermen engaged to procure parent salmon for this house were seining in these pools: they have taken as many as a hundred and more of these young salmon at one sweep.

When the enormous drain upon our salmon fishery is considered—the almost endless number of nets from the mouth of the bay to the rapids—which are year by year doing a remunerative work—along with the facts that the waters are abounding with "parrs" "smolts" and "grilse"—it points to the conclusion that artificial hatching is the feeder that keeps up this supply, and is one of the greatest boons and benefits that can be granted to the fishermen of any river,—certain it is that, the natural sources could not supply the enormous demand—men of all opinions agree in this—and I may here add that the uniform good catches of fish for the past five years are now convincing the most skeptical of fishermen that the artificial breeding is most beneficial, as supplementing the products of natural-laid ova with millions of healthy—artificially bred fry—which are the surest safeguards against the depletion of our waters of these most valuable fish in future years.

Collection of Parent Salmon.

The work of collecting ova has been more successful this season than for the previous three or four years. The work was commenced about the first of September, but owing to extreme low water, very few salmon entered the River until the 25th of that month. Then there was a slight rise of water caused by heavy rain, which greatly lowered the temperature of the stream, in consequence of which great numbers of salmon and grilse which had been lying in the lower tidal waters began to ascend the upper parts of the rivers. As no wardens were appointed—until two weeks later—to guard the districts immediately below where our operations are carried on the poachers held full sway, and a great number of breeding salmon must have been destroyed by them. Therefore, our men did not meet with as great success as was expected. Then, again, when the guardians had been appointed, and when our men were doing good fishing, a large drive of lumber, which had been left at the heads of the streams since spring, came down with the high water, and our operations had to be suspended for five days, which caused us to lose part of the best run of fish. We succeeded, however, in capturing 261 parent salmon on the North-West and Little South-West Branches; and the man whom I had previously engaged procured 32 fish on the Big South-West Branch. Male fish predominated very largely. In some instances the men had to liberate as many as 100 or 150 grilse and male fish from the nets on one seining ground. Some of the female fish were very large, and the number of ova taken from each was above the usual average for our salmon of this river; quite a number of very small females were also taken.

The number of fish taken from the North-West Branch was 141, from the Little South-West 120 and from the Big South-West 32, making a total of 293 parent fish. Of these, 153 were females, from which I gathered 1,100,000 ova, giving an average to each fish of about 7,190 eggs.

In conclusion, I may say that this hatchery and its appliances, retaining ponds, etc., are all in good order, and I am pleased to state the ova is progressing favorably, and there is every appearance of a good crop of fry.

I am, Sir,
Your obedient servant,

ISSAC SHEASGREEN.

7.—RESTIGOUCHE HATCHERY.

PROVINCE OF QUEBEC.

Report of the Officer in charge of the Restigouche Hatchery for 1889.

I beg to lay before you a detailed report of the operations carried on at the Restigouche hatchery during the past year of 1889.

From the crops of eggs obtained last year, 1,280,000 fry were successfully hatched and distributed in good condition in the several streams, as follows:—

Restigouche River, from Indian House to Tracy Brook, including Brook, and 41 miles from hatchery	480,000
From Tracy Brook to Kedgewick, 50 miles from hatchery	200,000
Upsalquitch River above the Great Falls, 20 miles from hatchery	200,000
Restigouche River, from hatchery to Patapedia, including river, 20 miles	200,000
Metapedia Lake, 50 miles from hatchery	100,000
Metice River, 150 miles from hatchery	100,000
Total fry	1,280,000

Besides the above number of fry, 200,000 eyed eggs were distributed from the hatchery as follows:—50,000 were conveyed to the Miramichi establishment in the latter part of April, and 150,000 were conveyed at the same time to the St. John River nursery, all of which were deposited in the establishments in fine condition.

Distribution of Fry.

The distribution of fry began the 10th of June, and lasted until the 26th. The fry distributed in the Restigouche and its branches were all towed in large cribs 30 feet long by 3½ feet wide and 15 inches deep, divisioned off and so arranged that any desired supply of pure fresh water could flow amongst the fish while on their journey. In this way the little fish were kept healthy and lively until they reached their destination, and they are allowed to gradually drop out through little gates in the scows as they are being towed along at the rate of three or four miles an hour, and in this way they are distributed all along the river.

The fry distributed in the Metapedia Lake, and Metice River were conveyed in cans over the Intercolonial Railway. They were very lively when liberated, and hid themselves among the stones and moss immediately.

Net at Island to capture Parent Salmon.

Owing to the very early spring this net was set out in May, it being two weeks earlier than usual, and I am able to give a very satisfactory report on this important branch of the work, and herewith is given the catch of this net in detail:—

	No. of Fish.	Weight in lbs.
May, 30	2	40
do 31	4	80
June, 1	6	120
do 2	7	140
do 3	11	220
do 4	21	420
do 5	7	140
do 6	7	140
do 7	14	280
do 8	8	160
do 9	16	320
do 10 (Nets lifted to clean.)		
do 11	15	300
do 12	8	160
do 13	24	480

June	14	14	280
do	15	21	420
do	16	16	320
do	17	13	260
do	18	33	660
do	19	8	160
do	20	17	340
do	21	5	100
do	22	9	180
do	23	19	380
do	24	5	100
do	25	11	220
do	26	11	220
do	27	9	180
do	28	8	100
do	29	5	100
do	30	3	60
July	1	37	540
do	2	12	240
do	3	4	80
do	4	4	80
do	5	5	100
do	6 (Nets lifted to clean.)		
do	7	3	60
do	8	1	20
do	9	4	80
do	10	6	120
do	11	4	80
do	12	2	40
do	13 (Nets lifted on account of freshet.)		
do	14 do do		
do	15 do do		
do	16	3	60
do	17	2	40
do	18	1	20
do	19	2	40
do	20 (Nets lifted to clean.)		
do	21	2	40
do	22	1	20
do	23	1	20
do	24	1	20
do	25 (Nets lifted.)		
do	26	1	20
do	27	1	20
do	28 (Nil.)		
do	29	1	20
do	30 (Nil.)		
do	31 (Nil.)		
Aug.	1 (Nil.)		
do	2	2	40
do	— Grilse	28	84
		475	9,024
	Purchased from McAdams net	79	1,580
	Caught in Mission net	30	600
	Total	584	11,204

Some 70 of these fish, from injuries received in the nets and in towing them to the reservoirs, were useless for spawning purposes; those which were not affected with fungus were sold and accounted for.

Manipulation of Fish.

The work of spawning the fish began on the 15th October and lasted till the 10th of November; 512 fish were found in the reservoir—259 females and 253 males. From these were collected 3,022,000 eggs, which were packed in moss and conveyed some 15 miles up river to the hatchery by scows at various times during the spawning period. A small loss occurred in conveying the last batch to the hatchery, from the roughness of the road. The eggs in the hatchery at present are looking very well, and there is every reason to believe there will be a very successful hatching. But it will be necessary that a large number of the eyed eggs should be removed to some of the other establishments, to prevent overcrowding of the fry in the spring.

Repairs to the Retaining Pond.

As the instructions to build the block piers mentioned in my report were not received until too late in the season, the pond was only fitted up in a temporary way. It was also too late to obtain the necessary screen netting that was needed, the factory where it is made having closed down before the order was received.

To carry on this work successfully another year three small block piers will have to be built, and one hundred yards of fine mesh screen netting obtained. The old wire screens have been in use for four or five years, and they have become so decayed as to be unsafe and useless.

Repairs to Cribs and Plant Required.

The cribs for transporting the fry will need to be repaired, and one new one built. It will be necessary to get fifty fathoms of new small mesh net, also to put both fishing stations in good condition.

General Remarks.

The several letters obtained from net fishermen and others holding angling property on the Restigouche, hereto appended, are conclusive evidences that the salmon fisheries on the Restigouche and the Bay are in a very healthy condition and are improving. Some large catches among the net fishermen were reported; one party caught sixty and seventy at one tide, with an average weight of twenty-three pounds. With conversations had with some parties owning nets on the coast below Dalhousie, they told me they made very fine fishing this season. Many of the anglers made excellent scores. Mr. Rogers and his friend, in two weeks angling at the mouth of the Kedgewick, killed 100 salmon. I have not been able to ascertain the correct angling catch, but from information gathered from fishery officers and guardians the angling catch on the Restigouche and its tributaries was about 1,400 salmon. Angling in the latter part of the year was poor. Owing to the continuous dry weather the water in the river became so low and warm the fish would not rise to the fly.

The river was literally teeming with young "parr" and "smolt" this season. The rod fishermen complained of them as being a nuisance when angling for salmon. I have seen and conversed with many of the fishery officers and guardians, some of whom were forty miles up the Kedgewick, and with others stationed along the River in various places, and they all say they never saw more fish in the river than there was this fall. The scowmen, who have been towing seventy and eighty miles up the river, corroborate this statement and say all the spawning grounds and gravelly bars and shallows were overturned by the spawning salmon. Great numbers of fish spawned this season between the tide head and the hatchery, which is an unusual

occurence, and it is only of late years, and since the fish began to increase, that they spawned in this portion of the river at all.

A good deal of illegal fishing by drift nets and otherwise was reported having been carried on last season. It is to be hoped greater efforts will be made to stop this illegal fishing in the future.

I am, Sir,
Your obedient servant,

ALEX. MOWAT,
Officer in Charge of Restigouche Hatchery.

8.—GASPÉ HATCHERY.

PROVINCE OF QUEBEC.

Report of the Officer in Charge of the Gaspe Hatchery for 1889.

I beg to report on the operations of the Gaspé hatchery as follows:—

The management of this hatchery came under my control on the 13th of June last, upon the death of the late Philip Vibert.

The Department net was set on the 28th of May and taken up finally on the 6th August. One hundred and ten parent fish were taken, sixty-five females and forty-five males; all these fish were saved in good order, and not one was lost during the season. Owing to heavy freshets during the month of June the net had to be raised for some days.

I began planting the fry in the rivers on the 3rd of June, and had completed the distribution by the 21st of the same month. The fry were in good condition, strong and healthy.

The estimate of the number of ova placed in the trays last fall by Mr. Vibert proved to be below the actual quantity. The number of fry planted in June of this season is as follows:—

Dartmouth River, above the falls	250,000
do below do	100,000
York River	100,000
Total	450,000

I began spawning operations on the 1st October and finished the work by the 6th of November. I estimate the number of ova placed in the hatchery as follows:—

40	females,	averaging	14,000	560,000
20	do	do	11,000	220,000
5	do	do	8,000	40,000
65		Total		820,000

At present these eggs are looking well.

By your instructions I purchased a stove for the house at the reserve pond at a cost of $13.50. Scows, flats and cribs are all in safety for the winter. The trays and troughs were varnished in July and the interior of the hatchery was cleaned and aired, and everything is in good condition for the winter. The exterior of the building should receive a fresh coat of paint next season.

During the month of August the establishment was visited by the Hon. C. H. Tupper, Minister of Marine and Fisheries, who made a personal inspection of the property and ordered certain improvements and repairs which were accordingly made.

I beg also to report the following statements of facts in connection with the Gaspé nursery. Information is received from an old experienced canoeman, who has been employed the last twenty years by fly fishermen on these Gaspé rivers. He is a reliable man, and being well acquainted with him, his statement can be depended upon.

When he first became acquainted with the St. John River here in, 1870, he says the average weight of the salmon varied from 12 to 15 lbs.; that average continued up to the year 1880: But since that year there has been a continued increase in the size of most of the fish. In 1887–88, the average weight of the salmon taken in the St. John River ran up to 18 and 19 lbs., and in 1889 the average was 22 lbs. This is a most decided increase; and there has been salmon taken with the fly this season weighing 30 lbs.

The gill net fishermen of that river complain of losing many salmon this season by the meshes of their nets being too small. Now, all this goes to show that a very considerable increase has taken place in the size of the St. John River salmon, and the impression prevails that the cause of this increase is due to the work from this hatchery, and the canoemen say this comes from the numbers of young salmon which have been regularly put in the St. John River from the Gaspé hatchery, and hatched from the eggs of the larger breed of salmon belonging to the Dartmouth River. They say the form of these larger St. John River salmon resemble those of the Dartmouth, and that they enter the St. John two and three weeks earlier than formerly. These things certainly give good evidences of some benefits from the Gaspé nursery.

The reports from the York River are that a very great number of salmon were seen in the upper waters, and that a great quantity of young salmon were also seen in the estuary and tideway.

I cannot say much about the salmon in the upper parts of the Dartmouth River, but during the fall of 1885 I was up there and saw a great many parent salmon. In the year 1886 we planted fry above the falls; since that date I have particularly noticed a very great increase in the number of young salmon. The estuary waters of Dartmouth River this season were alive with little salmon of two and three years' growth; the greater number appeared to be "smolts," ready for their first migration to the sea.

In conclusion, I may say that before this hatchery was established the Gaspé Basin rivers contained few parent salmon; and "parrs" and "smolts," the young of the salmon, were not often seen, but at present all the rivers appear to be well supplied with parent salmon and their young. The latter are very numerous indeed in all the streams and in the estuaries.

I have the honor to be, Sir,
Your obedient servant,

HENRY DAVIS,
Officer in Charge of Gaspé Hatchery.

9.—TADOUSSAC HATCHERY.

PROVINCE OF QUEBEC.

Report of the Officer in Charge of the Tadoussac Hatchery for 1889.

I herewith submit my annual report of the operations connected with the fish hatchery under my charge. From the eggs laid down in the fall of 1888 there were successfully hatched 1,600,000 young fry, which were planted in the following rivers and lakes:—

Ste. Margaret River, N.-W. Branch	100,000
do do N.-E. Branch	300,000
St. John River	300,000

A Mars River	200,000
Little Saguenay River	100,000
Ste. Anne River "Côte Beaupré"	20,000
Mowat's Lake	450,000
Hatchery Lake	130,000
Total	1,600,000

All these fry were distributed in the best condition, every river receiving its complement. By the order from the Department no more fry will be planted in the Ste. Margaret River, and I hope a similar order will be given for the Little Saguenay River, as both rivers are considered unsafe for the salmon fry, on account of the enormous quanties of trout in them. The first consideration in the planting of fry should be their safety, and they should be taken as far up as possible to the head waters of the river at the head of the Saguenay.

Immediately after the distribution of the young fry the building was cleaned and ventilated. The improvements made in this house this year were very small, only repairing a certain number of troughs, and varnishing them and the taps; but the repairs necessarily required and mentioned in my report of 1888, estimated at a cost of $500, are now most urgent. The part of the building occupied for the hatchery is in a dangerous state. If the Department considers the sum of $500 too much to expend on the present old building, which stands on a wharf of slabs, and on that account being always a cause of trouble, with increasing expense, a new hatchery with stone foundation could be put up on the rock close by, on the stream which supplies the present house, which could be built for about $1,200. A good deal of the old building could be used, such as windows, doors and boards for covering the roof under the shingles.

Capture of Parent Salmon, 1889.

We caught in the Government nets 559 salmon; 310 were kept for breeding purposes, and 249 were liberated again, keeping only the largest sized fish. Those that were liberated were nearly all of the same size. On one occasion there were 70 salmon taken—the best tide of the season; of that number 42 salmon were put back in the water. The uniformity of size was very remarkable in these fish. During the whole summer we lost only one female and one male. Their cause of death was unknown, thus leaving 206 females and 102 males for manipulation. The 206 females were of large size and gave 2,557,000 ova. The eggs were all laid down in the hatching trays in good condition. The work of spawning commenced on the 21st of October, and was completed on the 9th of November. All the parent fish were retained in the pond after being stripped, and in a healthy condition. Residents of the place were invited to see them liberated. The Mayor of Tadoussac, J. E. Caron, Esq., and many others, saw that the salmon were as lively as before manipulation. No loss occurred in the spawning of the fish.

Very few smolts came down from the Hatchery Lake this season, on account of the dryness of the summer and fall; the water of the lake did not flow over the dams as usual. It is not desirable to put as large a quantity of fry in this little lake as formerly, for in a dry summer the water does not flow over the dams; and the young fish cannot get a free passage to the salt water; and for the last two years the trout have been encreasing enormously in the lake. I would only advise the planting of a small number, only to show to the public how they grow and what they are like.

A lake like Mowat's Lake is far better adapted to receive a large quantity of fry. This lake has a good stream running from it to the salt water. In July last I went down to this lake with my nephew, son of J. A. Gagné, Esq., ex-M.P., and now Judge. We caught young salmon of one, two and three years. The first planting of fry was in 1886; they were of the size of 4, 8 and 12 inches for the three years. It was a matter of the greatest satisfaction to see the great number of young fish that were jumping at the fly. On one occasion I permitted the Bishop of Chicoutimi

to fish in the hatchery lake. He was accompanied by the Rev. Mr. Mathieu, Superior of the Quebec Seminary, and the Rev. Mr. Lemieux, of Tadoussac; they were astonished at the number of young salmon that could be caught.

Increase of Salmon.

In my report of last year I said that there was a steady increase of salmon in my district. I am happy to state that for this season, with the same number of nets, the salmon fishing shows an increase of over 50 per cent. above last season, and the percentage would, no doubt, have been much better if there had not been so much time lost by repeated gales of winds, and the breaking up of the nets so often. I may also mention that we have taken nearly 300 per cent. more salmon with the same number of nets this season than we did in 1886—the first year of my taking charge of the Tadoussac hatchery. Salmon have been seen, and some were caught for the first time as far up as the River Shipshaw, about eighty-five miles from the mouth of the River Saguenay, and ten miles above the town of Chicoutimi. It is the opinion of many people in Chicoutimi that these salmon are the product of the Tadoussac hatchery. The editor of the *Progrès du Saguenay*, of the 26th of September, says: "One of the strongest evidence in favor of the Tadoussac hatchery is the fact that great quantities of smolts, of good size, have been seen at the entrance of rivers where there were none before." After this had been written, a gentleman from Ste. Anne du Saguenay, Mr. Joseph Villeneuve, when fishing for Winninish, caught a splendid salmon of 18 lbs. in the river Shipshaw; and another gentleman of the town of Chicoutimi, Mr. François Guay, caught another salmon of 8 lbs., close to the entrance of River du Moulin, in the town. I have been told the several salmon rivers are well stocked with salmon, but I cannot give full particulars, as the local guardians have not answered my enquiries regarding any of these rivers.

As an evidence of the salmon growing to a good size in the lakes where they were planted, a hunter of the name of Herménégilde Otis, whom I know well, when fishing trout to bait his traps caught in Lake de la Boule, through the ice, a salmon of 2 feet 9 inches long, and saw another one caught in the same lake by one of his friends of about 3 feet long. He knows that others have been taken, but he did not see the salmon. These are the fruit of some salmon fry planted by the late Mr. Radford in that lake.

I have received by the last mail a letter from Mr. I. D. Guay, proprietor of the newspaper *Le Progrès du Saguenay*. I send you a copy of his letter and a certificate of Mr. Guay, the gaoler of Chicoutimi, about some salmon caught in and around Chicoutimi. It is the first time that salmon have been seen above Ha! Ha! Bay, and they all give credit to the Tadoussac hatchery for the appearance of these salmon.

I have the honor to be, Sir,
Your obedient servant,

L. N. CATELLIER,
Officer in Charge Tadoussac Hatchery.

(*Translation.*)

CHICOUTIMI, 15th December, 1889.

L. A. CATELLIER, Esq.,
Officer in Charge Tadoussac Hatchery.

SIR,—As you are on the eve of making and sending your annual report, I wish to draw your attention to the importance for the Department of Fisheries to plant salmon fry in many rivers above Ha! Ha! Bay. We have in the following rivers: River of Pelletier's Cove, River Valin, River Caribou, River Shipshaw, &c., &c., some places favorable for the artificial reproduction of salmon, and it seems to me that the Government should give you orders to plant salmon fry in some of them. I take the liberty of enclosing a certificate showing the fact that many salmon, quite enough, have been caught by chance at Chicoutimi. I know a gentleman named Joseph

Villeneuve, from "Terres Rompues," caught a salmon of eighteen pounds in the River Shipshaw, ten miles above Chicoutimi. I am not able for the present to send you the certificate of the gentleman in question. Good many facts come to confirm me in the good opinion I always had in favor of the fish breeding in Tadoussac. My own experience, and the reports made to me, make me believe that the Government must continue its work and place your hatchery on a good footing. There is room in Tadoussac for important improvements, that would be prized with satisfaction by all.

I wish to congratulate you on your success since you are at the head of the Tadoussac hatchery.

Believe me, dear Sir,
Your obedient servant,
(Signed) I. D. GUAY.

(*Translation.*)

I, the undersigned, certify by these presents, that I have myself caught a salmon of 8½ pounds in the River Saguenay a little lower than River du Moulin, and about one mile below the Government wharf, and I certify also that it is in my personal knowledge that two more salmon have been caught, one in the River Shipshaw and the other in the basin of the River Chicoutimi. The first one caught by Mr. Francis Mattais, and the second, a salmon of 20 pounds, caught by a man named Harvey.

(Signed) FRS. GUAY.

CHICOUTIMI, 12th, December, 1889.
Witness—I. D. GUAY.

10.—MAGOG HATCHERY.

PROVINCE OF QUEBEC.

Report of the Officer in Charge of the Magog Hatchery for 1889.

I herewith submit the annual report of the operations of the Magog fish hatchery for the year 1889.

From the eggs received from the Newcastle hatchery in March, 1889, I had the good fortune to hatch out 1,700,000 whitefish, and 1,100,000 salmon-trout fry, which were safely deposited in the following named bodies of water, to wit:—

Whitefish.

Oxford Lake, Brome and Sherbrooke Counties	400,000
Massawippi Lake, Stanstead County	200,000
Megantic Lake, Megantic County	100,000
Memphremagog Lake, Stanstead and Brome Counties	1,000,000
Total	1,700,000

Salmon Trout.

Oxford Lake, Brome and Sherbrooke Counties	250,000
Megantic Lake, Megantic County	100,000
Massawippi Lake, Stanstead County	125,000
People's Lake, Stanstead County	50,000
Lake Fortin, Beauce County	25,000
Lake St. Charles, Beauce County	50,000
Memphremagog Lake, Stanstead and Brome Counties	500,000
Total	1,100,000

On account of the forwardness of the spring and consequently the high temperature of the water the fry were successfully developed and deposited in the above named sheets of water a fortnight earlier than usual. Whitefish did especially well this season, the loss being comparatively small. The glass incubators working well, kept themselves free, by carying off all bad eggs. The hatching proceeded regularly and the fry were exceptionally strong.

The salmon-trout eggs I consider were above the average, and the mortality was slight until hatching time, when a slight loss was sustained.

There were no whitefish in any of the waters hereinbefore named previous to their artificial propagation in the Magog hatchery. At the present time they are seen in large numbers, but as netting and spearing are prohibed, and as they do not take the hook, but few have been caught.

Guardians of Memphremagog Lake (the largest sheet of water in the Province) inform me that during the close season last autumn the shoals were visited by a much larger number of salmon-trout than ever before. Black bass are still rapidly increasing; the spawning beds in June last were fairly alive with them. Two were caught last fall, weighing respectively 7 and $7\frac{7}{8}$ lbs.

Illegal fishing still continues, and the cutting down of the appropriations the present season for guarding the shoals during the spawning season weakened the force of the guardians, and stimulated the feelings of poachers to break the law.

Repairs thus far have been slight but there now requires to be a new floor and underlays, the old one having become too much decayed by constant wetting to be safe. It will require about fifty dollars to put the hatchery in first-class condition.

All of which I most respectfully submit.

A. H. MOORE,
Officer in Charge of Magog Hatchery.

11.—NEWCASTLE FISH HATCHERY.

PROVINCE OF ONTARIO.

Report of the Officer in Charge of the Newcastle Establishment for 1889.

Herewith is submitted the annual report of operations carried on at this hatchery during the past year.

The fry distributed from this nursery last spring were liberated in excellent condition, notwithstanding the fact that a large proportion of them were subjected to long journeys.

The following detailed statement shows the number of semi-hatched eggs shipped to the different hatcheries in the Lower Provinces last winter; also the number and kinds of fry planted in the various waters of Ontario during the spring of 1889:—

Whitefish.

Lake Ontario, Newcastle	500,000
do Toronto	500,000
Bay of Quinté, Belleville	500,000
Lake Ontario, Port Hope	200,000
Georgian Bay, Meaford	200,000
do Thornberry	200,000
Lake White, Arnprior	100,000
Singleton Lake, north of Gananoque	100,000
Delta Lake do do	100,000
Couchiching Lake, Orillia	200,000
Simcoe Lake, Barrie	200,000
Total	2,800,000

Salmon-Trout.

Howard Lake, Toronto	50,000
Georgian Bay, Wiarton	300,000
Lake Ontario, Hamilton	100,000
do Toronto	100,000
do Whitby	100,000
do Port Hope	100,000
do Toronto	100,000
do Newcastle	800,000
Georgian Bay, Meaford	200,000
Crow Bay and Ely's Falls, Campbellford	100,000
Charleston Lake, North of Gananoque	50,000
Bay of Quinté, Belleville	100,000
Doctor Dean's Lake, Brighton	50,000
Rosseau Lake, Muskoka	100,000
Vernon Lake, Huntsville	50,000
Fary Lake do	50,000
Peninsula Lake do	50,000
Simcoe Lake, Barrie	100,000
Stoco Lake, Tweed	50,000
Humphrey's Lake, North Hastings	25,000
Nick's Lake do	10,000
Wilson's Lake do	25,000
Bear Shanty Lake do	25,000
Eagle Lake do	25,000
Total	2,760,000

Speckled Trout.

J. B. Thompson, Orillia	4,000
Henry Pellat, Orillia	4,000
Stanley Trout Club, Hagersville	5,000
William Henry, Niagara Falls	5,000
D. Martin, Guelph	2,500
Thomas Goldie, Guelph	7,000
G. W. Lawrence, Stratford	10,000
Samuel Grigg, London	5,000
Warren Tolton, Woodstock	20,000
R. C. Hulme, Belleville	4,000
Cyrus Teal, Wooler	4,000
George Hoar, Clinton	1,000
J. H. McCall, Vittoria	8,000
E. R. C. Clarkson, Toronto	10,000
Thomas Ford, Credit Forks	20,000
Mr. Gouin, Ottawa	10,000
S. Dice, Milton	6,000
R. J. Laidlaw, Hamilton	1,000
R. Southam, London	7,000
W. Myres, Orangeville	10,000
H. C. Dennis, Cobourg	40,000
Government Museum, Ottawa	3,000
Kept for pond at Newcastle hatchery	20,000
Total	206,500

Black Bass.

Howard Lake, Toronto	30,000
Thos. Elliott, Hampton	30,000
Ponds at Newcastle hatchery	20,000
Total	80,000

Salmon-Trout Eggs shipped to Lower Provinces in semi-hatched state.

Magog Hatchery, Quebec	1,200,000
Bedford Hatchery, Nova Scotia	500,000
St. John Hatchery, New Brunswick	1,000,000
Fishery Museum, Ottawa	20,000
Total	2,720,000

Grand Total.

Whitefish fry	2,800,000
Salmon-trout	2,760,000
Salmon-trout eggs semi-hatched	2,720,000
Speckled trout	206,500
Grand total of all kinds	8,566,000

Applications for Fry.

On account of the increased demand for speckled trout I am of the opinion that it would be advisable for the Department to authorize the purchase of a larger number of eggs than have been obtained in past years. The Superintendent's form of application for fry recently issued by the Department, which is being circulated throughout the Dominion, will impart information to parties interested in the culture of fish which has not been generally understood heretofore, in consequence of which it is only reasonable to assume that the applications from persons living in remote parts of the country will be more numerous. Trout eggs can be purchased from American breeders at a very low figure when taken in large quantities, and I trust the Department will sanction more extensive operations than have formerly been carried on under this branch of our work. The form of application referred to contains full directions as to where the several kinds of fry should be deposited to ensure successful results. This valuable information to parties receiving fry will enable them to plant the young fish with perfect safety, a duty hitherto wholly devolving upon the officers in charge of hatcheries to perform. The regulations set forth in the application will enable them to carry on the work more expeditiously; the fry will in this way be planted in more desirable localities and as early in the spring as it is practicable, and all trouble and annoyance will be avoided from parties sending in applications for fry subsequent to the proper time for distribution.

Repairs to Hatchery.

After the disposal of the fry last spring the hatchery was put in a satisfactory working condition, with the expectation of receiving a larger supply of eggs than usual. The following autumn the main reservoir was repaired and all the appliances connected with the establishment thoroughly overhauled. It has been found that the large number of hatching trays transferred with eggs to other hatcheries on previous occasions to the lower Provinces were permanently required there. This has considerably diminished our stock, and we will require upwards of five hundred new trays in order to ensure the successful hatching of our own supply. The building has not been painted for a number of years. This should be done during the coming summer, otherwise, it will be damaged to a considerable extent. The continued dampness arising from the water is causing premature decay of the wood.

Importance of the Newcastle Hatchery.

The increasing usefulness, coupled with the more enlarged operations which are now carried on at this hatchery, call for greater consideration as regards its general efficiency and management. In addition to its former work, it has become the parent institution for annually supplying large quantities of semi-hatched eggs of the more important kinds of fresh water commercial fishes to many of the Maritime Province hatcheries. On this account, this establishment has necessarily annually to collect at Wiarton, on the Georgian Bay, a much larger number of salmon-trout eggs than its own requirements would demand. This additional supply so obtained is also cared for and kept in this hatchery until the 1st of February, and even later, and then transferred in semi-hatched condition to Magog, Bedford, St. John and such other hatcheries as may require them, and now that a hatchery has also been established at Ottawa, requiring annually a large supply of salmon-trout eggs, additional importance is given to this establishment, and necessitates the work being carried on at this hatchery on a much more extensive scale than has been the case hitherto. These several institutions in the Maritime Provinces have no means within their range of operations for collecting supplies of salmon-trout or whitefish eggs, and, even if they had, it would necessitate almost as large an expenditure for each hatchery as is at present incurred by this establishment in collecting a sufficient number for all. The duty and extra work devolving upon us of looking after these eggs in addition to our own supply makes it necessary to employ a larger staff of officers than otherwise would be required.

Collection of Salmon-Trout Eggs.

In former years the system adopted for collecting a supply of salmon-trout eggs for Newcastle and the other hatcheries was carried on by employing an expert fisherman to set three pound nets in Colpoy's Bay at such cost as might be agreed upon.

In addition to the sum paid for this service, pound net licenses were granted by the Department to the fisherman so employed, which enabled him to fish these pound nets in open season in this locality up to the first of November, where pound net licenses were formerly prohibited. This caused considerable dissatisfaction among other fishermen, so much so, that it was deemed advisable by the Department to purchase an outfit for its own use. I was, therefore, directed to secure the requisite appliances necessary for carrying on the work of collecting eggs, and to visit Wiarton, with a view to the selection of proper grounds for setting the nets. The department forwarded to me at Wiarton two confiscated nets, with instructions that if at all suitable they were to be used in connection with the work. A few repairs placed them in proper condition, and after purchasing one new net I was enabled to proceed with the work. This new net was set at Gravelly Point, an old reliable fishing ground inside Colpoy's Bay. With the knowledge of the Indian Department, the other two nets were set in the vicinity of Hay and White Cloud Islands, on the reserve of the Cape Croker Band of Indians. All the nets were fairly successful in capturing parent fish, but by far the largest number was taken from the Gravelly Point net. The undertaking last autumn was the most satisfactory one we have ever experienced, not only from a financial standpoint, but also from the number of eggs secured. The unusually large quantity of [illegible] was collected in the short space of sixteen days, and many more could have been gathered, but this amount filled the hatchery to its utmost capacity. This record surpasses that of any other year, and to a certain extent may be attributed to the setting of the nets at an earlier date than in former seasons, thus allowing a supply of fish to enter the nets before the "close time." Last year every effort was put forth during the entire close season of the month of November, and we only succeeded in obtaining five millions of eggs.

I am convinced from experience, that two nets set in the vicinity of Gravelly Point in Colpoys Bay, will secure an ample supply of parent fish from which a sufficient quantity of eggs can be collected to stock all of the hatcheries requiring them.

By the proposed means a considerable reduction in the expenses can be effected. The cost of tug hire will not be so great, as the distance from Wiarton will be much shorter than when the nets were set at Hay and White Cloud Islands the past season. Further reduction in the running expenses will also be made as only one guardian will be required to protect the two nets against the encroachment of poachers as they will be situated only a short distance apart.

Daily Statement.

A statement showing the daily operations at Wiarton during the past close season is herewith appended, which gives the gross number of eggs taken, the fish manipulated, those injured and salted, and also the dates when the eggs were collected.

STATEMENT showing the daily operations of collecting Salmon Trout Eggs at Wiarton during the Season of 1889.

Date of Lifting Nets.	No. of Nets Lifted.	No. of Fish from which Spawn was collected and liberated.		No. of Fish Spawned out before entering Nets and liberated.	No. of Fish found injured or dead in Nets.		No. of Eggs collected.	Remarks.
		Males.	Females.		Whitefish.	Salmon Trout.		
Oct. 31	1	83	297	3	3	17	1,100,000	Spawn running freely ; have evidently struck an early run of fish ; blowing fresh.
Nov. 1								Too rough to lift ; did not go down to nets.
do 2	3	71	245	8	5	22	900,000	Upwards of 1,000 fish in Gravelly Point net ; spawning freely.
do 3								A large number of fresh fish in nets which are not ripe ; the Indian reserve nets are doing well now.
do 4	1	68	160	10	4	12	550,000	These eggs were collected from Indian reserve nets.
do 5	2	49	141	7	1	15	450,000	Wind blowing fresh ; cold weather.
do 6								Lifted Gravelly Point net, but fish not ripe ; very windy.
do 7								Weather very fine ; did not lift ; fish not ripe for spawning.
do 8	3	182	607	59	4	47	2,000,000	Weather favorable ; upwards of 2,000 fish in nets ; Indian reserve nets have a good many fish in them ; this is a very large number of eggs for one day.
do 9								Fish left in nets are not ripe for spawning ; favorable weather.
do 10								Sunday.
do 11	3	189	650	71	5	19	2,500,000	Weather fine ; fish spawning freely ; this is the largest number of eggs ever taken in one day by us.
do 12								Fish left in nets not ready for spawning ; fine weather.
do 13	3	127	525	51	2	25	2,200,000	Cloudy, but smooth water ; this is a very large number of eggs to be taken in one day.
do 14	1	24	97	20	5	14	300,000	Snowing ; took one net up at White Cloud Island, and liberated a large number of fish from which spawn could have been collected.
do 15								Blowing and freezing ; slight fall of snow.
do 16	1	145	317	67	7	37	1,150,000	Lifted and took up the other two nets ; weather cold but fine.
do 17								Put all nets and appliances away carefully.
		938	3,039	296	36	208	11,150,000	

By an examination of this year's daily statement in conjunction with similar reports of former years it will be found that the Government had adopted the proper period for the protection of salmon-trout during the spawning season in the waters of the Georgian Bay and Lake Huron, where extensive fishing operations are carried on. I have noticed that complaints have been forwarded to your Department to the effect that the present close season for salmon-trout and white fish is not in the interest of the country for the preservation of these valuable fish in our inland waters. My practical observations in collecting the ova of these fish during many years past leads me to conclude otherwise, and the very fact that large numbers of ripe eggs can be gathered only during the month of November is conclusive evidence also that the month of November is the proper close time for the protection of these fish, as it is their true spawning time.

Condition of Eggs.

At the present time the eggs in this establishment are in a very healthy condition, but owing to their being overcrowded in numbers and the continued rainfall this season, causing more sedimentary matter to settle upon them has given more work than usual to clean them. A large number of these ova must be transferred in a short time to the other hatcheries requiring them; otherwise many will die from suffocation during the period of hatching.

I have the honor to be, Sir,
Your obedient servant,

C. WILMOT.
Officer in Charge of Newcastle Hatchery.

12.—SANDWICH HATCHERY.

PROVINCE OF ONTARIO.

Report of the Officer in Charge of the Sandwich Hatchery for 1889.

I herewith submit my annual report of the works of this hatchery for the past year.

In my last report I stated that there were in the hatchery 40,000,000 whitefish eggs, and that I expected to obtain from them a good return. This report will show that I was not far astray in my view of the numbers of fry which would be turned out. From this number of eggs were hatched 21,000,000 young fish, and in addition 11,000,000 eyed eggs were sent to other hatcheries, making a total of 32,000,000, or a product of 80 per cent. of the whole. The young fish were placed in the waters at the following places:—

Belle River, Lake St. Clair	2,000,000
Peach Island, Detroit River	1,000,000
Fighting Island do	2,000,000
Stoney Island do	1,000,000
Bois Blanc Island do	2,000,000
Bar Point, Lake Erie	1,000,000
Pigeon Bay do	1,000,000
Colchester do	1,000,000
Kingsville do	1,000,000
Leamington do	1,000,000
Port Stanley do	1,000,000
Hamilton, Lake Ontario	1,000,000
Niagara do	1,000,000

In river at Hatchery.		5,000,000
Sent to Newcastle, Ont.		3,000,000
do St. John, N. B.	Semi-hatched	3,000,000
do Bedford, N. S.		3,000,000
do Magog, Que.		2,000,000
Total		32,000,000

After having distributed all the young whitefish, the next part of the work was to clean up the hatchery, and re-fill it with the eggs of the pickerel (doré). From four fishing grounds we were successful in gathering 30,000,000 eggs of this fish, and placing them in the hatchery. I might here state that while gathering these eggs at Port Lambton, during one night, when about a million eggs were in the floats ready to be conveyed to the hatchery, some person or persons either stole or destroyed the lot. As I could place the blame on no particular person, I was obliged to put up with this loss without any remedy. The fishing grounds where the eggs were gathered were as follows, in Lake Huron:—

Wees Bros.	8,000,000
Joseph Leazeu	7,000,000
Stead & Hitchcock	10,000,000
Soloman's, River St. Clair	5,000,000
Total	30,000,000

From these eggs we hatched out 70 per cent., or 21,000,000 young pickerel, and placed them in the following waters:—

Point Edward, Lake Huron	2,000,000
Port Lambton, River St. Clair	2,000,000
Belle River, Lake St. Clair	2,000,000
Stony Island, Detroit River	1,000,000
Bois Blanc Island do	1,000,000
Fighting Island do	2,000,000
Pigeon Bay, Lake Erie	2,000,000
Port Stanley do	1,000,000
In river at Hatchery.	8,000,000
	21,000,000

The fishermen throughout this quarter believe that through the agency of the hatchery this fishery is greatly improved. The run of pickerel this year was very much the same as last, and all seem to be satisfied with the catch.

Eggs Collected, Season of 1889.

The number of whitefish eggs laid down in the hatchery this year was far greater than any previous year since the hatchery was started—in fact, nearly double. This is accounted for by the measures adopted by the Department in securing many fishing grounds at which we could handle the fish. The number of eggs put in the hatchery this year was 70,000,000. They were secured at the following places:—

Bois Blanc Island, Detroit River	30,000,000
Stony Island do	20,000,000
Fighting Island do	20,000,000
Total	70,000,000

In addition to this number put in the hatchery, 4,000,000 eggs were taken from fish at different stations, and impregnated and then thrown into the river. The places where this work was done were as follows:—

Bois Blanc Island	1,000,000
Fighting Island (pier fishery)	1,000,000
Jollie's (main land fishery)	1,000,000
Gauthier's do	500,000
McKee's do	500,000
Total	4,000,000

The fishing at all points of the river this year was considered good by all the fishermen. At Bois Blanc Island the Government fishery the fishing was much better than it was last year, but a good deal of trouble was experienced from high winds at Bois Blanc Island, which at times would cause the water to recede some 20 paces from the shore, leaving dry land where at other times it was covered with water. This necessitates a great deal of work—so much so, that we were obliged to frequently carry the racks with fish into deeper water. The way I remedy this will be to build a movable breakwater, which could be filled with stone and sunk in deep water, and taken up again every year after the fishing season was over. This breakwater would cost about $100. This provision is very requisite for the preservation of the parent fish placed in the pens, from the heavy seas which dash the fish against the rocks and so injures them as to make many of them useless for spawning purposes.

Provision must also be made for the building of another windmill on Lake Huron at Wee's ground, for the purpose of supplying water for the tanks in which the pickerel are kept until ripe enough to take the spawn from them.

In my last report it was shown to be a necessity for having more room in the building for hatching purposes. This year, with the large amount of eggs put into the house, they are altogether too over-crowded for their safety. As quite a lot of repairs will have to be made to the building next season. I would again ask the Department to consider the advisability of building a dwelling for the officer in charge and his family. If this were done the whole floor of the house could be used for fish-breeding purposes. By doing this there would be plenty of room to run 700 incubators, with a capacity of turning out over a hundred millions of fish. The repairs required will be quite general. The foundations of the building have rotted away and must be replaced, together with a new floor, as the present one is much decayed.

The hatchery in Detroit, on the American side, formerly run 300 jars, but this year the capacity has been increased to 1,000 jars. I would, therefore, urge upon the Government to make the change I have proposed, when I feel certain we can maintain the credit which the Sandwich hatchery has hitherto held as being the original whitefish nursery of America, and the good work it has done since in replenishing many of the waters of Canada with these valuable fish.

Respectfully submitted.

WM. PARKER,
Officer in Charge of Sandwich Hatchery.

We, the undersigned, hereby acknowledge that we saw Mr. Wm. Parker, of the Sandwich fish-breeding establishment, turn out from the racks at Bois Blanc Island a large number of whitefish, he having received instructions from the Department of Fisheries at Ottawa to do so.

ANDREW HACKETT,
Lighthouse Keeper, Bois Blanc Island,
H. A. HACKETT,
WM. HILL,
SAMUEL ADAMSON,
A. W. MARKS, *Detroit,*
JOSEPH MARTIN.

ANNEX TO FISH-BREEDING REPORT.

REPORT

OF

OPERATIONS OF THE HATCHERY AT FLODEVIGEN

DURING THE FIVE YEARS 1883-1888

BY

G. M. DANNEVIG,

SUPERINTENDENT OF THE HATCHERY.

ARENDAL, 1889.

(*Translation from the Report of the Board of Directions for Arendal and Omegn's Branch of the Society for the Encouragement of the Norwegian Fisheries.*)

To the Directors of the Arendal and Omegn's Branch of the Society for the Encouragement of Norwegian Fisheries:

I have the honor to submit herewith the following report of the labors of the hatchery at Flodevigen for 1888, as well as a recapitulation of labors during the last five years.

1.—The History of the Hatchery.

In the beginning of 1880 there appeared in the local press lively articles discussing the fisheries in the district. It was universally agreed that the fish were steadily and alarmingly decreasing, and that some remedial measures were necessary, but nothing was done. There was but one opinion with regard to the decrease complained of as well as the means of counteracting it. About this time there appeared a report by Mr. F. M. Walkem upon the Fisheries Exhibition in Berlin, in which amongst other things, was given an account of experiments in the United States during 1878-79 of artificially hatching cod, and which were considered to be successful. These experiments were referred to, as follows: After a special grant by Congress was allowed, a steamboat was constructed to carry on cod hatching on a greater scale, and is now in full operation, supplying suitable areas with the hatched brood.

It was very promising, and I supposed that as with us there would always be a sufficient stock of spawn and the cost of labour seemed to me very small, it appeared the most suitable, and for the general public, least expensive means of restoring the fisheries; consequently, I commenced, through the medium of the press, to disclose my plans, and when the branch of Arendal was instituted in 1882 I submitted to them a report on the matter. The construction of a hatchery for salt-water fish was included in the programme of the institution's labors. As the establishment was just started, and

was without capital or sufficient members for so large an undertaking, special arrangements had to be made to get the necessary means to carry out the plans; therefore, application for voluntary grants were forwarded to the Savings Bank of Arendal; the Society for Norway's Welfare: Arendal's Spirituous Liquor Association, and to the Society for the Encouragement of Norwegian Fisheries, all of which replied favorably. I was also instructed to proceed to all the villages along the coast to take up subscriptions from private individuals and to do anything in my power to promote the undertaking. However, as the Fisheries Exhibition was to be opened in London, in the spring of 1883, and as it was generally believed that correct and reliable information respecting hatching of salt water-fish could be obtained there, I went there, to enable me to study the matter. Here I was met with disappointment of a very serious nature. It was shown that the reports by Mr. Walkem respecting the American Fishery Commission's Labors had been exaggerated inasmuch, as the vessel had never been used for hatching salt-water fish. An attempt had been made in 1878-79, but it was characterized by the Americans themselves as anything but satisfactory. After that the matter was dropped. I had occasion to inspect the apparatus used, but this was of little benefit to me, as I was informed they were considered inapplicable. My position was therefore not improved. Instead of finding a path cut out for me, as I was led to believe, I was met by doubts and uncertainties, which the most prominent men and the best informed on the subject had been unable to solve.

My own limited knowledge of the practical side of fish culture, and anything concerning it, did not improve my situation, but I consoled myself with the thought of having undertaken the job in good faith, and I knew that with a little perseverance I could inform myself on the subject, as it was too late to give it up.

Furnished with all the information I could possibly get, for which my thanks are principally due to the very polite American gentlemen, I left for home after a sojourn of about three weeks, to make practical use of what I had learned.

The erection of the building was commenced that fall and finished in January, 1884. The building is a two-story one, 40 feet long and 30 feet wide, and contained at that time as many appliances as were thought necessary for a yearly production of a brood of about 80 millions. The American appliances and experiments not having met with success, I was left on my resources. I adopted the rotary apparatus used by the Americans, and Clark's hatching-trough, before tried. These seemed to me most suitable, and I hoped after a short time to know both their good and bad points, and to be able to use them as a kind of foundation for more useful improvements. Later on I gave up altogether the rotary apparatus and made many improvements in the other one, rendering it more suitable for our business. The Americans have, however, given up both, and are working now with a new, very cleverly arranged apparatus, which, for reasons I will give further on, could not be used by us, because other improvements planned by myself had been adopted.

The size of the building and the number of the appliances, I may state, was entirely experimental, which, if successful, would be enlarged. In measuring the lot the directors got right of pre-emption of such quantity of ground as would be necessary for the extensions. When the rotary appliances were discarded, the space previously occupied by them was used for tanks for the stock-fish, thus reducing the factory's production-stock to only half of what was originally calculated, and causing an extension of the factory to be much more needed.

To give a detailed statement of the fittings of the building, I consider at present quite unnecessary, as already application for a grant towards the extension and removal of the factory is submitted for the consideration of the Parliament at its first sitting; the extension and removal necessary which will be specified below.

2.—The Procurement and Keeping of Stock Fish.

The common belief that a female cod each year develops 2,000,000 of spawn does not hold good with the common bay or coast cod. The number is large enough, but when only about 400,000 to 500,000 matured spawn can be accredited to one fish, it must be a very prolific cod to develop 1,000,000, not to say 2,000,000. As a rule, the cod caught

on the coast is very small compared to the sea cod proper. The reasons for this are that the coast or bay cod seldom lives long enough to be fully grown. The greatest numbers are caught between one to ten years of age.

When a hatchery is to be provided with stock fish to enable a certain number of receptacles to be filled with spawn, there are circumstances which are to be taken into consideration, and which, for safety, necessitates purchasing far in excess of calculations.

For instance, if you begin before the spawn is sufficiently developed, and you cannot determine the sexes, you are liable to get a greater number of males than females; hence, a scarcity of eggs would result. Again, you may get fish that may have already spawned, or for some reasons produce less spawn than expected; and others again, from various causes produce dead spawn.

The prevailing method of spawning the fish is to carefully press the hand over the belly and the spawn flows out. Notwithstanding the greatest care, considerable immature and dead spawn, incapable of impregnation, is sure to become mixed with the mature and vivified ova, resulting in considerable loss. There is no doubt this process is much in need of improvement. I have therefore kept my attention fixed on this subject, and I have succeeded in finding a plan by which the stock fish can, without being touched by human hands, themselves accomplish the fecundation in a natural way, after which the eggs are carried to an especially constructed apparatus and conducted to the hatching boxes. I shall further on explain this method, when I describe my plan for the extension and removal of the hatchery.

I have already stated that from a living cod you will sometimes get dead spawn. This strange fact can be accounted for by the manner in which the fish is taken, as the spawn gets destroyed just when the fish is removed from salt to fresher water. That it is this sudden change which causes the loss of eggs has been proven by the fact that fishes which have for a year, or at least a good while, been kept in less saline water, produce healthy spawn.

If you have got such fish, which often happens, there is no other way but to remove them into stronger saline water. Of course, the diseased spawn cannot be saved by this or any other means, but the later developed eggs will be of use, and much is saved thereby. The cod does not bring forth all the spawn at once; some will not ripen or mature until several weeks after the first are laid. The most suitable as well as the cheapest method regarding the stock fish and their treatment would be to have the fish bring forth their spawn themselves, by transferring them to the basin for fecundation at the proper time, and when done to return them to the tanks, to be kept, if necessary, until the following year. Of course, they have to be fed the whole year, but this will be a very small expense compared with buying a new stock each year. The fish will both grow and thrive, and produce a considerable amount of spawn. * * * * *

3.—The Hatching Process.

On the 19th February, 1884, the first eggs were put into the apparatus, and, as was expected, one difficulty arose after the other. On account of the weakness of the salt water the majority of the eggs sank to the bottom of the apparatus, and as the water was not filtered the eggs became dirty and would not rise again and were thus spoiled. To arrange the apparatus to keep the water running all the time and prevent the eggs from remaining on the bottom was the first problem to solve. Work was continued at this for a long time, until at length, towards the end of the season, I succeeded in inventing an arrangement suitable, and which is described in my report for 1885. To prevent the apparatus from becoming unclean from the water running through it, a very simple filter was attached, which afterwards was exchanged for a more perfect one, with moveable frames, which caught the sediment; but I regret to say a great deal of it went back into the water when the frames were lifted up to get cleaned. This inconvenience can be avoided, if when the hatchery is rebuilt, there are constructed several smaller filter-boxes, instead of only one large one. To use in turns one or two of them and let those that are to be cleaned run dry

before the frames are touched, the filtering process will be regular and to be depended upon. A complete cleansing of the water is of great importance, not alone because the eggs will thrive better, but also because you avoid the additional labor connected with cleaning the apparatus.

Often the question has been raised how the hatching process takes place and in what way the spawn or brood are counted. I will give a short description of the plan followed here.

When a number of the stock fish is supposed to bear ripe spawn it is necessary to get hold of them, and this is done in the following manner:—In a small tub of salt sea water (spec. weight, 1.024) enough of the male fish's milt is put to give the water a milky color. Then one of the female fish is examined, and if the eggs come freely let them drop into the tub, and move the water slightly with the hand. After the fish are examined they are thrown into another tank, and thus every fish is tried until none are left. This work is gone over again every other or third day for a couple of months, and when you have several hundred fishes to work with, it is easily understood that this work is very tedious, and at the same time trying to the fish. The fertilised spawn is then washed clean and put into an 18-inches-high glass cylinder, which is half-filled with clear, salt sea water. In a few minutes a change takes place, and the living eggs gather in a close layer on the surface, and the dead spawn and sediment sink to the bottom. Between the layers of good and bad eggs is a belt of clean water. With a ladle perforated at the bottom transfer the living spawn into a smaller cylinder, as a measure which may be found after careful measurement and weighing to contain 60,000. After this the spawn is transferred into the hatching troughs. These are 8 feet long and 2 feet wide, and contain each ten spawn boxes, which hold 3,000,000 spawn, or 300,000 in each box. In this trough let a steady current of water run for two or three days. The eggs may then be taken up to allow the apparatus to be cleaned, and the spawn will have to undergo another sorting, in the same manner as before, the living spawn to be returned to the boxes and the sinking or dead ones to be thrown away.

In this way the work is continued every second or third day until the eggs mature. The living spawn is quite transparent, so that the growth or development of the embryo can be followed in every detail. Dead spawn will be greyish white, and altogether opaque.

A few days before the fry is ready to break through the shells the apparatus and spawn is cleansed for the last time, and notes made as to how much of the good spawn is left. The loss may run from 20 to 70 per cent., and depends mostly on the saltness of the water during the time of development. If, at the collection of the eggs, unripe ones are taken, of course the loss will be greater.

By following this very easy process you can keep track of the hatched quantity. A difficulty is when some of the brood die after being hatched. Measure and weight are then of no use, but the loss may be made up by calculation, which, after some experience, can be made pretty accurately.

Sometimes the sea water gets too fresh, and when this takes place the greatest loss is experienced.

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That the greater or less saltness of the water plays an important part over the fish which inhabit it is well known. There are fishes that spend all their time in fresh water, and others that alternately live in fresh and salt water, and others again that never leave the ocean Some fishes, for instance the salmon, go from the ocean up into the rivers to lay their spawn. The eel, on the contrary, leaves the fresh water for the open sea.

* * * * * *

If the spawn of different kinds of fish is examined it will be seen that the so-called mikropyle (the opening through which the fecundation takes place, and through which the egg is provided with air and water) is alike with all fishes, but in regard to the place where it is situated is very different. At the salmon spawning, the female fish places her eggs in the gravel purposely dug up, after which the male

fish oversprays it with his fertilizing fluid. The micropyle here turns upward, which is necessary in order that fecundation may take place. This is also the most suitable posture, because the opening then cannot be closed up, which might happen very often if the opening were on the under side of the egg, in which case it would rest upon the bottom.

In regard to the cod, what has been said of the salmon does not hold good. It is just the opposite, but still the results will be always the same and most satisfactory. The spawning of codfish takes place in the middle water; the male fish swims below, and as the eggs as well as the melt are lighter than the sea water, they float upwards and the fecundation takes place from below. This agrees perfectly with the construction of the eggs of the cod, as the opening or womb is on the underside of the egg.

In another respect, and one of great importance, is that the opening for impregnation is placed on the underside of the floating egg. In this way the channel through which they become vitalized is not open to the outer world, being constantly under water, even though the eggs in calm weather should remain a long time on the surface.

I have before mentioned about how the less salt water is destructive for the spawn even before it is emitted, and I have by means of special trials found that the same takes place with the already fertilized spawn. I have also stated that the water on this coast at times is below the normal saltness, and that this is unnatural for the cod-spawn consequently, one would easily think that the destruction would be enormous. This is, however, not the case everything here, as well as anywhere else in nature, is well arranged, and therefore necessary precautions are provided. When the fresh water's specific weight is 1.000 the weight of the cod-spawn is 1.022, and the salt water 1.025; consequently, the spawn floats in the salt water but sinks in fresh water. This is the course which nature has prescribed, and which we soon will find as infallible. If, for instance, a quantity of the cod-spawn is carried by the current towards the mouth of a river or other gathering of fresh water, it will at once sink until it again strikes a current of salt water, which is heavy enough to support it. The spawn has thus simply settled under the river water to avoid coming into too close proximity of the dangerous fresh water.

Respecting our more common kinds of fish, I may only remark that the mackerel, haddock, whiting (sey and lyng,—kinds of haddock), and all kinds of flounders have floating spawn, lay their spawn in lumps on the bottom, and that the spawn of the herring, after being shed and fertilized, sinks to the bottom and sticks to it. Of all kinds of spawn I have examined I have found the spawn of the herring most hardy, and consequently the loss during the development very insignificant. The newly-born herring-brood is well fitted out for swimming facilities and surpasses in this respect, from the very beginning, the helpless cod-brood. Also here the wise arrangement of nature can be seen, because upon the presence of the necessary number of herrings depend to a large degree the existence of the other fishes. On the contrary, the fishes with floating spawn seem to be better fitted out in another way, viz; in the quantity of spawn produced, and which, for each one, may be counted in millions. There is not the least doubt of this wise arrangement of nature here, when one takes into consideration the myriads of herring broods which, at the time the floating spawn is developed, are swarming in the upper parts of the water. After having shown thus how the great teacher, Nature has arranged precautions against unnecessary dangerous influence, I will show these circumstances when in the apparatus. We have seen above how the spawn, to avoid the fresh water, sinks to the bottom. When the water pumped into the apparatus is not of sufficient saltness the same thing occurs, but as the apparatus is only about 8 to 10 inches deep, the spawn will go to the bottom and remain there. This is two-fold dangerous, firstly, because the spawn is in most unsuitable water, and secondly, because it is on the bottom, which is against its nature. To avoid this I have made arrangements so that with the help of the current and other mechanical inventions the eggs are always kept in motion, but in regard to the saltness of the water I am no further ahead. But the only true way will be to have at all times the water of enough saline

strength to cause the spawn to float in the apparatus, which can be easily managed in the following manner:—

To the hatchery is connected a salt water basin, with a capacity of about 2,500 cubic meters, the surface water of which is about 8 meters over the one in the apparatus. It is sheltered from the south by a wall 5 meters high. After the plan now under consideration, it is the intention to remove the building from its present site to this wall. The surface of the water in the basin will then lay about 3 meters higher than the floor of the building, and through this arrangement the necessary pressure is obtained to conduct the water to all the apparatus placed all round in the building. This basin is thus a reservoir, from which the necessary quantity of water can at any time be got. To keep this basin full of water always the engine is used for pumping, now as before, but with this difference, that the water is only pumped from the sea such days when it is sufficiently salt, when on the other side the water is pumped back to the basin after having passed through the apparatus, and for this purpose is retained in a tank under the floor of the building. Fears may arise that the water in passing through the apparatus may lose the air contained in it, but this is easily remedied by making a fine hole in the pipe between the pump and the basin. Through this hole the air will enter and mix with the water in the valves, and the water will become like a fine foam. A person is also apt to fear that the temperature in the basin may become too low for the development of the brood. To prevent this the waste steam from the engine is let into a box where it is condensed, and through this, the pipe from the basin runs, and should the heat not be sufficient a supply of steam direct from the boiler may be let in. The considerable heat which passes through the chimney would be used also for this purpose. There is then nothing hindering me to overcome this, the greatest difficulty I have had in a technical respect to fight against. It only remains to get the hatchery removed and fitted up according to proposed plans, because upon this removal depends all the improvements I have made on the work of hatching at present.

The specific weight of the sea water was found to be in the apparatus:

1884	1.0217.	An average for four years 1.023.
1885	1.0252.	
1886	1.0231.	
1887	1.0249.	

Maximum was 1,027, and mininum 1,015–4. The proportion between for the development favorable and unfavorable days was as 3 to 1. The changes come often very suddenly, and it sums up as above cited. They are results of the strength or direction of the wind. In the four years the hatching process has produced a total of 101½ millions young codfish.

4.—Breeding of Cod.

This question, which stands in connection with the hatching, I have also tried to solve, and met with favorable results. True, the number or quantity brought up is not considerable, but sufficient enough to show the possibility of breeding, which is all that is necessary. My intention was, first, to show the public that the fish hatched at this place also had enough vital power to develop themselves further, to which, later on, came the wish to know the reason for the great difference in color reigning between the different families of cod, and for which, to my knowledge, science has failed to give any explanation. As regards the breeding, trials were made by me in 1884, and continued during the winter of 1885. Direct results were not attained, but I acquired a great deal of information and experience, and came to the conclusion of how the matter had to be commenced to meet with success.

When the young fish is delivered from the hatchery, it is only 6 to 8 days old, and has a length of 3 to 4 m.m. To keep it longer would not do, as the fish requires, for its further development, nourishment, which, of course, cannot be got in the filtered water where it has been kept. To do away with the filtering process would be of no use, as the comparatively small quantity of water in the apparatus (about

15 litres to 200,000 fry) could not contain any nourishment worth mentioning, even if the speed of the current was increased over the average, viz., full change of water each time. Thus there are only some trifling and helpless difficulties to be met with.

If a number of the young fish is let into a glass cylinder, with sea-water of suitable saltness, one will see them attempt to reach the surface, and when this is reached, gather together at the edge that is turned towards the light. Under these circumstances, it is quite possible, with most careful changing of water, to keep them alive a longer period. If, on the contrary, water of less saltness is used, the results will be opposite. The young fish, the swimming capacity of which is limited to a few intervals of interrupted movements, or pushes, attempts now to reach the surface, but its weight, being more than the water, will pull it back and cause it to sink to the bottom, where its destruction is certain. Thus the first and most essential condition to make the breeding a success is, that the water in which the young fish is placed may have so much specific weight that the fish, without exertion, may be able to keep away from the bottom. Besides this, care must be taken that the water has not got too high a temperature, which has proven itself to have a dangerous influence upon the eggs, as well as the young fish. Lastly, the water must contain necessary nourishment, and must be changed at regular intervals.

To cut off a ground bay, and let the change of water be made direct from the sea-water outside, would not do, because this water at the surface would be too much mixed with fresh water; and I selected, therefore, a more costly, but more sure course, to build a large basin up on the shore, and filled, it by means of the steam pump, with water from the depths of the sea.

The basin was finished in the fall of 1885, and has, as before stated, a capacity of about 2,500 c. m., and the greatest depth of 4·75 metres. After having been cleansed in April, 1886, and provided with different sea-weeds, etc., it was filled with sea-water, in which, on the 3rd May, was placed about 500,000 cod and a few thousands of flounders and herring brood. It may here be remarked that, when the basin was new, with well-washed walls and bottom, it contained too little nourishment for such a great number of fish, and to this may be ascribed as the most essential reason why a great number did not grow. The same basin, which is now all over covered with sea-weeds, and which, especially in the spring, shows a great deal of vegetation, would now, without any difficulty, be able to give nourishment to a manifold number.

In regard to the young cod's further development and growth, I refer to my report of 1886 as follows :

Date.	Age.	Size in M. M.
April [illegible]	[illegible] days	[illegible] M. M.
May [illegible]	6 do	[illegible] do
do 1[illegible]	1[illegible] do	[illegible] do
do 18	21 do	[illegible] do
do [illegible]	21 do	[illegible] do
do [illegible]	1 month, 5 days	1[illegible] do
June [illegible]	1 do 8 do	12 do
do [illegible]	1 do 11 do	15 do
July 12	2 do 1[illegible] do	[illegible] do
Aug. 12	3 do 1[illegible] do	[illegible] do
Sept. 12	4 do 15 do	85 do
Oct. 12	5 do 1[illegible] do	11[illegible] do

Between the 6th June and the 12th July, there is, as can be seen from the table above, a great leap in the development, which, however, must be explained by the fact that the young fish at this time commenced to eat the food thrown to them twice a day, and in considerable quantity.

Since the above was written the fish have gradually increased in size, but their number has had a considerable falling off. The most essential reason to the death

rate has been the cold of the winter which, especially last winter (1887–88) was both piercing and of long continuance, so that on the 1st April there was ice 20 inches thick in the basin. The size of the fish is, at present (at 2½ years of age) from 9 to 18 inches. The biggest fishes keep themselves mostly in the deepest hidings, and are seldom to be seen. The present number is 200 to 400, and there is a chance that they will spawn in the spring. Further information respecting them will be given in the next yearly report. That the brood hatched in the hatchery is in possession of enough vitality to further develop itself is thus proven: That, in proportion, only a small number has been brought up to eatable fish, depends, as shown before, upon other circumstances altogether than the vitality of the brood.

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5.—The Lobster.

After some time, studying the development of lobster spawn, I found proofs that it may, without great difficulty, be hatched after being taken from the mother. I constructed, during the spring of 1885, necessary apparatus, and commenced then experiments after a certain manner. In my report for said year is given the successful results obtained, why the problem of hatching lobsters, upon which so much time has been spent, may be said to have been solved.

The only difference in my method was, as mentioned before, that I worked with the spawn alone, and not as my predecessors in this line, who all seem to have been of the opinion that the spawn absolutely must remain attached to the mother during the development, and therefrom put them into the hatching boxes. The difference may seem, to the ignorant, to be of no importance, but, really, it is extremely so. To illustrate the difference, I wish to show that when the loosened spawn of 6,000 lobsters, the number which the hatchery will be able to hold after the extensions are made, can be easily handled by four men, it will take a great deal of work to attend to 600 in the water-flowing boxes, with ten lobsters in each. The food alone, of 6,000 lobsters, at ½ øre each, is Kr. 30$^{00}_{00}$ per day, or twice what the whole hatching after my method will cost. The same year, experiments were made at breeding of the young lobsters, and which met with success, which is well known never happened before. I believe, though, as mentioned in my report of 1885, that the breeding of the young lobsters will never reach any importance, as the young lobster's repugnant or voracious nature is such that they can never be kept together in any great number like other fish. What the result would be, should the breeding be done in larger basins, I cannot at present say. That some could be brought up is without doubt, but whether the number would agree with the expenditure, is another question. Although I entertain some doubts, I believe that an experiment ought to be made as soon as the hatchery is removed inasmuch as no other extra arrangements need be made, because the hatchery has all the necessary basins, and the expenditure would be very small. In regard to the hatching of the spawn, I believe this business has a grand future. "What *can* be done and what *ought* to be done is that yearly, in the months of May or June, gather as much spawn as possible and send it to the nearest hatchery, to be hatched there, and then when the young lobster is about eight days old let it loose. To do this, and thus save a part, anyhow, of the immense quantity of spawn which yearly is destroyed and of no use to man, has been the aim of my labour, and as shown above, also reached.

6.—Oysters.

In my last yearly report, I gave a statement of the results arrived at during the two previous years with breeding of oysters in artificial basins. The work was continued this summer, and, notwithstanding the low temperature during part of the summer, the results were very satisfactory. As the basin now used for oysters was constructed for another purpose altogether, I sent the Government a petition, asking for a grant of Kr. 3,000$^{00}_{00}$ for the construction and running of a more suitable basin, and to get a chance to prove my oft uttered assertion, that oyster breeding can be carried on successfully in artificial basins.

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As well known, the oyster-breeding in our country has been carried on more or less by companies of considerable capital, which have, to begin with, procured one or more of the so-called ponds, without which oyster-breeding, up to this, has been considered impossible. That these ponds, when properly managed, can give very good profits, I have no doubt, but as their number is very small, the Norwegian oyster breeding, if exclusively depending upon these, will never be of any importance; and what I most fear is the business will never come into the hands of the coast inhabitants, who are most in need of such an extra income. To make the oyster-breeding independent of these few natural ponds, and so that it may be carried on all along along the coast, and to find out a simple and cheap method of working, by which old people, women and children could find a paying employment, has been the problem I put before myself, and which, if three years' successful labors can be considered decisive, has been solved in a satisfactory manner. There are now sure proofs that the oysters spawn in small closed-in basins with artificial water temperature, and that the young oysters thrive with very little change of water; that they, after swarming time, attach themselves to the traps or tiles put out, and that the labors in connection will be very insignificant compared to the gain derived. Thus there is a chance offered to use all the little bays, as well as coves or hollows in the rocks, all along the coast, which could easily be closed in, and in that way be useful for oyster breeding. To show farther the importance of such an industry is considered unnecessary. That the experiment ought to be continued is plain, partly to gain more experience and partly to endeavor to make the work cheaper; but there are two questions which cannot be solved with the means that now are at my disposal, and I believed it just to submit this petition. These questions are:—

1. With how low water can work be done without fears of a failure?

2. In what proportion does the cost of running of a rationally managed basin stand to the average profits?

In regard to the first question, it is a very important one, as the dimensions of the walls and the strength of the pumps, and thus the whole cost of the undertaking, is depending upon it. To close in a bay, for instance, 10 feet deep, will, in many places, be a very easy task, when an additional building of, for instance, 5 feet, may be impossible. My present basin has a depth of 16 feet, and has, as will be shown below, given very satisfactory results, but it is necessary to gain knowledge if not a shallower water, for instance of 8 feet, would be sufficient; that this would make a great change in the running expenses is plain.

To lower the water to any extent in my basin would not help to any result, as the area would then be only too small and the surface would lay so far down between steep walls that the wind could not cause the least movement, which I consider to be of a very great importance. That my experiment will be successful I am pretty sure, notwithstanding I know that others have in other places made trials and met with failure. The reasons for this were, perhaps, that those parties could not spend so much of their time to follow the development in all its details, which, besides a thorough knowledge of the business, is absolutely necessary if these experiments may reach good results.

The basin I intend to build, and in which the work would be carried on next summer, has now 1 foot of water at ordinary water height, which, after closing up and pumping, is increased to 8 or 9 feet. The capacity will then be about 400 cubic fathoms. The bottom is very even, and consists of sand and shells. It was by the owner, Mr. C. T. Boe, kindly given to the hatchery, in the close vicinity of which it is situated. To fill this basin there is one windmill and two vessel pumps to be used.

The next question is to show the proportion between cost of running and profits, and I had thought to keep special accounts over this. This is so much more necessary, as artifical hatching, for the present, is looked upon with distrust.

The only work with the running is to chalk the tiles, to place them upon the trestle-work, to tie and put out the brush-wood, and to keep the windmill going when pumping is necessary. To do this one only man is required from 1st of May to 31st of

October, and during the greater part of this time he will have very little to do. The yearly cost of running such a brood-basin can, when everything is to be paid, be placed at about Kr. 400. The plans are, to, after sometime use brush-wood exclusively and thus make the work more simple and more easy to be performed by old people, women and children. In regard to the possible results in such a basin, I cannot very well say, as this experiment would differ so much from any previous ones, but if successful, which I venture to hope, I think, taking in consideration my present basin, that the new one may produce about 200,000 brood. I calculate then, that in the basin is placed 10,000 tiles, and an amount of brush-wood compared to that, the average number of, on each tile attached, oysters, would be 10, which I consider for my present basin a very poor result.

After this calculation the production of brood, rents of ground, etc., will cost about 25 to 30 ore per 100. By using the method proposed by me, the main work can be done by the members of a family, so that the father can attend to his regular work.

To show of what importance the oyster breeding may be to a country, I refer to Professor Browne Goode's work, "The Oyster Industry of the World;" that the oyster culture in France employs 29,431 persons: the yearly production is 680,400,000, and that these, valued at Kr. 1.83 per hundred, represent a capital of 13,000,000 Kr. This colossal industry, which is not 20 years old, received from the very start, and later, considerable assistance from the French Government.

With regard to my earlier operations with oysters, I beg to refer to my report of 1887. This year the work has been as follows:—

From Tysnees and Stavanger, 650 small oysters and 25 older ones were bought last May, which, together with 25 from previous year, were placed in frames, with bottom of wire, and hung out in the basin. During the first fortnight a few died, probably from the transport; but during the last three months I have only found two dead ones out of about 600, which shows that the natural circumstances were very favorable in the basin for the oysters.*

Swarming brood were first seen the 5th July, and increased in number until the end of the month. From the 9th August it again increased, and still continues, but widely spread.†

The first discovered young oysters attached to tiles were found on 29th July, thus 24 days after the commencement of spawning time. The first traps, or gatherers, were placed out on 18th July, and were kept on until the 14th August, or long after the first cold had come.

Besides being put out on different occasions, the traps were put out in different positions and depths, from the surface down to 10 feet. The reason for so doing was to gain as much knowledge as possible, which seems to me to be of much more importance than to obtain the largest quantity of oysters. For traps have been used 1,000, tiles and a quantity of brushwood, of which 500 tiles and five-sixths of the brush were put out after the cold had come. The birch brush, which was brought from Stavanger, reached here too late. On examining the traps, one comes to the following results:—Those first put out are most covered with young oysters, and of them those that are put deepest down. Tiles put out from 18th to 21st July, in 9 feet deep water, have from 113 to 24 attached oysters, an average of 55. Tiles put out 23rd to 24th July, in 1 to 3 feet deep water, have from 2 to 34 oysters, an average of 14. (The last number were arranged in three layers). Tiles placed out at the same time all over the basin, in different depths, were all well covered, but on account of the water not being transparent, I am unable to tell the average number. Oyster and other shells, fastened to wire or twine, and suspended from other wires down to about 8 feet depth, are covered up to 15 oysters on one shell. A number of 8 to 10 is very common. The original stock oysters placed out are also covered with young oysters, and these in proportion to the depth they were placed. The greatest number found hitherto on one single oyster was 7. Still more uneven than the tile were

*Since the above was written (middle of September), and up to New Year, none are dead.
†Middle of September.

the brush wood bundles covered. On one very small bundle, smaller than a common broom, I have found 83 young oysters, when on others, many times that size, I did not find one. A third reason arises for to explain this. When new birch brushwood is placed into salt water it is covered by a kind of white spots, or a kind of thin salivary coating, which hinders the attachment of the oysters. Brush-wood already used is, therefore, better. A more specified report will be given in my annual report for this year. The number of young oysters gathered are supposed to be 12,000 to 15,000, and the number of tiles or traps used for the first swarm, 600, thus 20 to 25 on each. Respecting the last swarm, no information can be given; if the oysters attach themselves even, it is expected to be small, and of little importance. Taken on the whole, the culture of oysters this year has been under the average, on account of the unusual low temperature of the sea water. For instance, + 9° R in the middle of July. The temperature in the basin has this year been 15°, and 20° last year. The results of my experiments during the last three years have shown that broods of oysters can easily be produced in small artificial basins, and this yearly, as a rule. The many difficulties and uncertainties generally met with by oyster breeders have not occurred to me, and I have found that the whole oyster culture depends on two main conditions, namely, the saltness of the water and its temperature. The biological circumstances appear to be pretty even all the time, and do not seem to prevent the breeding any. In regard to the breeding, I have many plans, but want of means has prevented me from putting them into operation. If necessary, the young oysters could be placed in the sea, their natural home, and where they could pass the winter. I intend, however, to let the greater part remain in the basin, to find how much the oysters can stand, and which way to success I find the most suitable. To continue the gathering of spawn in my present basin I consider of small use. Having only a capacity of about 15 cubic fathoms and keeping in it a large number of cod, it is quite natural that it is hard to be worked, and will never give the results that I wish for in the interest of the business.

As the nature and the position of the basin used has made it possible to make daily observations of the stock molluscs as well as the swarming brood, I have succeeded in clearing up a number of circumstances which, by some oyster breeders, were explained in a different manner.

The assertion that oysters do not spawn the same year they are removed has been shown by experiments in three successive years to be erroneous, and the same thing with the same assertion about stock oysters when placed upon suspended frames. These results are, however, quite natural. The oyster must spawn when the time has come, like any other creature, as the process is not in any way depending upon the well-being of the oyster.

That a very low temperature is unfavorable to the oyster is admitted; but it is going too far to say that oysters do not spawn during cold summers. In 1886 the temperature in the basin was 12°, in 1887 20°, and in 1888 15°+R. In the first year the temperature was exceedingly low, but this notwithstanding, the spawning went on as usual during the right season, namely, the first part of July. With regard to the development of the swarming brood the process was slow, so that it took thirty-five days from the time the first young ones were discovered in the basin until they attached themselves on the tiles or brushwood. In 1888, with a temperature of 15° R., it took only twenty-four days. In the year between, in every way so favorable to oyster-breeding, I took however no notes, as all work with the oysters was discontinued on account of the bad economical position of the hatchery.

As a lower temperature than 12°+R. is very rare at our coasts in the month of July, I believe, and for good reasons, that the oysters spawn every year, provided no sickness caused by local casualties, have made them unfit for propagation. That the slow development of the swarming brood in a low temperature, can contribute to that the harvest of oysters becomes very small, is very likely, and it is therefore necessary to receive from the oyster-breeders of our country information about the number of oysters and temperature during the different years.

The amount of dangerous effects upon oysters by low temperature in an oyster basin is also dependent upon other very important accessory circumstances. In an open basin, where the water can run in and out, the loss of swarming brood will be larger for want of warmth than in a basin closed in. The depth of the water always changes. In an open basin there will always be a constant current that at outgoing or incoming will cause a large loss of brood, and it is plain that the longer the time of swarming lasts the greater the loss. But this is not all. During warm summers easterly winds with calm and low waters prevail, when during cold summers, as a rule, strong westerly wind with rough water is usual. The current in the inlet to the basin will then be stronger and more changing, and consequently still more diminish the number of swarming brood in the basin. That the harvest of oysters in such a basin during a cold summer may be very insignificant or perhaps a total failure is easy understood. One thing of great importance to the oyster-breeding is to find out the reasons why the oysters in different years attach themselves on different depths. Two factors seem to account for this, namely, the saltness of the water and the temperature. Which one of these is the most important I cannot at present say, and a reliable result can only be arrived at from satisfactory and large experiments in the course of years. If this question is solved, so that one only by the help of the thermometer or the arcometer can give the depth at which the traps have to be put, much useless work can be done away with and a security in the whole oyster breeding be assured. Besides these, there are a number of other questions to be solved, which I now, from lack of means, am unable to determine.

7. How the Hatchery has Solved its Problems.

The hatchery was erected and put into operation to find some means to restore the number of fish at our coasts.

The first questions to answer were:—

1. Can artificial hatching be carried on under any circumstances?

2. Can the hatching be carried on on such a large scale that through its help it may be expected to increase the number of fish?

3. Can the work be done so cheap that full value may be expected from the money laid out?

After five years' operation, the reply is as follows:—

Saltwater fish can, without difficulty, be hatched. Yearly thousands of millions can be produced, and when all the information gained is utilized, 8 days' old cod can be sold at the rate of 4 ore per 1,000.

Besides this, the original problem, the hatchery has shown the possibility of hatching and breeding lobsters, which before this was considered impossible, and it has furthermore carried the oyster culture in on a track which, if everything goes as up to this, will make this a national industry and provide many families with a paying extra income. When to this is added that the hatchery in no way has been a failure, and that none of the money spent has been thrown away, it must be acknowledged that the hatchery of Flodevigen in every way has solved the problem in a most satisfactory manner.

That the operations just now concluded should have been able to increase the number of fish in any considerable quantity I never expected, as much more, when the large devastations by the eels are taken into consideration. However, the increase of small cod has not only been noticeable but very striking where the young brood were left out, because an unusual large number of small cod have been caught in those places during the last years. During the first time the young fish were put out in Flodevigen, Hovekilen and adjoining bays, during the two last years in Tromosund; the results in both places were striking, but the eel nets and a lot of other more rational fishing gear made soon a clean sweep, so that it will soon be as ever before.

The catch of small cod in the so-called boudcayb (shallow waters) has been very great during the two last years; two fishermen with lines have been able to pull up

about 14 dozen per day each boat. Something similar occurred in Hovekilen and in the strait outside, but did not last long. To communicate with the fishermen about the results of the operations of the hatchery is of no use or satisfaction, when most of them consider the hatchery an encroachment upon the rights of the Creator and thus damnable. The information received from that quarter is, therefore, everything but reliable. There are, though, a few who possess sounder powers of comprehension regarding the rights and duties of man, and from them can be heard unanimous testimonials to the usefulness of the hatchery, provided it is carried on on a large scale. My own observations, gradually developed, have convinced me that the artificial hatchery of saltwater fish, especially in our country, with its many closed-in bays and gulfs, will be of great importance to the community if carried on with proper vigor.

8.—Is Artificial Hatching of Saltwater Fish Required.

Not only with us, but from most of the foreign countries, there is a complaint that the fish, as well as the lobsters and oysters, are decreasing along the coasts, and that the fishermen on account of this must go farther out into the sea to make their living. The American Fishery Commission, the extensive experiments of which throw good light on the question, says, among other things: "It may with safety be said that as soon as the white man puts his foot on new discovered ground and commences the so-called civilization the inhabitants of the air and sea and earth quickly diminish in number. The fishes, immensely profuse from the beginning, will first feel the influence, and especially those kinds that belong to fresh water, and whose increase is much more limited. That the reason of this is not a natural and needed use of the animals to satisfy the want for livelihood is shown by the fact, that the original wild inhabitants, who were far more dependent upon the products of nature than the white man, could supply their demand through centuries without a noticeable decrease. It is the frequent shameful destruction in masses, which so often is undertaken merely for a few moment's pleasure or to secure a few; in some instances, only to use parts of the creatures destroyed. As an example, how the number of fish has decreased is given that of shad, there was caught in the Potomac River:—

In 1833	25,500,000
1866	1,326,000
1878	224,000

Of other freshwater fish, there was captured in same place:—

In 1833	750,000,000
1866	21,000,000
1876	12,000,000
1878	5,000,000

In both cases the catch, notwithstanding the improved appliances, is reduced to below $\frac{1}{100}$ of what it was in 1833. Of bass, there was:—

	Lbs.
In 1866 caught	316,000
1876	100,000
1878	50,000

Similar proofs of the decrease of the saltwater fish can be given in great numbers. During the first days of the Republic the fish were swarming along the Atlantic coast, when now, on the contrary, they are pretty scarce. Hatteflyndran (*Hippoglorue vulgaris*), which was so numerous once on the New England coast that it was considered a plague by the fishermen, is now nearly all rooted out, so that it must be sought after on the outside banks: Even the Mackerel, whose home is the great ocean, and which thus seemed to have been safe against the destruction, has been made to feel the intrusion of man. The largest catch that was ever brought on shore by the fishermen of Massachusetts was in 1831, when there were 385,000

barrels salted, and which was mostly caught on hooks. In spite of numerous steamboats and other vessels, and a much larger fleet of fishermen, has the largest catch in the '80's been only 305,000 barrels and in 1886, which was a bad year, 65,000 barrels.

One of the best proofs for the decrease of the fish is the decreasing size of them, and on this the American reports gives some information. The statement below shows how large a part of the mackerel caught that each five years has been put down as No. 1 by the Fishery Inspectors.

1865–69	53	per cent.
1870–74	38	do
1875–79	14	do
1880–84	10	do
1885	7	do

The formerly valuable lobster fisheries are now in many places given up, and those remaining diminish year from year. Even the fishermen themselves have come to the conclusion that nothing but the wholesale catching of spawning fish could have caused such results.

The natural oyster beds on the Atlantic coasts of the United States, that hitherto were considered inexhaustible, show now such an alarming decrease that the sharpest rules of prohibition have come into operation for its conservation. In 1860 the market was nearly altogether supplied with oysters from the natural beds, while, on the contrary, in 1886, about 60 per cent. came from private beds. What has been said above in regard to the United States may also be said of the Atlantic coast of Canada. As well known, these are the seats of the greatest lobster fisheries in the world, but which have just as little, as the European, been able to escape the common danger to diminish year after year, and this to such a degree that now there are proposed certain prohibitory regulations, to which I will revert, and which approach nearly total prohibition.

From Scotland, where, during the last few years, a committee of fisheries has been appointed, the same complaint is heard in regard to the decrease of fish, lobsters and oysters. In a letter from the committee received lately, it is stated that the oysters are practically exterminated. Similar reports have been received from the most different countries, as well as in outside Europe; but I suppose that what has been said above is sufficient to show that a decrease in the number of fish on our coasts is nothing singular, but an exhibition to be found all over, and which draws the attention of the respective authorities. In regard to our home circumstances, it would be expected that they should be well known, but this is, however, not the fact. There are persons yet who, by looking at the residue in the cauf at their wharves, consider that they have sufficient proofs that there is yet enough fish in the ocean, and who do not know or do not wish to know that the number of the fish has increased with the growing efficiency of the fishing appliances, and that a considerable number of fish is imported from Sweden and Denmark.

When to this is added that our natural oyster grounds are destroyed, and that the export of lobsters during the last 20 years has been down from 1,858,000 to 835,000 which, at the current price, is a national loss of over half a million kroners per year, then an attempt to get these matters corrected must not be considered out of place. One must not expect or entertain any allusion that these things will become better by themselves; when in year after year the capital is spent, it is plain that this as well as the interest will grow less.

When the results of prodigality with the richness of nature commence to be felt in a higher degree, and people slowly get their eyes opened to see that the reproduction cannot keep steps with the increasing devastation, as a rule the nearest means are grasped at, to decrease the catch by means of prohibition. The usefulness of this will, at all times, stand in a decided comparison to the length of the prohibition and the way in which it is watched. I will give a few samples. If a certain water can stand a yearly assessment of 1,000 fishes, and the owner, to save against

loss, agrees only to fish one month during the year and keep strictly to this agreement, there would be no use of this, supposing there are caught during the allowed period, for instance, 5,000. The stock will in this case always decrease and the owners can rightly assert that prohibition has been of no use. How a real good law becomes valueless through neglected inspection is shown at our salmon fisheries. The law prescribes here a certain size of the mesh of the netting, allowing fish of about 18 inches length to slip through, and this is quite right. But what is the use of such a regulation when the fisher with the small meshed nets catches as many young salmon as he can get hold of when it only has a length of 8 inches, and without grumbling these are sold under the name of "blegers." It is plain that the law in this case is without aim, when the just mentioned abuse is so common, that after my experience there are in this district many more young salmon under than over 18 inches length caught. When prohibitory laws on account of above named reasons and others so seldom have proven themselves to be of use, and as a consequence come into discredit, especially amongst the fishermen, who say that the more prohibited the more the fish disappear. That this in most cases is true cannot be denied, but the reason for this is not that there is prohibition, but that the prohibition is not strong enough. To cause any perceivable increase in the number of fish through prohibitory laws alone is very doubtful, or rather impossible, as for many districts or fisheries nothing but absolute prohibition during a longer period could produce results so that a reasonable catch in the future could satisfy the daily want. With us, where the daily fisheries plays such an important part, these arrangements with prohibition would be impossible, and there remains nothing but either to allow the fish to gradually diminish until totally destroyed, or use the artificial hatchery. The best proof that in foreign parts people have got their eyes opened to see that the case is as above stated, is the eagerness with which they seem to explore the causes. Expeditions sent and sustained by the different Governments and provided with scientific and practical expedients have been employed for some years and have already produced rich results and assisted in explaining many hitherto enigmatical problems in regard to the ocean and its inhabitants.

Regarding the main question, the reasons for the decrease of the fishes, as well as other useful sea animals, it has been agreed upon that increased consumption, mainly caused by improved means of communication, has caused a stronger assessment than the stock could bear, and consequently a decrease takes place. On the other hand, the statistics of fishery has shown what enormous interest is at stake, and strongly urged that the respective Governments take steps to correct the matters in an energetic manner. In regard to this, how it can be done, the well known Prof. Spencer F. Baird says, that there are only two ways towards the increase of the fisheries, and that is, strict prohibitory laws or artificial hatching. He says that one of these may, in single cases, be sufficient to reach the desired aim, but by using both one gets the power to restore the fishery to its old position, and, on the whole, produce results that, without the experierience gained during the last ten years, would have been considered impossible. That the professor does not stand alone in his opinion is shown by the many existing hatcheries, in different methods, that have commenced operations, or are planned, and which will give this business an importance never before thought of.

The United States have now two hatcheries in operation for salt-water fish designed to produce each 100 millions at a time, which, when the work is extended over the whole spawning season, is equal to a yearly production of about 500 millions. Of lobsters there is a quantity hatched, both for output on the Atlantic coast and to send to the Pacific, on which coast it is desired to be introduce them.

That in Newfoundland it is intended to follow the same plan, is seen by an enquiry received, asking for a man well posted with the labors of a hatchery to take the place of manager in such an institution.

In Europe this one was the first institution of its kind, and has been, during its short duration, visited by many foreigners seeking information.

A hatchery for lobsters is now under construction in Durham, England, and is expected to commence operations next summer. It is calculated to cost about Kr. 30,000, and it is built for the Government. A sample apparatus was sent from here some time ago, and by what is known as my method to be used, which is clearly proven by the fact that I have been requested to go over there when the work is to commence.

The Marine Fisheries Society of Grimsby is constructing a hatchery for salt-water fish, to commence operations this winter if possible. The secretary of the society, Mr. A. T. Olson, visited our hatchery some time ago to get information and advice.

Also, from other places in Europe—for instance, France, Austria, Russia, Denmark, Iceland, etc.—many enquiries have come respecting the hatching operations in their different branches.

Before I finish this chapter I will briefly give a few words as to how in foreign parts the laws of prohibition are, and in what way they are enforced.

In the United States, the history of which is so short, and where the results of spawn fisheries can so easily be seen, the regulations prescribed are very strict. I may say, for an example, that the punishment for having put out during time of prohibition one so-called pound (a kind of net) is confiscation of the implements, $1,000 fine and six months imprisonment. For having brought on shore mackerel during the time from 1st March to 1st June, caught otherwise than with hooks, the punishment is the loss of the catch and loss of license to carry on fishery.*

Quite lately a collision took place between some fishermen who were fishing oysters on prohibited beds and one steamer of the inspectors. The result was that two schooners were sunk, four were driven aground and one captured; nine of the oyster fishermen, who were looked upon as pirates, were drowned, and some were wounded. In Canada, as is above said, proposition made to restricted prohibitory rules for lobsters, which stipulates that the time for fishing would be limited to two months in the year. The half of the number of the members of the committee proposes furthermore that the minimum length, which is now 9½ in., shall be increased to 10½ inches, and that all canning factories for lobsters in Canada be closed for a period of from three to five years. When it is said that the number of these latter are about 500, with a ground capital of about $1,000,000, it is easily understood, that there is really danger ahead. In 1886, over half of the factories in Prince Edward Island had to be closed for want of lobsters in the middle of July. Compared with above mentioned strict regulations, our laws, with their insignificant fines and want of superintendence, look rather innocent. The main contention of all above said is this, that the number of fish at the coasts of all civilized countries are rapidly declining, and that the laws of prohibition, as generally put in force, never will be able to stop this decrease, but only delay the total destruction. I find, therefore, and may once more say it, that the only way that we can find to save what we have and to effect an increase is artificial hatching.

9.—What Remains to be Done.

To continue with experiments after the problems that caused them were solved in a satisfactory manner is, according to my ideas, a superflous labor. What to do, is to get proofs that artificial hatching of salt-water fish also is able to increase the quantity of fish, and for this purpose the present hatchery is too small. When I therefore, repeatly, have proposed the extension of the hatchery, and now strongly urge the same, it is because I feel sure that it will never till its destiny to such a degree that this matter will gain the assistance of the public, which I consider absolutely necessary if it will ever be, what it ought to or could be, a blessing to the coast inhabitants.

If it was thus that the expenditure rose in the same degree as the production, people might be right to entertain doubts, but this is far from the case. In my

*This law was proposed in the House of Representatives on 21st May, 1886, and also passed through the Senate, and, as far as known, is probably in force now.

report for last year I gave an average calculation of what the production of brood would cost in hatcheries of different sizes, which is below:—

30	millions	will cost	Kr. 5,000,—	thus	$16\frac{2}{3}$	ore per	1,000
100	do	do	6,500	do	$6\frac{1}{2}$	do	1,000
200	do	do	8,000	do	4	do	1,000

If the hatchery is removed, as proposed, the expenditures will be still more reduced, and, to a considerable degree, this saving will be accomplished in two months —first, directly from the method of working being cheaper, and then indirectly that the mortality becomes less and the gain consequently larger for the same amount of work. Would a person calculate further, it will be seen that where there is now produced 3,000,000 to a price of $16\frac{2}{3}$ ore per 1,000, the hatchery will, after the extension, produce the balance of 70,000,000 for $1\frac{1}{2}$ ore per 1,000. Taking these numbers into consideration, it must be admitted that if it pays to run a smaller hatchery it will do so to a much greater extent with a larger one.

From one source has been heard the saying that the hatchery in its present extension is large enough, but this is not easy to understand. If the intention was only to supply a single closed-in bay with brood, this assertion may have its reasons, but not when our long-stretched and our depleted fishing coasts are taken into consideration. Here may the saying fit in—the more the better.

Besides the number of hatched brood, which, according to above statement, causes the said expenditure, one gets for the same money received the work that the manager can perform outside the time of hatching, and which, if he is fit for his position, can be of great importance to the fisheries. In regard to myself, I beg to refer to my experiments with lobsters and oysters, which have cost hardly anything, and consequently, when the building is removed closer to the basins, such work will be performed in a larger degree, as the necessary quantity of water then can be taken from the basins, the contents of which, however, has to be renewed from time to time.

In regard to the future work, I wish to propose that after the hatchery is removed and extended the cod hatching be again taken up on the largest possible scale, and then that the experiments with hatching and breeding of lobsters may be continued on a smaller scale, if possible, to introduce improvements in the method of working. Finally, oyster culture should be tried for two years in the proposed new basin, and their breeding in a similar long period. If the work brings forth good results, which, to judge from work done up to this, is most probable, we may then be able to direct the public as to the most advantageous method in the business, and with this the work of the hatchery may be said to have finished. Later on experiments ought to be made with the breeding of the hatched cod-brood, thus, that it reached a length of about 1 inch before being liberated, and thus much be gained. This breeding ought to be done in a bay separated from the sea of a couple of fathoms' depth and would hardly cost anything. The most important improvements to overcome the worst difficulties have all been planned, and the reason that I will not explain them now is that this question is only for publication when reply has been received (regarding the future of the hatchery and its cause) to these my above proposed plans.

10.—Who Pays the Expenditure of the Hatchery at Flodevigen.

That there appears, in this era of inventions in which we now live, manifold propositions more or less suitable to the assistance of industry, is plain, and it must not be considered asking too much if those making the propositions, and who believe themselves to work for the general good of the people, believe themselves also entitled to some support to have their plans realized. In this they do not succeed well, as the Government, as a rule, and of course, rightly enough, takes a watchful position before new and doubtful enterprises, and only renders its assistance in connection with and on account of the utterances given on the subject from that quarter which

will be benefited by the work. That such an order, referring to the great carefulness with which, in this country, new ideas are met with, in some single instances may stop or delay the introduction of new improvements, is true, but on the other hand it has many advantages. The issuer of those propositions is then forced to look to the great public, and especially to that class of people he will through his invention be of most use to, and who understand the thing best of all and its possible practical usefulness.

The change of opinions taking place thus between the opposition and the defence opens up his eyes, and causes him to look at the thing from other sides and in a new light. If the plan be practicable, and the inventor has succeeded in convincing the public of this, and its being of great importance to the community, it will seldom occur that it will be dropped for lack of assistance, provided not too much money is required for its realization. The practical experiments then commenced leave the decision altogether to the public. If these fail, the cause will soon be given up by that side; if happy results are met with on the other hand, the cause has gained a place in the practical life and will cause itself to be acknowledged. With these suppositions I took up the question of artificial hatching of salt-water fish, which, looking at the great decrease in our daily fishery, was greatly needed.

I turned with my petitions for money contributions, first to private gentlemen and corporations, and not in vain.

The income of the hatchery has been, up to the end of 1888, Kr. 43,000—of which Government assistance.

1884, through the Fishery Society			Kr. 2,000
1885,	do	do	2,000
1887,	de	do	2,000
1887, through Parliament			2,500
1888, through the Fishery Society			3,500

Thus, Government assistance, Kr. 13,000.
Private assistance, Kr. 30,000.

In this sum is included Kr. 2,000 from the Royal Society for the Welfare of Norway. I believe thus to have fulfilled the common rule in a case like this—to have principally, with assistance of private contributions, brought the thing so far that its practicability is proven, when the reasons that caused the construction of the hatchery always are at hand and never, either in foreign countries or here, was there any other or better means found to restore the quantity of fish than artificial hatching. It is plain that the work ought to be continued, and then comes the question, who will in the future have to defray the expenses. The last five years' statement from the bailiff in Nedeuces shows that the coast district of the bailiwick have together a population of 42,600 inhabitants. If to this is added the poplation of the villages, the total number will be above 50,000 souls who thus can be said to have an interest in the daily fishery.

The gain of this, as well as the indirect advantages of a rich supply of fresh fish, is so evenly dealt out that, outside of this, the original fishermen cannot be said to make a great pecuniary gain. On the whole, this matter is of the greatest importance. If it is supposed that the above-named 50,000 people form 10,000 families, and each of them uses about 80 ore worth of fish per week, the total amount for the year will amount to 400,000 kroners. This only refers to the bailiwick of Nedeuces. In the country between the Swedish boundary and Lindosnes, along the coast, where the number of inhabitants is about 400,000 individuals, the value of the consumption as above would amount to close upon three and a-half millions, and for the whole country to about six million kroners per annum. It is thus this income which is on the decrease, and which is to be saved. To look to those men who, with such liberality seldom seen, have helped the undertaking over the first and worst difficulties, will not do. They have shown their interest in the matter, and this is the only correct way, namely, by assisting at one time so plentifully that the work could be per-

formed in a satisfactory manner. This has, more than anything else, helped to reach satisfactory results. To petition the great public is of no use, as every single individual, when asked for a pecuniary help, considers the question out of his line; also it is impossible to ask for assistance, by contributions, from the community of surrounding villages or districts, when this question is not yet quite clear to the public generally. First there must be such plain proofs produced of the usefulness of the hatchery that all doubts and opposition are silenced; but this can never be done with the hatchery in its present state. As the daily fishery is of such an enormous importance, and private voluntary contributions to any extent can no longer be expected to run the hatchery in the future, it seems but reasonable that the Government should now take up the case or rather allow a sum yearly sufficiently large to run the hatchery without the help of private people, except what comes in as contingencies from the members. This is also the rule for the Fishery Society of Bergen, as well as other branches. That this branch at Arendal is in need of assistance to larger extent is a consequence of its greater operations. In the yearly report for 1884, page xi, the Fishery Society says, in regard to this matter: "Should these experiments fail, this allowance will probably be taken away in five years. If again successful there will arise the question to establish similar hatcheries in other places, and as no individual is specially benefitted by it, but the matter becomes an interest of the public generally, and consequently should be kept up by public funds. If the society, by saying public funds means exclusively allowances from the Government, I may say that I cannot agree to that. I know the disposition of the coast inhabitants, and feel sure that as soon as the increase of the number of fish through the operation of the hatchery is proven, the different districts will gladly contribute towards the running of the new established hatcheries. But to produce these proofs is in the hands of the Government. For instance, some would say that too much is expected from the Government. I will give a comparative statement between the salmon and fresh-water fisheries on one hand and the daily fish and lobster fisheries on the other. The value of the first named is, if I remember right, put down to about 800,000 kroner per annum, when the income of the daily fishery may be put down to about six and the lobster fishery to about one million, or about seven million kronor per annum. The salmon fisheries are pursued principally by well-off persons, while, on the other hand, the daily fishery is what may be called the daily bread of the poorer inhabitants of the coast. The salmon fisheries form, truly enough, a valuable export article, but the same can be said about the lobster fisheries, the amount of both being about the same. In regard to the daily consumption, then the salmon is a luxury that only comes upon the table of the wealthy, while, on the contrary the daily fishery forms such a valuable and common industry that, for the coast, inhabitants, it may be considered an article of exigency. The daily fishery may then be said to be of far more economical importance to the country than the salmon fishery, a[illegible] sums (in 1888 23,940 k[illegible] to be asking a yearly a[illegible]herto neglected daily fi[illegible].

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Canada. Dept. of Fisheries
Report on fish culture

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