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FISHERY COMMISSION, HALIFAX, 1877.

THE EFFECT
OF THE
FISHERY CLAUSES
OF THE
TREATY OF WASHINGTON
ON THE
FISHERIES
AND
FISHERMEN
OF
BRITISH NORTH AMERICA.
PART I.

BY HENRY YOULE HIND, M. A.

HALIFAX, N. S.
PRINTED BY CHARLES ANNAND,
1877.

R. W. Kenney

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INTRODUCTORY SKETCH.

I. The Atlantic Coast of British North America is washed by the waters of that branch of the great Arctic outflow which is known by the name of the Labrador Current (83.) (1.) The predominant characteristics of this Current are its low temperature, and an extraordinary profusion of those forms of Marine life which abound in cold oceanic waters, (83 to 89, and 99 to 101) among which are the chief commercial food fishes.

II. A large portion of the sea-board swept by the Labrador Current is incapable of settlement on account of its orographic features and rocky character, the remaining portion is thinly settled, (4) and almost exclusively by a population engaged in sea fisheries. The pursuit of this industry on the coasts of the Dominion is carried on chiefly by means of open boats, which necessarily reduces it in a great but variable measure to the condition of a Shore Fishery. While there are not less than 20,241 boats, manned by 40,023 in-shore fishermen, there are only 1379 sea-going vessels, manned by 9097 fishermen sailors, engaged in this special industry of the sea. (2.)

III. The ratio of the number of men exclusively engaged in the Dominion Shore boat fishery to the number of men engaged in the Deep Sea Fishery, using decked vessels, is as 4.4 to 1; and the total number of boats employed is nearly one-half the total number of tons of shipping. Hence it follows that by far the largest proportion of the fishing industry of the Dominion is pursued in coastal waters, and much of it rarely extends beyond the limit of three marine miles from the coast line.

Table showing the number of Boats and Men in the Shore Sea Fisheries of the Dominion in 1876. (3.)

	No. of Boats.	No. of Men.
Nova Scotia.....	9585	18,093
New Brunswick.....	3850	7322
Quebec.....	5815	10,777
Prince Edward Island.....	991	3831
	20,241 Boats.	40,023 Men.

Table showing the number of Vessels and Men engaged in the Sea Fisheries.

	No. of Vessels.	No. of Men.
Nova Scotia.....	653	6049
New Brunswick.....	463	1794
Quebec.....	256	1219
Prince Edward Island.....	7	35
	1379	9097

1. NOTE.—The figures in brackets refer to the paragraphs and sections in the descriptive text.

2. Official Returns—Report of Commissioner of Fisheries.

3. Report of Commissioner of Fisheries, 1876.

Tonnage engaged in the Fisheries.

	No. of Tons.
Nova Scotia.....	24,800
New Brunswick.....	5,061
Quebec.....	14,635
Prince Edward Island.....	385
Total.....	44,881 Tons
Total No. of Men.....	49,120
“ “ Boats.....	20,241
“ Tonnage of Vessels.....	44,881

IV. In Newfoundland the DEEP SEA FISHERY, as distinguished from the fishery pursued in coastal waters, or within three Marine miles from the shore, has scarcely a separate existence. The vessels which are enumerated in the census are used chiefly for the purpose of sailing from one Coastal Fishery Station to another on the Island of Newfoundland, or for the Labrador Fishery. The total number of boats employed in the Shore Fishery was 18,611 in 1874, and 14,755 in 1869, and the number of persons engaged in catching and curing fish 45,854 in 1874 and 37,259 in 1869. The number of vessels was 1,197 during 1874, with a tonnage of 61,551 tons, manned by 8394 fishermen sailors. Sealers are included in the enumeration. The combined fishing industry of the Dominion and Newfoundland is thus represented :—

Number of Boats.....	38,852
Number of Vessels.....	2,576
Tonnage of Vessels.....	106,432
Number of persons engaged in catching and curing fish.....	103,368

The appliances used in these Fisheries indicate, to a certain extent, their character. Where decked vessels are necessarily employed beyond the limit of three Marine miles from the shore, it is essentially a DEEP SEA FISHERY. Where open boats only are used, it is in general a COAST FISHERY, although, as in the case of Newfoundland, the depth of water near to the coast line may vary from 10 to 100 fathoms and more. Where the fishery is pursued from the shore, but with the use of open boats, as in the taking of Mackerel, Herring, and especially Caplin, Smelt and Launce, it is a STRAND FISHERY. Both the Deep Sea Fishery and the Coast Fishery are dependant in a very large measure on the Strand Fishery for Bait. The character of the Newfoundland Fishery is further indicated by the large number of Fishing Rooms, in actual use. (1) In 1874 these amounted to 8902 in number, in 1869 to 7,444. The Islands so numerous on the Coast of Nova Scotia, the southern part and north-eastern part of Newfoundland, the North Shore of the Gulf of St. Lawrence and the Labrador, north of Spotted Island, offer an immense area of coastal waters and boat fishery, which does not appear on maps drawn to an ordinary scale.

V. While it is difficult to establish an exact ratio between the quantities of any particular kind of fish caught in coastal waters or beyond the limit of three Marine miles from the shore, yet the very general employment of open boats for fishing purposes precludes the idea that a considerable portion of the aggregate catch is taken outside of coastal waters. (2)

1. A fishing "room" is a definite portion of the shore appropriated to the curing and storing of fish.

2. Under the term "Coastal Waters" is understood that portion of the sea which lies within three marine miles from the shore line.

The changeable character of the weather on the British American Coast,—the sudden and unexpected occurrence of fogs,—the variations of currents produced by tides,—the long experience of the dangers attending fishing in open boats some distance from the land,^(1.)—the pecuniary resources of the fishermen,—conjointly with the abundant fish resources of the coastal waters, have combined to limit the industry of the British American fishermen, in a great measure, to the immediate vicinity of the shore line and within easy reach of harbours. This is particularly the case in Newfoundland, when deep water generally prevails close to an “iron bound” coast, and where much fishing is prosecuted in the vicinity of Islands.

Some idea may be formed of the extraordinary risks and terrible losses attending the Deep Sea Fishery on the American coast, even in well found decked vessels, from the following enumeration of the shipwrecks and loss of life, according to the Wreck List of one United States Fishery Port alone, namely, Gloucester, Massachusetts.^(2.)

Period from 1830 to July 1st, 1873.

Number of Vessels lost.....	280
“ Lives lost.....	1265
Value of Vessels lost	\$1,145,500
Amount of Insurance.....	\$839,525
Losses of Cables, Anchors, &c.....	150,000
Average loss of vessels yearly.....	6
Average loss of lives yearly.....	28

In a pamphlet published in 1876 by Procter Brothers, of Gloucester,^(3.) the losses of the “Gloucester Fisheries” have been carried down to the year 1875. The total losses since 1830, are thus summarized, (page 73):

Table of Losses.

Men.....	1590
Vessels.....	333
Valuation.....	\$1,361,300
Insurance.....	,024,718

“The foregoing losses show an aggregate of 1265 lives and 280 vessels lost during the past 42 1-2 years. Of this number, 93 vessels and 708 lives were lost in the Georges fishery; 19 vessels and 209 lives in the Grand and Western Bank fisheries; 56 vessels and 107 lives in the shore cod and mackerel fisheries; 48 vessels and 96 lives in the Bay of St. Lawrence mackerel fishery; 19 vessels and 68 lives in the Newfoundland herring fishery; 34 vessels and 65 lives in the freighting business; 2 vessels in the Grand Manan herring fishery; 1 vessel and 12 lives in the Greenland halibut fishery; 6 vessels burnt by pirate Tacony; 1 pilot boat lost in the harbor. Of the 280 vessels lost, the crews of 147 (a little more than half) were saved. The loss of life and property on Georges is upwards of one half the entire loss. The total value of vessels lost is \$1,145,500, on which there was an insurance of \$839,525, mostly in the local offices. In addition to the above are the partial losses, of cables, anchors, etc., which cannot be reckoned less than \$150,000, making the total loss, \$1,295,500.”

1. A list of vessels lost in pursuit of the British American Fisheries, is given in the Appendix.

2. The Fisherman's Memorial and Record Book,—By George H. Procter Gloucester, Mass, 1875.

3. THE FISHERIES OF GLOUCESTER, from the First Catch of the English in 1623, to the Centennial Year, 1876. Gloucester—Procter Brothers, Publishers.

"As no record of the number of widows and orphans made by these losses was kept previous to 1858, it is impossible to get at the correct number, but taking an average of the past twelve years, it would give ten widows and twenty fatherless children yearly, or a total of 422 widows and 844 children. The losses average 28 lives and 6 vessels yearly."—*Ibid*, (page 51.)

VI. As a Maritime power the Dominion stands fifth among the Nations of the World. Its Commercial Marine, almost wholly sustained in its most important element by its fishing population, born to the sea, is only surpassed by that of the Mother Country, the United States, Norway and Italy. Its tonnage increases at the rate of 60,000 tons a year, ^[1.] and it draws its supply of trained seamen from a fishing population scattered over three thousand miles of sea-board.

VII. The possession of a very extended line of coast, stretching fully five thousand two hundred miles, ⁽¹²⁾ where the Fishing Industry is pursued in open boats by a sparse population not exceeding 6.4 persons to the square mile, ⁽⁴⁾ but whose industry assures to them an aggregate annual catch reaching the enormous sum of about twenty millions of dollars, is justly esteemed as an inheritance of priceless value, and in its far reaching influence upon the future of the State, is jealously regarded as a birthright; for which no other material advantages could be accepted as an equivalent compensation.

Setting aside the annual pecuniary value of the industry it assures, the indirect relation of that industry to the maritime interests of British America, when measured by the estimation in which Fishing Nurseries for seamen have always been entertained by political economists, confers on its coast line and coastal waters a value without parallel in history. They are an unrivalled security for future political influence and power; especially where the foundations have been so well and deeply laid as on the Dominion Sea-board, in its infancy as a State, and where the instincts of the people lead them to pursuits which compel familiarity with the dangers of the SEA.

VIII. Whatever tends to lessen or impair the value of that industry whose pursuit necessarily involves early and special training in the hardships of a seafaring life, strikes at the root of maritime excellence, ⁽¹⁶⁾ and checks, if it does not arrest the progress of the State. ^[2.] Hence it is that the British American Coast Fisheries are not only a source of great present wealth to its maritime population, but the strongest security that can be offered for the maintenance and permanency of the Commercial

1. COMPARATIVE STATEMENT showing the number of Vessels and number of Tons on the Registry Books of the Dominion of Canada, on the 31st December, 1873, 1874, 1875, and 1876.

PROVINCES.	1873.		1874.		1875.		1876.	
	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.	Vessels.	Tons.
New Brunswick.....	1,147	277,850	1,144	294,741	1,133	307,020	1,154	324,513
Nova Scotia.....	2,303	440,701	2,737	470,000	2,759	505,144	2,807	529,252
Quebec.....	1,642	314,043	1,397	218,040	1,831	222,005	1,902	223,502
Ontario.....	681	83,111	515	118,003	325	114,320	380	123,017
Prince Edward Island	230	33,918	312	43,388	335	50,677	333	50,092
British Columbia.....	30	4,005	35	3,611	40	3,085	40	3,809
Manitoba.....	.....	.....	.....	.....	2	173	2	173
Total.....	6,733	1,073,718	6,930	1,158,303	6,062	1,205,505	7,192	1,200,893

2. See page XI. Report of the U. S. Commissioner of Fish and Fisheries for 1872-73. Also, a Report by M. Coste, 'On the organization of Fisheries as regards the Increase of the Naval Force of France,' 1861. Also, United States "Report on the Reciprocity Treaty with Great Britain," Feb. 5th, 1867, and "Report rendered in the name of the Commission for the Enquiry into the Law relating to the Great Sea Fisheries," by M. Ancet, 1851.

Marine of the Dominion, of the industry of those who sustain it in the capacity of Ocean Carriers, and of the political future of the State.

That this view of the importance of Sea Fisheries, wholly apart from the pecuniary value of the catch, is entertained by political economists of the United States, is sufficiently testified by the acknowledged loss resulting to the Union on account of the decline of the New England Cod Fisheries, elsewhere referred to. (28.)

IX. The length of coast line in the United States opened by the Treaty of Washington to British American Fishermen, does not exceed 1030 miles, north of the 39th parallel of Latitude, which forms the southern limit of the Concession. The length of coast line in British America opened to fishermen of the United States, not covered by pre-existing treaty arrangements, is about 3700 miles. ^[1] The area of Coastal Waters conceded by the United States is about 3500 statute miles. The area of British American Coastal Waters conceded by the treaty is about 11,900 miles, or more than three times as large a marine area as that embraced within the Coastal Waters of the United States subject to the Treaty.

X. The industry pursued by the Fishermen of the United States within the limits of the Coastal Waters of that country, north of the 39th parallel, was formerly very great, and of immense importance to its Commercial Marine. (16.) But owing to the acts of her own citizens and the depredations of predacious fishes, the Coastal Waters of New England have lost very much of their former value as fishing grounds, and the cod-fishery, once of vast commercial importance, has been ruined, in a great measure beyond repair. ^[2] (14 to 20)

XI. The Coastal Waters of the United States south of the 39th parallel still maintain much of their original wealth of the food fishes, and supply annually enormous quantities of fresh fish to the United States markets. ^[3] But to these prolific fishing grounds access is forbidden to British American fishermen, because they lie south of the 39th parallel of latitude. United States fishermen under the same treaty, may fish during the summer in British American coastal waters, and when the approach of winter renders the fishing industry hazardous or impracticable there, they can start at once for prolific fishing grounds south of an imaginary boundary, and pursue their calling throughout the winter months. ^[4] This is a practical advantage, and indeed a

1.	Nova Scotia.....	1170 miles.
	Quebec.....	864 "
	Newfoundland.....	800 "
	New Brunswick.....	545 "
	Prince Edward's Island.....	340 "

3719 miles.

2. "Report of U. S. Commissioner of Fish and Fisheries," for 1871-2, page XXXVII. Also Report for 1872-3, page XI.

3. The Fish supplied by the Washington market in 1874. (Sept 30, 1873, to Sept. 30, 1874) weighed in the aggregate 11,000,000 pounds; and by far the greater proportion were derived from the Potomac River and the lower part of Chesapeake Bay. When we bear in mind that Alexandria, Norfolk, Richmond and many other places were supplied from the same storehouse, to any nothing of the immense quantities exported to more distant points, we may realize the importance of the fisheries as bearing upon the question of national economy, "*Annual Record of Science and Industry*," 1875. Edited by Spencer F. Baird.

4. The Fishery Smacks owned at Nonak, Connecticut, fish on the outer banks or in the vicinity of Nonak during the summer, and in winter are employed in fishing off the Coast of Florida, page XII.—Report of U. S. Commissioner of Fish and Fisheries, for 1874-75. See also "Fisheries of Gloucester," quoted in foot-note to paragraph XII.

positive gain so great, that it frequently determines whether a northern summer fishery can be the profitable basis of a continually expanding industry throughout the year; winter employment being found for summer outfit.

From this great advantage, the fishermen of British America are debarred by the limiting clause of the treaty of Washington, and are compelled to lay up their vessels during the winter season. But the United States fishermen, to whom have been conceded the right of fishing in British American coastal waters, in the full enjoyment of all the privileges and immunities belonging to equal and unrestricted co-partnership during the entire summer fishing season, hasten at the approach of winter to pursue their industry in Southern waters, from which their Northern partners are by treaty excluded. [1.]

XII. The fish whose pursuit forms the industry enjoyed by the fishermen of the United States in Southern waters, belong in part to the class known as 'Anadromous' fishes, or, "such as live for most of the year in the sea, and obtain the greater part of their growth there, and run up into fresh water for the purpose of spawning: among them the Shad, the Alewife, or fresh water Herring, the Rock Fish the striped Bass, &c., [2.] The destruction of the Cod fisheries which formerly existed on the Coast of New England have been attributed by the United States Commissioner of Fish and Fisheries, to the comparative annihilation of the anadromous species on the New England coast [3.] by the various land industries established on the New England rivers. South of the 39th parallel, the anadromous species, whose pursuit is a most extensive and remunerative industry, find an accessible winter home in the warm waters off the coast of the Southern States, and enter the rivers to spawn as early as February. To this winter home and the vicinity of the mouths of the spawning rivers, the U. S. fishermen are privileged to pursue them, but this is withheld from British American fishermen, who are thus placed in a position of unequal and greatly restricted competitive rivalry in one and the same commercial pursuit.

This is a state of things which has arisen, we may suppose, from insufficient knowledge of the habits of the species, and how those habits may be modified by climate, and how greatly they may influence commercial relations. Be this as it may, it led to the adoption of those remarkable conditions, which fetter the movements and cramp the enterprise of one side, while they free the movements and expand the enterprise of the other. [4.]

1. "As the Georges Fishery wanes in the closing Spring months, the sportive mackerel puts in an appearance at the far South, and works northward as the season advances. A large portion of the fleet engage at once in the pursuit of this delectable fish, and follow his previous wanderings until he disappears to an unknown haunt as winter approaches. The fleet sit away in April, going as far south as Virginia, but gradually working towards the waters of Rhode Island, and marketing their catch for the most part in New York."—"The Fisheries of Gloucester." Proctor Brothers, 1876.

2. "Annual Record of Science and Industry" for 1875.—Edited by Spencer F. Baird. (page 415.)

3. Appendix No. 1, Chap. I, II. Letter of Spencer F. Baird, to the Commissioner of Maine.

Common Anadromous Species.

1. Shad.
2. Alewife, or Gaspereau or Fresh Water Herring.
3. Salmon.
4. Smelt.
5. Striped Bass.

4. "As at present conducted the fisheries of Gloucester furnish remunerative employment for its vessels and mariners for the greater part of the year, and it is not probable that any considerable portion of its energies need be turned to new fishing fields in the years to come."—*Fisheries of Gloucester.*

They place an obstructive boundary on the operations of the British American Fishermen far more limited and confined than formerly existed under the Reciprocity Treaty, and in the same breath they remove every impediment to perfect freedom of action to American Fisherman throughout an area of great productiveness and practically unlimited extent.

XIII. The species of fish pursued on British American Coasts for commercial purposes, are almost exclusively those whose habitat is limited to cold waters, (11) and the most important of these appear to find the coldest waters, within certain limits, best suited to their development in American Seas (2) (99-103). The great degree of cold characteristic of the Marine climate in which the commercial fishes (Cod, Haddock, Hake, Halibut, Herring, Mackerel, &c., &c.) are best developed, is derived from the Labrador Current. (1) The area affected by this current off the Coasts of the United States within the hundred fathom line of soundings, and north of the 39th parallel of latitude does not exceed 45,000 square miles (12). A similar area in British American waters exceeds 200,000 square miles. The cold waters of the Labrador Current on the Coast of the United States occupy a wedge shaped area passing under or intermingling with the warm waters of the Gulf Stream south of New York. (3) In British American waters, the area is practically limitless.

XIV. The original source of the food of the commercial fishes is brought down from the north by the Labrador Current (99), the great storehouse from which the cold water fishes derive their sustenance. The manner in which many of the commercial fishes spawn, such as the Cod tribe, the Mackerel tribe, the Flat-fish tribe, coupled with the remarkable adjustment of the specific gravity of their spawn, so that it floats in suitable saline waters, necessarily involve the principle that whenever depletion takes place along any considerable extent of coast line, the species will be preserved and restored by an influx of ova *from the North*, or in the direction of the Labrador Current (103). Hence the natural restoration of depleted United States waters, in relation to the commercial deep sea fisheries, is largely dependant upon a southerly distribution of ova by the Labrador Current.

XV. The relation of each species of the Commercial Sea fishes to a certain sea area adjacent to a coast line is established by the natural habits of the species. (22) This limited area is the home of the fish. As a general rule all fish return as near as possible to their birth place. (22) As far as known, they winter in deep water near to their birth place. The supposed migration of the so-called bottom feeders, such as the cod tribe and the flat fish tribe are imaginary. These fish are indigenous to the waters in which they are found. The so-called surface feeders, such as the mackerel, come in general from their winter homes direct to the coast line, and their summer wanderings are very local in geographical extent.

XVI. The relation of the deep sea commercial fishes is intimately connected with the condition of the coastal waters as

1. See Appendix No. I, Chap. V. Also "Further Inquiries on Oceanic Circulation," by W. B. Carpenter, M. D., F.R.S. Page 201.

2. See "Catalogue of the Fishes of the East Coast of North America," by Theodore Gill, page 778. Report of the U. S. Commissioner of Fish and Fisheries for 1871-72. The range of each species of fish in the cold water seas, is given in pages 792-814.

3. United States Coast Survey—Professor Verrill.

feeding and breeding grounds, and their greater or less abundance or, in other words, the commercial value of a fishing ground subtending a given length of coast line, is largely dependant upon the preservation of sheltered coastal waters as nurseries for bait, nurseries for young fry, for spawning, hatching and feeding grounds. So intimate is this relation that the abundance or poverty of many deep sea fisheries is measured by the preservation of these natural nurseries in their original state, before the land area they subtend was occupied by man. (16).

XVII. The Anadromous Species which serve so largely as the food of the deep sea commercial fishes, are dependant for their abundance or diminution on the preservation of uninterrupted communication between their inland spawning grounds in rivers and the sea. (Appen. IV. Ch. II.) Where local land industries have led to the destruction of this communication, important deep sea fisheries have been ruined. The approach of many of the Anadromous species to the shore is dependant upon temperature, and within the boundaries of the Labrador Current they come in the Spring from an inaccessible deep sea area opposite or nearly so to their spawning rivers, and their approach to the coast is roughly indicated by an isothermal line. (Page xxx. U. S. Commissioners' Report for 1871-72.) Beyond and south of the Labrador Current, they find a suitable winter home in accessible waters on the coast of the United States south of the 39th parallel (XII).

XVIII. The coast line of the United States washed by the Labrador Current, represents the commercial fish producing area related to that coast line. Similarly the coast line of British America represents the commercial fish producing area related to its coast line. These ratios are as follows :

United States.....	1030 miles.
British America, not affected by Treaties....	3700 "

The ratio of population affecting the fisheries to the coast line fronting each sea area represents the drain upon the resources of that area. These ratios are (Appendix I, Chap. I)—

United States.....	100 persons per sq. mile.
British America.....	13 " "

XIX. The unrestrained acts of man, either by the unrestricted use of destructive engines in the capture of the food fishes, or by cutting off the supply of food on account of the necessities of great inland industries, have in a great measure, depopulated the coastal waters of the United States. In British America this has not been done beyond speedy repair, and this has arisen, firstly, from the great extent of the British American coast line; secondly, from the paucity of population, and the absence of manufacturing industries; thirdly, from the control exercised by the Government, and fourthly, from the illimitable area of cold water suitable for the development of the commercial fishes off the entire coast line, and ceaselessly flowing past it, freighted with fish food and fish ova.

XX. The catch of the commercial fishes in the deep sea is dependant upon bait procured in coastal waters, but the spawn and young fry of the bait-fishes are the food of the commercial fishes, and as these diminish, the accessible supply of the commercial fishes diminishes also; arising chiefly from their retiring from the coast line owing to scarcity of food. Hence the taking of bait fishes from coastal waters diminishes the number of the

deep sea fish in a given accessible area,⁽¹⁾ and the value of a deep sea fishery, as long as it depends upon bait, is in direct ratio to the abundance of bait for food and for catch.

XXI. The bait used to take the deep sea commercial fishes varies with the seasons of the year, the character of the sea bottom, and the marine climate. (Chapter VII.) What may be an attractive bait one month is useless the next. A fishery abounding in fish may be valueless on account of the want of suitable bait. This occurs throughout the Dominion and Newfoundland boat fisheries, and has long been recognized also on the coast of Norway, establishing the most intimate and inseparable relation between the facility with which proper bait is procured and the catch of fish. Similarly where nets are used in coastal waters to take herrings, or mackerel, or cod during the spawning season, it is not so much the destruction of spawning fish which affects the fishery, as the diminution in the quantities of spawn and fish fry, which lure to the shore the deep sea fish. Whatever, in a word, affects the abundance of fish life, or of the lower forms, large or small, in coastal waters, affects also in a corresponding ratio the deep sea fishing area lying outside. Hence an equal participation in a rich coastal fishery, affects disadvantageously an outside deep sea fishery, and may ruin it, as has occurred on the New England Coasts. (App. IV., Ch. II.) The movement of certain kinds of fish, especially the cod tribe, farther and farther from the shore, is inevitable, if inshore food supplies are not maintained. This result is clearly manifest in numerous localities which are more especially referred to in the Chapter on BAIT.

XXII. It is shown in paragraph V that the fishery chiefly pursued on the British American coast is a shore fishery, carried on for the most part within the limit of three marine miles from the coast line. Its annual yield, amounting to about \$20,000,000, is, in the main, the result of this inshore fishery, which is very largely dependant upon bait, not so much as a mean for taking fish, but as a lure to bring them into the vicinity of the shore in a natural and accustomed search for food. If by any act of man affecting the coast line, or the rivers which debouch into the sea, or the indiscriminate destruction of fish, the lure becomes lessened, the class of accessible fish which depended upon the abundance of the lure, diminish in like ratio. Hence it arises that the taking of bait for the purpose of sale as a commercial product, is in the long run, unless scrupulously controlled, an inevitable precursor and a direct cause of ultimate destruction to the shore fishery. The French fishery on the Grand Banks off Newfoundland is almost entirely dependant upon bait procured from the coastal waters, and however abundant the bait may appear to be in certain favorable localities, experience in all countries shows, that it is liable to sudden and disastrous diminution. (Vide extracts from Capt. Fortin's Reports. Also Perley's Report.)

XXIII. But owing to want of information respecting the relation which one marine form bears to the life of another, very erroneous conclusions are frequently adopted. Lobsters and Crabs for instance, when in the condition of embryos or Zœca, are attractive food for mackerel and herring; when in the

1. The United States Commissioner of Fisheries described the exhaustion of a local fishery as "not like dipping water out of a bucket, where the vacancy is immediately filled from the surrounding body; but it is more like taking hard out of a keg where there is a space left that does not become occupied by anything else." P. XXIX. Report 1871-2.

form of the young developed Crustacean, they are eagerly sought for by the Cod and its tribe. A Crab produces two million Zœa, ^(1.) a Lobster twenty-five thousand Zœa. These free swimming creatures attract the mackerel and herring. Those which pass through the embryonic form and assume that of the perfect crustacean, become a lure to the cod drawing them inshore. (Chapter VI.) The enormous catch of Lobsters on the American Coasts affects the coast fisheries in the manner described, and the destruction of the Crustacean itself, in a secondary consideration when compared with the loss of inshore bait, which brings the deep sea fishes towards the land. The same reasoning applies to all the lower forms of marine life, which, in their embryonic condition, serve as fish food, and to all forms of fish life, which, as spawn or fry, serve as food.

Striking as the relation appears to be between the free swimming young of the lobster and crab, and the wandering schools of herring and mackerel, it is scarcely so strange as the marvellous adjustment of the specific gravity of the egg of the cod to the medium in which it has to float during the period of its development. (32) Should it rain continuously for one or two day's at a time during the spawning period of a school of cod, and the surface of the sea meanwhile be agitated by a gentle wind, just sufficient to mix the surface diluted stratum with the undiluted sea-water on which it rests, to the depth of a few feet, the salinity of this upper stratum is diminished, its specific gravity lessened, and the delicately balanced embryo of the cod will no longer float where air and light can reach it. It sinks to a zone where its specific gravity is exactly equal to that of the medium in which it remains suspended, but its chances of survival are immensely lessened and frequently rendered nil.

Prolonged rainy weather may thus destroy innumerable Cod ova even in the Sea, ^(2.) yet, unless such dependance were clearly worked out and established step by step, with no link in the chain of evidence wanting, how few would be willing to receive for an instant, the statement that there was an intimate connection between—to use a common-place, but suggestive form of speech—the season crop of young Codfish and the monthly distribution of rain.

Yet such is the fact, and its exemplification foreshadows relations apparently the most diverse, yet in reality the most intimate, between meteorological phenomena and the productiveness and unproductiveness of fish seasons; in a word, on the fluctuations of the Fisheries. Nor is the relation of the loathsome 'slimefish' ^(3.) to the destruction of long celebrated "old grounds" less curious and instructive; or the varying instinct which impels the yearling cod suddenly to abandon one fertile source of food for another yet unseen, but coming towards the shores, and leaving this again to meet a third advancing army whose approach some instinct heralds. ^(4.) But we glean from these facts an inkling as to the causes of the fluctuations in our fisheries, as well as of those mysterious intervals during which the fishermen lose sight of the cod, between their 'spring and fall fishings.'

f. To destroy on a given extent of coast line the food which

1. See Joint Appendix in No. II. Reports on the Crab and Lobster Fisheries of England and Wales, 1877.

2. G. O. Sars.

3. *Myxine Glutina*.

4. See "Report to the Home Department," by Dr. G. O. Sars, on the Scientific investigation respecting the Cod Fisheries in the Lofoten from 1870 to 1873—Christiania 1874.

sustains the deep sea fish in the sea area opposite to such coast line, as has occurred in New England waters, is to destroy the deep sea line fishery it subtends, and this destruction, using the simile employed by the United States Commissioner of Fish and Fisheries, is a hopeless exhaustion for many years in succession.

"It is easy therefore to understand why, after five or ten years fishing, the supply of fish in a given Bay, or along a certain stretch of the coast, will be reduced to a very considerable degree, and although it may be perfectly true that the sea is practically inexhaustible of its fish, yet if the fish of a particular region are cleaned out, there is no hope that others will come in from surrounding localities to take their places, since those already related to a given undisturbed area continue in that relationship, and have no inducement to change their ground. It should therefore be understood that the exhaustion of a local fishery is not like dipping water out of a bucket, where the vacancy is immediately filled from the surrounding body; but it is more like taking lard out of a keg, where there is a space left that does not become occupied by anything else." (1.)

XXIV. The exhaustion of several contiguous local fisheries is practically the exhaustion of a definite area of coast line, which may extend from ten to a thousand miles in length, as has been the case in New England. But the relation which the deep sea commercial fishes indigenous to a given sea area is so intimate and dependant, with regard to food at certain seasons of the year, and spawning at another season, that the transformation of the coastal waters into a marine desert, implies to a very great extent the exhaustion of the deep sea area outside.

XXV. From these premises it follows generally, that the exclusive possession of productive coastal waters is tantamount to the control of the preservation of the productive character of the deep sea fisheries adjacent to and subtending the coast. If the one becomes exhausted, the exhaustion of the other speedily follows; and if a coast line will bear without injurious diminution a certain constant drain upon its commercial resources, an increase of that drain will lessen its value in proportion to the extent of the additional drain.

When, therefore, the right is conferred by one party who holds exclusive property rights over certain coastal waters, to another party to participate in and share that right on perfectly equal terms and with equal or even greater resources, not only have the resulting proceeds to be taken into consideration from a commercial point of view, but the effect produced upon the property so conceded by the exercise of the rights conferred. This effect in many instances will be, in the case of equal participation of coastal fisheries, absolute ruin to the fisheries so conceded, and not merely the fisheries of the coastal waters, but the deep sea area subtended within certain ascertainable limits, dependant largely upon orographic outlines. It resembles in a measure the participation in the profits of a productive farm which has not been overcropped, and the sudden introduction of a constant succession of exhausting crops without adding fertilizers or improved methods of tillage. The yield may be commercially profitable for a few years, but the end is ruin. Referring again to the simile adopted by the United States Commissioner of Fish and Fisheries, XXIII, these

1. Page XXIX. Report of the United States Commissioner of Fish and Fisheries, 1871-72.

enquiries are equivalent to ascertaining the *quantity* of lard dipped out of the keg and the *time* consumed in withdrawing it.

XXVI. The Fishing Industry in British American waters is confined to certain species of cold water fishes whose habits determine whether their pursuit is to be carried on within the limits of coastal waters or beyond those limits. (The Cod, Chap. II) It often happens too that the acts of man so tend to change the habits of certain fish that the pursuit in coastal waters becomes changed into a Deep Sea Fishing Industry. (1) One tendency of the constant drain of bait fishes from coastal waters is to gradually drive the Cod and its kind farther off shore. Similarly, the destruction of that class of marine animals (Crustaceans, &c.) whose zoea swim in countless millions near the surface, will lead the herring and the mackerel to search for other and more prolific feeding grounds. Hence it is that from whatever point of view we regard the coastal waters, we arrive at the inevitable conclusion that these are at once the source and the mainstay of the deep sea fisheries, both in respect of bait, food, spawning grounds, shelter for young fry, and recuperating nurseries. An equal participation in the yield of those which are still comparatively unimpaired, brings with it the responsibilities attending the conservation which original undivided possession involved.

XXVII. The Dominion Government possesses entire control over the fisheries of the coastal and inland waters in all the Maritime Provinces. This control has been carefully exercised in the preservation to a very considerable extent of the marine spawning grounds, and in securing uninterrupted access to the fresh water grounds of the anadromous species frequenting the rivers of the Dominion. In the United States the local control exercised by separate State Governments over the marine and fresh water fisheries within the limits of each State, coupled

1. "The great change affected in the character and methods of the Gloucester fisheries, within a comparatively few years, has been the result of numerous causes. In the early days of the town there was little difficulty in securing good fares of merchantable fish, in pleasant weather, at a short distance from shore, and accordingly the shore fishery, with its inexpensive craft and outfits, assumed leading proportions. As the fish removed farther and farther from the shore, in consequence of the disappearance of fish food in near proximity to the coast, a better class of vessels and longer voyages became a necessity. With this improvement in fishing craft, and increased expense, new fishing grounds, and a longer fishing season, became possible and necessary. The enterprise of Gloucester fishermen was not long in finding new resorts for their calling, and the introduction of the herring trade, by supplying bait at proper seasons, gave an added impetus to the business. The increased facilities for transportation, and the development of the ice business, affording better means of preserving and forwarding fish long distances, however, wrought the greatest revolution that these fisheries have witnessed, and placed Gloucester in the fore-front of the fishing ports of America. Since the opening of railroad communication with Gloucester in 1846, but more particularly during the past dozen years, an immense business has been done in shipping fresh fish to all parts of the country, the order being received daily by telegraph, and the fish being iced and shipped direct to distant customers. Another outgrowth of the increased facilities for transportation is the direct shipment of cured fish to all parts of the country, a business that has increased from a modest beginning in 1863 to huge dimensions, until Gloucester has become the distributing head-quarters for its own productions, and to a considerable extent for those of other fishing ports. Several business houses in this line send out trade circulars weekly, and fill large orders daily from a long list of correspondents. A single house in 1874 shipped nearly 50,000 quintals of codfish, 214 tons of codfish stripped from the bones and skin and packed in small compass, and over 100 tons of smoked halibut, to its numerous customers in the West and South. It is largely through the importance of this branch of the business, in connection with the fresh fish trade, that the Gloucester Branch Railroad has proved a profitable property to a bankrupt corporation, and that a large steamer, making daily trips to Boston, and a respectable fleet of first-class freighting vessels, plying between Gloucester and New York, find lucrative employment."—*The Fisheries of Gloucester, Pruter Brothers.*

with powerful lumbering and manufacturing industries, obstructing the free passage of the anadromous fishes to their spawning grounds, has resulted disastrously to the coast and river fisheries, and rendered their restoration not only extremely difficult but tardy, and to a certain extent ineffectual. The result of this difference on the political and industrial status of the two countries, is marked by extraordinary differences in the present productive capacity of their coastal waters.

XXVIII. The effect of the admission of American fishermen to British American coastal waters, can be gathered from the premises recited, and may be thus classified in relation to sea privileges and land privileges.

I.—SEA PRIVILEGES.

I. Effect on the food of the commercial fishes.

The indiscriminate and uncontrolled taking of bait, will rapidly diminish the supply already becoming in many localities scarce. In proportion to the diminution of the supply of bait in coastal waters, the deep sea fish will retire from the shore, and so impoverish the coast fisheries that they will become practically unproductive. This will involve an entire change in the character of the British American fisheries, and the use of open boats must be replaced by sea-going vessels, or decked vessels of a class capable of venturing a considerable distance from the shore beyond the three miles limit. In very many instances the condition of the fishermen is such that they will not be able to procure the necessary vessels and outfit, hence, starvation, or a total change in their industry, will supervene, and a hardy class of people, trained to the sea, will be lost to the commercial marine of the country. There will result throughout an immense stretch of the British American coast line the lamentable condition so truthfully described by the United States Commissioner of Fish and Fisheries in his second Report on the Fisheries of the United States, under the heading "Conclusions as to decrease of Cod-Fisheries on the New England Coast":—

"Whatever may be the importance of increasing the supply of salmon, it is trifling compared with the restoration of our exhausted Cod-fisheries; and should these be brought back to their original condition, we shall find within a short time, an increase of wealth on our shores, the amount of which it would be difficult to calculate. Not only would the general prosperity of the adjacent States be enhanced, but in the increased number of vessels built, in the larger number of men induced to devote themselves to Maritime pursuits, and in the general stimulus to every thing connected with the business of the Seafaring profession, we should be recovering in a great measure, from that loss which has been the source of so much lamentation to political economists and well-wishers of the country."^(1.)

II. The decrease of fish is always rapid after it has reached a certain point. The reproductive character of the food fishes is largely determined, not so much by the number of Ova produced, but by the number of the enemies of the young fry,

1. Page XIV. Report of Commissioner of Fish and Fisheries, 1872-73:—

"The Gloucester, Massachusetts shore fishery for cod probably reached its maximum in 1832, when the amount of tonnage engaged in it was 6463 tons, the number of men employed 709, and the product of fish 63,122 quintals, valued at \$157,780; to which must be added the bounty of \$25,172, received from the general government. But another fishery had now for a few years attracted the attention of the fishermen; and the shore-fishing for cod, except that carried on in winter, declined from this time, till it came to be, as at the present day, of insignificant account in the business of the town."—*The Fisheries of Gloucester.*

which become greatly increased in consequence of other sources of food, such as the bait fishes, their spawn and their young being lost to them.^(1.)

The indications of a considerable decrease in the Cod in some localities is established, not only by the less catch per man, but by the small size of the fish caught. The gradual increase in the number of fish required to make a quintal of cod is a sure sign of approaching depletion.

III. The modes of fishing practised by the American fishermen are very destructive. ^(2.) It is a most serious error to state that mother or spawning fish are not taken by the bultow. The gravid females seize bait lying on the bottom which they will not rise to take when suspended in the water. An enormous quantity of spawning fish are thus taken, and also in seines, in the act of spawning, and the effect is felt in the diminution of the vast supply of food these would furnish to marine forms on which the adult cod and other species of fish feed.

IV. The taking of fish in the spawning season is always prejudicial, (43) and yet the Herring and the Mackerel are largely caught at that period, and so also is the Cod with the bultow. The most convenient localities for entrapping the first named of these fish are often near to the shore, and the addition of so many fishermen amply provided with the most approved modern fishing gear will speedily tell, in the different ways described, upon the schools frequenting well known spawning grounds. No one class of fish can be diminished or destroyed, except predaceous fishes, without injuring the increase or diverting the movements of another class; indeed, so potent is this influence that in Norwegian waters the abandonment of many old Cod fishing stations in the well known Loffoten waters, has been attributed in part by Prof. G. O. Sars to the changes which have occurred in the movements of the schools of herring. ^(3.)

V. The unrestricted admission of the American fishermen to the coastal waters of British America, can only be mitigated in its disastrous effect upon the Fisheries, by extraordinary outlay and precaution in preserving the anadromous and bait species, and offering every possible facility for their increase and protection, so that this supply of bait and food and lure shall be increased and maintained. The control exercised by the Dominion Government over the rivers and the mouths of rivers enables this to be done in many places, but it can not be applied in waters such as those washing Newfoundland, the North Shore of the Gulf and Labrador, where many of the anadromous species do not exist. But here, in place of these anadromous species, come in new forms of marine life which require the coast line

1. "We know that fish spawn, and fish in different stages of growth, constitute the principal source of food to other fishes in the sea, and that the great proportion of fishes devoured are of tender age." Prof. Spencer F. Baird, p. xxiii. Report 1871-72.

2. "The success with which this fishery is now pursued is doubtless due in a considerable degree to the practice of trawl-fishing. From the earliest times, till within a few years past, it was the custom of the New England fishermen, who resorted to that Bank, to fish from the vessel only; but they now use the French mode of fishing with trawls, which are lines, sometimes several hundred feet in length, with short lines and baited hooks suspended from them at frequent intervals. They are often set a long distance from the vessel, and as this work must be done and the trawls tended in dories, as their small boats are called, it is sometimes very hazardous, and, unhappily, liable to fatal accidents."—*The Fisheries of Gloucester*.

3. Report to the Home Department, by Dr. G. O. Sars, on the Practical and Scientific investigations respecting the Cod Fisheries in the Lofoten, from 1870 to 1873—Christiania, 1874.

for their spawning grounds, breeding grounds, nurseries and early development, and the taking of these belongs to the STRAND FISHERY.

II.—LAND PRIVILEGES.

I. One of the first requisites for the successful prosecution of the codfishery is the possession of good 'rooms' in capacious harbors. A large, safe and easily accessible "room" is an advantage of such material importance that in former times among the British in some provinces, and until the present time among the French, the setting apart of "rooms" has been a Government act, regulated by Special Surveys and Laws. It is equivalent to the possession of a suitable and commodious property for the carrying on of an extensive industry which, without the facilities offered by that property, would be in many instances valueless. Struggles and disputes for the possession of "rooms" have always been the fruitful causes of international troubles and local disputes, and are still so at the present day on the so called French shore of Newfoundland, where a concurrent right of fishing is established by Treaty. Canso, a famous Cod fishing station for three hundred years, when taken from the French, was re-allotted into rooms in 1725, and at that time its fish trade with New England alone was £150,000 currency per annum. Sir Thomas Bury's "Room" at Canso in 1725 was 920 feet long, and 270 broad. Where the advantages and privileges of "rooms" are not enjoyed to make and store fish, one-third probably of the value of a fishery is lost, for it must then be shipped in bulk 'green,' by which process it loses some of its value, and is more expensive to make. It is thus that the use of the Strand becomes an element of great importance in the prosecution of the Deep Sea Fishery,^[1.] wholly apart from the advantage it secures in the means afforded for taking fresh bait and storing it in ice.^[2.]

II. For the taking of Bait, and for taking those fish whose habits bring them close in shore, the use of the Strand, and the fishing in waters which wash the Strand, is essential to a very large extent. So valuable has this privilege been esteemed, even centuries ago, that the most stringent laws were enacted for its regulation, and even the penalty of Death was attached to their infringement.

The "Saturday's Stop" was considered so important in England, Ireland and Scotland, that imperial enactments, involving the severest penalties, were the law of the Land. General Malines, in his *LEX MERCATORIA*,^(3.) Anno Domini 1656, thus defines the Statutes then existing:—

"Statute Law of England, Ireland and Scotland concerning fishing:—The several Statutes of these Kingdoms have established good orders concerning the Fishing Trade, whereunto relation may be had, containing, in substance, the ordinances to build ships and boats and appointing of certain times for fishing; and then only to fish upon pain, not only of forfeiture and fines, but Death, also according to the manner of offence made, and contempt of those decrees and ordinances. Prohibiting (for the increase of fishes) the making, setting and using of crows, yarres, dams, ditches, tramlets, parkings, dlykeing and

1. Anspach in his History of Newfoundland (1819) notices the value of *shore cured* fish as recognized by the British Merchants in 1549. He refers to the injury done to the fish by salt and pickle, and the pressure to which it is subjected in the holds of vessels. Page 55.

2. See Decree (French) of 2nd March, 1852, for an illustration of the manner in which the French Government authorized the use of the Strand in Newfoundland. Appendix.

3. See App. to Jour. of Assembly, Newf'd, 1857, page 343.

wacirs; and albeit, some are permitted to lay nets and to make wacirs, yet must he keep the Saturday's Stop, that is to lift the same from Saturday in the afternoon until Monday—and he is to make each space of his net 3 inches wide, excepting for taking smelts and other fish, which will never be bigger, and the same is to be set upon the water, that the mid stream may have the space of SIX FOOT WIDE UPON PAIN OF FIVE POUNDS."

"That till sunset on Sunday, no man lay or traile nets, great line, or exercise any labor, upon paine as aforesaid."

In Norway numerous regulations exist, and are efficiently maintained by a police force, all tending towards the preservation of the Strand fisheries.

The difficulty of establishing and carrying out the necessary regulations for the protection of the Strand fisheries and maintaining a free passage in rivers for the Anadromous fishes in the United States, has been already adverted to, and further reference may be made to the Report of the United States Commissioner of Fish and Fisheries on this subject. ^[1.]

It is, however, proper to notice that in the opinion of the U.S. Commissioner "Any marked increase in the number of the Shore fishes, resulting from their protection during the spawning season, will probably tend to restore the Blue sh to their original numbers. (page xl.) The destructive influence exerted by the Blue fish is noticed at length in paragraphs 14 to 16.

Hence it appears that the preservation of the Strand Fisheries is an element of much importance, not only in relation to the productive character of these fisheries, but as bearing upon the productiveness and preservation of the deep sea-fisheries outside.

XXIX. The fishing gear ^[2.] employed by the United States fishermen is, in all respects, superior to the gear generally used in many parts of the British American fishing grounds, and particularly in Newfoundland. Complaints are constantly made by the Newfoundland fishermen of the very indifferent character of their fishing apparatus, and they urge that competitive rivalry with Americans in the same waters places them in a very disadvantageous position. It may not be out of place here to refer briefly to another disparity which is felt and seen in a marked degree. The system of education which has so long prevailed in the New England States, exercises its potent influence on the calling of the fishermen. General knowledge, however superficial, which is so common,—almost universal—among New Englanders, gives to them all the advantages which education confers in any walk of life. For resolute daring, and skill in all that relates to the mechanical work of a sea-faring life, the British American fishermen are unsurpassed, and are often selected for their pre-eminence in these qualities by their American rivals. But there is a lack of the higher elements which result from preliminary education and training. Hence it happens, too, that they have become wedded to old ideas, loath to break loose from the customs of their forefathers, and slow to recognize the improvements which, in recent times, have been so extensively introduced into one of the oldest industries, and yet one the least indebted to the discoveries of Science or the devotion of cultured minds to its pursuit. ^[3.]

1. Report for 1871-1872, page xxxix.

2. See Report on Fisheries pursued by Americans in Canadian waters, by W. H. Venning, Inspector of Fisheries, 28th October, 1873.

3. In Norway extraordinary efforts have been made for many years under the auspices of the Government to aid the fishermen, not merely in the construction of better apparatus for taking fish, but also in obtaining a knowledge of the habits of the fish, of their food, of the season best adapted to capture them, without injure to the fisheries, of the relation one kind of fish bears to another—in a word, of the SCIENCE OF THE FISHERIES.

In the United States the successive Reports of the United States Commissioner of Fish and Fisheries (Professor Spencer F. Baird) embrace the results of observations carried on for several years under the auspices and authority of the United States Government. These Reports embody the labors of many scientific men of the first rank. They abound in varied information of the most useful and practical character. They contain also, important papers translated from various sources of acknowledged merit and standing. The whole is presented in a spirit of impartial and unbiassed enquiry, looking to a "knowledge of the truth" as the sole object in view. The efforts of the United States Government and of the gentleman who presides over the United States Commission of Enquiry, are ably seconded by the several States interested in the preservation of the Deep Sea, as well as the Inland Fisheries. The results of these governmental scientific labors, joined with those carried on in equal spirit and with like aims by the Dominion Government, can not fail to be in a few years of the greatest benefit to that special industry of the sea, whose aggregate annual income in North America exceeds thirty-five millions of dollars, and whose prosecution engages the sole attention, and, as in most cases is the sole resource, of more than half a million of people.

But the object of these enquiries on the part of the United States, is to effect, if possible, *the restoration of that which has been ruined, and the recuperation of that which has been impaired.* With the Dominion Government, it is *the preservation of that which exists in a highly remunerative condition, and is possessed as a national inheritance.* During the period which must necessarily elapse before restoration begins, or while recuperation progresses, the fishermen of the United States are privileged to participate in the enjoyment of a remunerative industry, which they may leave, after a few years' lucrative joint share of proceeds, in a condition of hopeless depletion.

No wonder, then, that the resigning of one-half interest in the Strand and Inshore Fisheries is of the gravest moment to the Dominion, in regard to the maintenance of its Commercial Marine, as well as of that wide spreading industry which sustains so large a portion of its population on comparatively barren shores, where the land area is generally unproductive, but the sea a perennial source of wealth.

No wonder, too, that the acquisition by the United States of this privilege is regarded as a gain equivalent to the restoration of their Commercial Marine, (XXVIII.) and far exceeding the aggregate value of the bounties by which efforts have so long been made to nurture and sustain it through the Fisheries. It is a gain which overshadows the supply of food it assures, because it affords time and opportunities for endeavoring to recuperate the waters of the United States, and for bringing back similar conditions to those which formerly existed there, and which still obtain in such fruitful abundance, on the coasts of British America.

XXX. From preceding paragraphs it will be seen that any discussion of the amount of just compensation which may be claimed for an equal participation in the British American Fisheries, conceded by the Treaty of Washington, involves many other considerations besides those belonging to the additional annual commercial advantages it secures. Among the most important of these are—

First—Its effect upon the British American Deep Sea Fishery—the Inshore Fishery and the Strand Fishery—singly and combined.

Secondly—Its effect upon the British American fishermen, formerly in the enjoyment of those Fisheries with enormous advantage to themselves and the State.

Thirdly—Its effect upon the Commercial Marine, and its maritime population as Ocean Carriers.

Fourthly—Its effect upon the United States Fishing Industry, by lessening the risks at which the fish food demanded by a rapidly growing population is secured.

Fifthly—Its effect in restoring the Commercial Marine of the United States.

Sixthly—The condition in which it will leave the British American Fisheries, after the period over which the Concession extends has expired.

FRENCH DECREE REGULATING THEIR NEWFOUNDLAND FISHERIES.

"The Decree of the 2nd March, 1852, comprises forty-eight articles, amongst which, that the harbours and places with the *grèves*, which belong to the coast of the Island of Newfoundland, do not continue to be of the choice of the first person who arrives nor of the first occupant.

The particulars shall be made known according to a topographic plan of the Coasts of Newfoundland, as follows:—

Names of Harbours.

Number and names of places comprised in each Harbour, and number of *Batteaux*.

The nomenclature of places will be divided in the following manner in three established series.

First Series, 15 *Batteaux* and above.

Second Series, 10 to 15 *Batteaux*, exclusively.

Third Series, 0 *Batteaux* and above.

Every five years the "*Armateurs*" of the different ports of France, who propose to send vessels to the Cod Fishery upon the coast of Newfoundland, shall make to the *Chef de service de la marine à St Servan* a declaration of the number of vessels they will arm for the Fishery, with tonnage and number of men, and the class of the vessels in these Series. That is to say, First Series, 153 tons, and over 50 men, at least. Second Series, 100 to 153, exclusively, 30 men. Third Series, under 100 tons, 20 men and 25 if to use a seine

Bulletins will be prepared, bearing the name of the vessel and the series, and put in an urn from whence they will be successively drawn in the presence of all the "*Armateurs*."

As fast as the Bulletin is drawn, the "*Armateur*" of *Marée* indicated by the Bulletin chooses a place in the Series to which the vessel belongs.

The Second and Third Series are proceeded with in the same manner and form as the First Series, afterwards to draw for vessels fishing on the Banks for places to dry fish on the coast.

Each *Armateur* will conserve, during five years, the enjoyment of the Harbor and place which shall be assigned to them.

No vessel can go fishing upon the coasts of the Island of Newfoundland if there is not delivered to the *Armateur* a *Bulletin de mise en possession* for the place of which he is *concessionnaire*, or a *Bulletin d'authorisation de pêche dans les baies communes*

Every *Armateur* who shall not, within the year, *du tirage général des places*, send his vessel, will lose his rights to the enjoyment of that place and be otherwise subject to one of the penalties following.

4000 fr. for the *navires* of the 1st Series.

3000 fr. for the *navires* of the 2nd Series.

2000 fr. for the *navires* of the 3rd Series.

1000 fr. for the *navires*, who obtained concession of a place on the coast for drying fish.

The *amende*, or penalty, shall be pronounced by the *Chef de Service de la Marine à St Servan*: when the parties believe they ought to call for that decision, the affair will be submitted to the examination of three *Arbitres*, designated by the *Armateurs* in General Assemble; if their decision is not conformable to that of the *Chef du Service*, *Le Ministre de la Marine* will decree definitively after having taken communication *du Chef du Service* and of *Arbitres*.

Every *Armateur*, to whom shall be conceded a place, shall be held to occupy the first year of *tirage*, by the ship conceded to, or another of the same series at least, if the ship is sold, the purchasers will be held to the same obligations, under the responsibility of the vendor.

During the four years following that of the *tirage général*, there will be made each year on the 5th January, *un tirage partiel* of vacant place in the manner prescribed for the *tirage général*.

The oldest Captain shall perform the functions of *Préfet* in all the harbours, and in all the *Baies communes*; but the Captain *au long cours*, shall have always priority over the *Maîtres de Cabotage*.

The Captain *Préfet*, is specially charged to maintain discipline, police, and good order, in the harbours, and the *Baies communes*, to assure to each Captain the enjoyment of the harbour, the *grève* or anchorage, and roads; to receive the complaints of *Captitines Pêcheurs*, and to decide whenever he is competent to judge of them, after having examined the facts, and acquired proof as far as possible.

He presides at all meetings of Captains which may take place in the harbours under the *Baies communes*, and terminates as *Préfet honoraire*, and without charge the contests that may arise between the Captains; he cannot exact any retribution nor emolument of the *Captitines Pêcheurs*; he will weigh minutely the decisions that he makes, and state the proof of the facts, *par des procès verbaux*, of all the contraventions of the decree committed, pending the duration of the fishery, and sign these *procès verbaux*, and cause them to be signed by the officers, and the *maître d'équipage*, and on his return he shall transmit the said *procès verbaux* and the decisions to the *Commissaire de l'inscription maritime*, in the port from whence he parted; besides he shall send to the said *Commissaire* a detailed report upon the navigation, and upon all that may concern the improvement of the Fishery.

If the Captain *Préfet* is himself interested, or if he is absent, the affair shall be brought and submitted to the judgment of the *Préfet honoraire* of the neighbouring port.

The Captain *Préfet* is bound to send to the *Commandant des bâtiments de la Station* when they make inspection of harbours, specifying the state and condition of each place in particular; if it is or not occupied as the rule prescribes, and if all things there are legally observed.

All crimes or outrages, contrary to discipline, all contraventions to established rules in that which concerns the *régime* of the Fishery, and the mode of occupation of places will be by him denounced to the *Commandant des dits bâtiments*, whose mission is to repress them and to maintaining, everywhere, good order and the observance of the decree.

If one commits a crime, which in France is under the jurisdiction des tribunaux the Captain *Préfet* fulfils the functions of *judge de paix*, he forms the first instruction and watches to prevent his escape, and commits him to the *Commandant de la Station* with the documents stating the proofs and verifying the facts of the crime.

The *Navires pêcheurs* cannot obtain their papers before the 1st March for the Banks and for the West Coast, and before 1st April for the East Coast of Newfoundland.

All Captains of *Navires* who shall set sail and make route before these dates, will be subject to a penalty of a thousand francs for which the *Armateur* will be wholly responsible.

No Captain can establish his *Navire* to fish or dry it in a harbour, other than that which shall have been assigned by *bulletin de mise en possession*, under a penalty of five thousand francs. It is forbidden to all Captains, under a penalty of five hundred francs, to cast ballast into harbours or break or transport stages, or other articles remaining on the shore.

The Captains are obliged to procure for the *Commandant des bâtiments en Station* upon the coast of Newfoundland, details that these officers demand of them upon the working of the Fishery, upon the police observed by fishermen, upon the number and state of their *navires*, their *Batteaux* and their *équipages*.

All *Navires* destined for the Cod Fishery, whose equipage shall be forty men or more, shall have on board a surgeon. It is formally interdicted to embark spirituous liquors *à bord des bâtiments*. The administration *de la marine* will concert with those *des douanes* the measures to take for preventing the embarkation of spirituous liquor.

A penalty of five hundred francs will be incurred by all *Armateurs* who shall make sale of spirituous liquors for their own account to the *équipages de ses navires*. The revenue of the penalties or *amendes* shall be put in the chest of the *Invalides de la Marine*."

"The above list shows that there are:—

- 51 Harbours.
- 156 Places assigned for Fishery.
- 102 Places which are occupied.
- 101 Vessels.
- 583 *Batteaux*.
- 178 Cod Seines.
- 5917 Men."

CHAPTER I.

CONTENTS.

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1. The principles which guide the operations of Fishermen in conducting the Deep-Sea Fisheries, possess great similarity in every country and on every sea. The views so universally held, and supposed to be the result of centuries of experience, relate, for the most part, to the migration of fishes, their modes of spawning, their food, their habits of life, and generally, to the causes which have led to their increase or decrease. They profess to embrace, too, and, in some instances, to explain, the fluctuations which are inseparable from the pursuit of extremely active and habitually wandering creatures, whose movements during the greater part of the year are wholly or in part hidden from our eyes, and are at the best conjectural:

2. It is only within the last ten or twelve years that many of these views and the principles to which they have led, have been proved to be erroneous, and, in some cases, opposed to actual fact. But guided, in many instances, by myths handed down from father to son through many generations, disastrous enterprises have been very frequently undertaken, a useless and injurious legislation successfully invoked, enormous interests jeopardized or sacrificed, ⁽¹⁾ and treaty concessions made, productive of unexpected and disastrous results.

3. The supposed migrations of the Cod, the Herring, and the Mackerel, the three leading commercial fishes in our seas, are all based upon an incorrect interpretation of observed facts, and have often injuriously operated upon the fishing industries in different parts of the world. But most of all have those great natural influences, exemplified by meteorological effects and their relation to fish life, been lost sight of or ignored, and what is a purely natural result, has been rashly attributed to apparent disturbing causes, of which man is supposed to be the originator. The French terms, "Coureurs du Golfe," "Defileurs," and the operation involved in the term "defiler le

1. For an enumeration of the evils which have resulted from ill-considered legislation, brought about by ignorant clamour, see the various Reports on the Sea Fisheries of the United Kingdom and the Reports of the U. S. Commissioner of Fish and Fisheries.

Golfe,"^(1.) are illustrations of terms which have led to misconceptions, arising from incorrect interpretations of the supposed movements of fish. In their extended application they have been the cause of much loss of labor and capital, erroneous views of the state of the Fisheries, and, in some instances, of angry international discussions and impotent conclusions.

4. On the other hand, the landsman, engaged in pursuits far removed from the seaboard, which apparently could have no possible relation to the fisheries in coastal waters, has been unobtrusively, yet most effectually, leading to their gradual diminution and ultimate destruction, by polluting the waters and barring the passage of rivers to myriads of spawning fish, which, on their descent to the sea, became the annual source of the food which lured the deep sea fish to approach the sea margin.^(2.) Where the interests of the landsman, whose independent industries have thus destroyed the coastal sea fisheries, are so bound up with the ramifications of great manufacturing and lumbering interests, that any sudden change in these is felt over wide areas and throughout populous communities, restoration becomes exceedingly expensive, tardy, and, in some instances, impracticable, as on many parts of the New England coasts, formerly celebrated for the extent of their cod fisheries and the different industries to which that pursuit gave rise. But in thinly settled and, to a large extent, rocky and barren countries on the sea coast, such as large portions of the Maritime Provinces of the Dominion, the North Shore of the Gulf, Newfoundland and the Labrador, where the number of persons inhabiting the country does not exceed 6.4 per square mile, and where the inland industries have not, even in the most settled portions, acquired either great development or powerful political control, the evils which may there have insidiously crept into existence, can be easily and speedily remedied, and the original relation between marine and river life not only re-established, but vastly improved.

But throughout the wealthy and politically powerful New England seaboard, where the population is 99.66 to the square mile and the country settled, as it were, to the sea margin,^(3.) the repair and restoration of some of the coast fisheries, formerly so abundant and lucrative, is now acknowledged to be in a measure beyond relief. This is the result of opposing inland interests, confronting a contracted and *insufficient sea area*, suitable for reproduction, equal to the demands of an excessive and constantly increasing population.^(4.) In Dominion waters the process of restoration has already commenced, under the fostering care of the Central Government, who control the sea and inland fisheries of each Province, and the result of their work is already seen in the re peopling of many coastal waters with the food of the deep sea fish. Whereas, in the United States, the central power, however far-seeing, willing and liberal, is limited in its action by the authority of individual States, who control their own inland waters. Concurrent action, faithfully worked out, might produce considerable results, but it is just the

1. Pêche de Terre-Neuve. App. iii.

2. See Report of the U. S. Commissioner of Fish and Fisheries on this subject. Vol. II. 1872-73. P. xii.

3. See Appendix to this Chapter, No. i.

4. The "Sea Fisheries" refer not only to that great Staple Fishing Industry of the Dominion and Newfoundland, the Cod Fishery, but to the decline of other fish of a purely local character and not represented in Dominion waters. See page xxvii. of the "Report of the U. S. Commissioner of Fish and Fisheries," for 1871-72, for an enumeration of these fish, and page xi. Vol. for 1872-73, for "Conclusions as to decrease of Cod-fisheries on the New England Coast."

concurrent action between Federal and State Governments which it is so difficult to inaugurate and control.

Hence it is, that in any endeavor to form an estimate of the evils which have been permitted to accrue to the Deep Sea Fisheries by wholly independent operations on the land, we must carefully distinguish between those which are susceptible of diminution or removal, and those which are so deeply engrafted into the political or commercial system, that remedial measures are difficult and, in some instances, impracticable, and the fisheries affected, hopelessly ruined for commercial purposes. On the other hand, it is incumbent upon us to assign its full bearing and value to that political status which permits, not only of the restoration of depleted coastal waters to their original wealth of fish life, but has within its grasp the power to increase, to an indefinite extent, the productive and life-sustaining capabilities of the seas under its control:

Apart, too, from the mere length of Coast line belonging to any State, its geographical, as well as its orographical features, must be taken into consideration. A serrated or indented coast line, with numerous bays and indents, islands and harbors, is essential to vigorous and abundant fish life and fishing industry. An unbroken stretch of coast, without indents or bays, is unsuited to the perpetuation, if once impaired, of its original stock of fishes. Fish fry or embryos living near the surface of the sea, find the chances requisite for the attainment of maturity to be less in the open ocean than within the limits of protecting bays. Permanent and successful sedentary Coast Fisheries are nearly always situated within the borders of headlands, where they are secure from the uncontrolled sweep of the ocean waves. But a glance at any map of the United States and British America shows at once a disproportion in geographical outline. The curves of the Coast of the United States, for long stretches south of Maine, are unbroken and uniform (106.) In the British Provinces the coast line is in general a serrated edge with profound bays and inlets, stretching inland for miles, all of them affording those protecting nurseries for young fish life which are essential to the maintenance of the species in numbers equal to the yearly increasing attacks upon them, whether directly, as a commercial product, or indirectly as food for those which form the object of man's pursuit. The importance of geographical outline of coast in an opposite direction is strikingly illustrated by the condition of the Shell-Fish Fisheries on the English coast. Where Nature protects these fisheries by exposure to storms, the fishery is still as productive as ever; where the fishery is prosecuted in sheltered bays, decline is the prevailing outcry. Mr. Frank Buckland's recent reports on the "Crab and Lobster Fisheries of England and Wales" (1.) states that "where the ground is small and sheltered, the fishery is decaying; where it is exposed to the sea, as at the Lizard and the Land's End, or at some distance from the shore, as at Gorran, near Mevagissey, there is no clear proof of any decrease whatever. The whole of the Cornish evidence may, in fact, be summed up in the sentence that the fisheries in bays require protection, but that the large fisheries off headlands or in the deep water need no protection from the Legislature" (Page xi.) This decision, it must be remembered, refers to the Crab and Lobster Fisheries only, but these are of vast moment to the Deep Sea Fisheries. (xxiii.)

5. In nearly all legislation hitherto, relating to the Deep Sea Fisheries, the views entertained with regard to the habits

1. London, 1877.

of life, and particularly the manner and time of the spawning of various species of deep sea fish, have led to enormous expenditure and disastrous enactments. If the discoveries of Dr G. O. Sars in 1864-5 had been known to the "Committee appointed to enquire into the Sea Fisheries of the United Kingdom?" in 1863, whose work was continued for three years, the greater part of their prolonged labor and of their voluminous report, would have been regarded as useless before issued from the press.

6. In like manner certain efforts which are stated to have been made during the negotiations connected with the Fishery clauses of the Treaty of Washington, to prove that the mackerel is a fish belonging exclusively to United States waters, and only wander occasionally into British American Seas, would have been early set at rest, if it had been then known what Sars knew in 1865, about the spawning habits of that fish.

7. So also with regard to the herring and its winter home, the manner in which it seeks, and the places where it finds its food, the different periods at which it spawns, the depth of water it selects to accomplish the spawning process, and its general relation to other deep sea food fishes, are all subjects which, if they had been properly understood at the beginning of the present generation, would have led to the avoidance of much litigation, many vexatious regulations and enactments, and wide spread inconvenience and suffering.

8. But apart from all these illustrations of imaginary principles, and the uprearing upon them of fallacious arguments, there are those new principles, hereafter referred to at length, which have so long escaped observation, but which appear to embody the best exposition of our knowledge of the subject at the present time. These go far to subvert popular ideas respecting fish life and its preservation in useful abundance. But they tend to prove that the cold water sea area on the coasts of the United States is utterly insufficient to resist the drain made upon it.

9. It is not the least remarkable feature in the endless discussions, which have arisen on the subject of the fisheries during the past half century, that until within the last decade, exclusive attention has been devoted to the living inhabitant of the sea, without reference to the physics of the sea itself. This can only be paralleled by an attempt to discuss exhaustively, the theory of the respiration of land animals, without referring to the physical and chemical constitution of the atmosphere they breathe. Or, it may be likened to an attempt to comprehend the principles of modern agriculture, without reference to the chemical composition and physical properties of the soil.—to drainage and rotation of crops.

10. It is true that existing information respecting the relations of marine life to temperature, food, and different zones of depth in the sea, is still very imperfect, yet what is known, not only outlines the direction which must be taken in all enquiries into the Deep Sea Fisheries, but it satisfactorily disproves much that has hitherto been the basis of argument and of action on this comprehensive subject.

11. The broad relation of our commercial food fishes—the Cod, the Herring and the Mackerel—to the temperature of the medium in which they live, is clear and beyond dispute.⁽¹⁾ Cold water sensare necessary to their existence in numbers suffi-

1. In the report of the United States Commissioner of Fish and Fisheries for 1871-2, the following geographical limits of these fish are given in a

cient to become objects of commercial importance. Warm water seas, such as the Gulf Stream, are wholly unsuited to their habits and increase. No one would expect ever to see the Arctic hare successfully acclimated in the pampas of South America, or the graceful tropic bird sweeping through the frigid atmosphere of the North Atlantic. We have, therefore, a well defined geographical question to answer at the outset, namely, the boundaries and area of the seas suitable for the feeding grounds and home of our commercial deep sea fishes, a question which brings us at once to the geographical limits of the Gulf Stream, on the coasts of North America, and the area occupied by the Labrador Current, which lies between it and the coast line. In other words, we require to know the relative area and character of the great feeding grounds of our commercial sea fishes subtending the coasts of the United States and of the British American Provinces. Continued and surprising productiveness, within certain limits, where almost every square mile has been annually fished for more than two centuries, with not unfavorable results during an average of years, is represented by some of the fishing grounds in the Straits of Belle Isle, where an ice-cold current is not only maintained all the year round, but where ice is to be met with in abundance near at hand during every month of the year.

12. According to the Charts published by the United States Coast Survey, the area of coastal waters north of Cape Hatteras, within the hundred fathom line of soundings, does not exceed 45,000 square miles. The area embraced within the limits of a similar line of soundings in the seas off the British American coasts exceeds, according to the Admiralty charts, two hundred thousand square miles. These are seas rarely invaded, except at their extreme Southern edges, by the Northern surface flow of the Gulf Stream,⁽¹⁾ and are especially adapted, from their low temperature, to be the homes of the commercial food fishes named. They are seas teeming with that kind of marine life which serves as food for bottom feeders, such as the Cod, or for surface feeders, such as the Herring and Mackerel.

The hundred fathom curve of soundings is bounded more or less closely off the coasts of the United States by the heated waters of the Gulf Stream, and the area of cold waters during the summer months is greatly invaded by its surface swing towards the shores. The hundred fathom curve of soundings in British American waters is invaded only on its outer edge in a few places along the Coasts of Nova Scotia and the Southern edge of the Grand Banks of Newfoundland. All within these limits and lying to the North, West and North-East in a limitless sea of cold water, covering, beyond the hundred fathom curve of soundings, many hundreds of thousands of square miles. It is the home of those minute forms of marine life which are, indirectly, the sole known source of the food, not only of our commercial fishes, but of most, if not all cold water inhabitants of the deep sea.

"Catalogue of the Fishes of the East Coast of North America," by Theodore Gill:—

Scomber Scombus—Mackerel—Greenland to Cape Hatteras.

Gadus Morrhua—Common Cod Fish—Polar Regions to Cape Hatteras.

Clupea Harengus—English Herring—Polar Regions to Cape Cod.

See also an article entitled "Account of the Fisheries and Seal Hunting in the White Sea, the Arctic Ocean, and the Caspian Sea," by Alexander Schultz. Report for 1874-5.

1. See Dr A. Petromann's Mittheilungen, 1870. Chart of the Gulf Stream in Summer, (July): showing the distribution of the Marine Isothermals. Also, Chart of the Gulf Stream in Winter, showing the distribution of the Marine Isothermals in January. (1870). Also Admiralty Chart.

The United States Cold Water area is but a thin projecting wedge thrusting itself between the land and the Gulf Stream towards the south-west; and it derives much of its wealth of cold water marine life from the seas lying adjacent to, and to the north of British America, and partly washing its north-eastern shores.

Whatever source of food exists in the northern Arctic and Sub-Arctic waters on the North American coast, must drift with the current past the British American coast line, to the waters off the United States, or be carried beneath the Gulf Stream itself (119).

13. But it is in relation to coast line and the immense area of shallow waters, commanded by the coast line,—the breeding ground a vast variety of marine forms which become the food of the commercial fishes,—that the contrast between the feeding and reproducing areas in British American and United States waters, stands out in the most striking disproportion.

The length of coast line in the United States north of Cape Hatteras is about 1070 geographical miles. The length of the British American Coast line is—

	Miles.
Of Newfoundland.....	2000
Of Labrador as far as Nain, not including the deep indents or Fords.....	360
New Brunswick.....	545
Nova Scotia.....	1170
Quebec.....	1164
* Total.....	5239

The greater portion of this coast line is rocky, barren, and incapable of settlement. There, the sea fronts a thinly settled and to a great extent, a desert country, but as a necessary sequence to this, the natural wealth of the sea is preserved from diminution, the rivers, for the most part, from impassible dams, and the shore fisheries are rarely subject to speedy decline from engines of destruction, such as have, jointly with the Blue fish, injured the Sea fisheries of the United States.

This enormous length of coast line bordering British American waters confronts in a great measure the spawning grounds of the herring, the mackerel, to a certain extent of the cod, and to an immense extent those of smaller fish which serve as fish food. No doubt each of the species of fish above enumerated spawns also in deep water and in the open sea, in some cases remote from land, but large schools spawn in known localities in the vicinity of the coast, and it is this feature which draws to the coastal waters the schools of cod in pursuit of their natural food. There are two, as will be hereafter enumerated, other species of fish such as the Capelin,⁽¹⁾ which habitually approach the coast to spawn, in the cold waters of British American seas, but which are not found in the coastal waters of the United States. There are no other fish known which approach the shores in such infinite numbers as the Capelin, in the almost ice-cold waters of British North America, Greenland, and the Northern Coasts of Norway in Europe; and these innumerable hosts are generally followed, through sometimes preceded, by schools of Cod, which find in them their natural food during the early summer months, and probably prey on them during the winter months in the deep waters nearest to the coast line. ⁽²⁾

*See Appendix to this Chapter, No. 1.

1. *Molletus villosus*—Capelin. Polar Regions to Nova Scotia. Theodore Gill.

Report of U. S. Commission of Fish and Fisheries, 1871-2. page 810.

2. The Finmark "Lodde," or Capelin Cod Fishery.

14. The coldness of these northern waters not only adapts them to the requirements of our commercial fishes in regard to breeding grounds, and an inexhaustible supply of food, but it secures them from the destructive ravages of certain predacious fishes, which according to the testimony of the United States Commissioner of Fish and Fisheries, have largely assisted in destroying the food fishes in the coastal waters of the United States. "The decrease of the fish may be considered as due to the combined action of the fish-pounds or weirs and the Blue fish; the former destroying a very large percentage of the spawning fish before they have deposited their eggs, and the latter innumerable numbers of young fish, after they have passed the ordinary perils of immaturity."^[1] According to the same distinguished authority, "There is no parallel in point of destructiveness to the Blue-fish among the marine species on our (the United States) coasts."^[2] It is a warm water, wandering fish, visiting the northern coastal waters of the United States only when they are warmed by the sun's rays in the early summer. As the winter approaches they return to the South. In this respect they differ from the Cod, the Herring and the Mackerel, which fish, contrary to popular and long prevailing views, have their winter homes throughout British American Seas, as well as on the coast of the northern United States. Its influence on the Mackerel Schools which frequent United States waters farther to the south than either the Cod or the Herring, can not but be very detrimental, since young Mackerel are found in the stomachs of this most destructive fish; and being largely a surface feeder, its ravages are mostly directed against other surface feeders, in the deep sea as well as in shallow water, on which it preys. The Sea Herring, (*Clupea Harengus*) although a surface feeder, is not included in the list of fishes destroyed by the Blue-fish, because its habitat does not extend below Cape Cod, nor does the Blue-fish reach to where the Herring is most abundant.^[3] Mr. Commissioner Baird in his exhaustive Report on the Blue-fish (page 242) estimates that the number of Blue-fish on the coasts of the United States during the years 1871-2, at about one thousand millions, and the number of pounds weight of fish they consumed during an average stay of 120 days amounted daily to 2,500,000,000, or equal to three hundred thousand million pounds for the season, (page 242). The Commissioner well states that in whatever light we may view the estimates made of the destructive ravages of the Blue-fish, "there still remains an appalling aggregate of destruction."

15. The Blue Fish is not known within the limits of British American waters. Happily its appearance on the coast of the United States in numbers so great and destructive, is a calamity which appears to occur periodically only, and continues for a limited number of years; but the bare fact that the coastal Fisheries of the United States are subject to the periodical incursion of a powerful and destructive enemy of the food fishes like the Blue Fish, which literally sweeps the coastal waters during the time of its invasion, vastly diminishes the value of those coastal waters for the deep sea fisheries which lie at the base of commercial enterprise. The Blue Fish in United States waters is a substitute for these commercial fishes, it is consumed to an

1. Page XXXIX., Report of the United States Commissioner of Fish and Fisheries."

2. Ibid. page 241.

3. See page 235, of the Report of the U. S. Commissioner of Fish and Fisheries 1871-73, for a full account of the habits and ravages of the Blue-fish.

immense extent in a fresh state, but it is not suited for exportation to foreign markets, and while it destroys the special industry which relates to one branch of the Deep Sea Fisheries, it gives rise to another industry in the catch of these fish and their sale as fresh fish, of a purely local character, which is carried on as far south as the Carolinas and Georgia, and far south of the 39th parallel, or the limits assigned to British American Fishermen under the Fishery Clauses of the Treaty of Washington, or three degrees less than were enjoyed under the Reciprocity Treaty. In the early winter months the Blue Fish is taken in immense numbers for the northern markets on the shores of North Carolina, "where from Nag's Head, in Currituck County, to Cape Look-out, there is a very extensive fishery prosecuted, which furnishes Blue Fish for the northern markets;" (page 236, Commissioner Baird's Report for 1871-72). From all participation in this Southern Fishery, the British American Fisherman is debarred by the limiting clauses of the Treaty. It is thus, that while directly destroying or greatly injuring the cold water fisheries on the northern coasts of the United States, and indirectly, diminishing the fish fry which serve as food for the Commercial Fishes, the Cod and the Mackerel, the fact of its being a warm water migratory fish, seeking a winter home on the coasts of the Southern States of the Union, and giving rise to a great industry there, in which British American fishermen cannot participate, the Blue fish, notwithstanding its ravages, is a very important source of wealth to the United States, and to such a degree is its importance recognized, that the United States Commissioner of Fisheries officially declares that "there are no measures at our command for destroying the Blue fish, nor would it be desirable to do this, in view of their value as an article of food" (Page XXXIX—Report of Commissioner of Fish and Fisheries, 1871-72)

16. Besides the winter pursuit of the Anadromous Fishes in this forbidden ground, the Gloucester Fishermen, as soon as their codfishing is over on the Georges' Banks, prepare in April for the Mackerel fishery, and go as far south as Virginia, gradually working their way north easterly towards the waters of Rhode Island and marketing their catch for the most part in New York. (1.)

The history of a year's work of a Gloucester Fishing Craft, may be thus briefly summed up: She may start from Gloucester on the first of December for Fortune Bay, Newfoundland, and take in a cargo of frozen Herring, which she purchases at a merely nominal price from the fishermen of Fortune Bay. She arrives home in February, and refits at once for the Georges' Bank fishery; returns with full fare in April, refits, and starts for waters south of the 39th parallel and engages in the Mackerel fishery, fishing north-easterly. "The number of Gloucester vessels finding employment in the Mackerel fishery in 1875 was 180, of these, 93 made southern trips, 117 fished off shore, and 58 visited the Bay St. Lawrence." "Six hundred and eighteen fares were received, 133 from the South, 425 from off shore, and 50 from the Bay." (2.) Returning from the South the Gloucester vessel may again refit and start for the Newfoundland Cod Fishery, getting her Bait from the Newfoundland coast. If successful, she returns to Gloucester, and may again refit and go once more into Southern Waters, and continue her calling throughout the entire winter, and pursue it without interruption from year to year, as a natural result of the advan-

1. The Fisheries of Gloucester, by Proctor Brothers.

2. *Ibid.*

tage she enjoys of being able to sail wheresoever the prospects of remunerative fares are most encouraging, without regard to parallels of latitude, or the fear of passing forbidden boundaries.

17. It is admitted that the Blue Fish jointly with the engines of destruction used by man, has in a large measure ruined the coastal fisheries of the United States. "The decrease of the fish may be considered as due to the combined action of fish pounds, or wiers, and the Blue fish, the former destroying a very large per centage of the spawning fish before they have deposited their eggs, and the latter devouring immense numbers of young fish after they have passed the ordinary perils of immaturity." But the Blue fish in its summer migration appears to leave the waters which lie south of the 39th parallel free from its depredations. These waters furnish an immense amount of fish food, measured by tens of millions pounds annually, and to them the limiting clause of the Treaty of Washington, closes the door. So that while the Maine Fisherman can pursue his calling in Northern waters during the summer months, and Southern waters during the winter months, the British American Fishermen is limited to cold Northern waters during the whole year.

18. The following quantities of fish were inspected in Washington market during 1873-4 and '5 :

	lbs.
Inspected in 1873 (1).....	8,548,851
" " 1874.....	10,827,967
" " 1875.....	7,002,049

The diminution of Herring and Shad was the most noteworthy feature in relation to the relative abundance of the fish in each year, but the most important fact to the British American Fisherman is that nearly all these fish, if not all, were taken South of the 39th parallel, and chiefly from the Potomac and Chesapeake Bay. In these extensive coast fisheries all British Fishermen are debarred from participating by Treaty.

The United States fresh fish trade, including only such products of the coast fisheries as are brought in by vessels making entry at the Customs Houses, is not only enormous in magnitude, but a large proportion comes from Southern waters and is taken where British American vessels are forbidden to go. The statement derives force from the fact that if the quarterly entries at the Customs Houses are examined, it will be found that the product of the six winter months is double the product of the six summer months. Thus, taking the imports recorded during the year 1873-74, the following are the relative proportions :— (2)

Fresh fish (not Shell fish) entered during the six winter months :

September 30th, 1873, to Dec. 31st, 1873,....	18,205,900 lbs.
December 31st, 1873, to March 31st, 1874,....	3,040,600 "

Total fresh fish during six winter months, 21,246,500 lbs.

Fresh fish (not shell fish) entered during the six summer months :

June 30th, 1873, to Sep. 30th, 1873,.....	3,148,466 "
March 31st, 1874, to June 30th, 1874,.....	7,382,700 "

Total fresh fish during six summer months, 10,531,166 lbs.

Total yearly imports of fresh fish during the year 1873-74,..... 31,777,666 lbs.
or 14,186 tons.

1. See "Annual Record of Science and Industry." Edited by Spencer F. Baird, U. S. Commissioner of Fish and Fisheries.

1. Monthly Reports.

19. In another and subsequent report (1872-73) the United States Commissioner of Fish and Fisheries refers to his "conclusions as to decrease of Cod-fisheries on the New England Coast," and prefaces his remarks with the statement that "of all the various fisheries formerly prosecuted directly off the coast of New England, north of Cape Cod, the depreciation in that of the Cod appears to be of the greatest economical importance." (Page xi. Report of 1872-73.) The cause of the destruction of the Cod fisheries is stated in substance to be as follows: The construction of impassable dams across rivers has prevented the alewives, the shad and the salmon from ascending and depositing their spawn. The result has been the almost extermination of these fish on the New England Coast. The Cod formerly approached the shore to feed on the young fry, but there being now no young fry to feed on, the Cod have been starved off the coast, and thus one important fishery ruined. ⁽¹⁾

Similar statements are made in a letter addressed by Commissioner Baird in 1872, to E. M. Stillwell, one of the Commissioners of Fisheries of Maine, U. S.

These important statements and conclusions are elaborated and confirmed by the Maine Commissioners in their report for that year, and reproduced with additional force in the Eighth Report of the Fishery Commissioners for the same State in 1874.

So great has been the ruin occasioned by the mill-dams barring the upward route of the Anadromous fishes, that Professor Baird says: "Whatever may be the importance of increasing the supply of Salmon, it is trifling compared with the restoration of our exhausted Cod fisheries; and should these be brought back to their original condition, we shall find within a short time, an increase of wealth on our shores, the amount of which it would be difficult to calculate." ⁽²⁾ But there is no effectual remedy for this condition of things, in consequence of the powerful lumbering and manufacturing interests of New Hampshire and Massachusetts. ⁽³⁾

20. Here then we have three potent and sufficient causes assigned by the United States Commissioner of Fisheries for the decline and exhaustion of the Deep Sea and Coastal Fisheries within United States waters:

- I. The Blue Fish.
- II. The pounds, weirs and other engines of destruction.
- III. The barring of Rivers.

To these may be added a fourth, namely, the *limited cold water sea area subtending the Coasts of the United States* (56)

The Blue Fish, it is admitted, it is not desirable to destroy, for it is a valuable article of summer and winter food.

The obstructive barring and pollution of Rivers can not be remedied except during a long lapse of years, owing to the opposition of powerful manufacturing and lumbering interests. Some of the pounds and weirs have been removed to British American waters, where, unless they were suitably controlled, they would produce similar effects to those existing in the coastal waters of the United States, but in a measure determined by the injudicious and uncontrolled use of these fishing engines.

21. In British American seas the present condition of the coastal waters, in relation to our commercial food fishes, is en-

1. Page xii. Report of Commissioner of Fish and Fisheries, 1872-73.
 2. Report 1872-3. Page XIV.
 3. Ibid. Page XII.

tirely different. The Blue Fish is unknown. The rivers are each and all under the control of the central Government, with the exception of those in the colony of Newfoundland. There are no powerful manufacturing or lumbering interests, which prevent the construction of suitable fish ways. The coast line is thinly settled, very much of it is barren, incapable of settlement, and is five times as long as that of the United States. The cold coastal water feeding grounds of the commercial fishes are four times as great, and, with the exception of a few isolated cases, these coastal waters are not seriously injured or impaired by engines of destruction, under the present system of organized protection, which has existed for some years past. But, what is of far greater consequence, they lie to the South of the vast marine area which is the great manufactory and storehouse of the food of our cold water marine life. Whatever, too, of this food supply reaches the thin wedge-shaped area off the United States, must pass through seas confronting British American coast lines.

22. At the first blush it might appear that these distinctions were of minor importance; that the swift and agile inhabitants of our seas would pass backwards and forwards, for instance, from the banks of Newfoundland to Cape Cod, and from Cape Cod to the Grand Banks again, with constant and undeviating regularity. Indeed, it might be urged that the very depletion of the waters at the thin end of the wedge on the United States coast, would be periodically supplied from the broad base on British American shores, and a better climate and a longer fishing year were the advantages enjoyed by the United States, owing to geographical position. But here steps in a principle, elaborated and defended by the United States Commissioner of Fish and Fisheries, which, of itself, and without and assistance from other independent considerations, wholly disproves this view.

"In all discussions and considerations," writes the United States Commissioner of Fish and Fisheries, ⁽¹⁾ "in regard to the sea fisheries, one important principle should be carefully borne in mind, and that is, that every fish that spawns on or near the shores has a definite relationship to a particular area of sea-bottom; or, in other words, that, as far as we can judge from experiment and observation, every fish returns, as nearly as possible, to its own birth-place, to exercise the function of reproduction, and continues to do so, year after year, during the whole period of its existence." And again—"A second law, equally positive, with a great variety of fish, is that they pass from their spawning grounds to the sea by the shortest route that will take them out into the deeper waters, where they spend the winter; and that coming and going to and from a given locality, they follow a determinate and definite line of migration."

23. It follows, from a recognition of these principles, that if we know the geographical position and the aggregate area of the breeding grounds of different species of fish, we are in a great measure acquainted with the geographical position of their winter homes. We are able to form a well-defined opinion respecting the relative numbers which do or may visit any particular length of coast line, and the relative facilities offered by different coast lines and coastal waters, not only for the reproduction and maintenance of the species, but for the annual catch of such species in remunerative quantities for commercial purposes.

1. Page xxviii.—Report of Commissioner of Fish and Fisheries, 1871-72

In effect, this opinion, once correctly framed, would determine the relative values of British American and United States Sea Fisheries

24. But at the outset of this enquiry we are confronted with views and statements relating to the habits of our commercial sea fishes which are not only opposed to fact, but to the last degree prejudicial to a fair and unbiased statement of the case. The Cod, for instance, is said to migrate from the Grand Banks in American Seas during the winter months, and to proceed to the Fiords of Norway, via Iceland, for the purpose of spawning, returning in the spring to the coasts of North America. This remarkable statement is embodied in a letter addressed by Commissioner Baird to the Fishery Commissioner for the State of Maine, before referred to, and printed in the report for 1874, without comment or contradiction. (See Appendix I Chap. II.) It is not to be supposed that the "United States Commissioner of Fish and Fisheries" endorses this statement, but merely there refers to it as a popular and widespread opinion which had not been successfully controverted.

But if not controverted in the clearest manner, the presence of this fish at any particular part of the British American Coast, might be regarded as an accident of migration, and liable to be greatly influenced by many contingencies, such as difference in the seasons, the presence of ice, &c.

The attraction which draws the Cod to the Grand Banks of Newfoundland is said to be the numerous schools of herring, and other wandering fish which frequent those Banks in the spring of the year. The Mackerel is stated by some to be equally migratory in its movements, and to wander only during summer into British American Seas, returning during the winter into waters off the Coast of the United States. These opinions are so engrained into men's minds, that nothing less than a strict record of contrary fact will subvert them, and give place to correct views of the habits and relations of these fish. This is a first step necessary to a true exposition of the wealth of British American waters, and an acknowledgment that they are the great storehouse of our fish supplies, and the real and only mainstay of the Deep Sea Fishery Industries both of British North America and of the United States.

Such a record of fact will establish, too, the principle enunciated by the United States Commissioner of Fish and Fisheries, and show that the homes of the great majority of the deep sea commercial fishes are in the vicinity of the coasts of those cold water seas which wash the extended shores of British America.

When to this record there is added a correct view of the spawning habits of most of our commercial sea fish, joined to a brief exposition of the physics of our seas, it will follow as a necessary deduction, that along the whole flow of the Labrador current, from Hudson's Straits to the coast of Massachusetts, the natural re-peopling of depleted waters goes on from North towards the South, and is ultimately limited and governed in all its details by the surface Southerly movement of the Labrador current, which is, at the same time, the chief instrument by which the fish life is diffused, sustained and either directly or indirectly fed, on the entire North American Coast where its cold waters prevail.

The Lofoten Cod Fisheries have long been celebrated for the extraordinary gathering of Cod fish there during the winter for the purposes of spawning, and the view is also widely entertained that here alone is the spawning ground for Cod on the

Norwegian coast. The true statement of the case, however, is widely different. The Cod spawn all along the twelve hundred miles of the coast of Norway, confronting the ocean, just as the American Cod spawn at different periods of the year all along the North American coast, from Labrador to Massachusetts. In Professor Sars' report for 1870, this extraordinary delusion with regard to the habits of the Cod is noticed at length, and the views of that distinguished Ichthyologist are of such weight, and their bearing of such importance in relation to the whole subject, that a translation of his remarks will be acceptable:—

(1) "Regarding the occurrence of the winter Cod in general, I have already, in my first report, given it as my opinion that the same does not only visit some certain parts of our coasts for the purpose of spawning; but that in, all probability, they press forward at the same time under the land along the whole of our coast, north and west, and that the reputation which the Lofoten Fishery has so long had, is more particularly owing to the peculiar orographic formation of its groups of Islands, stretched far out into the sea like a wedge or tongue of land, than to an unusual richness in fish of the outer sea.

"Everywhere where, at the time the Lofoten fishery ceases, trials have been made at the Fish-places lying against the ocean swell, the winter Cod has also been observed, and likewise, in later times, several formerly little noticed fish-grounds have turned up, where even an unusually rich winter fishing might have been carried on.

"The information I obtained at Bodo seems likewise to point to the fact that innumerable quantities of fish do also here spawn outside the reefs every year. In general, where the "Smaagjed" (young of the winter cod, 1½ year old) is met with in quantity under the land, we may with certainty reckon on that likewise their ancestors, the winter cod, will show themselves at a certain time in the channels, at all events, at the outer fish places, lying in the ocean swell, for the purpose of spawning.

"I am convinced that many stations well adapted for Skrei-fishing (cod fishing) are now lying as good as idle, a thing which is essentially owing to adhering so obstinately to old ways and usages, which forms so conspicuous a feature in the Northlander's character." (2)

1. The writer is indebted to Herr Verkrutzen, member of the Malacozoological Society, at Frankfort on Main, for the translation from Norwegian of Prof. G. O. Sars' Reports for the year 1870 to 1874.

2. Report to the Home Department, by Dr G. O. Sars, on the Practical and Scientific investigations respecting the Cod Fisheries on the Lofoten, from 1870 to 1873. Christiania, 1874.

CHAPTER II

THE COD.

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25. To those who are not familiar with the extent of the industry implied by the term "North American Cod-fisheries," some insight into its magnitude and importance may be gathered from the fact that there are annually taken from North American waters about one hundred and fifty millions of cod-fish. This is assuming that the number of fish required to

make one quintal of dried fish averages forty. On the Labrador it often exceed one hundred to the quintal, on the Banks it often falls much below forty to the quintal. But taking the entire number caught, small and great, one hundred and fifty to one hundred and seventy-five millions of fish each year, would be a fair representation of the aggregate catch, which is thus apportioned :

	Quintals.
Dominion of Canada ⁽¹⁾	1,000,000
Newfoundland, including Labrador ⁽²⁾	1,200,000
Newfoundland and Labrador, home consumption, one quintal per inhabitant	170,000
French exports from the Bank Fishery and the Shore Fishery ⁽³⁾	500,000
United States ⁽⁴⁾	750,000

Total quintals, or 185,000 tons of codfish ⁽⁵⁾ 3,700,000

In Norway, the Lofoten catch of 1873 yielded 12,000,000 fish, cured and prepared as Cliffish. ⁽⁶⁾ and producing 360,000 quintals, which would be at the rate of 32 fish to the quintal. The aggregate catch of the Lofoten Cod fisheries averages about 20,000,000 fish, and the entire Norwegian catch of Cod in 1873—a very good year—reached 46,000,000 fish, valued at nearly \$3,000,000. The North American catch, of 3,700,000 quintals, at \$4 a quintal, would amount to \$14,800,000. An industry so enormous in its extent, so varied in its character, and so far-reaching in its influence on maritime pre-eminence, well deserves that some consideration should be given to the life history of the creature upon whose numbers and habits it is altogether dependent. ⁽⁷⁾

So far from the American Codfish possessing the marvellous migratory characteristics imputed to this, the first in importance among our sea fishes, it is essentially a 'home fish,' wintering near our shores, spawning near our shores, and spending its life in traversing a comparatively limited area in search of food. It is taken on the coast of North America during every month of the year. When the Norwegians are pursuing their annual catch of what is termed there "The Winter Cod," the Newfoundlanders on the South coast of their Island are taking the same species of fish the winter through.

When the coasts of Finmark are thronged with fishermen catching their fares of the "Lodde" or summer Cod, the shores of North-east Newfoundland and the entire shore of the Gulf of St. Lawrence are alive with fishermen, successfully capturing the same variety of fish in British American waters; and when the Russian on the Murmanian coast is laying in his winter stock of Cod, and accumulating a large overplus for a foreign market, the Newfoundlander and the Labradorian are securing full fares as far as the Moravian Missionary Stations,

1. Deduced from Tables prepared by the Deputy Minister of Agriculture (J. C. Tache), showing the Statistics of catch and adding local consumption.

2. Deduced from exports during 1869 to 1875, inclusive.

3. The French Newfoundland Codfishery produced, in 1872, 10,500,000 francs; in 1871, 8,300,000 francs. At 20 francs a quintal this would yield about 500,000 quintals. (See Appendix.)

4. Mean of 1870, 559,982 quintals, and 1874, 950,732 quintals. Vide "Census" and "Monthly Reports."

5. See Statistics of the Cod Fishery at end of this Chapter.

6. The Stockfish are dried in the air, without salt, and are as hard as a board.

The Cliffish are salted and dried in the same manner as the Newfoundland shore-cured Cod.

7. See Appendix F., at the end of this Chapter, for Statistics of the Norwegian Cod Fisheries.

Okak, and Nain. So also in the North Sea, and on the coast of the British Isles, around the Feroe Islands, all along Icelandic shores, on the South coast of Greenland, off Arksut Fiord, away up North to the Torske Banks and down the Atlantic coast of America over the Grand Banks and as far as, and even beyond St. George's Shoal, the Cod is taken simultaneously and in great abundance.

Local variations of days and even weeks occur in a coast line, or stretch of shallow sea, of not more than a hundred miles in length, but these arise from the one great leading cause which guides the Cod in its approach to known feeding grounds on the coast, or known banks at sea. This leading cause is temperature, which determines the movement toward the coast of the various forms of marine life, on which the Cod inhabiting different waters, is accustomed to feed.

It is also the one great guide in determining the season for spawning, which on the North American coast runs through nearly all, if not quite all the months of the year, and is regulated at different localities by temperature, conjointly with the presence of ice.

The Cod caught on each stretch of coast line, within variable but tolerably well-defined limits, are INDIGENOUS to the sea area adjacent to the coast which they frequent. Thus, the winter haunts of the Cod caught on the Northern Labrador are the slopes of the great range of outside Banks on that coast. ^(1.) The summer haunts of the "winter cod" caught on the coasts of Norway during the winter season, are on the slope of the "Storegg" and its continuations, which lie seawards from the Norwegian coast, following the edge of the barrier separating the "Polar Deeps" from the shallower coastal seas. ^(2.) The seasonal movements of the Cod are reversed in these cases, purposely introduced, but they afford a beautiful illustration of the principles adopted and confirmed by Professor Baird, and of the influence of marine climate on fish life.

The food which lures the cod to the shore at stated periods, varies also in different seas and at different periods of the year. On the northern coasts of Norway, in Southern Greenland waters, throughout the whole coast line of Newfoundland, all along the south-west and north shore of the Gulf of St. Lawrence, and far up the Labrador coast, it is the Caplin or Lodde of the Norwegian and Danes, which brings in the summer young cod. Throughout the North Sea in Europe, on the Atlantic coast of the British Isles, on the Atlantic coast of Nova Scotia and the United States, it is the Herring. These at the best, are broad generalizations, but they outline the movements of the Cod and the causes which lead them coastwards in different seas, remotely apart, and they dissipate the idea of that grand imaginary migratory movement, which has found such wide spread favour.

The following details of the Fishing Seasons for Cod in Europe and America sufficiently establish the simultaneous appearance of this fish in various seas belonging to the two continents. Brief notices of the character of some of the fisheries for cod in distant waters are interspersed for future reference.

1. See notes on the Northern Labrador Fishing Ground, by the author of this paper. November, 1876.

2. Prof. G. D. Sars. The Norwegian North Sea Expedition.

A.

FISHING SEASON FOR COD—EUROPE.

BRITISH ISLES. (1.)

Staithe (E. coast Eng.), November until March.
 Great Grimsby (E. coast Eng.), October and November.
 Orkneys (Kirkwall), Winter and Summer.
 Shetland (Lerwick), Winter—May until August.
 Dungarvan (Ireland), Christmas to end of March.
 Carrickfergus (Ireland), November until March.
 Tenby (Wales), November to February.
 London (England), January to May.
 Dingle (Ireland), South-west Coast, Christmas to August.
 Stornaway (Hebrides), Winter and Spring.
 Summer fishing on the English coast, ten to thirty miles from land—July to October.

B. NORTH SEA.

Dogger Bank—November to March or April.
 Cromer Knoll—November to February.
 Foula Bank—(Between Foul Island and Coast of Zetland).
 April until September.

ATLANTIC OCEAN.

Faroe Banks—South-South-West of the Faroe Islands, April until September. (2.)

“Hand-line” fishing for Cod commences in the coast or “home” waters in July, and is continued till near the end of October. “This fishing is mostly carried on at from 10 to 30 miles from the coast, as the herrings at that time are approaching the shore, and the cod follows them closely.” (3.)

Iceland Ground—West Coast. Summer. (4.)

C. HOCKAID.

A bank 300 miles west of the outer Hebrides—Spring and Summer.

D. NORWAY. (5.)

LOFOTEN.—January to the middle of April.

ROMSDAL.—January to the middle of April.

FINMARK.—End of March to July.

The Lofoten Fish are full of Roe or Spawn, of which 31,000 barrels were taken in 1873. The Fish are supposed to spawn in the Fiords. Romsdal Fiord is south of the Lofoten group of Islands and the great ‘West Fiord.’ The Finmark Cod Fish are much more rarely found with roes or spawn in them. They are locally supposed to be the remnant of the Schools which spawned around the Lofoten Islands in the early part of the year. But as they are much smaller than the Lofoten fish, this must be a mistake. The Fiord fishery for Cod is prosecuted all the year round, but less in summer than at any other period.

E. THE WHITE SEA.

On the Murmanian Coast the Cod Fisheries occupy about 5000 fishermen from April to August. (6.)

F. DENMARK.

North-East Coast of Zealand, The Kattegat, Nymindégab,

1. Appendix to Report of the Commissioners appointed to enquire into the Sea Fisheries of the United Kingdom.

2. Holdsworth—Deep Sea fishing, p. 305.

3. Ibid, p. 146.

4. In 1875 Iceland imported 9,000,000 lbs. of *Klip fish* (salted and dried Cod) and 250,000 lbs. *tor fish* (dried Cod.)

5. Consular Reports, 1873.

6. M. A. Schultz—Journal of the Dresden Geographical Society, 1873-4.

Lym-fiord, Odense-fiord. Season as in the Norwegian Fiords, and on the Norwegian Coasts.

From the foregoing statement (A) it appears that the Cod fishery is carried on at different parts of the coasts of the British Isles during every month of the year. The fish are always present there, and as the fish are generally caught with long lines or hand lines, whatever so called "mother," or spawning fish are taken, must be captured by this means, as few are gathered in the trawl nets, and seining for Cod is not pursued.

G. ICELAND.

The large Cod remain, during the winter months, near to this Island, and as on the coast of Norway, in February and March approach the South coast to spawn; the fishermen, according to Vice-Consul Crowe,^[1] affirm that the direction of the fish is from West and South.

The best fishings commence in the months stated above, at and near the Vestinauris Islands to Versterhorn, and towards the end of June or beginning of July, the fishings begin further round to the north. "Cod is found in great numbers in Faxebay as late as May, and in Breida Bay in June, and somewhat later along the coast to the northwest."^[2]

In this respect the Cod fisheries at Iceland resemble the Cod fisheries on the Grand Bank of Newfoundland and towards Belle Isle and the Labrador. The French "*Defileurs*" in the Gulf, "*following*," as is stated, the fish towards Belle Isle. A similar apparent change of quarters is observed on the Norwegian coast. After the Lofoten Fishery ceases the Finnmark Fishery begins, and goes gradually further north towards the White Sea.

But are these different "fishings" true indications of the movements of the fish. There are reasons for believing that the schools are distinct, and that their appearance on the coast is the result of age and a search for food. Many of them consist of young Cod which have not begun spawning.

In his report, Consul Crowe expresses the following opinion: "As the principal fishings begin on the Newfoundland Banks, at the Faroe Islands, the Loffödens (Norway) and in Iceland about the same time, it is quite evident that the Iceland Cod is not a migratory fish, but a dweller in the vicinity of the Island where it finds its food—in summer out at sea, in the other seasons near the land."^[3] He goes on to say that "the winter and spring fishings give the large fat cod which is sold at the factories and trading ports, and afterwards prepared for export, while the summer fishings only produce the small cod, coal fish, haddock and halibut."

Fishing by nets is only carried on in the south part of Faxebay, between Skagen and Havnefjord, where the nets are sunk, as the fish in these parts generally keep close to the bottom; the fish taken by the net are different from those caught on the line, being more squat and plump, with smaller heads."

In 1862, 1489 barrels of Cod Roes were exported from Iceland.

The average export of Fish is as follows:

	Ordinary year.	Abundant year.
Clippfish, lbs.	3,520,000	5,280,000
Stockfish, lbs.	1,408,000	2,112,000

The French catch, however, greatly exceeds this annual yield. In 1864 there were 260 vessels and 4,337 men engaged

1. Report by Vice-Consul Crowe, on the Fisheries, Trade and General Features of Iceland, 1865 and 1866.

2. *Ibid.*

3. Page 30. Iceland, 1867.

in the Iceland Cod Fisheries. They take frequently 30,000 Cod per ship,^[1] and their annual catch was then estimated at about 5,000,000 francs. In 1872 the French Iceland Codfishery employed 252 vessels and yielded about 6,400,000 francs worth of fish, against 10,500,000 francs and 187 vessels representing their Newfoundland Fishing industry.

H. GREENLAND SEAS.

Greenland, Riscoll Bank, (67°—68° Lat. N.) May, June, July and August.—(Sutherland, Arctic Regions, Pro. Geo. Soc. 1853.)

Bank, (probably Viktori Ground, lat. 66—67.) In 1846, two vessels took 29,405 cod from this Bank, many with the jigger or rasper, but most of them with hand lines in 15 to 40 fathoms, 30 to 40 miles from land. The catch was made by 20 men in 28 days. Some of the fish weighed, when dressed, 60 lbs. In 1847 the fishing was pursued from 23rd June to 16th August, when 42,142 fish were caught. (British Commission, 1846, quoted by Perley.)

Torske Bank, near Sukkerstoppen (Lat. 63.30.)

Tallart Bank, (Lat. 62.)

Holstenburg, (Lat. 67.)

Arksut Fiord, (lat. 61) famous for Caplin. (Sir. C. Giesecke.)

I. DAVIS STRAITS.—*East Side.*

This water is also mentioned by Mr. Holdsworth, but the locality is not given, probably the Viktori ground. In 1846 Mr. Hay, of Lerwick, sent some of his vessels there and had a very successful season. The three following years proved also very good, but 1850, 1851, 1852 were very bad seasons, and no more attempts were made until 1862. But the cod were scarce in that year, and the fishery was abandoned.

Comparing the results of the Davis Straits fishery with the general results of the Newfoundland fishery of the same years, we have the following approximation.

DAVIS STRAITS.	NEWFOUNDLAND.
1846. good.	bad.
1847. "	"
1848. "	medium.
1849. "	very good.
1850. bad.	good.
1851. "	medium.
1852. "	bad.
1853. "	"
1854. "	very bad.

J. DAVIS STRAITS.—*West Side.*

August and September.—Davis describes the schools of Codfish on the Coast between Latitudes 67 and 57 N., on the Labrador, in the following language: "Coasting the shore towards the South, we saw an incredible number of birds; having divers fishermen aboard our barke, they all concluded that there was a great skull of fish; we, being unprovided of fishing furniture, with a long spike nayle made a hooke and fastened the same to one of our sounding lines; before the baite was changed we took more than fortie great Cods (September 7th, 1586, or near 300 years ago). The fish swimming so abundantly thicke about our barke as is incredible to bee reported, of which, with a small portion of salt we had, we preserved some thirtie couple or thereabouts, and so returned for England." (Haklut III., p. 120).

Davis also saw the Cod in possession of the Esquimaux who inhabit the land between Cape Raleigh and Cumberland Strait. (Quoted by Richardson. Fauna Am. Bor.) It is not improbable that the birds noticed by Davis were feeding on Caplin or Herring.

1. Consul Crowe.

K. MOVEMENTS OF THE COD ON THE LABRADOR.*

The following tables show the periods of first arrival and last catch of Cod on the Newfoundland and Labrador coasts. In framing these tables the writer has been careful to eliminate extreme seasons, for the Cod have been known to approach the shore during an exceptionally early season, a fortnight or three weeks sooner than during the average of years. Early and late springs occur in the movements of fish just as irregularly as in the movements of migratory birds, or in the leafing and flowering of plants. The salmon and the cod generally come within a week of one another, and the Eskimo of Ukkasiksalik have a tradition that the salmon may always be looked for on the day of the first spring tide after the 16th July. In 1875, a very late season, codfish were not taken before the 7th August at Ukkasiksalik (Lat. 55.52); in 1876 they came in on the 20th July, and this accords with the experience on other parts of the coast.

Table showing the approximate mean date of arrival, mean date of close of fishery and mean length of the fishing season for Cod in North-Eastern Newfoundland, Southern and Northern Labrador.

Lat.	Locality.	Mean date of arrival.	Mean date of close of fishery.	Mean length of fishing season.
NEWFOUNDLAND.				
47.30	Conception Bay	1st June	20th Nov.	} 143 days.
48.20	Bonavista Bay	10th "	10th "	
48.30	Notre Dame Bay	20th "	10th "	
50	Cape St. John to Par. Pt.	20th "	1st "	
49.50	White Bay	10th "	1st "	
51	Cape Rouge Harbor	10th "	1st "	
51.30	Cape Bauld to C. Onion.	20th "	20th Oct.	

Over Four Degrees of Latitude.

SOUTHERN LABRADOR.				
52.0	Chateau Bay	20th June	1st October	} 87 days.
	Batteaux	12th "	" "	
54.30	Indian Harbor	15th "	" "	
54.56	Cape Harrison	18th "	" "	

Over Three Degrees of Latitude.

NORTHERN LABRADOR.				
55.9	Aillik	20th July	1st October	} 52 days.
55.12	Kypokok	20th "	" "	
55.27	Hopedale	20th "	" "	
55.30	Double Island Harbour	22nd "	" "	
55.52	Ukka-iksalik	28th "	" "	
56.30	Nain	28th "	" "	
57.30	Okak	28th "	" "	
58.30	Hebron	15th Aug.	25th Sept.	
58.46	Lampson	15th "	15th "	

Over Three and a Half Degrees of Latitude.

From this Table, imperfect as it is, we may deduce the following law: "Over an area, extending northerly from Conception Bay for seven hundred miles, the cod approach the shore about one week later for every degree of latitude we advance to the north."

These tables show also that for a period of about forty days the cod-fishery goes on simultaneously during August and September, throughout the length of a coast-line extending from latitude 47.30 to lat. 58.30, or more than seven hundred statute miles in one continuous line. Hence it appears that the migrations of the schools of this fish are merely from deep

* See "Notes on the Northern Labrador Fishing Grounds," 1876, by the writer.

water winter feeding grounds to the nearest coast, and from the coast to the nearest deep water feeding grounds again.* The coast migrations during the summer months appear to be of equally limited extent, and schools of cod frequenting any particular coast, may be said to be indigenous to it.

ATLANTIC COASTS OF NOVA SCOTIA AND CAPE BRETON ISLAND.

CAPE BRETON ISLAND.

20th February to 20th May ^[1] on the coast near Ingonish. St. Lawrence Bay.—April and May, close in shore. ^[2]

Cod are commonly taken in the winter through holes in the ice in Bras d'Or Lake. ^[3]

ATLANTIC COASTS OF NOVA SCOTIA.

March to end of November. Cod are often found in the Halifax market in February. This year (1877) the writer purchased at Windsor, N. S., a Cod 22 lbs. in weight, which had been brought from Halifax at the end of February.

"Of the Cod family alone we know the winter quarters. All winter long they are taken 10 to 15 miles seaward in about 80 fathoms soundings."—Dr. B. Gilpin, *Trans. Nov. Scot. Inst., Nat. Sci.*, 1865-66.

"During the winter small specimens (of herring) are frequently taken from the cods' stomach caught upon the Banks. ^[4] The Banks here spoken of are about 10 miles seaward off Halifax Harbour.

The fishermen in the Halifax market assured the writer that Cod could be taken at any time during the winter season in deep water off Halifax Harbour. By deep water they explained 75 to 80 fathoms; two lines and a half to three lines. They believe that the Cod spawn on Sambro Bank in July. In June they cease to catch large spawning fish, but up to that month they take them full of spawn, but not ready to shed the spawn.

EAST COAST OF CAPE BRETON ISLAND,

Cod are taken until Christmas, when navigation closes. (Capt. P. A. Scott, R. N., 1870.) In Great Bras D'Or Lake, through the ice in winter.

M. BAY OF FUNDY.

—February to Christmas. Cod are taken in the winter season through the ice in the Kennebecensis estuary.

BRIAR ISLAND,

—Entrance to Bay of Fundy—20th April to 1st October.

In the estuary of the Avon they catch Cod as soon as the coast ice disappears, often in March, by means of hooks fastened to stakes driven in near to low water mark, the tide rising from 33 to 38 feet. They have to watch the line of bait to prevent the crows from taking it, and they generally bait at the beginning of flood, and find the caught fish at the ebb.

N. NEWFOUNDLAND.—*South Coast.*

Lapointe Bay. (Long 58.)—Cod all the year round.

Burgeo Island—Cod comes in from March to June; Salmon, May to July; Caplin, June to September; Squid, July to October; Herring all Summer.

Great Jervis Harbor, Bay D'Espoir—Cod and Herring all the year round.

Hermitage Cove—Fish with hook and line all the year round.

* This law, regulating movements of several species of fish, has long been recognized in other countries.

1. Appendix No. 16. Sessional papers, 1870. Report of Capt. P. A. Scott, R. N., Commander of the *Druid*.

2. *Ibid*.

3. Joseph Hardy, J. P., Baddeck, C. B.

4. Dr. Bernard Gilpin—*Trans. N. S. Ins.*, 1863.

Harbour Briton to Fortune—1st May to 31st October, is the season here for cod. ^(1.)

Off Port-aux-Basques.—“ All deep sea fishing handline in ninety to two hundred fathoms, five miles off shore. ^(2.) The Esquimo around South East Bay (lat. 68°) fish in the water for Halibut with lines 300 fathoms long at the foot of the Cloushaven Glacier. ^(3.)

Sagona Island (Fortune Bay)—February the best month for cod. ^(4.)

Sagona Island enjoys an excellent reputation for Cod, and the fishery there has always been esteemed a safe one.

In 1857 it is stated by the officer of the Revenue Service, that each fishermen averaged 200 quintals of fish. Sagona had then a population of 240. February is considered the most productive month for Cod fish. The winter caught fish are ready for shipment by the 20th June.^(5.) The winter fishery for Cod on the South Shore of Newfoundland, so far as the period of the year is concerned, goes on simultaneously with the great winter fishery off the Lofoten Islands in North West Fiord, Norway.

BAY DE NORD AND BAY D' EAST.—Winter and early Spring.

M. NORTH-EAST ATLANTIC COAST. ^(6.)

Table showing the dates of first appearance and departure of the Cod from the north-east Atlantic Coast of Newfoundland.

Station.	Year.	First arrival.	Departure.	No. of Days.
Cape St. John to Partridge Point.....	1871..20	June..10	October...	122
	1872..20	" ..31	" ..	133
	1873..			
	1874..	June 11..		
White Bay {	1871..20	June..15	August ...	56
Canada Har. {	1872..10	" ..20	Sept.....	102
Cape Rouge Har.....	1872..3	" ..1	October...	120
Croc Har. to Hare Bay. {	1871..20	" ..25	Sept.....	97
	1872..16	May..25	July.....	70
	1873..23	June..		
St. Anthony.....	1871..15	" ..25	Sept.....	102
Quirpon.....	1871..25	" ..		
	1872..20	" ..1	Oct.	103
	1873..30	" ..		

GULF COAST OF NEWFOUNDLAND.

Table showing the dates of the first appearance and departure of the Cod from the Gulf Coast of Newfoundland.

Station.	Year.	First Arrivals.	Departure.	No. of Days.
St. Margaret's Bay.....	1871..			
to				
Ingarnachois.....	1872..	15th April..	10th Nov.....	209
Ingarnachois.....				
to				
Bonne Bay.....	1872..	20th May..	30th Nov.....	194
Bay of Islands.....	1872..	1st May...	30th Nov.....	210
St. George's Bay.....		all the year		
to				
Cape Ray.....		round.		

SOUTH COAST OF NEWFOUNDLAND.

Cod found and taken all the year round on the South Coast :

1. Capt. Miller, R. N., H. M. S. Sirius—Fishery Report, 1873.
2. Capt. Erskine, R. N., H. M. S. Eclipse—Fishery Report, 1875, p. 9.
3. Sutherland—Q. J. Geol. Soc., 1853.
4. Revenue Officers Report, 1857. (Nil)
5. Appen. Newfoundland Journal of Assembly, 1857, page 379.
6. Captain Brown, R. N., H. M. S. "Dunne," 1871. Captain Erskine, R. N., H. M. S. "Eclipse," 1872.

STRAITS OF BELLE ISLE.

NEWFOUNDLAND COAST.

Table showing the dates of the first arrival and departure of the Cod from the Coasts of the Straits of Belle Isle.

Station.	Year.	First Arrival.	Departure.	No. of days.
Cape Bauld to Cape Onion	1871..			
	1872..	20 June..	1 October..	102
Pistolet Bay	1871..			
	1872..	"	20 August..	61
Cape Norman to)	1871..			
Savage Cove)	1872..			
Savage Cove)	1871..			
to St. Barbes)	1872..	10 June..	31st July..	51
Bay)	1873..	10 July..		
LABRADOR COAST OF THE STRAITS.				
Chateau Bay	1871..	20 June..	1st. Nov..	133
	1872..	"	30th Sep..	132
Red Bay	1871..	18 June..		
	1872..	20 July..		
Black Bay	1871..	20 June..	31st Aug..	72
	1872..	15 July..	Sep.....	
Forteau Bay	1871..	10 June..	25th Dec..	198
	1872..	9 June..	end of season	
Blanc Sablon	1871..	1 June..	10th Sept..	102

O.—ATLANTIC COASTS OF THE UNITED STATES.^(1.)

NEWPORT, RHODE ISLAND.

"The Cod are very generally distributed during the cold weather in the lower waters of the Bay, and on the approach of warm weather, work off into deeper water outside the bay, and are there less generally caught, but may be taken at all seasons the year round."

The Cod are generally found on this coast from March to Christmas.

Nantucket.—Spring and fall. A large school of small Cod remains in shore all the winter. ^(2.)

Coast of Massachusetts.—March to May.

Coast of Rhode Island.—All the year round. ^(3.)

Grand Manan —All the winter. ^(4.)

From these tables it appears to be incontrovertible,

1st. That the Cod is not, as has been alleged, a migratory fish.

2nd. That it is Indigenous to the coasts where it appears regularly at certain periods of the year, be those periods during the winter or summer.

3rd. That it is captured simultaneously all the year round in Europe and in America.

4th. That the great body of Codfish inhabiting American Seas are divided into very numerous separate schools, which are local in their habits, and that this is the result of marine climate.

It will now be shown that in whatever relates to the season and time of spawning, the relation of different schools of Cod to a definite area of the Sea is maintained and preserved.

THE SPAWNING OF FISH AND THEIR RELATION TO COASTAL WATERS.

26. Before we can arrive at any correct opinion respecting the approach of the Cod, the Mackerel, the Herring, the Caplin and other fishes, to the shores or their immediate vicinity, for the alleged purpose of spawning, it is necessary that we should in-

1. Evidence in the Report of the Commissioner of Fish and Fisheries, U. S. 1871-72. 2. Ibid, p. 45. 3. Ibid, p. 78. 4. Ibid, p. 135.

form ourselves whether the spawning operation actually occurs as stated, or whether it may not take place in localities far removed from the coast, and be, in this respect, wholly opposed to the views generally entertained by fishermen, who have been so instrumental in guiding opinion and framing enactments bearing often, and at different times, in opposite directions.

If the spawning of a certain species of fish does not necessarily take place near the coast line or in shallow waters, its relation to the coast line appears to be materially lessened, and indeed its life may be altogether independent of coastal waters, or by some law not evident at the first consideration of the subject, it may become by accident intimately associated with the coast line. Such is actually the case with many of our commercial sea fishes. Their relation to the coast line is determined in a great measure by the act of man (See statement, p. xxxix and xxx of the Report of the U. S. Commissioner of Fish and Fisheries for 1871-72). This is an important consideration, and has especial bearing upon the present exhausted condition of the shore fisheries of the United States, and the abundant fish life which is still found throughout the wide stretch of the British American Sea front. It must too, be borne in mind, that geographical position often determines whether a definite statement be applicable or not to any particular locality, or to any particular sea area. For instance, to affirm on the Coast of Norway, where the known spawning season of the Cod is winter, that the Cod spawns in August, would meet with well deserved ridicule from the fishermen on the great Lofoten Banks; on the other hand, were a Norwegian, fully satisfied of the results of his experience in his own home waters, to declare to the fishermen of Belle Isle, an equally well known and ancient fishing ground, that the proper season for Cod spawning was the winter, the assertion would probably expose him to equal ridicule.

But both are correct according to their own experience, and it is geographical position, with a great change in climate, which is the cause of the seeming anomaly. So, also, in considering the very important question of Bait, an overwhelming majority will aver that the Caplin spawn on the beaches, and that they must have sandy beaches to spawn on. The statement is, no doubt, to a certain extent true, but it is equally true that the Caplin spawn on submarine beaches, and in from twenty to twenty-seven fathoms of water. So, also, the Herring approach the coast to spawn in from 5 to 15 fathoms, but they also spawn in 100 fathoms, and perhaps at much greater depths. The spawn of the Herring adheres to any substance it touches, but the spawn of the Cod floats on the surface of the water and is drifted to and fro by currents. There are important differences in the spawning of all species of fish, and these differences have the closest bearing to the relation of our commercial fishes to the coastal waters. So that it is quite impossible for any one to estimate the true value of any stretch of coast line as a fishing ground or fish nursery, unless he has informed himself of what is known respecting the spawning and other habits of the species under discussion.

The differences between the spawn of fishes is very far from being so great as the differences in the manner in which the eggs, so to speak, are laid. Their subsequent history, whether attended and cared for by one of the parent fish or left to chance temperatures and escape from harm, also varies greatly, and perhaps in none of the circles of Nature is there such astonishing diversity of method as we meet with in fish life history, notwithstanding the scarcity of our knowledge in that field of enquiry.

27. The Secretary to the Royal Sea Fishery Commission⁽¹⁾ has embodied in the Introductory Chapter of his work on "Deep Sea Fishing" (1874) the facts communicated to him by Professor Sars relative to what had been observed with regard to the spawning habits of the Cod, and the hatching of the spawn at the surface of the sea.

The following are some of the facts he has recorded: "In 1864 he obtained, by means of his surface-net,—apparently the same kind of apparatus as is commonly used by naturalists for collecting minute floating forms of marine life,—the ova of the common Cod (*Gadus morhua*) floating at the surface; examples in various stages of development were procured, the young fish hatched out, and the species identified beyond a doubt. In 1865 the same observations were made on the ova of the haddock (*Gadus aeglefinus*) and it was satisfactorily determined that they went through all their stages of development while floating at the surface, in the same manner as had been previously ascertained in the case of the Cod. M. Sars writes to us that he was at first inclined to believe this development of the ova while floating was peculiar to the members of the *Gadidae*, or Cod family, in its restricted sense; but in the summer of 1865 he visited the Southern Coast of Norway during the season for Mackerel, and found abundant evidence of the same rule obtaining in the case of that widely distinct fish." (Page 29).

28. Again: "Entirely subversive as these discoveries of Professor Sars are our popular notions about fish spawning, it is even more unexpected to find that both he and M. A. W. Malm, of Gothenburg, have independently ascertained that the ova of the plaice (*Pleuronectes platessa*) follow this same rule of floating at the surface; and M. Sars adds that it undoubtedly applies also to the other Pleuronectidæ. * * * *

* * * * * For if that be the rule with the spawn of the Cod and Haddock, there can hardly be a doubt about its being so with the Ling, Coalfish, Whiting, Pollock, Hake and Torsk (*Brosminus*), all belonging to the same family. Again, Turbot, Halibut, Brill, Soles, Plaice, Dabs and Flounders are all closely allied, agreeing in certain obvious peculiarities of structure and in general habits. It has been ascertained by both M. Sars and M. Malm that the ova of the plaice, one of the most typical of this group of fishes, go through their several stages of development while floating at the surface; there is every reason to believe therefore that the ova of the other members of the family are subject to the same conditions." (p. 31.)

29. The birth place is necessarily the spot where the young fish first issues from the ovum, otherwise the principle would fail at the outset in the case of the Salmon, and with regard to all those fishes of which the germs, so to speak, are transported thousands of miles by artificial means. The birth-place of the Salmon of the Pacific Coast, introduced into Atlantic waters, is the river in which spawn has been introduced by the hand of man, where it is hatched and to which it is expected to return. The birth-place of the Scottish or American Salmon, introduced into an Australian River, is the Australian River itself, where the introduced spawn is hatched, and where, exemplifying Professor Baird's principle, the Salmon returns to breed as soon as it reaches maturity.

30. Hence, also, the ova of Cod, shed on the coast of Cape

1. E. W. H. Holdsworth, F.L.S., F.Z.S., and late Secretary to the Royal Sea Fisheries Commission.

Breton, which may be carried by the Labrador current, during its sixteen or eighteen days of development, some three hundred miles to the south-west, has its birth-place near the southern extremity of Nova Scotia, and thither the matured fish will return to spawn, if the principle holds good in the case of sea fishes, of which there does not appear to be as yet any reason to doubt. But the consideration of this subject shows how intimately blended with the question of the relative value of different coastal waters in relation to fish life, are the physic of the seas, their currents and temperature, together with their freedom from pollution, and freedom from disturbance, &c., on which abundance or paucity of fish life depends.

31. Among the fish enumerated by Mr. Holdsworth,⁽¹⁾ whose spawn is likely to float on the surface during the period of its development, are :

1. Cod, Haddock, Coalfish, Whiting, Pollock, Hake and Torsk, all belonging to the same family.

2. Turbot, Halibut, Brill, Soles, Plaice, Dabs and Flounders

3. Mackerel, Gurnards, and the Dory.

Among the fish whose spawn adheres to the bottom, or to any object in the sea, there are :

1. Herring, Smelt, Species of *Gobius*, *Liparis*, &c.

THE SPAWNING OF THE COD.

32. Everywhere the impression prevails among fishermen that the Shore Cod, or Cod generally caught in coastal waters, is a different species to the Bank Cod, a fish taken on reefs and banks in comparatively deep water and at a considerable distance from, as well as close to the land. The same opinion has until recently, prevailed among naturalists, but previous to the instructive and very interesting observations of the Professors Sars, father and son, the life history of the cod had never been traced from the egg to the adult spawning fish, and until 1870 it was not really known that the shore cod was the same species of fish as the bank cod. It has been established by the last named of these painstaking and persevering naturalists, that the Norwegian form of the cod has no regular spawning ground, in the sense of a definite area of sea bottom, but that it drops its spawn free in the sea, at a considerable distance from the bottom. The spawn does not sink, but goes through all its stages of development swimming free in the sea quite near the surface. Professor G. O. Sars was of opinion, that besides the better opportunities for the impregnation of the ova, the future supply of food, which might be more easily and safely secured for the young fish near the coast line, instinctively determined the approach of the cod to the shores when about to spawn. The eggs of the cod are transparent, and have a specific gravity so near that of sea water that they float near the surface where the degree of salinity ensures the requisite density of the water. If it should rain and the surface be diluted, and its specific gravity lessened, the delicately freighted egg sinks then to the denser stratum. In fresh water they sink to the bottom. Hence, continued rain may have a material effect on the development of the egg of the Cod at the surface of the sea. The milt of the male is also of less specific gravity than sea water, and like the eggs or ova it floats at the surface. The time required for hatching is about 16 days, but a further period of 14 days is necessary before the yolk bag is absorbed and the young fish swims free.

1. "Deep Sea Fishing." London, 1874.

Sars has also pointed out another remarkable peculiarity in the egg of the Cod, which exhibits a wonderful adaptation of means to the end. He says "the spermatozoa of the Cod fish are oval, or rather pear shaped bodies, to whose pointed end the tail is fastened. The milt like the roe, is of less specific weight than the sea water, and it therefore floats upon the surface as soon as it is poured out. This may account for the fact that male fish during the act of spawning generally swim deeper than the female; and likewise for the fact that *the micropole is located near the lower portion of the egg*, while with other fish which have been observed this order of things is reversed." These conclusions are of great interest in exhibiting the mode in which impregnation may take place in the open sea and at the surface, and how water having a specific gravity less than that of the eggs and the milt may be extremely injurious to the reproductive process. Such waters occur in bays near the mouths of large Rivers, and these are necessarily unfavourable localities as Cod spawning areas. When therefore it is stated that Cod come into certain bays to spawn, without actual proof resulting from observation, the specific gravity of the water may lead to conclusions as to whether the assertion is probably correct or otherwise.

These considerations taken by themselves do not appear to have any bearing, at the first blush, upon the productiveness or decline of Sea Fisheries, or upon their commercial value, but when questions are discussed relating to the causes of such decline, as for instance, the effect of the destruction of spawning grounds, or the effect of severe and inclement seasons upon the fisheries, they point to possible explanations which otherwise would escape notice. The causes which lead to great fluctuations are very obscure, yet, if it could be shown that during the spawning period of the cod in a given sea area, there had been an unusual fall of rain, the catch, two or three years after such spawning period would probably be small in consequence of the destruction of ova, which would otherwise have supplied the average abundance of fish. The next succeeding year may be very favourable for the development of the ova, and three years after, the catch may be correspondingly great in the sea area in question. The Mackerel are surface spawners, and it is notorious that the fluctuations in the catch of this fish are extreme. The meteorological conditions of the present year or of two years in succession, will necessarily affect the catch two and three years and perhaps four years hence, and it would be an illogical conclusion to state, that because the Mackerel fishery had declined for a series of years, that the decline was permanent. A single favourable summer for the development of such floating spawn might bring the schools back to their original strength, and recuperate seas, apparently showing exhaustion. But this is not the case with those fish whose spawn, like that of the Herring, adheres to the bottom of the sea. If this be ruthlessly destroyed by the acts of man, the loss is felt, not so much in the destruction of the schools of Herring, as of the fish which are drawn to coastal waters to feed on the spawn.

The Cod grows rapidly, and a well-grown yearling Cod is about a foot in length. As early as six months from the egg they begin to go off into deep water and are found in thirty fathoms, and perhaps at a much greater depth, but it does not appear that up to this time they have assumed the character of bottom feeders. The two year old and three year old Cod remain on the Norwegian coast all the year round, and it is not until they attain probably their fourth year that they have their reproductive organs developed so that they are able to multiply.

The innumerable hosts of Cod about 18 to 22 inches in length which are taken on the Labrador, and also on the coast of Finmark, are most probably composed of schools in their second and third year, among which there are, as in the case of Herring, a certain proportion in which the reproductive organs are being developed. But the great mass of Labrador Cod, those which go 120 to 130 to the quintal, are probably only in their second and third year. In another season they will change their habits to a certain extent and frequent the outside banks, becoming in other words bank Cod, some of them only, as heretofore, visiting the coast during the Caplin season, the others remaining outside and feeding on the vast submarine banks which lie off the coast line at variable distances. The adult Norwegian Cod retire after the spawning season is over, far from the coast, and are found, according to Sars, during the summer, on the slopes of the great submarine hills which form the coastal barrier of the "Polar Deeps."

Cod derive their color from the nature of the bottom they frequent, and the food they consume. They show singular instinct and sagacity in the pursuit of different kinds of food at different periods of the year, and wait, as yearlings, at the edge of breakers for young crabs washed out by the plunging seas. Until they attain maturity and go to summer feeding grounds frequented chiefly by adults, they show a remarkable instinctive knowledge of the habits of other fish, and lower forms which frequent the coast. Leaving abundance of Crabs to prey upon the coming Launce, leaving the Launce to prey on approaching Herring, and so on, according as the advance of the year brings different varieties of food towards the coastal waters, or takes them towards deeper water. We may recognize in these movements the cause of the supposed closing of what is termed the Spring Cod Fishery, and after the lapse of an interval of greater or less length, the beginning of the Fall or Autumn Fishery. But where are the two and three year old Cod during this interval between the Spring and Fall Fishery? Doubtless they have wandered into some well-known channel or sea valley where some certain species of fish are approaching or retiring from the shore. If we knew the lure which draws the Cod away from a known fishing ground to another area which is unknown, and the lure which brings it back again, the Cod might be caught in all waters without cessation except from physical causes. But we do not know the lure, and it is only by a careful examination of the stomach that we can arrive at this knowledge.

The evidence of the act of spawning on our coasts, which would appear to satisfy even the most superficial enquirer, is the exportation of Cod Roes from Newfoundland, the southern part of the Gulf of St. Lawrence and from Nova Scotia. The Norwegians export large quantities of Cod Roes, and no one disputes the fact that the Cod spawn on the coast of Norway. The British Americans also export large quantities of Cod Roes, taken from fish caught on many different parts of their own coasts, hence the conclusion is, to all appearance, inevitable, that the Cod spawn in the neighbourhood where they are thus taken, namely, with roes in them. But it may be urged that the roe of the Cod, which not unfrequently weighs 20 lbs., and sometimes considerably exceeds that weight, requires many months to arrive at maturity. It may "grow" slowly, and even when a fish with a very heavy roe is taken, it may be hard and in a state which shows that some weeks, at least, will elapse before the spawn is in a fit state to be shed. But if fish are taken with the roe in such a mature condition that it runs out of the

fish, when handled, or taken in a net, or lifted into a boat, the evidence is no longer lacking in a single detail.

Now, fish in this mature condition, in so far as the maturity relates to the state of the spawn, which permits it to flow freely from the fish, are taken every year in great numbers on the coast of Newfoundland, and, indeed, throughout British American waters. The reason why they are not more commonly captured, is, doubtless, due to the well known fact that fish *generally* do not take the bait well, when they are near their spawning time. And so strongly rooted has this opinion become, that it has been urged as a reason why the use of the bultow is not injurious to the Cod fisheries.

On the other hand, there are many who state from their own experience that Cod are freely taken by the bultow when closely approaching the spawning period, and they allege that the reason why spawning Cod, or Cod about to spawn, are not taken with the ordinary baited long line, is because the heavy gravid female will not rise from the bottom to take the bait suspended a few feet above her, as in the long-line method of fishing. But if the bait lies on the ground, as in the bultow system, the gravid females, and also the males, heavy with milt, will take the bait.

33. In the Straits of Belle Isle, and north of the island of the same name, the fishermen constantly take gravid females, with spawn running out of them when lifted into the boat, during the month of August. By the accompanying statements, from different and independent sources, and covering a large number of years, these views are confirmed in all particulars. It is essential to bear in mind that in cases in which the habits of animals are concerned, whether marine or terrestrial, the evidence of a few reliable persons, who state that they have observed any particular but not easily recognized habit or characteristic, must be regarded as confirmatory, even when opposed by the statements of ten times the number of individuals, who may not have noticed, or had not the opportunity of noticing, the same habit or characteristic.

The fact, however, that spawning Cod are constantly taken within the Straits of Belle Isle and around the Island of the same name, also on the south coast of Newfoundland, and on the Gaspé coast, and on the Nova Scotian coast, is so well known to fishermen who have fished with bultows, or allowed the bait to touch the bottom, or fished with seines, that it is unnecessary further to allude to such a constant occurrence here. The authorities and extracts given farther on will sufficiently establish this important fact.

It is more difficult, for reasons already stated, to give the precise month of the year in which the Cod spawns in different parts of North American cold water seas. The Roe must be in a condition to flow freely from the fish, and in the excitement and hurry incident to the fishing season, which those only who have witnessed it as pursued on a grand scale in Newfoundland and Dominion waters, can well appreciate, it is difficult to collect facts perfectly reliable without observations have been carried on for the purpose.

34. The following tables show the number of barrels of Cod Roes exported from Newfoundland since any steps were taken to initiate a trade in this article. Table No I. was furnished to the writer by Mr. Aubyn Pearce, of St. John's Newfoundland, who first commenced to make a business of collecting and exporting the roes. Tables Nos. II. and III. are from various official documents, showing exports and imports,

published under the authority of the Government. The experience acquired by Mr. Pearce in the prosecution of his business, relative to the parts of the Newfoundland coast which furnish the Roes, is interesting and important. In a statement made to the writer, at his request, Mr. Pearce says:—

“As to the time of year the Cod spawn, all I can say about this is, that I have had roes from the coast, from Cape Ray to La Poile, (south coast), as early as March and as late as October. From the Burgeo neighbourhood, the roes are got about June and July. In Hermitage Bay and parts of Fortime Bay, fish with spawn in them are caught in the winter. In Placentia Bay, where I get my chief supply from, the roes are taken as late as September, but are chiefly taken in July. The fishermen in this Bay use bultows very much and fish in deep water, consequently take large fish and numbers of spawning fish, which generally are found in deep water.

“The fish caught on the Banks off St. Mary’s, give a large proportion of mother fish in June and July. St. Mary’s Bay, Trepassy and the south-east coast to St. John give very few roes, and these very small, except where the bultow is used and in deep water.

“To the north-east of St. John, I never get any roes. I have seen roes from Conception Bay on one occasion, but they were very small, indeed; and as to the coast of Labrador, I have had barrels of melt brought me from there, but not one roe, and from enquiries I have made, I think I am safe in saying there are very few spawning fish taken on that coast. The French fishermen on the Newfoundland shore, from Cape John, west to Bonne Bay, take spawning fish on their bultows.

“From personal observation and experience of others, I am safe in saying that the cod spawn over a range of eight months in the year, at different parts of the Island. My reason for stating this is that I have received firm full roes, caught from 15 February to November; and at Placentia I saw thirty mother fish split, the spawn run from some like quicksilver, while others would bear some severe handling and would be put into coarse salt. The first were near the time of spawning, the others months off. This was about the middle of May. I have seen the same in August in other places.

“The smallest sized fish that I have seen with firm spawn would be about six pound when taken out of the water. The largest sized fish that gave spawn I have seen weighed three quarters of a hundred weight, (84 pounds). The largest Cod roe I ever saw weighed 23 1-4 pounds. This was from Placentia Bay, and the smallest sized roe, I should say about three ounces. The average No. 1, roes are about 5 to 8 pounds.”

I. EXPORTATION OF COD ROES FROM NEWFOUNDLAND.

These tables were kindly furnished to the writer by Mr. Aubyn Pearce, of St. John’s, Newfoundland, the Exporter.

Year	No. of Barrels.
1862.....	180
1863.....	380
1864.....	964
1865.....	1892
1866.....	1387

“Since this period the number has varied from 1200 to 700 barrels each year.

II. ST. PIERRE AND MIQUELON.

1862.....	501 cwt.
1864.....	790 "
(1) 1873-74.....	900 bbls. (108,164 kilos.)
(1) 1874-75.....	1310 " (157,283 ")
(1) 1875-76.....	1371 " (164,608 ")

35. CUSTOMS RETURNS.

EXPORT OF COD ROES—NEWFOUNDLAND.

Year.	Barrels.	
1865.....	1590.....	British Shore, 1490 French " 100
1866.....		
1867.....		
1868.....	1084.....	
1869.....	964.....	
1870.....	1265.....	
1871.....	1939.....	
1872.....	910.....	
1873.....	858.....	
1874.....	1186.....	
1875.....	221.....	

NOVA SCOTIA.

1871.....1952.....

Under date, St. Mary's Harbour, (St. Mary's Bay, S. coast.) 15th June, 1871, Capt. Malcolm, R. N., of H. M. S. *Dunbar*, reports as follows:—"The system of bag net fishing for cod must, in my opinion, be very injurious, as they kill enormous quantities of spawning fish, the spawn, representing some billions of eggs, was heaped up and salted, being exported in casks to the Mediterranean, and, amongst other uses, it is used as bait for Sardines." The system of "bultow" fishing is also stated to be generally condemned by the fishermen on the south coast, because it destroys the mother fish. It is alleged that the baited hooks, resting on the bottom, are taken by the heavy gravid female fish, which will not rise from the bottom to the suspended hooks in hand-line fishing.

36. The Fishery Report of Captain Paisley, of H. M. S. *Niobe*, for the year 1869, supplies an important fact in relation to the spawning season of the Cod on the South Shore of Newfoundland, and the alleged injurious effect of the bultow system which permits the bait to lie on the bottom, within reach of the gravid female fish. Under date "Placentia, June 16th," Captain Paisley states: "Whilst here, I observed a boat load of very large Cod, mother fish, landed, and on enquiry found they had been caught with the bultow; remonstrating with the fishermen about the use of the bultow, I was told: 'We know it does harm, but other people use it; we do too.' Several millions of fish must have been prevented from being spawned by that one take." (2.)

THE GRAND BANKS.

On the Grand Banks full or spawning fish are taken in July. (3.)

STRAITS OF BELLE ISLE.

37. The Newfoundland Commissioner for the Protection of the Fisheries for the summer of 1864 records that on the 26th July he found six French fishing vessels lying at anchor between Isle Bois (Wood Island) and Green Island, close to the boundary line between Canada and that part of the Lab-

1. Official Returns. J. O. Fraser.

2. Report of Captain Paisley, of H. M. S. *Niobe*, on the Fisheries of Newfoundland and Labrador for the year 1869.

3. See also U. S. Fishery Commission Report for 1871-2.

rador under Newfoundland jurisdiction. "I found," says the Commissioner, "that these vessels had all of them large bul-tows out; those of one extending a distance of nine miles; and that they had taken, upon an average, three hundred quintals each of *spawning* fish." (1)

In 1848 the Cod and Caplin came into Red Bay during the first week in June, and into Blanc Sablon during the second week, fish and bait both being abundant. (Capt. Loch, R.M., *H. M. S. Alarm*.) Capt. Loch states that Blanc Sablon Harbor is blocked up with ice from November until June, sometimes to the latter end of that month.

Belle Isle.—Schools spawn in the neighborhood of Belle Isle in August and September. In Mr. Caleb Young's report for 1857, (2) the following paragraph occurs:

August 24th. Morning, rainy, wind S. by E. At 2 p. m. very foggy. The mother fish swarming around the Island bloated with spawn. "I believe were this harbor made safe for boats to moor, there could be more fish taken than in any one of our Southern Bays. From the first of June until the last of September each man can take from one to two quintals per day with jiggers." This statement about the spawning fish in the neighborhood of Belle Isle agrees completely with the voluminous evidence given before the Committee of the House of Assembly in 1856.

38. Mr. Jabez Tilley, who was employed by the Newfoundland Government, in 1872, for the protection of the fisheries in the vicinity of Belle Isle, stated to the writer that, according to his own observation, he had seen codfish ripe for spawn, in different years, all along the coast, from Cape Spear to Belle Isle, during June, July, August, September and October. The months of August and September are those in which spawning fish, or fish with the spawn running out of them when caught, were most numerous.

Mr. Tilley ridicules the idea that the Cod will not take the hook when full of ripe, or nearly ripe, spawn. He does not suppose that when in the very act of spawning they will feed, but he has often, with the hook, taken fish so near their spawning time, that when they were lifted into the boat, the roe from the female and the milt from the male would run freely out of them.

On the north side of the Island of Belle Isle, in the Straits of the same name, Mr. Tilley has seen "about seven quintals of this kind of fish (cod) taken in one net, in twelve or fourteen days in the former part of August." "I saw," says Mr. Tilley, "these fish in the net, and I saw spawn and milt run from them." (3) Each fish would weigh about 40 or 50 lbs. as they came out of the water.

Mr. Tilley informed me, as a fact which attracted his observation and excited his surprise, that he once caught a codfish, weighing not more than four pounds, full of spawn.

When questioned as to the size of the cod fish taken on the Labrador, Mr. Tilley assured me that he has known five cod fish, when dry, to make a quintal, taken from Sandy Island Bank, between Seal Island and Batteaux, on the north side of Black Bear Bay. This would make the average weight of the green fish to exceed fifty pounds each, and if they were

N.B.—In 1857 Cod were taken in seines at Cape St. John during the first week in June. On the 10th June 15,000 fish were "hauled." No Caplin had yet "hauled." Up to the 16th July 788,000 fish, equal to 5,253 quintals, had been taken since the Caplin came in at Cape St. John.

1. Journal of the Council, 1865, p. 108. (Newfoundland).

2. Journal of the House of Assembly, 1857. Page 452.

3. Communicated by Mr. Jabez Tilley in a letter to the author.

spawning fish, which he did not state, the weight would have been considerably more. The large size of the bank cod on the Labrador has long been known, but it is the inshore fishery which is generally pursued there, as elsewhere, by Newfoundland fishermen. The bank fishery may be said to be almost unknown to the great majority.

The size of the mother fish, when "full," is sometimes enormous. Instances of fish having been taken in the Straits of Belle Isle, in which the roes from two of them weighed half a quintal, are well authenticated. This would give for the weight of a roe of one fish about 28 lbs.

Monsieur Lambert de Boilieu, in his "Recollections of Labrador Life,"⁽¹⁾ describes the spawning of Cod on the Labrador in the following words:—"I found the men busy preparing for the toil of summer—fishing; for directly when the ice leaves the coast, shoals of cod make their appearance to deposit their spawn in the quiet bays with which the seaboard abounds." Mr. Boilieu is not precise in his dates and description of localities, which very greatly diminishes the value of his observations.

SEASON FOR SPAWNING IN THE GULF OF ST. LAWRENCE.

39. The condition of the cod, when taken full of roe, in the spring or early summer months on any well known fishing banks, must be accepted as a proof that the spawning season there is close at hand. On the Gaspé coast of the Gulf, the preparation of cod roes was carried on, according to Mr. Lavoie,⁽²⁾ for three or four years previous to 1874, but "is now nearly abandoned," only 138 barrels being pickled that year.

Mr. Lavoie states in his report for 1870, referring to the Gaspé Fisheries:

"A new industry, connected with cod fishing, has just sprung up in the preparing and export of cod fish roe. The eggs or roe, which, at a certain period of the season, reckon for one-third in the weight of a fish, were formerly thrown away with the rest of offals. Now they are utilized; they are pickled in exactly the same manner as cod fish. I did all I could to make popular this new kind of industry, and several hundred barrels have already been sold at Percé, Grand River and Magdalen Islands at a fair price—\$5 or \$6. I hope that by next year the importance of this new source of wealth will be better understood, it being so easily carried on when cod is scarce, as there is plenty of time to prepare the roe; fishermen can thus draw double profit from their catch. The pickled eggs are exported to France by a New York firm, and are mostly used in the Bay of Biscay as bait for sardine fishing. There is a great demand for this article. I am informed by Mr. Levy, agent for the New York firm, that he is willing to give as much as \$8 for any quantity supplied. Cod fishing in 1869, yielded, in the Gaspé division, 132,394 cwts.; it was much better in 1870, and yielded 152,414 cwts. Although capelin and squid failed during the fishing season, herring and mackerel, in the shape of bait, were plentiful enough to insure the fishermen a season's return larger than any during the last ten years."

Cod fishing begins in May on the Gaspé coast, but sometimes it is earlier. In 1870 it commenced at Percé on the 25th April, about a month before the usual time. In the same year the cod fishery began on the 27th April at the Magdalen Islands, in both cases being about a month before the average time of the appearance of the Cod on the coasts named. The same irregularity is observed everywhere in the Gulf, on the

1. London, 1861. Saunders, Otley & Co.

2. Vide Sessional Papers, No. 5, 1875.

Scotia to spawn in October. Some of the Bank Cod, very large and long fish, also come in at the same time for the same purpose. ^[1.]

BAY OF FUNDY.

At the entrance to the Bay of Fundy, near Grand Manan, Cod are taken full of ripe spawn in November and December. ^[2.]

ATLANTIC COASTS OF THE UNITED STATES.^[3.]

41. *Nantucket*.—Full fish are found off Nantucket in October and November, and are supposed to spawn there at that period.

Brown and George's Banks—February and March. ^[4.]

WINTER FISHING FOR COD.

NEWFOUNDLAND COAST.

42. The southern coast of Newfoundland, between Cape Race and Cape Ray, is divided into nearly two equal parts by Point May, close to the islands of St. Pierre and Miquelon. This wide extent of coast line is nearly six hundred miles in length, the large bays, as well as the numerous profound inlets, resembling Fjords, where the water is very deep and the coast often steep-to.

In 1856 Mr. Canning was appointed by the Newfoundland Government to report, in the interests of the Revenue Service, on the western portion (south shore) of the Island. His report is, in many particulars, very valuable. He states that "the coast, from Cape Ray down to Long Harbour, a distance of about 200 miles, is indented with numerous harbours, most of which are within three miles of one another, affording shelter to those only who are well acquainted with them. These harbours are of very great depth of water, hence there is great danger in entering any of them in stormy and foggy weather. The numerous rocks near to, and at a distance from, land, the immense quantity of fog, rapid tides, etc., all together render this part of the coast anything but inviting, especially in the winter season, at which time the Fishery is here carried on, commencing in October and continuing until April."

Mr. Canning gives the following results of the fall and winter fishery off this coast. It amounted in 1856 to 145,390 quintals, or about one-eighth of the entire exports of the Province for that year. The Custom House returns show a great falling off since 1856, but whether this arises from the entries being now made to a greater extent than formerly at St. John's, or from a decline in the annual catch, is not quite clear. The following are the returns for the stations named:—

	1856.	1874.	1875.
	Quintals Cod.	Quintals Cod.	Quintals Cod.
Harbour Briton.....	42,963	12,589	13,245
Lapointe.....	44,998	16,886	10,510
Gaultois.....	17,429	16,267	13,278
Fortune and Grand Bank..		3,324	610
Total.....	105,390	49,060	37,643

In 1856 the following estimate was made of the catch between Cape Ray and Point May, by Mr. Canning:—

1. Some observations on the Fishing Grounds and Fish of St. Margaret's Bay, N. S. Transaction of the N. S. Inst. of Nat. Science, 1865-66.

2. See Report of the U. S. Fishery Commission, 1871-72.

3. See the Report of the Commissioner of Fish and Fisheries—U.S., 1871-72, page 45.

4. J. F. Whiteaves—Report on Deep Sea Dredging in the Gulf of St. Lawrence, 1872.

App. to Jour. of House of Assembly, 1871, page 391.

Entered at Custom House.....	qtls. 105,390
Sent to St. John's, coastwise.....	" 20,000
Sent to Halifax and other places without clearing at Custom House.....	" 20,000

Total quintals.....145,390

It would be very interesting to know how this large fall and winter catch of cod fish was distributed. The fact, however, remains that cod winter on the coast of Newfoundland, and are taken there during that season. Capt. Malcolm states that the cod are taken on this coast all the year round, and are caught by hook and line, often in 120 fathoms water. ⁽¹⁾ On the 15th June, as stated further on, heaps of fresh cod fish spawn were seen lying at St. Mary's Harbor, preparing for exportation.

As an illustration of the great depth at which cod are taken by hand lines on the south coast of Newfoundland, the report of Capt. Parish, R. N., of H. M. S. *Sphinx*, (1868) mentions that "Jersey Harbour has ten small boats employed cod fishing off the heads, in 80 to 180 fathoms water, all the year round;" and among the places enumerated where cod fishing is carried on all the year round, besides Jersey Harbour, are Bonne Bay in Hermitage Bay; Push Through and Great Jersey; Hermitage Cove, Harbour Briton and off Port-aux-Basques, in 90 to 200 fathoms.

It thus appears that at different parts of the south coast of Newfoundland cod fishing is carried on successfully during the winter season in water from

80 to 100 fathoms.....	Capt. Parish, R. N.
— to 120 "	Capt. Malcolm, R. N.
90 to 200 "	Capt. Erskine, R. N.

Mr. J. S. Harward, in an official Report, dated 1st November, St. John, 1865, mentions the fishermen catching cod in 140 fathoms water, at Push Through.

Captain Miller, of H. M. S. *Sicias*, states that "On some parts of the south coast where the water is very deep, a certain amount of codfish remain all the year round, and cod fishing is carried on throughout the winter; but the great mass of fish which supply the fishermen come in from the ocean, and appear to come in streams or rivets, as it were, of fish, which are more or less erratic in their course, as may be seen by the fishery reports from the different places.

"It is natural to suppose that they follow the bait, but sometimes the bait is present in abundance with little or no codfish. The enormous quantity of fish in these streams or rivers of fish, may be inferred from the success of the process of jigging; our pilot, who has had great experience on the coast, says that in letting down your jigger you can often feel it striking the backs of fish as it goes down.

"On asking our pilot, who has had great experience on the fisheries, what is the greatest amount of fish he has known one man catch in a day, he said that he has himself, with one other man, caught 32 quintals, and that he does not know of more having been caught; this, of course, is exceptional success; selling at a pound per quintal, it is very good work." ⁽²⁾

On the north-east shore, from Rouge Harbour to Canada Bay, the fishermen say that, although the fish remain until about Christmas, the weather will not let them fish much longer than the beginning of October. ⁽³⁾ The periods of "coming in and going out" of the cod, on the north-east shore, as the fishermen term these movements, showing that

1. Fishery Report, 1871. (Capt. Malcolm, of H. M. S. *Danae*, Great Jersey Harbour, Bay Despair.)

2. Newfoundland Fishery Report, 1873

3. *Ibid.*, page 735.

the fish appear to remain different lengths of time in widely separate neighbourhoods, are given elsewhere.

At Cape Ray, the cod taken in January have well developed, but small roes. In February, the size of the spawn is increased, but it is still hard and compact. In March, with continued increase in size, it begins to acquire a softer character, and towards the last week in April it runs easily from the fish. Rarely, after the first week in May, are cod taken near Cape Ray with any spawn in them. The season for spawning for the schools which frequent the vicinity of this part of the Newfoundland coast is the last week in April, while on the Cape Breton shore, not more than sixty or seventy miles off, the schools spawn in August. On St. Peter's Bank, in May and June, and on some other parts of the south coast of Newfoundland in July. Hence it appears that on a coast line not more than 300 miles in extent, in nearly a straight line, running about east and west, different schools of Cod spawn in April, May, June, July and August. Continuing further west, we find them spawning off the coast of Nova Scotia in September and October, and still further to the west, in November. On the banks off the New England coast, we find them spawning in December. Hence it appears that on the Atlantic coast of Newfoundland, Nova Scotia and the United States, in a line stretching nearly east and west for 1000 miles, Cod are taken with ripe spawn in them in every month in the year. This fact, in itself, must be accepted as conclusive that the cod is a local fish, and that the schools are distinct and local in their habits. When, however, we consider the different external features presented by different schools, well known to fishermen, coupled with the simultaneous appearance of schools in waters so far removed from each other as those on the south coast of Newfoundland, Nova Scotia and New England, the chain of evidence is complete.⁽¹⁾

CAPE BRETON.

It has long been known that cod fishing is carried on through the ice in the Bras D'Or Lake, Cape Breton. Mr. Joseph Hart, J. P., of Baddeck, states that he has known "hundreds of quintals of cod fish caught in Bras D'Or lake every winter, or every other winter."

EFFECT OF TAKING SPAWNING FISH.

43. The ultimate effect of constantly taking the adult or spawning fish, as practised by many fishermen, can best be expressed by a quotation from the United States Commissioner of Fish and Fisheries, (page xxxi, 1871-72): "Objections have been made to the use of what is called the trawl-line, trot-line, bultow, etc., in capturing fish of the cod family. * * *"

"Although this practice has excited the animadversions of some, on account of its supposed destructive nature, it seems hardly possible that it can be really injurious, since it does not take the spawning fish, and merely represents the result of an increased number of hand-lines."

It is submitted that the abundant exportation of cod roes, coupled with the numerous statements of fishermen that spawning cod are taken by the bultows, ⁽²⁾ establishes the allegation that the use of the bultow does capture the mother fish in destructive abundance, and deserving of the condemnation the U. S. Commissioner very justly applies to the act of taking spawning fish in the following words:—"It therefore would be no evil should every full grown fish, of three to five years old and upward, be lifted from the sea after the close of

1. See page 78, U. S. Fishery Report, 1871-72.

2. See also evidence adduced in the Report of the Fishery Commission in Newfoundland in 1857.—(*Journal of Assembly.*)

the spawning season, in the course of a season, since the following year we may look for a new generation coming in to exercise the function of reproduction; and ample provision will thus exist for a renewed supply from year to year. As already explained, the case is entirely different when these fish are caught before they spawn, all the evils that we have depicted following in the train of such thoughtless destruction, precisely equivalent to killing off all the mature hens in a farm yard before they have laid their eggs, and then expecting to have the stock continued indefinitely. As well might the farmer expect to keep up his supply of wheat year by year, while he consumed all his grain, reserving none for seed, and without the possibility of obtaining it from any other source."

The conclusion drawn by the Commissioner would be perfectly justifiable, even in relation to the cod, if it were not for the enormous area which constitutes its feeding and breeding grounds. There are, no doubt, very many localities in the broad fishing grounds of American waters never touched by a bultow, and these are the preserves which keep up the supply of this fish. But it is in the vicinity of the coast line where these spawning fish are taken, that tends to diminish the annual supply, when the enormous drain is considered. It may be urged that every one has a perfect right to take spawning fish in the open sea, beyond the three marine mile limit. This is no doubt true, but the act of procuring bait caught on the strand or in coastal waters for that purpose certainly comes within the limits of a restrictive right, which has been conceded. In fact, the sale of bait, or the concession of the right to take bait, in coastal waters, places in the hands of those to whom the bait is sold, or by whom the bait is taken and used on a bultow, the power of diminishing the coastal fisheries for cod to a great extent.⁽¹⁾ and perhaps, on due enquiry, it might be ascertained that the destruction of the New England cod fisheries, could in part be traced to the use of bultows and the taking by these or other means of spawning fish.

It appears from the foregoing statements that the following deductions may be drawn as to the spawning habits of the cod on the North American coast.

1. It probably spawns throughout every month of the year.
2. Two or more schools may spawn in the same deep Newfoundland Bay, or any Bay, at different seasons, separated by two or three weeks.
3. That the spawning season is adjusted to the temperature of the water, and that ice cold water, such as exists throughout the year in the Straits of Belle Isle, is not uncongential to the spawning habits of the American form of the cod, but favorable to it.
4. That the spawning seasons are adjusted to the probable absence of newly formed ice, irrespective of the coldness of the water.
5. That the act of spawning takes place in bays and in-shore coastal waters, as well as in the open sea, but the bays and coastal waters are instinctively frequented by many spawning fish on account of their freedom from ocean currents. Hence geographical configuration of the coast is a

1. F. Bortean, of Burin, Newfoundland, declares under oath that in 1874 he bought from U. S. Fishermen "three or four barrels of Cod Roes." There can be little doubt that these spawning fish were taken by the bultow, and of the quantities so taken in the aggregate by this means, we can form but a very imperfect idea. That it must be enormous, the complaints of the practice, so long prevalent, affords indirect proof.

very important consideration, bays and inlets being fish nurseries.

6. That the spawn floats on the surface of the water during probably the whole period of its existence, the period varying from 16 to 20 days, or more. The spawn is subject to the action of ocean currents, and the resultant direction of the currents determines the places where the spawn is hatched.

8. The use of the bultow is decidedly prejudicial, and the concession of the right to take bait in coastal waters confers on those to whom the right is conceded the power to inflict great injury upon the productive character of the waters in which the bultow is used.

APPENDIX—CHAPTER II.

I. LETTER FROM PROFESSOR SPENCER F. BAIRD TO E. M. STILLWELL, ESQ., COMMISSIONER OF FISHERIES, BANGOR, MAINE.

Washington D. C., November 16, 1872.

MY DEAR SIR.—I am in receipt of your letter, asking my opinion 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 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 schools. It was during this period that the deep sea fisheries of the coast were also of great extent and value. Cod, haddock, halibut, 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 a short distance 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 the cod and other deep sea species near our coasts; but it was not until quite recently that the relationships between the two series of phenomena were appreciated as those of cause and effect. Halibut, it is believed, can be reduced in abundance by over-fishing with the hook and line, but experiences in Europe and America coincide in the confirmation of the opinion that none of the methods now in vogue for the capture of fish of the cod family (including the cod, haddock, pollack, hake, ling, etc.) can seriously affect their numbers. Fish, the females of which deposit from one to two millions of eggs every year, are not easily exterminated unless they are interfered with during the spawning season, and as this takes place in the winter and in the open sea, (the spawn floating near the surface of the water,) there is no possibility of any human interferences with the process. Still, however, these fish have become comparatively very scarce on our coast, so that our people are forced to resort to far distant regions to obtain the supply which formerly could be secured almost within sight of their homes.

It is now a well-established fact that the movements of the fishes of the cod family are determined; first, by the search after suitable places for the deposit of their eggs; second, by their quest of food. Thus, the cod, as a summer fish, is comparatively little known on the coasts of northern Europe; but as winter approaches, the schools begin to make their appearance on the north-western coast of Norway, especially around the Lofoden Islands, arriving there, finally, in so great numbers that the fishermen are said to determine their presence by feeling the sounding lead strike on the backs of the fish.

Here they spend several months in the process of reproduction, the eggs being deposited in January, and the fishery being prosecuted at the same time. Twenty-five to thirty thousand men are employed in this business for several months, at the end of which the fish disappear, and the fishermen return to their alternate occupations as farmers and mechanics. The fish are supposed to move off in a body to the Grand Banks, which they reach in early summer, and where they fatten up and feed until it is time for them to return to the north-east. It is believed that the great attraction to the cod on the Banks, consists in great part of the immense schools of herring or other wandering fish, that come in from the region of the Labrador and Newfoundland seas, and which they follow close in to the shore, so that they are easily captured.

It is well known that the presence or absence of herring determines the abundance of hake and cod on the Grand Manan Fishing Banks, the fishes of the first mentioned family having a peculiar attraction to carnivorous fish of all kinds. It is, however, the anadromous fishes of the coast which bring the cod and other fishes of that family close upon our shores. The sea herring is but little known outside the region of the Bay of Fundy, excepting in September and October, when they visit the entire coast from Grand Manan to Scituate, for the purpose of depositing their spawn; this act depending upon their finding water sufficiently cold for their purposes, a condition which, of course, occurs later and later in the season in going south.

In the early spring, the alewives formerly made their appearance on the coast, crowding along our shores, and ascended the rivers in order to deposit their spawn, being followed later in the season by the shad and salmon. Returning when their eggs were laid, these fish spend the summer along the coast; and in the course of a few months were joined by their young, which formed immense schools in every direction, extending outward, in some instances, for many miles. It was in pursuit of these and other summer fish, that the cod and other species referred to, came in to the shores; but with the decrease of the former in number the attraction became less and less, and the deep sea fishes have now, we may say, almost disappeared along the coast.

It is therefore perfectly safe to assume that the improvement of the line fishing along the coast of Maine is closely connected with the increase in number of alewives, shad and salmon; and that, whatever measures are taken to facilitate the restoration of these last mentioned fish to their pristine abundance, will act, in an equal ratio, upon the first mentioned interest. The most important of the steps in question are the proper protection of these spring fish, and the giving to them every facility needed for passing up the streams to their original spawning grounds; this is to be done, of course, by the construction of suitable fishways and ladders. The real question at issue in regard to the construction of these fishways is, therefore, after all, not whether salmon shall become more plentiful, so that the sportsman can capture them with the fly, or the man of means be able to procure a coveted delicacy in large quantities and at moderate expense. This is simply an incident; the more important consideration is, really, whether the alewife and shad shall be made as abundant as before, and whether the cod or other equally desirable sea fish shall be brought back to our coast, so that any one who may be so inclined, can readily capture several hundred weight in a day.

The value of the alewife is not fully appreciated in our country. It is, in many respects, superior to the sea herring as an article of food; is, if anything, more valuable for export; and can be captured with vastly less trouble, and under circumstances and at a season more convenient for most persons engaged in the fisheries.

I have already extended this letter to an unreasonable length, and must therefore bring it to a close, with the assurance, however, that all the propositions I have thrown out can be amply substantiated.

Very truly yours,

SPENCER F. BAIRD.

U. S. Commissioner of Fish and Fisheries.

E. M. Stillwell, Esq.,

Commissioner of Fisheries,

Bangor, Maine.

APPENDIX No. II.—CHAPTER II.

II. Cod. *Gadus morhua*, Linn. Gunther and Gill

Codfish appear to leave shallow soundings and the inshore banks in winter, and go farther out to sea. A large school visits the east coast of Cape Breton, from Chetigan, round by Scatarie, in April. Cod appear to spawn all the year round, even in winter. Schools have been taken spawning on Brown and George's Banks, in February and March, also in November and December in the Bay of Fundy and elsewhere. A few codfish are taken now and then in Gaspe Bay in winter. It is not an uncommon circumstance for a school of cod to follow herring as far as Mahogany Islands, at the entrance of St. John Harbor, New Brunswick, in February and March, where they are taken plentifully with trawls by the inshore fishermen. This school does not apparently strike in shore during the summer, at least not in New Brunswick. A peculiar variety of this fish, "with a dark back and a black ring round the jaws" (Purdy) is taken on the Orphan and Brudelle Banks, as well as on the east coast of Prince Edward Island. They are of a large size and will, it is said, only take the hook *at night*, hence they are known to the fishermen as "night fish." With the exception of haddock, cod is the only fish that is well cured in the northern part of the Gulf. Cod prefer a bottom of stones, gravel, or sand, especially where crabs and shells abound. The season for cod, north of the Bay des Chaleurs, is from about May 15th to November 15th. In Bras d'Or Lake, Cape Breton, also on the north coast of Newfoundland and in Bay of Islands, cod and herring are caught in winter through holes cut in the ice. The "bull-dog" cod, spoken of by Perley, are supposed to be individuals which have been bitten when young by other fish. A prejudice seems to exist along parts of the coast against the use of "trawls" or hultow lines, but I have not heard of any that appear to me sound arguments against them. It is believed by many experienced fishermen that quantities of young cod are annually destroyed by drag seines, used for bait near shore, but it is not easy to suggest a remedy for this state of things. The clam, of which Perley says the cod are particularly fond, is *Cyrtolus siliqua*.

HADDOCK. *Gadus aeglefinus*, Linn. Gunther. *Melanogrammus aeglefinus*, Linn., sq. Gill.

Most plentiful on the south and west coast of Nova Scotia, and on the west coast of New Brunswick, but common throughout the Gulf. This species is taken all the year round, generally in schools alone, but sometimes associated with cod. They frequent clam banks, in from twelve to eight fathoms. A very valuable market fish, and one which will be much more so when the Intercolonial Railway is opened. At Digby, St. Andrew's and Western Isles, "finnan Haddies" are prepared for various markets in Canada and the United States. Haddocks are taken on the west coast of Newfoundland in winter.

POLLACK. *Gadus virens?* Linn. Gunther *Pol'achius carbonarius*, Bon. Gill.

Although this fish is commonly called "pollack" by the fishermen of the lower provinces and by those of the United States, it is not the same as the pollack of Europe. Its proper name is the coal fish, and it is common to both shores of the Atlantic. The species is locally known as the "sea-salmon," and is of somewhat southern distribution. It does not appear to range farther north than the Bay des Chaleurs, if so far, and has never been taken in the waters of the Province of Quebec. The species is most frequent in tideways in Nova Scotia and New Brunswick. As a table fish it is preferred by many to cod. To the north of the North Cape of Prince Edward Island no great business is done in the curing of pollack. They are, exceptionally, caught in winter among cod. They are not often taken on banks, but mostly along the shore. They school like mackerel, and are caught at the surface, to which they are brought by ground bait. Their food is said to consist largely of herring. The livers of this species yield the best oil; it is used for machinery and in making leather. Salted and dried pollack is worth from \$2 to \$3 per quintal." (1.)

III.—THE SPAWNING TIME OF THE COD IN BRITISH WATERS.

EUROPE—ENGLAND,(2)

Lerwick (Shetland Is.)—March.

Dingle (Ireland, Atlantic Coast.)—March.

Westport, " " " " March.

IV.—SPAWNING OF THE COD IN NORWEGIAN WATERS.

NORWAY,(3)

On the Lofoden Banks—January to March.

In the Romsdal Fiords—January to March.

1. J. F. Whiteaves. Report on Deep Sea Dredging in the Gulf of St. Lawrence, 1872.

2. Vile Fishery Commission, 1864-5.

3. Consular Report, 1873.

The take of spawning fish in Norwegian waters is enormous. In 1873, not less than 31,000 barrels of Roe were taken from fish caught on the Lofoden Banks. In the same year 14,087 barrels of Roe were taken from the Romsdal fishery, producing in the aggregate the enormous quantity of 45,087 barrels of Roe, which sold at 8 and 9 dollars a barrel. The largest quantity of Roe exported from Newfoundland between 1868 and 1875 was 1939 barrels, or less than the twentieth part of the quantity of fish eggs exported by Norway in 1873. The relation of the annual take of roe to the Norwegian fisheries is very important, and may be thus summarized for 1873:—

Loföden Fishery—Begins at the end of January, closes at the end of March. Catch 1873—22,250,000 fish: divided into:

12,000,000	cured or clipfish. (18,000 tons.)
8,000,000	dried and split fish.
1,500,000	salted in barrels.
750,000	consumed.

Total Fish.....22,250,000

These yielded 31,000 barrels of Roe and 59,000 barrels of Liver. They were caught in the following manner:—

With Nets.....	10,782,000	fish.
With Lines.....	10,683,000	"
With Deep Sea Lines....	750,000	"

Total.....22,250,000 "

From 60 to 63 fish went to the quintal or cwt. of stock-fish, and 280 to 300 to the cwt. of clip-fish.

At Romsdal, in the same year the number of fish taken was 6,656,000, yielding 22,259 barrels of liver, and 14,087 barrels of roe. The price of Loföden Roe was 8 specie dollars a barrel: of Romsdal Roe, 9 specie dollars a barrel.

The FINMARK fisheries yielded 16,200,000 Cod fish, yielding 42,407 barrels of liver, but no roe. This Fishery beginning in April, or the end of March, after the fish have spawned on the Loföden Banks, as supposed. The Finmark Fishery is locally termed the Lollö or Caplin Fishery, because the arrival of the Cod is always preceded by shoals of Caplin or Lodde.

The Finmark fish are smaller than the Bank fish, and are said to resemble the Labrador fish. There is apparent analogy between the conditions under which the fish are taken on these distant coasts so remote from one another.

The depth at which the Norwegian fishermen set their nets or sink their bait depends upon the depth at which the schools of fish are to be found. They are not, as generally supposed in America, always at the bottom, but often floating or swimming in mid sea—that is, at variable depths. The causes (probably food) which induce the fish to select different depths at different periods are worthy of the closest investigation.

V.—STATISTICAL MEMORANDUM ON CANADIAN FISHERIES. (C)

The figures of the Fisheries' Report are a very great deal short of the real quantities caught every year, as regards Cod and Herring, although coming quite close to the catch of Mackerel. The reason is that it is specially from large commercial houses, which are principally exporters of fish, that the information is gathered by the fisheries' officers: then it comes that Mackerel, being principally obtained for exportation and held in hand by large dealers, is found almost adequately represented in these returns; while a very large portion indeed of the enormous bulk of cod and herring consumed every year in the fresh state, salted or dried on the coast, and finding its way to all other parts of the Dominion through the medium of small dealers and intermediaries is left out of the returns, the deficiency being the greatest where the catch for home consumption is also the greatest, namely for the Province of Quebec.

Nevertheless as these returns are collected under a system, incomplete but uninterruptedly carried into operation in the same manner, every year since 1869, they offer a correct idea, not of the actual quantities, but of the comparative productiveness of each season from year to year.

The quantities caught *so far* as they are returned, by the Fisheries' Report, are in their aggregate, for the Atlantic Provinces of the Dominion, shown in the following table:

TABLE I.

Years.	Cod, Haddock, Hake and Pollock, Quintals.	Herrings in Barrels.	Mackerel in Barrels.	Average prices indicated by the Fisheries' Returns.		
				Cod.	Herrings.	Mackerel.
				\$	\$	\$
1869	531,387	307,478	53,011	3 00	3 00	10 00
1870	582,731	248,839	92,213	3 90	4 07	11 90
1871	700,926	380,600	240,426	3 00	3 00	10 00
1872	997,598	324,877	119,859	4 00	3 90	14 00
1873	1,033,602	349,616	160,617	4 15	3 90	9 95
1874	936,885	326,476	161,793	4 40	4 15	9 75
1875	882,094	340,382	123,960	4 35	4 15	10 00

The existence of complete statistics of the fish catch of one year, gathered through the regular process of a carefully taken census (1870), rendered these annual reports available for deductions, which being, furthermore, as a whole borne out by the Trade Reports, and such broad means of comparison as are furnished by the previous censuses, cannot fail to bring a very near approximation to exactness.

The following table is the result of calculations, made on such bases, and is confidently given as expressing the quantities of the catch of the years therein mentioned. The quantities in this table refer to the Province of Nova Scotia, New Brunswick, Prince Edward Island, and to the Province of Quebec from the gulf up the river St. Lawrence, as far as Pointe des Monts and Cap Chat: in other words it gives the result of the yearly catch of the Cod, Herring and Mackerel in the fishing fields concerned in the Treaty of Washington.

TABLE II.

Years.	Quintals of Cod, Haddock, Hake and Pollock.	Barrels of Herrings.	Barrels of Mackerel.
1869	730,928	505,595	54,022
1870	801,558*	408,850*	93,972*
1871	964,131	625,337	245,012
1872	1,372,207	533,783	122,145
1873	1,405,804	557,979	163,681
1874	1,278,409	534,307	164,879
1875	1,193,579	555,371	126,324
Totals of 7 years.....	7,746,701	3,720,822	970,035

The figures marked by an asterisk are the figures given by the Censuses of 1870-71, of the Dominion and of Prince Edward Island, less the quantities of fish caught West of a line drawn from Point des Monts to Cap Chat.

It is to be remarked that the returns of the Fisheries' Department previous to the year 1873, do not contain the fish catch of Prince Edward Island; and that the quantities, included in the returns for 1873, 1874 and 1875, on account of Prince Edward Island, have been deducted for Cod and Herring, Mackerel not being caught in any quantity west of Cap Chat. In making up the terms of the ratios, the absence of the products of the Island being taken as a set off for including the St. Lawrence portion of Quebec in the Fisheries' returns used as an element of the calculation.

Besides Cod, Herring and Mackerel, there came under the purview of the Treaty of Washington, Halibut and such species of fish as are used for bait. An idea sufficiently definite of the quantity of Halibut caught annually may be derived from the quantities given in table I, extracted from the Census of 1871, heretofore given. It would be venturesome to try to estimate the quantity of fish annually used as bait in fishing, which it will be easily seen amounts to many thousand quintals every year.

As to the proportionate quantities of the species of the Cod kind, and, as to the distribution of the various quantities of them and of Herrings and Mackerel amongst the four Provinces for the share each of them contributes to the total catch, they evidently vary from year to year within certain limits, but in the long run, and as an average the following apportionment of quantities may be taken as the expression of the broad fact it is intended to convey, namely:

The quantity of Cod is to the quantity of Haddock, Hake and Pollock taken together (with which it is associated in the foregoing Tables) as 6 is to 1.

The proportion in which each province comes in the grand total catch may be stated as follows:

For Cod: Quebec 38 per cent.; Nova Scotia 54 per cent.; New Brunswick 6 per cent.; Prince Edward Island 2 per cent.

For Haddock, Hake, and Pollock: Quebec 2 per cent.; Nova Scotia 80 per cent.; New Brunswick 14 per cent.; Prince Edward Island 4 per cent.

For Herring: Quebec 21 per cent.; Nova Scotia 32 per cent.; New Brunswick 43 per cent.; Prince Edward Island 4 per cent.

For Mackerel: Quebec 7 per cent.; Nova Scotia 50 per cent.; New Brunswick 3 per cent.; Prince Edward Island 10 per cent.

J. C. TACHE.

Deputy of the Minister of Agriculture.

OTTAWA,
DEPARTMENT OF AGRICULTURE,
June, 1876.

APPENDIX No. VI

		1870
Population of Maine.....		626,915
" Massachusetts.....		1,457,351
" New Hampshire.....		318,300
" Rhode Island.....		217,353
" Connecticut.....		537,454
" New Jersey.....		906,095
" New York.....		4,382,759
" Pennsylvania.....		3,521,951
	Total.....	11,968,178
AREA.....	Area in Square Miles,	Pop. in a Square Mile.
Maine.....	35,000	17.91
Massachusetts.....	7,800	186.84
New Hampshire.....	9,280	34.30
Rhode Island.....	1,306	166.43
Connecticut.....	4,750	113.15
New Jersey.....	8,320	108.91
New York.....	47,000	93.25
Pennsylvania.....	46,000	76.56
	Total.....	797.35
		Mean.....99.66
Aggregate Population of the several States bordering the Atlantic Coast as far South as Pennsylvania inclusive.....		11,968,178
Area.....		159,456 Sq. miles.
Population per Square Mile.....		9.966
Aggregate Population of the British Provinces bordering the Atlantic, and the Gulf of St. Lawrence.....		1,864,910
Area.....		238,741
Newfoundland and the Labrador, estimated 100 miles back from the coast....		77,000
	Total area.....	315,741
Population of Newfoundland and the Labrador.....		170,000
Total Population British American Maritime Provinces.....		2,034,910
Population to the Square Mile.....		6.4

NOTE.—The remaining portion of Appendix to Chapter II. will be found at the close of the last Chapter.

CHAPTER III.

THE HERRING.

CONTENTS.

44. Distribution of the Sea Herring in British American and United States waters; 45, Migratory Instincts of the Herring; 46, Effects of these Instincts; 47, The spawning of the Herring; In Dominion waters; In United States waters; 48, The winter Herring fishery—Newfoundland—Bay of Fundy; 49, Summer Herring fishery—Newfoundland—Periods of approach to the coast—Newfoundland—Straits of Belle Isle: Gulf Coast; 50, Extent of the Herring fishery in British American waters; 51, Value of Herring bait to American fishermen; 52, Fluctuations in the Catch of Herrings—Estuary of the St. Lawrence, Magdalen Islands, Nova Scotia, Newfoundland, Scottish Seas, Norwegian Seas; 53, Some points in the Natural History of the Herring; 54, Supposed inexhaustible character of certain Sea fisheries; 55, Effect of the limited area of the United States Cold water seas; 56, The starvation of the Cod in British American and Norwegian Seas; 57, Habits of the Herring, Huxley in 1863, Axel Brock's views; 58, Axel Vilhelm Ljirgman's views; 59, Hjalmar Widegren's description of the life of the Baltic Herring in 1871; 60, Professor G. O. Sars' views—The Cod; 61, The Herring, 1877; 62.

44. "It is well known that the presence or absence of Herring determines the abundance of Hake and Cod on the Grand Manan Fishing Banks, the fishes of the first mentioned family having a peculiar attraction to carnivorous fish of all kinds. It is, however, the anadromous fishes of the coast which bring the Cod and other fishes of that family close upon our shores. The Sea Herring is but little known outside the region of the Bay of Fundy, excepting in September and October, when they visit the entire coast from Grand Manan to Seintuate, for the purpose of depositing their spawn; this act depending upon their finding water sufficiently cold for their purposes, a condition which, of course, occurs later and later in the season in going South." The foregoing extract from the letter addressed by the United States Commissioner of Fish and Fisheries to the Commissioner of Fisheries in the State of Maine, embodies three important facts in relation to the Herring. ⁽¹⁾

- 1st. The peculiar attraction it presents for the Cod tribe.
- 2nd. The geographical distribution of its spawning grounds in United States waters.
- 3rd. Its dependance upon cold waters.
- 4th. The limited extent to which it is found in waters off the coasts of the United States.

It is true that United States waters, south of the 39th parallel of latitude, abound with another variety of Herring called Alewife, a fresh water herring, an anadromous species, and this is considered by the United States Commissioner of Fish and Fisheries as "in many respects superior to the Sea Herring as an article of Food; if anything, more valuable for export; and can be captured with vastly less trouble, and under circumstances, and at a season much more convenient for most persons engaged in the Fisheries." But the pursuit of the Alewife in the waters where it is most abundant, and at the season of the year where it would be most remunerative is forbidden to British American Fishermen under the limiting clause of the Treaty of Washington. ⁽²⁾ (See para. XI. to XII., Introductory Chapter).

1. Vide Letter referred to. Appendix No. 1., Chapter II.

2. In 1874 there were 6,567,240 fresh water Herring sold in Washington Market alone.

The Sea Herring, on the other hand, although little known on the Coasts of the United States beyond the limits between Eastport and Scituate, (See Chap. on Bait): and only in the fall and winter months, is abundant for upwards of three thousand miles on the British American Coasts, is the great lure for the Cod at certain seasons, and forms of itself an article of food which is represented annually by an aggregate catch not now falling short of one million barrels. It is taken generally close to the coast line, it is the first bait for the Cod, and it may truly be said that if the Herring were to be annihilated in British American waters, the Cod fishery, as now pursued along the coasts and on the Grand Banks, would be deprived of one half its commercial value, and the British Fisheries would receive a fatal blow.

It winters in vast schools in the deep bays on the coast and from its habits, its spawning periods, the two distinct varieties which exist in British American waters, bringing it within our reach in spring, in the fall and during the winter, its habitat in our seas is a possession which cannot be over-estimated in value and effect. The zones of depth at which it feeds or 'rests' during the winter are beginning to be known, the myths which have enveloped its movements are gradually being dispersed, and it presents itself now as a strictly home fish, whose spawning grounds are on our shores, and whose summer wanderings are limited to the cold waters of our seas.

But the Herring is subject to migratory movements which appear at the first blush to make it, at the best, a fish upon whose presence reliance is not to be placed for a great many years together. Happily the impressions which have prevailed on this important subject are likely to be dispelled to a large extent by the investigations of Professor G. O. Sars, following up the earlier information obtained by different Swedish, Norwegian and Danish Naturalists. Temperature, and, in general, Meteorological conditions, appear to determine the depth at which the Herring spawn, and the nearness with which they approach to the shore for that purpose. But with regard to the American Spring Herring there need be no fears akin to those which disturb the minds of the fishermen of Norway and the United Kingdom. British American Seas are ice-encumbered during four or five months of the year, and it is on the breaking up of the ice that the spring Herring approaches to spawn. In European Atlantic Seas, where this fish is so important an article of commerce, the seas are very rarely ice-encumbered, and the Herring live longer in outside waters than on the North American coasts. In the Western Atlantic waters it seeks its winter resting place much earlier than in Europe, and it is thus less liable to be drawn away by its food being driven far off the land, as described by Sars. The fluctuations in North American waters are small in extent compared with those astonishing changes which take place in Europe, sometimes causing the entire ruin of large commercial and fishing communities, and leading to general distress. But the permanency of the Herring schools in British American Seas, the comparative small size of the schools, and their uniform distribution over an immense extent of coast line, give them a direct and indirect value to our fisheries greater than is enjoyed even in Norway, particularly when the condition of the people and relative ages of each State are taken into consideration. Norway and Sweden were great fishing countries when British America was untrodden by civilized man, and, indeed, as far as the Herring is concerned, this fish has not been an object of

pursuit for a longer period here, than the last epoch of successful Spring Herring fishery, which terminated in Norway in 1874, bringing down the annual exports of the Spring Herring from an average of 600,000 barrels to a total of 60,000 barrels, between the years 1823 and 1873.

The Herring fishery in British American waters, is in its infancy, for we now know where to look for this fish in the winter months and how to take it at different depths. The temperature of different strata of water determine its position on Newfoundland and Nova Scotian Coasts, and there does not appear to be any reason why an enormous winter fishery should not be carried on, just as on the shores of the Baltic beneath the ice. The United States fishermen, as is shown in subsequent pages, are alive to this enterprize, and will not fail to take advantage of the present dearth in Europe, owing to the expected wanderings of the Spring Herring there, perhaps just out of reach of the fishermen, and to the outside spawning grounds.

MIGRATORY INSTINCTS OF THE HERRING.

45. The instinct which impels schools of herring to start from their winter homes—be it some profound bay or some deep ocean valley—and move towards accustomed spawning grounds, or seawards, to pursue their summer wanderings, is akin to the migratory instincts of birds, and, like this wonderful knowledge, is to some extent the result of growing experience. ⁽¹⁾

It is observed among birds, which, like fishes, have the power of rapid locomotion through a medium serving them as a means of progression as well as of food in numerous cases that the young of some migratory species rarely go with the old birds, but group together and start on their journey alone, or following some of the latest stragglers. ⁽²⁾

The young birds do not go so far as the old birds, and they wander about much more than those which have the benefit of experience; and the result is that many of them are destroyed before the next spring, and the number of those which return is by no means so great as that of those which left.

Numbers of young birds, in their southward migration, do not cross the Mediterranean, but stay in the south of Europe. The same rule, according to Wallace, applies to the northward migration, the young birds stopping short of the Arctic regions, to which the old birds migrate. ⁽³⁾

46. Now, these remarkable peculiarities, so contrary to what might have been expected, are observed in the movements of certain fishes, particularly the Herring and the Cod. The young of the Herring school together, rarely going nearly so far out to sea as their progenitors, and wintering by themselves, generally wholly apart from the older fish. In none of the deep bays on the Coasts of Newfoundland, the Bay of Fundy, Nova Scotia and the northern part of the State of Maine where the old herrings winter, are any considerable portion of immature fish taken. They are wintering apart, probably in different zones of water in the deep sea outside. There is a reason for this separation we may be assured, and we discover it, probably, in the simple fact that if it were not so, the inveterate and insatiable enemy of the Herring, namely the Cod, would annihilate the species, if the breeding Herrings were not preserved. In deep water, from 100 to 200 fathoms,

1. "The annual movements of many fishes are more strictly analogous to the migration of birds, since they take place in large bodies and often to considerable distances, and immediately connected with the process of reproduction."—Wallace's "Geographical Distribution of Animals."

2. *Ibid.*

3. Wallace—"Geographical Distribution of Animals."

all along the south shore of Newfoundland there are innumerable Cod during the winter season; in the profound bays on the same shore there are innumerable Herring. But the Herring rest undisturbed at the edge of the ice, and partly under it, throughout the winter, almost within view of the cod schools. These are the spawning herring. But where are the young herrings? those of the first, second and, it may be, the third year, the greater number of which do not spawn, and which will not begin to spawn until they have attained their third or fourth year. These are doubtless distributed through the ocean valleys, not remote from land, and on these young schools, as well as on the capelin and other small fish, the cod feed, for they are found in their stomachs when caught in the winter. ⁽¹⁾

The practical teaching of this law of distribution and local migration is the preservation of the spawning grounds of the old herring to their fullest extent, otherwise the winter supply of food for the cod will diminish in those areas where the young herring find a winter home.

In the Baltic the herring is caught in the winter under the ice, at a depth varying from five to twenty-four fathoms, with nets set at those depths. This is a point to which the Newfoundland fishermen would do well to direct their attention, and test the depth at which the herring is lying in their profound inlets and bays, by nets sunk to different depths.

Sars has shown that the young yearling herring like the young yearling cod, spend their first year near the coast, and congregate there in large schools. The fishermen of Nantucket in Massachusetts, have observed that a very large school of Cod visit that coast in the winter which will not average more than a pound and a half a piece. ⁽²⁾ These are probably yearling Cod, or rather Cod which have entered upon their second year, and, like the one or two year old Herring, do not venture so far out into the deep as the older fish.

THE SPAWNING OF THE HERRING.

It will now be shown that the spawning grounds of the herring are very widely distributed throughout the length of the British American coast line, and that the young herrings born in these breeding grounds form the natural and constant lure which brings the one, two and three year old cod—the inshore cod—to the coast.

The spawning takes place at two distinct periods of the year, namely, in the spring, or early summer, and in the autumn. In this particular the American forms of the herring are like the Norwegian "Spring Herring" and the "Bohustan," or Swedish Herring, which spawn in the autumn. The point is one of importance, for it develops two distinct periods on the American coast, during which the herring lure for the cod is present on our shores in its supposed most attractive form.

This occurs over a very wide stretch of coast line in the early spring months, when the herring first come in to spawn, and the act of spawning appears to develop an odour characteristic of the herring, which first indicates to the insatiable cod the whereabouts of the spawn which is so strong an attraction to them as food.

The numerous local schools of herring, the different runs and sizes of the fish which are found on widely separated parts of the coast as well as near together, appear to show that similar variations occur in American waters as are found in European seas.

2. Report of the U. S. Commissioner of Fish and Fisheries, 1871-72.

1. Dr. Gilpin, Trans. Int. Nat. Sci., 1873.

Mr. John Mitchell, in his work on "The Herring," states that the spawning ground near Dunbar, Scotland, after being visited by a school of Herrings at the end of August or beginning of September, is not only known by the sea having a whitish, opaque appearance, but also from the strong fishy or oily odour. "Immediately after spawning the herring started off, and for the space of three weeks the ground was swarming with whittings, cod and other fish, which were evidently attracted by the spawn." [1] The spawning grounds of Herrings are very attractive to Cod, who are inveterate spawn eaters, and it is thus that Herring on an extended coast line become very powerful means for luring the Cod to the Shore, and this appears to be done in a large degree by the strong oil smell emitted by Herring schools when on the spawning beds. In this particular they resemble the Caplin and Smelt, which, as stated in a separate article having especial reference to the subject, attract the Cod and other fish to the shore through the sense of smell, the Caplin and Smelt emitting during the season of reproduction a strong odour of the cucumber.

Before proceeding to refer to some peculiarities in the Natural History of the Herring bearing upon its importance to the North American Fisheries generally, it would be advisable to allude briefly to the following subjects :

- 1st. The spawning of the Herring.
- 2nd. The Winter Fisheries in British American waters.
- 3rd. The Spring and Autumn Fisheries.
- 4th. The periods of its approach to the coast.
- 5th. The extent of the Herring Fisheries in British American waters.
- 6th. The value of Herring as bait to the American Fishermen.
- 7th. The fluctuation in the catch.

The spawn of the Herring adheres in lumps and masses to everything with which it comes in contact. It is deposited at various depths on the bottom of the sea. Ropes drawn through Herring spawn, or merely lying near where it is deposited, become so thickly and uniformly coated as to resemble cables. Perley says [2] that on the 30th August, 1850, when on the Grand Manan Herring spawning grounds, "many of the nets were thickly covered with Herring spawn, and, in cleansing them the decks of some of the vessels were covered ankle deep. It was said to be no unusual circumstance for the net-rope (9 thread ratline) to be found in the morning as thick as a man's arm with the spawn, while a vessel's cable would be increased to the size of a five gallon keg."

Professor Huxley states in the "Report of the Royal Commission of 1863," that "If a female in this state (ready to spawn) be squeezed, and the ova received into a vessel full of sea-water, they will all fall to the bottom, and the viscid substance, with which the ova are coated, causing them to adhere together, they will form a thick cake, which, after a few hours rest, constitutes a dense consistent mass, so firmly adherent to the bottom of the vessel that the latter may be suddenly inverted without detaching the ova. Indeed, to separate these either from one another, or from the body to which they adhere, demands the exertion of a certain force, which, as often, ends in the destruction of the eggs as their detachment."

1. See also G. O. Sars' Report for 1872, relative to Cod being taken in Herring spawning grounds, with their stomachs full of spawn.

1. Report on the Fisheries of the Bay of Fundy.

SPRING SPAWNING GROUNDS.

GULF OF ST. LAWRENCE—EASTERN SHORE OF NEW BRUNSWICK
—AROUND MISCOU ISLAND—BAY OF CHALEUR—LAST
WEEK IN APRIL, MAY, TO THE 10TH JUNE.

In the Bay of Chaleur, Port Daniel, Cascapedia, Bonaventure and Carleton, are noted localities as herring spawning grounds.

Herring appear early in the spring on the north shore of the Gulf, at Seven Islands, Natashquan, Kegashen and Bradore. "They leave the shore in June and reappear in August on the western part of the Gulf coast, and gradually later towards Belle Isle, where they appear about the first week in September."

MAGDALEN ISLANDS—PLEASANT BAY—NEW BRUNSWICK SHORE

Herring spawn on the whole eastern shore of New Brunswick, around Miscou Island, and within the Bay of Chaleur (Perley, 1849.) The first, or Spring Herring, appear as soon as the coast fringe of ice leaves, about the middle of April, according to the character of the season. The second, or Fall Herring, appear about the 20th August. There are, besides these, local schools, such as the Miscou Herring, which come in at the end of June and remain all the season. This herring is small and fat, and is caught in an inch and a quarter net, at from $\frac{1}{2}$ a mile to 20 miles from shore. They are distinct from the Spring Herring. (Perley.)

BAY OF FUNDY.

The Digby Herring appear in Annapolis Basin about the beginning of April and spawn about the 1st of May. By the 20th of that month they have in general left the Basin.

Grand Manan, Southern Head—July, August and part of September.

Basin of Minas—June.

NEWFOUNDLAND—NORTH-EAST ATLANTIC COAST.

Mr. Michael Carrol states that "as soon as the ice moves off the shore in the different northern bays, in spring, the herrings are sure to strike in to spawn," and they visit the same harbour, cove or creek each season for that purpose. They are generally in a poor condition and of the same size. They are caught in seines, herring nets, cast or dip nets, and large quantities at a time. Ice alone prevents them from being taken regularly every year.

AUTUMN SPAWNING GROUND.

ATLANTIC COAST, NOVA SCOTIA.

September and October. "They approach the Nova Scotia Shore early in March, at first very straggling and very lean. I have myself seen spawn fish in May. The fishermen tell me they find them at all seasons. * * * During the latter part of August they are in their prime, and preparing to spawn—which operation takes place in September and October." "The various sandy coves and land-locked bays about Sambro, Eastern Passage, Shelburne and Prospect, are favorite resorts, in from five to ten fathoms. Here the fish may be seen lying upon the bottom in thousands. They may be measured by the acre. The sea is white and turbid with the spawn, and ropes, in passing through it, become as large as small hawsers. The Cod and his varieties approach to feed upon it, while quantities are cast upon the beaches of the sea." [2]

UNITED STATES WATERS.

From: Eastport to Scituate (Maine)—September and October.

48.—WINTER HERRING FISHERY.

NEWFOUNDLAND.

BAY OF ISLANDS—Middle Arm and Humber Sound—End of October to March, and in May and June.

In autumn and winter taken in nets 2½ and three inch mesh, put down in holes and drains cut through the ice at different parts of the Humber Sound. (1)

In 1864, during October and November, there were taken
 In nets.....6900 bbls. Autumn fishing
 In Jan., Feb. & Mch. 19700 “ Winter “
 In May (1865.) ... 3900 “ in seines..... Summer “

Total30500 “

Exports of Herring in 1868 50,000 bbls.

ENGLISH HARBOR—In 1864, 24,908, barrels of Herrings were taken from Fortune Bay. In 1865, 12,600 barrels frozen Herrings from the same District. These Herrings are taken in the latter part of December and in the month of January. Mr. Hayward states that he was informed that 8000 barrels are “annually thrown overboard in consequence of the mildness of the weather; the herrings are hauled, and the weather not being sufficiently hard to freeze them.” “Numbers are also destroyed by being barred for a long time. (1)

	1863.	1864.
Exports from English Harbor.....	2000	27308
“ “ Baie de Nord.....	10560	—

At Fortune Bay, the Herring is stated to strike the shore about the first week in December. They take up their quarters in the deep arm about the 1st January, where they remain, chiefly under the ice, until about the 20th March. From the 20th March to the 20th April they are usually abundant and quite near the shore; they then go into deep water and remain there until the 5th to 10th May, when they make their appearance in every cove and harbour for the purpose of spawning; the season lasts until about the 5th June, but a few schools are later, and it is not completely over until about the 1st August; they then go into deep water to recuperate. (1) Herring are alleged to be more numerous now than 25 years ago.

WINTER HAUNTS OF HERRING AT THE ENTRANCE TO THE BAY OF FUNDY.

In Bays on the Coast within thirty to thirty-five miles of the Passamaquoddy Bay, near the Island of Grand Manan, at the entrance to the Bay of Fundy.

A very extensive and valuable winter Herring Fishery has its headquarters at Eastport, in the State of Maine, U. S. The Herrings are frozen as soon as caught, and shipped to markets in that State. In order to take advantage of changes in the weather, a signal telegraph station is connected with the chief fishery Depot at Eastport, to give suitable warning of the probable approach of warm or cold weather, and thus prepare the dealers for the changes advisable in their operations. The Herrings begin to approach their winter quarters in October, and leave them early in April. (1)

1. Mr. Hayward (1865)

1. Report, 1865, App. to Journal of the Council, 1866.

1. Letter of G. R. Bennett, App., Newfoundland Journal of Assembly.

1. For further information on the distribution and uses of the Herring on the Atlantic coast of Nova Scotia and the State of Maine. See Chapter on Hail.

COAST OF NOVA SCOTIA.

During the past ten years the fishermen in the neighbourhood of Halifax and Margaret's Bay have taken Winter Herring on the shores in from four to six fathoms water. In some places they have, it is stated, left their accustomed winter quarters during the season of 1876-77, but probably they were only a little further out at sea. It is stated that vessels took cargoes of herring from Margaret's Bay this last winter to ship to Sweden. A winter herring fishery of considerable magnitude might spring up on the Nova Scotian coast. Indeed, the fishermen have stated to the writer, that recently American vessels have received much of their bait on Nova Scotian shores, for the LeHave and George's Banks, which they were accustomed to get at Newfoundland.

WINTER HERRING FISHERY IN EUROPE.

An extensive Winter Herring Fishery exists on the White Sea. Opposite the village of Soroka upwards of 750 thirty-six fathom nets are employed by the fishermen under the ice. A good haul will bring up 100,000 fish. At night the net is left in the water, during the day time it is dragged from hole to hole several times. Both the small and the large herring are always to be found in the White Sea.

In the Baltic and its approaches the herring has also been seen to pass under the ice, and are taken in nets.

SUMMER HERRING FISHERY—NEWFOUNDLAND.

BAY ST. GEORGE.—Herring are taken here in the mouth of May, and "are of a thin description, not resembling those taken in Bay of Islands." Exports for 1864 20,260 barrels, all taken in nets.

RAMEO ISLANDS.—Mr. Hayward reported the herring fishery rapidly decreasing at this station in 1865. He was informed by the residents that some fifteen or sixteen years previous to 1865, 20,000 barrels were annually taken here. The practice of barring herrings has been extensively carried on.

Mr. J. M. Kelly reported in 1857 that the usual catch of herring in St. George's Bay some years ago, was from 20,000 to 30,000 barrels, but previous to 1857, for a few years, it had begun to decrease so much, that when his estimate was framed in 1857 not more than 12,000 or 13,000 barrels were taken. The cause of the decrease was then attributed to the practice adopted by the schooner masters, who came for herring, of throwing the offal of the herring overboard on the fishing ground.

In 1868 the number of barrels of herring for bait, taken by the French fleet, of about 300 vessels, sailing from St. Pierre, was 66,000, besides a large quantity of capelin. The value of the herring was estimated to be about £27,000 stg., and of the capelin, £16,000 to £18,000 stg., together, about £45,000 stg. (Capt. Parish.)

PERIODS OF APPROACH TO THE COAST.—NEW-
FOUNDLAND.

NORTH EAST ATLANTIC COAST. D-I.

50. Table showing the dates of the first appearance and departure of the HERRING from the North East Atlantic Coast of Newfoundland :

Station.	Year.	Spring Herring.	No. of Days.	Autumn Herring.	No. of Days.	
Cape St. John to Partridge Point.....	1871. 1872.	15th May..... All the Season.....	.....	All the Season.....	.....	Middle of May to middle of Sep.
White Bay and Canada Bay.....	1871. 1872.	.....	.....	1st Aug. to 15th Sep. 1st Aug. to 20th Sep.	46. 51.	.....
Cape Rouge Harbour.....	1872.	May.....	.....	October.....	.....	All the Season.
Crock Harbour.....	1871.	May.....	.....	October.....	.....	All the Season.
St. Anthony.....	1871. 1872.	..... 11th May.....	.....	1st Aug..... 31st October.....	184.	.....

1. Captain Brown, R.N., H.M.S. "DANÆ," for the year 1871; Captain Hoskins, R.N., H.M.S. "ECLIPSE," for 1872. Reports on the Newfoundland fisheries.

STRAITS OF BELLE ISLE.

NEWFOUNDLAND COAST.

Table showing the dates of the first appearance and departure of the HERRING from the coasts of the Straits of Belle Isle.

Station.	Year.	Spring Herring.	No. Days.	Autumn Herring.	No. Days.
Cape Bauld	1871.				
to					
Cape Onion	1872:		Aug. 10 to	Sep. 30	51
Pistolet Bay	1871:				
	1872:				
C. Norman	1871.				
to					
Savage Cove	1872:				
Savage Cove	1871:		July 31.		
to					
St. Barbe's B:	1872:		Aug. 14 to	Sep. 30	46
	1873: July 10				

LABRADOR COAST OF THE STRAIT.

Chateau Bay:	1871:	Aug. 5.	
Red Bay	1871:	Aug. 20 to Sep. 25	36
Black Bay	1871:	Aug. 20 to Sep. 30	41
Forteau Bay	1871:	Aug. 10 to Dec. 20	132

HERRING ARRIVED.

Henly Harbour:	8th Sept., 1868.
Fox Harbour	3rd "
Black Bay, Pinware	4th "
East and West Modeste	4th "
Seal Bight	14th Aug.,

GULF COAST OF NEWFOUNDLAND.

Table showing the dates of the first appearance and departure of the Herring from the Gulf coasts of Newfoundland.

Station.	Year.	Spring Herring.	No. of Days.	Autumn herring.	No. of Days.
St. Margaret's Bay.....	{ 1871 } { 1872 }	.....	.....	Small herring, 15 Aug. to 15 Oct.; large herring, 15 Sep. to 15 Oct.	{ 61 } { 30 }
St. Margaret's Bay to In- garnichois.....	1872	.....	.....	1st Oct. to end of season.....	.....
Ingarnichois to Bonne Bay.....	1872	Herring winter in Bonne Bay.....	.....	.....	.....
Bay of Islands.....	.....	1st May to 30th June.....	61	.....	.....
St. George's Bay to Cape Ray.....	.....	Herring winter here.....	.....	.....	.....

Two distinct schools.

SOUTH COAST OF NEWFOUNDLAND.

Herring winter in many of the deep Bays on the South Coast of Newfoundland.

EXTENT OF THE HERRING FISHERY IN BRITISH AMERICAN WATERS.

51. There are three ways in which the Herring taken in British American waters are consumed :

- First as Food.
- Second as Bait.
- Third as Manure.

The Tables of Catch, as of Exports, furnish but very imperfect information as to the annual quantities of this fish which are used in the different ways named, but a close approximation can be obtained of the amount consumed as food; and for this we are indebted to the comparison and estimates of the Deputy Minister of Agriculture, Mr. J. C. Tache.

The following tables show the reported catch, and the estimated Dominion catch for the years 1869 to 1876 inclusive:

Year.	Reported Catch in Barrels.	Estimated Catch in Barrels.
1869.	307,478	505,195
1870.	248,839	408,850
1871.	380,600	625,337
1872.	324,877	533,783
1873.	349,666	557,979
1874.	326,476	534,307
1875.	340,382	555,371
1876.	418,859	

The catch of Herring in Newfoundland and Labrador is very much greater than would be gathered from the annual export. The Census is the only true test of the magnitude of this industry. The exports of Newfoundland for the year 1874 are returned as amounting to no more than 42,585 barrels, while the total catch, including what was cured for home consumption, sold as Bait and exported, reached upwards of 270,000 barrels. The Census gives the following enumeration of the number of barrels of Herring cured in the Colony and its Dependency during 1874:

	Barrels.
Herring cured in the Electoral Districts	75,297
“ “ on the French Shore	93,825
“ “ on the Labrador	16,265

Total cured 185,382

Add to the total number barrels of Herring cured the number sold to the French as Bait ⁽¹⁾	70,000
Sold to the Americans ⁽²⁾	16,000

Total number of bbls. of Herrings caught . . 271,382

Total number exported 42,585

Difference between export and catch . . 228,797

The aggregate number of barrels of herring caught in Dominion and Newfoundland waters during the year 1874, probably exceeded eight hundred thousand barrels, thus:—

Dominion waters	534,307 bbls.
Newfoundland do.	271,382 “

Total 805,689 “

To this we add the quantity used for manure, which rarely appears in any returns, the quantity consumed as bait, without being enumerated, and the quantity destroyed by the hurtful process of herring. A million barrels of herring each year, and gradually increasing, will fairly represent the quantities of this fish taken from British American seas.

1. This estimate of the annual quantity of Herring sold to the French as Bait is taken from Mr. Hayward's official report in 1864. In 1876, estimated quantity of Herring sold to the French for Bait—200,000 barrels—Evidence of George Rose.

2. Estimated. See evidence obtained by Mr. T. O. Fraser.

THE VALUE OF THE HERRING AS BAIT TO THE AMERICAN FISHERIES.

52. The testimony embodied in the following extract from the "Fisheries of Gloucester," afford ample proof of the great value of the British American Herring Fishery as bait for American Fishermen. Indeed, no further addition to the eminently practical statement there given is necessary.

"The Newfoundland and New Brunswick Herring Fisheries, of comparatively recent origin, while not unattended with hardship and danger, became at once an important auxiliary of the Georges' and Banks fisheries, and have been pursued unremittingly from the start. During the present season herring have been shipped hence to Sweden, at a good profit, and it is not impossible that this may prove the initial step toward the resumption of exportation of fish to foreign ports, an important industry of the port in the early days of its fishing enterprise. The Spring of 1876 has also been marked by a new feature in the Georges' fishery, the capture of haddock in immense quantities in deep water on the edge of the bank, good fares having been secured in a hundred and fifty fathoms of water, a greater depth than was before thought likely to furnish profitable returns."

"With the close of one fishing season another is inaugurated. On the winding up of the mackerel fishery, and the partial suspension of the Bank fisheries in the Fall, the better class of vessels thus employed commence fitting for the Herring Trade, to which the energies of quite a fleet are devoted during the winter months. A few vessels only engage in what is known as the salt herring trade, the majority of the fleet securing their fares fresh, freezing them thoroughly and stowing them in bulk, allowing their cargoes to remain undisturbed until they are marketed in as good order as when taken from the water. The Newfoundland herring trade was inaugurated in the winter of 1856, and has been pursued with varying success since that time. This fleet usually sails from the middle to the last of November, with an outward cargo of such supplies as are likely to find a quick demand among the herring fishers of Newfoundland, which are exchanged for the products of the sea. The crews of the fleet do not engage in fishing to any extent, being occupied in taking proper care of the herring purchased of the local fishermen. Having secured a cargo they return home, usually arriving in January and February, when a portion of their cargoes find a ready sale to the Bank fleet, for bait, the rest being marketed in Boston, New York and Philadelphia markets, for food, where they are in active demand, especially during Lent. The business is an important one, furnishing employment for the vessels and men at a time when they might otherwise be compelled to lie idle, and providing the means for the early embarkation of the Georges' and Bank fleets in the late Winter and early Spring months. The business is also a godsend to the people of Newfoundland, who are thus enabled to exchange the products of their Winter fishery for the necessaries of life on much more favorable terms than would otherwise be possible. The New Brunswick herring fishery is another valuable pursuit, and attended with much less danger than the more distant voyages to Newfoundland. In the season of 1874-5, twenty-three schooners made Newfoundland trips, and thirty-three were engaged in the New Brunswick fishery.

Early in February, on the arrival of their supply of bait, the Georges fleet fit away for their early trips, and the Grand and Western Bank fishery assumes more important proportions. The cost of an average Georgesman fitted for sea is

about \$7,868; this includes the cost of hull, \$5,200, spars, \$400, rigging, \$550, sails, \$575, 230 fathoms of cable, \$450, 3 anchors, weighing 500 lbs. each, \$120, 12,000 herring for bait, \$150, dory, 30 tons of ballast, platforms, ice-houses, gurry-pens, lines, cabin furniture, lanterns, horns, compasses, 4 tons of ice, wood, coal, water, etc. Each vessel takes a crew of eight or ten men, and ordinarily is absent from two to three weeks on a trip. The fish are caught by hand lines, and each man keeps account of his catch by cutting out the tongues of the codfish, which are carried to the skipper for record when the day's work is closed, and by marking the halibut caught on the head or tail. At the end of the voyage each man's halibut are identified and weighed separately, and the average weight or value of the codfish taken is ascertained, and each man credited with the number caught. The gross proceeds of the catch are subject to deductions for the cost of bait and ice, and one-fourth of one per cent. is reserved for the Widows' and Orphans' Fund, so that each man engaged in the business contributes something towards the support of the families of those whose lives are sacrificed in this hazardous occupation."—*Fisheries of Gloucester*," Procter Brothers.

FLUCTUATIONS IN THE CATCH.

The fluctuations in the Herring fishery in the Estuary of the Lawrence are well shown in the following table. (1.)

SOUTH SHORE—POINT LEWIS TO CAPE CHATTE.

Year.	No of bbls.	Year.	No of bbls.
1868	30,117	1872	7,174
1869	13,135	1873	12,545
1870	6,671	1874	12,903
1871	2,169	1875	6,311

In 1874 the Herring appeared in large numbers in the estuary of the St. Lawrence, as high up as Malbaie, where they had not been seen for many years past. The prevalence of south-east winds was locally supposed to be the cause of their return.

Mr. Miller states in his Official Report to the Minister of Marine and Fisheries, for 1867 (Sess. papers No. 43, 1867) that "along the north shore of New Brunswick, almost any quantity of Herrings could be captured in the Spring season."

FLUCTUATIONS AT THE MAGDALEN ISLANDS.

Year.	Date of first appearance.	No. of Barrels taken.	
1861.	May 1st.	41,500.	
1862.	May 2nd.	9,195.	
1863.	May 17th.	26,500.	
1864.	May 1st.	3,000.	
1865.	April 27th.	29,640.	Very abundant.
1866.	April 25th.	10,893.	
1867.	May 7th.	15,620.	" "
1868.		39,000.	Spawned after vessels left with cargoes.
1869.		70,800.	Strangers, 63,600 barrels; inhabitants, 7,200 barrels.
1870.	April 15th.	2,915.	Three weeks earlier than usual; fish abundant, but fleet too late in arriving.
1871.		52,575.	
1872.	May 3rd.	17,822.	
1873.		4,847.	
1874.		12,137.	
1875.	May 6th.	49,951.	Said not to have spawned in the bays, as usual; probably spawned in deeper water.
1876.		77,443.	

1. Appendix No. 9, Sessional Papers, No. 5, 1876.

FLUCTUATIONS IN NOVA SCOTIAN WATERS.

Annual Return of Herring caught in Nova Scotia by Counties for each year since Confederation (1868), and also in 1851 and 1861, as shown in the Census Tables of those two years. The other years (1869-76) are taken from Reports of Marine and Fisheries Department.

HERRING.

COUNTIES.	1851.	1861.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.	Bbls. Boxes.
Cumberland.....	678	752	1345	1235	1475	3200	3870	3350	1720	2790
Colchester	112	387		20	275	1250	305	250	50	160
Halifax	340	86				255	250	239	82	59
Kings	849	956	5040	2900	3121	2318	500	2650	5950	7481
Antigonish	529	4333	6155	4392	6735	1216	500	2565	33574	14555
Richmond	5213	13717	1000	3530	5500	4158	4200	2870	8570	20780
Yarmouth	1398	6456	197	1671	3676	3459	780	3461	2076	7585
Shelburne.....	6950	25801	5300	19875	24398	30145	30000	10384	3385	11975
Queens	4850	5400	5744	5235	7194	8131	6394	6580	2749	5739
Launceburg	4578	28065	15944	8569	17787	17825	19486	19296	18700	14760
Halifax	5085	44199	29480	17499	37857	34950	51130	39772	22571	35742
Pictou.....	50	1550	300	422	1806	1640	21021	6158	309	9314
Antigonish	8400	36849	2307	3127	4750	4350	5000	4030	2450	2000
Cityborough.....		9201	38384	25540	47080	20311	15095	13225	16182	19000
Richmond	4398	15850	18850	12359	22210	18587	14025	15736	16970	16796
Cape Breton.....	6113	4157	4817	6983	5789	5636	5880	5215	6429	11203
Victoria.....		2352	1344	1400	1621	4500	3785	5705	4135	5205
Inverness.....	2297	7017	3080	8302	9446	3599	12035	11592	3145	5494
Total.....	51050	192557	133933	12183	201000	10200	197126	153028	50970	121358
				13150	34302	21430	50970	45700	1651424	51310

NEWFOUNDLAND.

The exportation of herrings from Newfoundland affords but a very imperfect clue to the extent of the catch. A large quantity is consumed by the population, and a very large quantity shipped during the winter months in American vessels for bait, and also to St. Pierre and Miquelon for the same purpose.

The following table shows the actual exports which came under the notice of the Custom House authorities. It will be shown hereafter that these form but a small proportion of the total amount caught, the greater portion of which is used as BAIT. (1)

EXPORTS OF HERRING FROM NEWFOUNDLAND.

Year.	Exports—No. of Barrels.	Year.	Exports—No. of Barrels.	Capital—No. of Barrels.
1817	1,726	1847	9,908	
1818	1,601	1848	13,872	
1819	1,668	1849	11,471	
1820	3,233	1850	19,556	
1821	526	1851	36,259	
1822	305	1852	42,715	
1823	333	1853	.....
1824	349	1854	.....
1825	263	1855	.....
1826	267	1856	32,294	
1827	.....	1857	40,789	157,362
1828	.....	1858	.....
1829	970	1859	61,594	
1830	1,524	1860	82,644	
1831	3,305	1861	73,633	
1832	3,285	1862	29,849	
1833	2,271	1863	80,056	
1834	.....	1864	43,007	
1835	.....	1865	.....
1836	1,534	1866	.....
1837	5,815	1867	.....
1838	15,276	1868	50,859	
1839	20,808	1869	† 80,935	97,035
1840	14,685	1870	† 54,869	
1841	9,685	1871	† 187,429	
1842	13,839	1872	* 154,771	
1843	9,649	1873	* 133,158	122,608
1844	13,410	1874	* 198,256	185,382(2)
1845	20,903	1875	* 207,088	
1846	12,119	1876	.....

SUPPOSED CAUSES OF THE FLUCTUATIONS IN THE NORWEGIAN HERRING FISHERIES.

The great Herring ground on the coast of Southern Norway extends from "Hekkefiord," in lat 58° 10', about 30 miles north-east of "The Naze," or most southerly point of Norway, to the headland of "Startland," in lat. 62° 10', a space covered by four degrees of latitude. But in consequence of the numerous islands and the depth of the Fjords, the actual coast line very much exceeds the length comprised within four degrees of latitude, on a north-westerly course, and the aggregate length may be from 950 to 1000 miles available fishing ground, but not all frequented by the Herring. (See maps of the movements of the Herring in Sars' Report for 1874.)

The Herring fishery on this part of the Norwegian coast has yielded annually about 800,000 barrels of Herrings for the last thirty years; at the rate of 1000 Herrings to the barrel, not less than 800,000,000 fish every year. But the vast schools

1. Authorities—From 1817 to 1852, inclusive, Official Returns, in Appendix to the late Matthew H. Warren's Lecture on "Newfoundland and its Fisheries."—(1853.)

2. Including 16,265 barrels from the Labrador (Census, 1874.)

* Including Labrador and Frozen Fish.

† Not including Frozen Herrings.

of fish which find their spawning grounds here for many years together, appear suddenly, and with little previous indications, to leave for other quarters, and seem to return again after intervals which sometimes exceed over twenty-five years, and, in some instances, double that period. It is very probable, however, according to the recent investigations of Sars, that this is a popular error, and that often, when the Herring are supposed to have left a long frequented coast line, they are in reality spawning in deeper water outside. This is a most important observation, for, as the Cod follow the Herring within certain limits, if fishermen find the Cod they will also know the whereabouts of the Herring. It explains too the occasional failure of the Herring fishery from the non-appearance of these fish on their usual spawning ground, and while fishermen are lamenting their losses and "the failure of the fishery," the Herring may really be spawning in deeper water outside of their accustomed haunts. In 1872 Sars reported as subjoined :

"It follows from this also, that a great number of herrings must have spawned under the coast, and that last year's failure (1871) of the spring herring fishery finds its cause not in a diminution of the herring, nor in a change of their track, but solely because, for one reason or another, the great mass of 'Sild' (herring) did not approach the land so near as before, but spawned on the outer grounds farther out to sea." In relation to the failure of the "Spring Herring Fishery" of 1871, Vice-Consul St. John reported as follows:—"The falling off will be severely felt by the fishing community of the Southern districts. Fears are entertained that it will be followed by great want and misery to many who hitherto had depended on those fisheries as their principal means of support."¹

If the fishermen had known that the Herring were spawning outside, how easily they might have saved themselves from the impending distress the Vice-Consul laments, may be seen from what Sars relates of the manner in which he ascertained the important fact.

"All fishermen here (at Hvitingsø Station) are agreed that great quantities of 'Sild' (Herring) stand under the land at the usual time, which might be seen, to name one proof, from the unusual numbers of whales and birds: and everything pointed to a rich harvest of 'Sild' at Hvitingsø. But they waited for a long time in hopes that the Herring might appear on the usual fishing spots; and the consequence was that the 'Sild' had finished spawning quietly, when they should have attempted to take them farther out to sea." As a further proof of this, a well known pilot here related to Sars, that when on a day after the close of the "Sild" fishery, he was fishing in the outer grounds, he found an unusual number of large Cod, so as to fill the boat in a very short time, and what was most surprising in this case, these fish had filled their stomachs with "Sildlegaas" (Herring spawn) which, as soon as they were got up into the boat, they vomited in quantity.

Referring to the fluctuation of the Herring Fisheries in Norwegian waters, the Commissioners of Scotland quote, in their report for 1875, the following extract from the National Magazine, which conveys a concise view of these remarkable variations in the apparent number of the herring visiting the Norwegian coast and so greatly affecting its industry.

"The coasts of Norway have long been famous for their fisheries, which have always proved a source of wealth to the Norwegians, who derive from this pursuit one of the main

1. Consuls Reports, 1871.

“branches of their commerce. The number of persons and
“vessels engaged show that it is a profitable and important
“maritime occupation. To Vice-Consul Crowe we are indebted
“for a lengthened account, both comparative and otherwise,
“of the fisheries for the year 1874, with an interesting des-
“cription of the novel uses to which certain portions of the
“food thus obtained have been applied. The spring herring
“fishery, with the exception of that in 1871, when there was
“an extraordinary rich catch, especially in the Sondmore dis-
“trict, has in the course of the last five years steadily de-
“creased, so much so that the produce of 1874 did not reach
“to one-thirtieth of the average quantity for the years 1851
“to 1865, from which it is to be presumed that the present
“herring period, which began in 1808, is at an end, or, at all
“events, very nearly so. The real cause of this decline has
“yet to be discovered; probably it will be found to be con-
“nected with some submarine agency, such as the abundance
“or scarcity of food, or the storms or currents affecting the
“temperature of the ocean. This is, however, not the first
“time that the spring herring fishery has been known to de-
“sert the coast, even for long periods. The details respecting
“this fishery in early times are naturally most uncertain and
“insufficient, but within the three last centuries the records
“have been more accurate, and from these we find that this
“fishery totally disappeared during the first half of the sev-
“enteenth century, and that in the years 1650 to 1654 only
“8,000 barrels were annually exported. In 1661 and 1662 the
“fishery seems to have been good, but not extraordinary; and
“so it continued for the latter half of the century. From 1700
“to 1784 the spring herrings visited the coast regularly, espe-
“cially between Stavanger and Bergen, and during the last
“ten years of the period they were unusually plentiful near
“Stavanger. From 1736 to 1756 the fishery continued good
“in the Romsdal districts, but in Sondmore it ceased alto-
“gether in the year 1758, but was replaced by a most profit-
“able cod fishery. From 1785 the spring herring is said to
“have entirely deserted the coast, not making its appearance
“again till 1808.”

THE FLUCTUATIONS IN SCOTTISH SEAS. ^(1.)

53. BALLANTRAE.—The Herring forsook the spawning ground on the banks off Ballantrae, on the Ayrshire coast, in 1854, but they returned in 1862, being absent for a period of eight years. The schools had certainly frequented these banks for 25 years before they took their departure in 1854.

ISLAND OF LEWIS.

LOCH ROAG.—Previous to 1750 this Loch was famous for Herring. But the fish abandoned

The waters in.....	1750
Returned in.....	1790
Abandoned in.....	1797
Returned in.....	1829

Season for fishing: November, December and January.

ROSS AND SUTHERLAND.—Periods of depression at the Island of Lewis appear to be periods of prosperity on these coasts, “and when the Stornoway fishing declines, that of Ross and Sutherland appears to augment.” ^(1.)

The quantity of fish supported for a short time by a limited area of water is one of the most astonishing and curious features of the conditions under which marine life is maintained. The area, for instance, of Loch Fyne, the celebrated Scottish Her-

1. Report of the Royal Commission, 1863.

ring Fishery, is about 90 square miles, the water from 10 to 100 fathoms in depth. During every five years between 1844 and 1862, the average number of herring caught in the Loch is shown in the annexed table.

1844—1848 . . .	15,400,000 herrings caught each year.
1849—1853 . . .	19,100,000 " " " "
1854—1858 . . .	25,700,000 " " " "
1859—1862 . . .	42,100,000 " " " "

During the spawning period they feed but little, a constant supply of air is however equally essential to their well being; currents must bring the supplies of air needed, of which the oxygen is the most important constituent.

In 1862 not less than 100,000,000 herrings were taken from Loch Fyne, or about 79,800 barrels,⁽¹⁾ but in 1852 only 10,600,000 fish were taken, and throughout the whole period the fluctuations were considerable, as is apparently the case in all Herring Fisheries. But in Loch Fyne the herring latterly taken have diminished in size, 1,300 going to a barrel instead of about 1,000.⁽²⁾

It is also noteworthy that, according to the report of the Fishery Officer at Loch Fyne, the greater part of the catch of 1862 consisted of *mill*, or *mule herrings*, and comparatively few roe herrings were seen. The bulk of the catch was supposed to be young fish. Few or none of the large Loch Fyne herrings were caught during the season.

Soon after this successful year (1862) the Loch Fyne Fishery began to decline, and the Commissioners, in their report for 1875, record its gradual failure in the following words: "The Herrings failed to pass up to the higher parts of Loch Fyne although about the end of July there was great abundance of small-sized Herrings between Otter and Minard, and nowhere above Ardrishaig was there anything but a poor and irregular fishing, the upper parts of the Loch being almost blank."

Should this scarcity of Herring in Loch Fyne continue, it might be worth while to take advantage of the observation of Sars and ascertain whether the Herring are not spawning outside of the Loch and not remote from their old spawning ground. Boeck states that the Herring spawn in water varying from ten to one hundred and fifty brasses (fathoms) in depth. Similar conclusions might be tried on parts of the Dominion coast line where old spawning grounds have been abandoned. The Herring may spawn near at hand but in deeper water, and where the Herring can spawn there will also the Cod be found. Hence the value of a Herring fishing ground becomes very much increased on account of the attraction it offers to schools of Cod, and it will probably yet be ascertained that the numerous abandoned spawning grounds in British American waters may be guides to at present unknown spawning grounds a short distance seawards of their old haunts, and because they are in deeper water the Cod will be found there in abundance during and just after the spawning season. (See Chapter on Bait.) "From 1736 to 1756 the fishery continued good in the Romsdal districts (Norway), but in Sondmore it ceased altogether in the year 1768, but was *replaced by a most profitable Cod fishery.*"

SOME POINTS IN THE NATURAL HISTORY OF THE HERRING AND COD.

The Herring has been the object of untiring pursuit, on a gigantic scale, for many centuries, in various parts of Europe,

1. Vide Report of Royal Commission, 1863.

2. The estimated number of herrings caught by 42,571 fishermen and boys in Scotland and England in 1862 was 900,000,000. In 1875 it must have approached 1,200,000,000.

particularly in Norwegian, British and Swedish seas, but the movements of the vast schools of these valuable fish have always been a subject of doubtful speculation, and frequently of great commercial distress and widespread suffering among the fishermen, who have depended upon their accustomed "migrations" being uninterruptedly completed.

The most trustworthy accounts of the fluctuations of the Herring are to be found in Norwegian records, where the supposed fish movements have been chronicled for more than two centuries, with considerable accuracy.

Although the American Herring (*Clupea Elongata vel Harengus*) is supposed by some to be a different species to the European Herring (*Clupea Harengus*), and the seas on European coasts are not nearly so ice-encumbered or so ice-bound, except in the Baltic, as those parts of the American continent, where the Herring is chiefly sought for, yet the experience gained in Norway, Sweden and Britain, is not only applicable to Dominion and Newfoundland waters, but pre-eminently valuable as a guide in any investigation which may be pursued. The recent report of the Commissioners of the Fishing Board, Scotland, (being for fishing, 1875,) contains useful facts on this subject, and the Norwegian Consular Reports are full of most valuable information. But beyond all others in scientific interest and commercial importance are the results of the investigation of the Norwegian Naturalists, and especially those of G. Ossian Sars. Indeed, it is to this painstaking and able observer that much of the practical knowledge we may now possess of the habits of the Herring may be said to be due. (1.)

SUPPOSED INEXHAUSTIBLE CHARACTER OF CERTAIN SEA FISHERIES.

55. It is customary to speak of the inexhaustible character of the Sea Fisheries. If this be true in American waters, how has it happened that the Cod fishery has declined to such a marked extent on the New England coast, and that there are numerous areas of small extent where Cod fishing used to be profitably carried on in British American waters, but which are now abandoned as unproductive. The truth appears to be that the productive sea area in American waters is greatly limited by the Gulf Stream, and that, except in the Labrador Current, the limit of practical exhaustion is much more easily attained in American than in European seas. This is owing to the vast extent of coast line in Europe occupied by the seas whose low temperature admits of the increase of the commercial cold water fishes. The Baltic Sea is in very many particulars analogous to the Gulf of St. Lawrence, both in temperature and in separation from the great body of oceanic waters. The coasts of Nova Scotia and Newfoundland more approach Norway and the United Kingdom in their relation to waters of comparatively low temperature. But the seas off the United States are bounded by a wall of warm water, forming as secure a barrier to the movements of certain fish as a line of coast. Wallace⁽¹⁾ states that

1. The writer takes this opportunity of acknowledging his indebtedness to Professor G. O. Sars for his reports from 1864 to 1869, and from 1870 to 1873, inclusive, with a map showing the movements of the Herring on the Norwegian coast, published in 1873. He is also greatly indebted to Mr. Theodor Anton Verkrüzen for a translation of some of these reports, and an abstract of others. Extended notices of Professor Sars' Reports are embodied in the Norwegian Parliamentary documents in the Library of Parliament at Ottawa. Indeed, the "Storting's Forhandlinger," (Parliamentary Reports) in the library of Parliament abound in valuable information respecting the Norwegian Fisheries.

1. "Geographical Distribution of Animals."

"Sea fish seem at first sight to have almost unlimited means of disposal, but this is far from being the case. Temperature forms a complete barrier to a large number of species, cold water being essential to many, while others can only dwell in the warmth of the tropics." An examination of any map showing the distribution of the Gulf Stream off the coasts of America, points to this barrier as limiting the area of United States waters suited to the commercial fishes, within very narrow bounds compared with those of the United Kingdom, Norway and Sweden, in Europe, and the Dominion and Newfoundland, in America. This is, in reality, a very potent reason why the coasts of the New England States are in such a depleted condition; the natural area off the shores is not suited to the development of numbers sufficient to supply the enormous drain upon them, demanded by so many millions of people, and they must seek a supply for increasing wants off other and foreign shores. The habits of the cod and of the herring point to this important fact, and herein we find a potent cause of present scarcity. But this can only be established by a knowledge of the habits of the species, and there are none among the food fishes so important as the herring and the cod. Hence it is essential that a summary of what is known of these fishes should be introduced, especially of the Norwegian, or spring spawning herring, and the Swedish (Bohustan), or autumn spawning variety, both of which appear to be abundant on our coasts.

EFFECT OF THE LIMITED AREA OF THE UNITED STATES COLD WATER SEAS.

56. The destruction of the Cod Fisheries on the coasts of New England is stated to have arisen from the comparative annihilation of the anadromous fishes, but in view of the limited area of waters suited to the habits of the Cod and its reproduction on those coasts, the question may well arise whether this fish can ever again become of commercial importance in New England waters, considering the constant drain to which the sea is subjected there. It is quite easy to understand how in an undisturbed condition the coastal waters may have abounded with this species, even near the southern limit of its habitat, but when once destroyed or reduced in numbers to an extent rendering it commercially valueless, it is open to serious doubt, now that the condition of the coastal waters are so changed in relation to fish life, whether the cod can be reinstated there, so as to make it an important object of pursuit. Indeed, reasoning from the known habits of this fish in relation to spawning, food, and temperature of the waters in which it thrives, it may be affirmed as a positive opinion that no efforts of man can ever reproduce the New England Cod Fishing Industry. Excepting the George's Shoals, the sea area from which the United States must in future derive its supplies of this important fish are chiefly limited to waters of the British American Coast line. (137.)

57. The area of cold waters required to support the innumerable hosts of fish which may render a Fishery commercially valuable for a long series of years, is so great, that a glance at Dr. Petermann's temperature maps showing the relative areas of such waters subtending different coast lines, determines at once to natural fish producing waters.

That general and wide spread starvation even now occasionally occur both in "European and American Seas," we have sufficient proof, from the miserable condition of the livers of the Cod during some seasons. The year 1874 was distinguished in Newfoundland for an extraordinary catch of Cod. The

amount actually cured reached no less than one million seven hundred thousand quintals, or eighty thousand tons of fish, but their livers yielded only a fourth part of the average quantity of oil; the fish were poor and watery, in fact half starved, and they drew towards the shore in immense numbers in search of food. Similar seasons of poor-livered fish occur in Norwegian waters, and there is good ground for the belief that a well-fed, rich-livered fish spawns earlier and with much more abundant fertile spawn than a poorly fed fish. At the Lofoten Fisheries in 1869, out of 20,700,000 large winter Cod caught that season, those which were taken early in the season were rich in liver, so that from 250 to 300 of net caught fish made a barrel of liver, while there went from 300 to 350 from the fish taken on lines. As the season advanced the fish became perceptibly poorer, so that 400 to 450 livers were required to fill a barrel from fish of nearly uniform size. On the western side of the Lofoten Islands, directly facing the sea, 600 to 700 livers were required to fill a barrel. The average number of livers being 450 to the barrel. ¹ The average weight of Cod Roes during different seasons varies in like manner, showing an intimate relation between the supply of food and the multiplication of the fish. The former condition of American coastal waters, abounding as they did with the anadromous fishes, and stored with innumerable Cod, show how soon, when compared with their present condition, the Sea Fisheries may be exhausted over certain areas by the acts of man.

In 1863 Huxley appeared to think that the European Herring attained its full size and maturity in about eighteen months. That there was no good evidence against the supposition that it reached its spawning condition in one year. That the eggs are hatched in at most from two to three weeks after deposition, and that in six or seven weeks more the young have attained a length of three inches, and reasoning from known facts respecting other fishes, it is probable, he then thought, that the herring attains its growth or maturity in 12, 15 or, at the most, 18 months. Sars and others differ from these opinions, which were but put forth in 1863 by Professor Huxley as purely theoretical, and derived more from analogy than experience. The views entertained by Sars, which are the result of actual experience, will be given in succeeding paragraphs.

On the British coast, February and March are the great spring spawning months, and August and September the chief season for the summer spawning. On British American coasts the spring spawning takes place in May and June; the autumn spawning in September and October. But here, as elsewhere, the season varies a little, and begins sometimes and in some places in April, extending to as late as November. The spring and the autumn shoals Huxley considers to be perfectly distinct in Europe, as they are in America. The depth at which Dr. Allman found herring spawn in the Firth of Forth during spawning, varied from 14 1-2 to 21 fathoms. It adhered tenaciously to every substance, living or dead, on which it happened to be deposited.

The Norwegian Herring, which is supposed to be identical with the American Sea Herring, spawns, according to Mr. Boeck, in from ten to one hundred and fifty fathoms.

HABITS OF THE HERRING.

Among several European Naturalists who have preceded

1. Report of Consul General Crowe. See also diagram showing the relation of the quantity of Cod Liver Oil to catch, in each year on the Newfoundland Coast.

Sars, and prepared the way for a general knowledge of the habits of the Herring, are the well known names of Nilsson and Boeck. The records left by the late lamented last named Naturalist are very important and instructive. [1]

According to Boeck the Norwegian Herring invariably approach the coast by well known sea valleys or gullies, and with such persistency that nets stretched across these do not cause them to vary from their accustomed route, the Herring pushing forward through the channel in spite of the nets, which of course detain large numbers. Their favorite spawning places are covered with rough gravel; bare rock and mud being unfavorable spawning grounds. The strength and direction of the wind determine which channels of approach to the shore the large schools select, and they rarely approach the shore if the wind is blowing strongly towards it. The Dutch observers have found that more fish are caught in the sea frequented by the Dutch fishermen when the temperature of the water is from 12° to 14° Celsius, than at any other time, and the fish are found in that stratum of water which nearest approaches this temperature. The higher the temperature of the water during the spawning season the deeper the Herring are found. Boeck noticed the fact that in unusually cold seasons the Herring keep out at sea as long as they can without approaching the coast, but cold does not interfere with their approach when the necessity for spawning compels them to come inshore, which they do as soon as wind mixes the warmer substratum with the cold surface water in the early spring months. Several varieties of the same species of Herring exists in certain localities, such as deep Bays and Fiords, and illustrations of these peculiarities are not uncommon in American seas, but there is no sufficient reason to suppose that there are several different species, but merely, as stated, varieties of one or at the most two species. The Spring spawning Herring can live in very deep water. Certain forms of food of the Herring known to inhabit seas at a depth of from two to three hundred fathoms and not found at a less depth, were frequently discovered by Boeck in the stomach of Herrings. He supposes that the Herring never makes long journeys, in this differing from Sars, who considers that their summer wanderings take them far out to sea, of which he has recently obtained circumstantial evidence. The entire Herring fishery of Norway is limited to catching the Herring when about to spawn, and although there are 68,000 eggs in a Herring; yet the ceaseless drain on the fish for centuries in Norwegian seas, has apparently produced no sensible diminution in the aggregate, showing how vast must be the area over which they are distributed, and how wide the range of their food supplies. Empty herring never approach the nets, but the spawning herring appear to press against them, with an instinctive desire to exude the spawn. The age of the herring when it approaches the shore to spawn for the first time, belongs to the investigations which Boeck has not been able to complete. No where, as yet, has this been accurately ascertained. Some have maintained, but without being able to furnish proof; that the age of the herring, when it spawns for the first time near the shore, varies between one-half and seven years. Boeck is in doubt whether the herring, when fully capable of spawning, is exactly six years of age; but he had likewise no means of establishing his own opinion, that it is only between three and four years old. He merely remarks that too little attention has been

1. For an excellent summary of Boeck's views see an article entitled the "Norwegian Herring Fisheries," in the last volume of the Reports of the U. S. Commissioner of Fish and Fisheries, translated from the Danish by G. O. Jacobson.

given to the fact that the herring, when it spawns, has by no means reached its full size, and he has found herrings eight inches long which contained roe and milk.

59. The Baltic Herring, (Bohuslan) according to Nilsson, is a different species to the Norwegian Herring, a view entirely concurred in by Boeck. The Bohuslan Herring spawns in the autumn, whereas the Norwegian Herring generally spawn in the spring. In American seas we have also the spring spawning and the autumn spawning herring.

The habits of the autumn spawning herring of the Baltic are thus described by Axel Vilhelm Ljungman,¹¹ in 1873-4:

"The young Herring generally begins to make its appearance in the early part of May, and grows so rapidly that toward the end of the year it has reached a length of $2\frac{1}{2}$ to $3\frac{1}{2}$ inches. Having measured a large number of Herring which were caught during the latter half of May I found the most of them can be divided into three groups, according to their size, viz.: those measuring about 4 inches in length, which must be considered as one year's fish; those of from $5\frac{1}{2}$ to 6 inches, probably two year's fish; and those of about $6\frac{3}{4}$ inches, which were supposed to be three years old, and had completely developed sexual organs. Some fish were occasionally found with flowing spawn measuring only about $2\frac{1}{2}$ inches; and some measuring somewhat more, but not yet ripe for spawning the same year. Larger fish, measuring about 8 inches are probably four years old. The Spring Herring sometimes reach a length of more than 12 inches, but even specimens of 9 $\frac{3}{4}$ are rare. The Bohuslan Herring seems, therefore, to spawn as early as at the age of *three*, although I do not wish to convey the idea that all the Herring spring from the same year's spawn begin to spawn at that age; but it seems rather as if one portion did not reach their maturity till the fourth year. The circumstance that the Herring spawns during three whole months, and that therefore there is a considerable difference in the ages of those that are produced first and those last, that some have better chances for securing food than others, taken in connection with other more or less accidental circumstances, explain the fact that fish of all possible sizes are frequently taken from the same net.

As to the age at which the Herring spawns for the first time, opinions have been much divided both among Scandinavian naturalists and those persons who have devoted their life to Herring fisheries. Professor Nilsson, from information received from "trustworthy fishermen," assumes that "no fish spawn in the second year," and that "the Herring does not spawn till the fifth or sixth year." Dean Ekstrom considers those Herring which measure 6 inches (counted from the point of the nose to the anal fin) to be two year's old; those measuring from 10 to 13 inches from four to five years old; and adds that "the Herring found in Bohuslan does not spawn till it measures from 7 to 8 inches, counting the whole length." Prof. C. J. Sundewall, who has made observations on the growth of the Herring on the coast near Stockholm, thinks that it becomes capable of spawning when it is from three to four years old. Mr. Widegren, Superintendent of Fisheries, thinks that the Herring is fit to spawn when it is "about three years old." Axel Boeck was inclined to think "that the youngest Herring, when spawning, is scarcely less than three years old, and certainly not more than four," although he could not give any sufficient reason for this view, but at the same time said that persons who had been long employed in fishing had told him that the Herring, when able to spawn, must be from six to eight years old. G. O. Sars also seems to have been of the same opinion as Professor Nilsson, and at first thought that the Herring became capable of spawning at the age of five years, but afterward assigned the age of six years."

Hjalman Widegren (1871) describes the life of the Baltic Herring in the following words:— (4)

60. "In May, when the water is cool, it takes from fourteen to eighteen days for the spawn to develop, while in July and August, when the water in the spawning places usually has a temperature of from 14° to 15° , Reaumer, it required only from six to eight days. The young herring which is smaller and more transparent than the young of most other fish, (and on this account difficult to distinguish) is a little more than one-quarter of an inch long, and has, till about eight

1. From the Report of the U. S. Commissioner of Fish and Fisheries, for 1874-5.

1. From the Report of the U. S. Commissioner of Fish and Fisheries, for 1874-5.

days after the development, a residue of the yolk remaining obliquely across the belly, which, at first, greatly impedes its movements. Only when the young herring has lost this so-called "belly bladder" does it begin to swim around, to collect in schools, and to seek food. It is difficult to determine the growth and size of the young herring until it reaches a certain age, especially as all the young ones have not the same ability to gather food, on which circumstance the development, of course, depends.

"Attempts have been made to raise young herring by having them inclosed in small basins, but they have never lived longer than about five weeks, at which time their length was about one-half of a decimal inch. During the whole first year of its existence, the young herring is found in its spawning place, both outside the coast and inside the fjords. Young herring, about one common inch in length, may be supposed to be about two months old. At the age of three months their length is about an inch and a half.

All the fins are fully developed, and the whole shape of the body resembles that of the mature herring, so that it can easily be recognized as the young of this fish, which before that time is somewhat difficult. From comparisons made with young herring found in the spawning places it is safe to assume that those of about three inches in length found in the spawning places in spring, are of the preceding year's spawning, and therefore about one year old. Young herring from five to six inches in length which are often caught in nets, are probably only two years old. In fish of this size the roe and the milk begin to be tolerably developed, and when the fish has reached the length of eight inches and the age of about three years, it is capable of spawning.

The food of the young as well as the grown herring, consists chiefly of small crustaceous animals, invisible to the naked eye, which are found in enormous quantities in the sea, both in shallow and deep waters. In passing sea water through a straining cloth, great numbers of these small animals will be found. Their quantity, however, varies at different seasons, during a change of temperature, and at different depths. This might possibly explain, to some extent, the appearance of herring at different depths. In summer these crustaceous animals are found nearer the surface of the water, and at this season the herring is also found to swim comparatively higher. Like other fish, the herring abstains from food some time before and after spawning, and its stomach is, therefore, generally found to be empty at this time. But after spawning it begins to eat again, and gradually regains the strength and fitness which it seems to lose during that process. This explains the fact that at some seasons of the year the herring is leaner than at others.

About two months before spawning, the herring may generally be considered the fattest and best. This fatness continues until spawning is over, when the fish becomes lean and thin, and not fit to be caught. The herring, after spawning, usually migrates to the deep sea to seek food, and does not return till it has again gained in flesh and strength. That the herring, like other kinds of fish, as soon as the spawning time approaches, again seeks the spot where it was born, is proved by the circumstance mentioned above, that certain easily recognizable tribes or kinds of herring spawn every year at a certain time and at the same place. That during one year it appears in larger numbers in one place than during another, has doubtless its cause in the change of the temperature, currents of the sea, and similar influences, which may even occasion the entire absence of the herring from certain bays in some years. Cold and inclement weather during spawning time often destroys almost the whole breed of one year, so that, naturally, for some years to come, the kind of herring, in places where this has happened, will be very poor. These, and other causes on which the development of herring is dependent, are, however, as yet, so little understood, that nothing definite can be said about them. But, on the other hand, it is well known that man himself can destroy the herring in a bay of the sea by catching the whole tribe, both old and young, in large nets, thereby also destroying the spawning places.

It has already been stated that certain kinds of herring, particularly the larger ones, spawn nearer the land, on a bottom overgrown with sea-weeds. If this bottom is made unfit for spawning, by taking up or destroying the sea-weeds, either by nets or in any other way, the herring is, of course, obliged to seek other and more suitable places, and, consequently, deserts those inlets where formerly it came regularly.

By experience, gained in Bohuslan and other places, it is proved that the herring is extremely sensitive in this respect, and deserts old spawning places entirely if their character is changed.

Every one, therefore, who desires to keep his herring fishery in good condition, ought to be very careful not to change the nature of the spawning places by disturbing the vegetation or by casting refuse and other matter into the water.

From what has been said concerning the herring's nature and

mode of living, it will be evident that, in order not to risk its annihilation, destroy the young and disturb the spawning places, it is best not to catch the fish in nets during the spawning season, but to use the net only during those portions of autumn and winter when the herring seeks the deep water in the inlets; while one can catch herring in seines without danger at every season of the year. This mode of fishing is, in the long run, the most advantageous in every respect."

61. The recent views entertained by Sars with reference to the movements of the Cod and Herring in European Seas, are embraced in his last Report on the subject. (1.)

"The kinds of fish which are found on the sea banks are, as is well known, principally ling, torsk, (*Beomus colupris*), halibut and cod, the so-called bank cod. I have already, in my reports to the department, clearly set it forth as my opinion that the so-called bank cod is not a different variety from the well known winter cod, or skreid, which in winter and all through spring visits our coast for the purpose of spawning. The earlier hypothesis concerning the migrations of the winter cod (skreid) from great distances in the sea, I have, after close study of the nature of this fish, been obliged entirely to abandon, and the experience obtained during our expedition confirms me in this.

It is my conviction that the winter cod, which is to be found along our coasts during winter, and which is the object of some of our most important fisheries, is, during the rest of the year, distributed only over that tract of sea, whose bottom forms the barrier against the polar sea deeps lying beyond it, and that the outer boundary of this barrier (the so-called Havbro), with its well developed animal life and favourable bottom, forms a suitable habitat for innumerable multitudes of this fish."

62. "Very dissimilar are the circumstances with reference to the second of the varieties of fish most important for our fisheries—the Herring. Here my earlier researches have led me just to the opposite conclusion. While the Cod is evidently a genuine bottom fish, and as such dependent on the nature of the bottom, and partly on the depth, the Herring, on the contrary, in consequence of its whole nature is a general pelagian fish, and its occurrence is therefore exceedingly independent of the depth or nature of the bottom; but, on the contrary, dependant on the physical and biological condition in the upper stratum of the sea.

As these are very changeable, this species of fish may have been furnished with means to enable it speedily to seek out the most favorable tract of sea. The Herring has also, as contrasted with the Cod, obtained its elegantly compressed, wedge-like form, whereby with the speed of an arrow it can shoot along through the water, and in a comparatively short time traverse long distances.

Although I do not adopt the old ideas, according to which the Spring Herring comes as it were from the ice covered sea about the North Pole, I am, however, inclined to believe that, not only when it visits the coast to spawn, but also during the rest of the year it undertakes irregular migrations in the open seas. The distribution of the Herring in the sea is dependant on the distribution of the small animals which form its food. These small animals are all pelagian, mainly small crustacea of the order Copepoda, which keep more or less near the surface of the sea, and are commonly known by our fishermen under the name of "Aat."

Only when the herring during winter resorts to the coast to deposit its spawn are its movements for the time independent of the occurrence of the "Aat." The whole other part of the year, on the contrary, the shoals range through the open sea, inasmuch as they prefer to betake themselves to that region of the sea where at various seasons there is the greatest abundance of "Aat." The great mass of the herring shoals can thus very naturally, towards the approach of winter, or at the time when the development of the organs of generation drives them to resort to the coast in order to spawn, be found sometimes at a less, sometimes at a greater distance from their spawning places, according as the sea, in one direction or another, has the greatest abundance of "Aat."

On this again mainly depends, I am convinced, the fluctuations in our spring herring fisheries. For, as the spawning migration begins long before the roe or milt are ready to be deposited, the mass of herring, if at that point of time it finds itself close to the coast, will reach it so early that they will be obliged to remain there for a considerable time, during which it will naturally come to seek closer in towards the coast in firds and bays. In the contrary case, when the mass of herring at this point of time finds itself at a considerable distance from its spawning places, so long time will have passed before it reaches them, that the spawning process will go on immediately after their arrival on the coast.

The herring will then remain only a short time along the coast, and the spawning will then for the most part be carried on, on the outmost banks, less accessible to the fishermen,—in other words, the spring herring fishery will be very short, or exceedingly unsuccessful."

THE MENHADEN. (1.)

The remarkable industry to which this species of Herring has given rise in the United States is noticed in Chapter VI. Its habits are allied to those of the Sea Herring, which have been described in the foregoing pages. According to the evidence contained in the report of the United States Commissioner of Fish and Fisheries for 1871 and 2, the spawning period is in the spring, and it appears to come from its winter home in the deeper waters off the coast to the shores, at dates corresponding to those of other fish whose movements are guided by the temperature. (2) Following the law which governs fish life, its mode of spawning resembles that of the typical Herring, and in the remarkable variations in numbers with which it approaches different coastal waters it agrees with the fluctuations distinguishing the Sea Herring. A few specimens of this fish have been taken as far north as Canso, and formerly it was abundant on the coast of Maine. Much information respecting its fluctuations is given in the following extract from a valuable Report:— (3)

VARIATIONS IN NUMBER AND RANGE.

"Though more constant by far than some other species that might be named, the menhaden has exhibited occasional fluctuations of importance. Two instances may be cited. The first is the general desertion of harbors and coves, observed during several years past, and the other is the desertion of the whole coast, east of Jonesport.

Of the desertion of the harbors and coves there seems to be abundant testimony. An observer in Booth Bay says:— 'Menhaden can be driven out of small bays so that they will not come in. Certain it is that they do not come into the bays as they used to.' In Bluehill we are told the same story. In Jonesport it is said, 'Pogies used to run into all the coves and creeks. Of late years they do not appear to frequent the shores as formerly.' Testimony of this sort might be multiplied, but it is unnecessary. The fact is notorious. During the past season they returned to some of their old haunts in great numbers, but have by no means resumed their former habits in this respect. Of this singular change of habit there are various explanations offered. According to some persons, it is caused by the habit of seining; others lay it to the oil and decaying matter from the oil factories. Neither of these causes appear sufficient to produce such a result. The desertion of the coves is observed in localities far removed from those where the alleged causes have operated. Perhaps, after all, the thing to be accounted for is why the menhaden ever crowded into small bays as they used to. Were they then in search of food, were they simply obeying blind instinct, or were they driven in by hordes of hungry foes outside? The latter supposition seems quite as probable as the others. We know that small fishes sometimes rush ashore to escape pursuit; we know that this happens with the herring when flying from the pollock, and with menhaden when flying from the blue fish and horse mackerel. The presence outside of a large number of predacious foes, of whatever species, would be am-

1. 1.: CLUPEIDÆ; *Bracoortia Menhaden*. Gill—The Menhaden—Pogy—Moss-bunker; Cape Cod to Cape Hatteras.—Theodore Gill.

2.—See page xxx. of the Report of the U. S. Commissioner of Fish and Fisheries for 1871-2.

3. Report of the Maine Board of Agriculture, 1875-6.

ple to drive the menhaden in. This might happen year after year; while, with the cessation of the cause, the result would cease, too, and the menhaden would no longer crowd into the coves as before. If this view be correct, then the recent absence of the menhaden from the shores indicates an improvement in its chances of life by the removal of its destroyers. Lack of information forbids an attempt to point out the species that have been most active in producing these movements of the menhaden; and, indeed, the theory itself is not proposed as one that has much positive evidence in its favor, but just to show the possibility of accounting for the absence of the fish from shore on the hypothesis of the operation of causes purely natural, and not inimical, but positively favorable. The desertion of the eastern coast also rests on ample evidence.

At Jonesport, Menhaden used to be very plenty. They were commonly caught in gill nets, two-and-one-half fathom deep, but it was practicable almost anytime to get enough to go fishing with by spearing. They became scarce seven, eight or ten years ago, and now very few are caught, although some come as far as this every year.

At Lubec, thirty years ago or more, Menhaden were so plenty during their short season (July and August) as to be a nuisance. They have not been plenty since 1840 or 1845, and now none are found east of Jonesport. They left suddenly, and since the date mentioned have been rarely seen. Mr. E. A. Davis, of Lubec, a man of long experience in the herring fishery, has not seen a single specimen for ten years. Mr. E. P. Gilles, also of large experience, in 1860, or thereabouts, got three hogsheds of them one afternoon tide, and since then has seen none.

At Pembroke, Mr. Moses L. Wilder, says that twenty years ago, and always before that, the Menhaden, used to come here every year in great numbers, filling every cove and creek; but for the past twenty years none whatever have been seen. Little use was ever made of them except for bait, and of that but little was needed here.

In 1850 the Menhaden was mentioned as being sometimes caught in weirs within the harbor of St. John, N. B., in considerable numbers. Of late years none have been found in New Brunswick, or to the north of Grand Manan. This well-established movement of the Menhaden is equally mysterious with the other, and speculation on its causes would, in the present state of our knowledge of the influences in operations, be equally fruitless. It is, however, worth observing that there do not appear to have been any artificial causes at work sufficient to produce such a result. Not only is that coast more thinly peopled than any other along which the Menhaden range, but the pursuit of them by man was on the very smallest scale. It is therefore among the natural causes affecting them that we must seek an explanation. Neither of the phenomena cited proves that there has been a general diminution of the number of the Menhaden. Even their absence from the coast of a whole state does not prove that they are not present somewhere else, Especially inadequate to the proof of diminished numbers is the absence of the fish from the immediate vicinity of the shore. The converse is equally true. Unusual abundance of Menhaden in any particular district, or even along the coast of a whole State, does not prove a general increase. All such variations, whether they seem to indicate decrease or increase, can be accounted for on the hypothesis of a change in range." *Report of the Maine Board of Agriculture, 1875-6.*

When the statements contained in the foregoing summary of the fluctuations in Menhaden schools are compared with those of the Sea Herring, the analogy in the habits of the two species will appear remarkable. Perley states that (about the year 1850) "it is sometimes caught in the weirs within the harbor of St. John in considerable numbers." Its value as a bait for Cod is in a considerable degree superseded by the Herring, but as a bait for "tolling Mackerel" it is still in repute, although other fish similarly treated and finely ground appear to be equally useful in this respect. Elsewhere it is shown that the pursuit of this fish is now made largely in the interests of the agriculturist and manufacturer as a source of fish guano and fish oil.

CHAPTER IV.

THE MACKEREL.

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Notices of Mackerel on the Newfoundland Coast and the Labrador, 64; The Torpidity of Mackerel during the winter season—In European waters—On the Coasts of Newfoundland—On Nova Scotian Shores, 65; On the Coasts of the United States, 66; Movements of the Mackerel, 67; Mackerel Catch by United States Fishermen, 68; Dominion Catch of Mackerel—Catch in Nova Scotia, 69; Annual Catch in Nova Scotia, 70; Periods when Mackerel approach the Coast—In Nova Scotia, 71; In the United States, 72; The spawning of Mackerel in European waters, 73; In the Gulf of St. Lawrence—On the Coasts of Massachusetts, 74; Periodical abundance on the Coasts of Nova Scotia, 75; The United States Mackerel Fishery, 76; Conclusion, 77.

THE MACKEREL ON NEWFOUNDLAND COASTS.

64. In a Work entitled "Wandering Thoughts or Solitary Hours," by P. Toeque, ^[1] published in London, in the year 1846, the author refers to the presence of the Mackerel on the shore of the Island, about the year 1774. It deserted the coast for about 30 years, returning in 1804. They appear to have been abundant until 1837, when they again abandoned the North-East Atlantic coast. In White Bay and Bay of Notre Dame all accounts represent them to have been very abundant a few years before their sudden disappearance in 1837. The quantity since taken has varied each year, but it does not appear that they have ever been observed since 1837 in such extraordinary numbers as to lead to the origin of the saying, hereafter referred to, that "they have been cursed off the coast."

At Aillik and Kypokok, on the Labrador, some 150 miles North-west of Hamilton Inlet, the writer was told by residents, that the Mackerel were abundant in 1871, and a few were caught in Cod seines.

At Double Island Harbor, some fifteen miles beyond Hopedale, a French Canadian resident informed the writer that there was "a scattering of Mackerel" in that part of the coast, but Herring, sometimes, in countless numbers, no Squid, a few Salmon, and many Salmon Trout.

Capt. deCourey, of H. M. S. Helena, states, in his Report addressed to Vice-Admiral Dundonald (5th September, 1850—Newfd Journal of Assembly, 1851, page 141), that "Mackerel have not been taken in Placentia Bay for the last twenty years; before that period 2000 to 3000 barrels were taken during each of the three or four previous years, and vessels from the Western part of Nova Scotia used to come regularly on that Fishery."

Basing their conclusions upon the date of the appearance of the Mackerel upon the North-east coast of Newfoundland, the fishermen state that the Mackerel appear first in the Strait of Belle Isle, then in White Bay, then in Green, or Notre Dame Bay. In this particular their movements resemble those of the Codfish on the N. E. coast. They are seen on the Atlantic coast of the Island, from Cape Spear to Quirpon, early in the month of August, and remain until November, or in mild weather, until as late as December; and according to Mr. Jabez Tilley, until "the frost sets in." Since the year 1835,

they have not been numerous on the North-east Atlantic coast, up to the year 1870. They are not unfrequently observed out at sea, but "playing on the surface." The impression among old fishermen, that they become blind on the approach of Winter is common, and numerous instances of traditional statements to this effect can be accumulated, but the younger generation do not appear to have given any attention to this subject, probably because the general scarcity of the fish during later years has prevented their attention being drawn to the subject.

THE TORPIDITY OF THE MACKEREL DURING THE WINTER SEASON IN EUROPEAN WATERS.

65. Mons. H. de la Blanchiere, in his "*La Pêche et Les Poissons*,"¹¹¹ states as subjoined with regard to the mackerel.

"Pleville-le-Pelay, on the contrary, affirms having seen in the middle of winter, in deep muddy bottoms, myriads of mackerel, packed close one against the other, with one half of the body plunged in the mud, where they remained during the winter, (*la mauvaise saison*). As soon as spring came, they aroused themselves from their torpor, and appeared always on the same day on the same coasts, at the surface of the sea, and repaired to favorable spots to spawn. This theory assimilates the mackerel to many other species of sedentary fish, which pass the winter at the bottom of the sea, stupefied in a kind of lethargy, and explains besides why in October young mackerel are caught from 0 m 10 to 0 m 15 in length, and why in winter large mackerel are taken, but not with a line, but with drag nets, catching those which had not buried themselves deep enough in the mud or sand."

ON THE COASTS OF NEWFOUNDLAND.

John Rice, of Little Harbor, Twillingate, informed the writer that he remembered his father frequently alluding to the Mackerel of White Bay, Newfoundland. His father stated that he had often seen Mackerel in White Bay come on shore like Squid with scales on their eyes and blind about Christmas. This occurred about 40 years ago, when Mackerel were very abundant in White Bay.

Mackerel have been taken in November in Trinity Bay, according to Mr. Jabez Tilley, before referred to. They are to be found on the whole coast from Quirpon to Cape Spear during November and December. The appearance of the fish "with scales on their eyes and blind" coincides in a remarkable manner with a similar appearance recorded in Nova Scotia and New England Atlantic waters, thus leading to the conclusion that the winter home of the fish is certainly known from the Straits of Belle Isle to Massachusetts Bay, and is in the deep waters off the coasts, assimilating in this respect to other food fishes whose life is spent in cold sub-Artic waters.

ON THE COASTS OF NOVA SCOTIA.

According to information received from Mr. Henry N. Paint, of Halifax, mackerel have been taken in the River Inhabitant's Basin, near the Gut of Canso, with a "film over the eye," in the last week in May.

The mackerel taken there in the spring, like those caught on the southern coasts of New England, are large, poor and flabby, and enjoy among local fishermen the name of "Leather Bellies." In October and November they call them, on account of their fatness, "Bloaters."

At the eastern part of Cape Canso, about the Canso Islands, they are taken up to the end of November. Formerly they were found in incredible numbers in the Basin of the

River Inhabitants, where the bottom is muddy. In 1870, No. 1 mackerel were taken in Bras D'Or Lake, on the 18th August, near Whycokenagh.

Dr. Gilpin describes, in the "Transactions of the Nova Scotian Institute of Science," a mackerel bought in the Halifax fish market, on the 27th October, 1865. The "film over the eye" is thus referred to:—"As the fish lies dead, a membrane from the posterior part of the orbit half closes the eye." In a subsequent paragraph Dr. Gilpin writes as follows:—"His asserted torpidity during winter, and blindness, both which conditions happen to the batrachians, favour these views, though I do not think we have yet sufficient proof to assert them as facts."

"The membrane half covering the eye is asserted by the fishermen, in early spring, to cover the whole eye,^[1] hence, perhaps, the story of his blindness. His small and numerous fins, according to the Agassizian theory, inasmuch as he resembles the embryo of all fishes, which have the fins in one narrow continued band from head to tail, also prove him low in the scale of intelligence." During some seasons they linger on the Nova Scotian coast until December.^[2] The Rev. John Ambrose, speaking of the mackerel, says:—^[3]

"The third run of mackerel takes place about the first of August. These have no spawn in them and are running westwardly. It is the opinion of many that these are not returning from the Gulf of St. Lawrence, but from sea, and it may be that a portion of the immense schools passing eastwardly in spring, strikes off to some favourite bank outside, to deposit the spawn. Or there may be a sort that never go as far east or west as the others, but winter along our shores, *for mackerel have been brought up from the muddy bottoms of some of our outer coves by persons spearing for eels through the ice.*"

In the fall of the year it is stated that among the schools of fat Mackerel then taken, there are always a certain percentage, some say as many as one-tenth, which are thin and poor, and go under the name of "racers" or "slinks."

The Sable Island Mackerel are said to be much larger and fatter than those caught elsewhere on the Nova Scotian coasts. "In 1850 the fish were plenty and took the hook well, but in 1851 the fish appeared at times to be abundant, but would not take the hook."^[4]

WINTERING OF MACKEREL ON THE COASTS OF THE UNITED STATES.^[5]

66. When the Mackerel first appear on the coasts of the United States in the southern part of New England, they are so poor that they can not be sold for food.^[6] After they have spawned in May (vide U. S. Fishery Report, p. 64.) they rapidly increase in fat and are taken in great numbers in the summer and fall.

1. The writer has seen mackerel caught at the end of June, in the Halifax market, with the film still covering the third part of the eye.

2. Gilpin—page 14. Trans. N. S. Inst. Nat. Scie., 1865-66. "We have seen that our herring passes his existence alternately in a state of rest in deep soundings, (this rest not so deep, though, as from recent facts, we infer the mackerel does, who, it would appear, becomes torpid and blind during winter, like certain batrachians, whom he resembles in his colour,) and of a highly aerated and lively existence upon the surface." (Dr. Bernard Gilpin, Trans. N. S. Inst. Nat. Scie., 1863.)

3. Observations on the Fishing Grounds and Fish of St. Margaret's Bay, N. S. (Pro. and Trans. of the N. S. Inst. of Nat. Scie., 1866-67.)

4. Paul Crowel, quoted by Lorenzo Sabine.

5. See Report of the United States Commission of Fish and Fisheries, 1871-72.

6. Ibid, p. 19.

In reply to the questions submitted by the United States Fishery Commissioner in 1871, which are printed on pages 3, 4 and 5 of Report for 1871-72, the following suggestive answer is give to question No. 18 :

Question.

No. 18.—“ Which sex comes in first, and how far advanced is the spawn in the female on first arriving ?”

Answer.

“ Mackerel.”

“ Both come in together. There is a scale over the eye, so that it looks very dim in the Spring, and they will not bite.”⁽¹⁾

MOVEMENTS OF THE MACKEREL.

67. Lorenzo Sabine⁽¹⁾ has given a description of the erratic movements of the Mackerel, as interpreted by ordinary observers on the shores of Southern New England, and he illustrates by numerous examples the precarious character of the Mackerel Fishery as pursued on the coasts of the United States.

“ As already intimated, the Mackerel is a capricious and sportive fish, and continually changing its haunts and habits. When first seen upon the coast in the Spring, it is thin and poor. It differs essentially from one season to another in size and quality. One year it is fat and large, and is sought for almost entirely in the Bay Chaleurs ; anon it is lean and small, deserts that bay and the adjacent waters, and frequents foreign Banks, or our own shores.”

“ During the first half of the last century there are statements which show that a single vessel, fishing in Massachusetts Bay, often took eight hundred barrels in a season. In our own day it has happened on the sudden appearance of a school, after a lapse of years, that landsmen, women and children abandoned their accustomed employments to fish with pans, baskets, trays and pitchforks, and the like, and to prove how true it is that “ necessity is the mother of invention.”

“ So too, our fishermen, professionally equipped, even to the *de suite* and *son'-vester*, recall many an exciting scene between and off the capes of Massachusetts within the last twenty-five years. Then in 1862 one hundred and fifty vessels and boats sailed from Gloucester in one day, to hook seine or gaff, as circumstances should require, the mass of fish that appeared near the harbor of that port ; in 1831, one hundred thousand barrels were caught in fifteen days ; in 1845, large quantities were secured from wharves and rocks, in boats and on rafts, on nets and cloths, by dipping and spearing ; in 1847, “ a store exceeding large and fat ” were seen at sea, off Cape Cod, where boats could not safely follow, and, in the absence of a considerable part of the vessels at the Bay Chaleurs, most were suffered to escape ; in 1848 a fleet of six hundred vessels and boats, caught twelve thousand barrels in twelve days, and in 1849 the success of a smaller number of vessels, though much less, was yet sufficient to retrieve the losses of other and more distant fishing grounds in the early part of that season.”⁽²⁾

The fluctuations in the appearance of this fish appear to be common to all American waters, and the accounts given of schools in Massachusetts Bay, New England, are in accord with those related of schools on the north-east Atlantic shore of Newfoundland.

1. *Ibid.*, p. 64.

1. “ Report on the Principal Fisheries of the American Seas.” Ex. Doc. Washington, 1852, p. 361.

2. Page 352.

68. Mr. Sabine gives a comprehensive table, showing the number of barrels of Mackerel inspected in Massachusetts, New Hampshire and Maine between 1804 and 1852. Between 1819 and 1852 the number of barrels submitted to inspection from all countries and seas varied from 400,000 in 1831 to 51,000 in 1840, and again from 56,000 in 1841 to 332,000 in 1851.

These are enormous variations, and show how irregular and hazardous the business of Mackerel fishery has been under the old system of management, and subject to the regulations imposed by separate maritime rights.

These remarkable differences in catch continue down to the present day, and are enumerated by Capt. Atwood, as given in subsequent paragraphs.

The variation annually taking place in the importation of Mackerel into the U. S., necessarily assimilates in a measure to the years or groups of years already given.

Thus in 1830 when there were 308,000 barrels inspected in Massachusetts, only 391 were imported. In 1849, when 234,723 were inspected, no less than 138,505 were imported; and in 1851, when 332,315 were inspected, 102,638 barrels were imported, all of which came from the British American Provinces.

In 1851 the number of United States fishermen employed in the Mackerel Fishery were as follows:—⁽¹⁾

Number of Men and Boys.	Tonnage.	Vessels.
9,993	59,410	940

The following table shows the tonnage employed in the Mackerel Fishery of the U. S. during triennial periods:—⁽²⁾

1838.....	56,649
1841.....	11,321
1844.....	16,170
1848.....	43,556
1851.....	50,539 ⁽³⁾

The sudden variation in the amount of tonnage employed in the fishery is very great, and fully indicates its precarious character under former treaty stipulations. The catch of 1852 differed from the catch of 1851 by no less than 131,509 barrels. This vast difference with all its attendant evils, might have been much diminished if perfect freedom of action among fishermen had existed in U. S. and Dominion waters.

Capt. Atwood enumerates in his "Remarks on the Fisheries of the Coast of Massachusetts," published in the Report of the U. S. Fishery Commissioner, for 1871-72,⁽⁴⁾ the following years as noted for extreme variations in catch.

1831	.....	Great catch, 385,559 barrels inspected.
1831—1839	.....	Gradual falling off.
1839—1844	.....	Fell to 75,000 barrels in a year.
1841	.....	Only 50,992 barrels.
1841—1861	.....	Gradual increase.
1861—1871	.....	200,000 barrels.
1871 ⁽⁵⁾	234,000 "

In Newfoundland the abundance of mackerel for many years on the north-east Atlantic coast was so great that the fish were not only used as manure, but gave so much trouble to the fishermen, that their subsequent diminution in numbers was attributed by the fishermen to their being "cursed off the coast."

1. Lorenzo Sabine. Ex. Doc. 1852, p. 362.

2. Ibid.

3. This differs from the Inspector General's return by nearly 9000 tons.

4. Page 117.

5. It would be difficult to show how much of this catch was taken in British American waters.

On the west coast of Ireland the visits of the mackerel are also very uncertain,^{1,1} and, indeed, a similar uncertainty to that of the herring everywhere appears to belong to the mackerel.

DOMINION CATCH OF MACKEREL.

69. The quantities of barrels of mackerel returned as caught on the coasts of the Atlantic Provinces of the Dominion, according to the tables contained in the Report of the Commissioner of Fisheries, are given in table No. I., which follows. Table No. II. contains the quantities caught, as estimated by the Deputy of the Minister of Agriculture.^(2.)

Years.	No. I.	No. II.
	Number of Barrels of Mackerel returned.	No. of Barrels of Mackerel estimated as caught.
1869	53,011	54,022
1870	92,213	93,972
1871	240,426	245,012
1872	119,859	122,145
1873	160,617	163,681
1874	161,793	164,879
1875	123,960	126,324
1876	104,356	

NOVA SCOTIA.

The following table shows the aggregate catch of mackerel in Nova Scotian waters during the years 1851, 1861, and 1869 to 1876, inclusive.

Year.	Barrels.	Cans.
1851.....	96,732.....	
1861.....	63,130.....	
1869.....	46,575.....	
1870.....	85,254.....	
1871.....	228,152.....	
1872.....	115,631.....	50,500
1873.....	141,005.....	10,842
1874.....	122,258.....	80,460
1875.....	91,235.....	24,400
1876.....	70,964.....	30,820

The succeeding table, showing the annual return of mackerel caught in each County of Nova Scotia, exhibits the nature of the fluctuations on definite portions of the coast line.

1. "Deep Sea Fishing," Holdsworth, page 129.

2. To the number of barrels returned as taken, there must be added the number of cans of mackerel manufactured, which average 20,000 each year, during the series, and 20,000 lbs. of mackerel returned under that denomination.

ANNUAL CATCH IN NOVA SCOTIA.

70. Annual Returns of Mackerel caught in Nova Scotia by Counties since Confederation (1868), and also in 1851 and 1861, as shown in the Census Tables of those two years. The other years (1869-76) are taken from the Reports of Marine and Fisheries Department.

MACKEREL.

COUNTIES.	1851.	1861.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.	Bbls. Cans.
Cumberland.....	36	44			25	50	75	375	33	16
Colchester.....	30	56						50	25	50
Hants.....	2	132								139
Kings.....	108	107	3		30	20	375		381	1870
Annapolis.....	1384	4387	2149	4361	955	1672	909	822	347	2537
Digby.....	1129	4988	578	734	955	11077	12000	8639	4675	10139
Yarmouth.....	4610	3407	2000	14906	31896	1488	1109	730	76	517
Shelburne.....	1441	315	987	2615	2637	1488	1109	1300	21300	300
Queens.....	9417	5992	5041	9984	25545	13941	204	11860	400	11600
Launceston.....	29335	15137	9832	14250	70908	36359	49000	37110	14080	17184
Halifax.....		268		64	100	200	4500	252	34	464
Pictou.....										
Antigonish.....	20054	12519	2919	3050	6720	2850	5000	4904	3790	2576
Guyssborough.....			11146	15460	30400	20980	10028	13922	15050	5780
Richmond.....	1573	784	579	4322	20182	15772	17625	16940	16825	7132
Cape Breton.....	928	4323	2418	1012	6681	1663	2382	9925	4006	23473
Victoria.....	3874	2371	2151	2660	7528	5310	3120	6620	3805	3805
Inverness.....			1580	5736	14635	3743	18801	11788	5258	5501
Total.....	96732	63130	46575	85251	228152	115631	141015	122258	91235	70064

* This includes Guysborough. † One pound Cans.

EXPORTS OF MACKEREL FROM NEWFOUNDLAND, TAKEN FROM OFFICIAL RETURNS. ^{1,2}

Year.	Casks Mackerel.	Year.	Barrels.
1814	1,685	1852	1 tr., 18 lbs.
1817	941	1856	no returns.
1818	1,158	to	
1819	780	1069	
1820	....	1870 ^{12,1}	1,019
1821	700	1871 ^{13,1}	1,374
1822	923	1872	604
1823	436	1873	47
1824	357	1874	10
1825	560	1875	
1826	752	1876	8
1827	....	
1828	....	
1829	621 lbs.		
1830	560		
1831	916		
1832	635		
1833	149		
1834	no returns.		
1835	" "		
1836	79		
1837	none.		
1838	4		
1839	none.		
1840	none caught.		
to			
1852			

PERIODS WHEN MACKEREL APPROACH THE COAST.

71. The periods when the mackerel approach the Atlantic coast of Nova Scotia and the United States, and the Gulf of St. Lawrence, are as follows:—

I. IN NOVA SCOTIAN WATERS.

South part of Nova Scotia.—18th to 25th May, ^{3,4} (1852). —“The chief places for netting and seining mackerel in the spring are the Tusket Islands, the west side of Cape Sable east side of St. Margaret's Bay, Little Harbour, White Head, St. Peter's, in Cape Breton, Antigonish, &c.”

Gulf of Canso, River Inhabitants Basin.—Last week in May, with film over the eye; disappear end of November; at the Canso Islands.

Halifax, Nova Scotia.—May 15th, with film over the eye; ^{5,6} disappear middle of November.

St. Margaret's Bay, west of Halifax.—May 15th.^{6,7} —“In one night the mackerel will strike the shores for over one hundred miles in extent, where not one was seen the day before.” ^{7,8}

Coast of Cape Breton Island.—Spring.—Mackerel are taken early in June. ^{18,1}

Minas Basin.—During the present season (1877) mackerel were taken in nets in the Basin of Minas, near Blomidon. This is the first time within the memory of men who have fished on the ground near Blomidon for thirty years. Drifting spawn from near the coast line below the Straits, leading into the Minas Basin, and the hatching of the spawn

1. From 1817 to 1852 the data is obtained from tables in the Appendix to “Lecture on Newfoundland and its Fisheries,” by Matthew H. Warren, published at St. John's, Newfoundland, in 1853.

2. Andrews—Commerce of the British North American Colonies. Ex. Doc. 31st Cong., 2nd Sess., Washington.

3. 1870 to 1874—Customs Returns.

4. Paul Crowell, quoted by Lorenzo Sabine.

5. Vide page 13. Pro. and Trans. of N. S. Inst. of Nat. Scie. Dr. Bernard Gilpin, 1865-66. Part IV.

6. Rev. J. Ambrose. Pro. N. S. Inst. of Nat. Scie., 1866-67.

7. *Ibid* page 70.

8. Report of Capt. Scott. R. N., 1869.

in the Great Eddy, near Blomidon, is the introduction of a school of fish there which will probably continue for many years, and by protection may be largely increased. No doubt a similar event has occurred at the same place often before, and, indeed, all round the coast line. The fish come again to spawn near the places of their birth. The strong currents drift the floating spawn about far and near, and wherever the hatching takes place a new school is established, and the old one will die out if not preserved by eddying spawn or by the introduction of fresh spawn from near or distant schools, brought by currents. The geographical distribution of the floating spawn of fishes is like the geographical distribution of the seeds of plants by winds.

72. II. IN UNITED STATES WATERS.

Massachusetts Bay.^(1.)—First and second week in May.

Vineyard Sound.^(2.)—5th to 10th May very abundant. 28th Sep., and also caught about middle of October, large mackerel. They are full of spawn, ripe and fit to run out about the 10th May. At Wood's Hole, young mackerel in the fall about 5 inches long.

Wood's Hole.^(3.)—Male and female come together first and second week in May, with scale over the eye; about 10th May ripe spawn runs out of them.

THE SPAWNING OF MACKEREL.

73. In the introductory chapter to Mr. E. W. H. Holdsworth's "Deep Sea Fishery," the discoveries of the Norwegian naturalist, Sars, in relation to the spawning of mackerel, are described at some length from written communications addressed to Mr. Holdsworth by Professor Sars. This able Naturalist obtained, in 1865, abundant evidence that the ova of the mackerel were developed at the surface of the sea, and also that there is good reason to believe that the act of spawning takes place near to the surface itself. Be this as it may, the floating of mackerel spawn during the period of its development is sufficient to show that the actual area where the spawn is deposited is of little moment, for its hatching is dependent upon currents.

74. According to Mr. Holdsworth, in British seas "the spawning season appears to vary within certain limits, but June is about the general time for it; and it has been already mentioned that mackerel do not go to the ground, like the herrings, for the purpose of depositing their spawn, but shed it quite at the surface, and at varying distances from the land. According to our observations on the Devonshire coast, mackerel remain in shoals or schools, until after they have spawned, and while thus congregated they do not very readily take a bait; but after this process has taken place, towards the middle of July, the shoals become dispersed, and the fish, instead of then making their way to deep water, as appears to be the general habit of the herrings under like circumstances, draw nearer the land and even enter the harbours, where they afford excellent sport with the hook and line. Mackerel do not lose condition so much as the herrings by the act of spawning, and they soon recover after feeding voraciously on the young sprats and other small fry which abound at that time near the land. Half-grown mackerel, with no appearance of roe in them, are more or less abundant on the sea coast at the same time as the large ones, or in some localities preceding, in others following, them; and it must be within the experience of most persons who have been engaged in mackerel fishing

1. Report of Commissioner of Fish and Fisheries, 1871-72, page 64.

2. *Ibid* p. 35, also pages 64 and 68.

3. *Ibid* p. 64.

that both large and small fish are frequently caught in the same place and on the same day. It seems quite clear that both kinds cannot make their approach to the land for the purpose of spawning; in fact, as the spawn floats there is no apparent reason why the mackerel should come in shore at all with that object; some other motive must be sought for these periodical visits, and it appears likely that an abundant supply of food is the main attraction to both old and half-grown fish, and that they instinctively seek it among the myriads of surface swimming fry which frequent the shoal water. We know little of what many kinds of fish feed on; but there can be little doubt that the search for food is one of the principal causes of their migrations; and to this we are disposed to look for an explanation of the movements of those species which periodically visit our coasts."

According to the evidence elicited by the British Sea Fisheries Commission in 1863, the mackerel off Torquay, on the south coast of England, spawn in April or beginning of May; at and near Ramsgate, in June and July; at Wyke Regis, in the beginning of June. ^(1.) Mr. Holdsworth ^(2.) considers that while the period for spawning in British waters varies within certain limits, yet June is about the general time for it.

The catch of mackerel on the British coast is sometimes enormous, and far exceeds the take in American Seas.

The London *Times*, of May 11, 1872, informs us that 1,100 tons of mackerel, estimated to weigh one pound each, had recently been taken in a single night, at a fishing station on the British coast. ^(3.)

IN THE GULF OF ST. LAWRENCE.

During the summer of 1852, H. M. S. "Devastation," Capt. Campbell, R. N., was cruising in the Gulf of St. Lawrence for the protection of the Fisheries. In the Report on the results of the seasons operations, Capt. Campbell refers to the spawning of the Mackerel, and to the size of the young fish at a certain portion of the year. Referring to the fishing grounds on the north shore of Prince Edward Island, this officer states as follows:—

"The Mackerel, as the season advances, are both more numerous and of finer quality, indeed the spring fish are very poor, and it would add greatly to the value of the Fisheries if they were not taken early.

Nature has provided that at this, their spawning season, they do not readily take bait, but from seining and other means adopted by the Americans, if it had not been checked, the fish would have been exterminated in a few years, while the production of the coast this year will, in all probability, cause a great increase in future seasons.

The water already abounds with small Mackerel, about three inches long; this, I am told, has not occurred before to any extent, and is imputed to the spawning fish during spring. ^(4.)

ON THE COASTS OF MASSACHUSETTS.

Three years subsequently to Capt. Campbell's observations on the north shore of Prince Edward Island, Capt. Nathaniel E. Atwood observed Mackerel spawn on the coast of Massachusetts, and watched their growth. ^(5.)

The Mackerel appeared on the coast about the first or second week in May.

1. See Fisheries Commission.
 2. Deep Sea Fishing.
 3. Quoted by Marsh, p. 106 "The Earth as modified by Human Action."
 4. Report of Capt. Campbell, H. M. S. "Devastation," Halifax, 10th Nov., 1852. App. 4. Nova Scotian Journals House of Assembly, 1853.
 5. U. S. Fish Commissioner Report 1871-2. P. 224.

They spawn between the twentieth of May and the first week in June. A month or thirty days after the height of the spawning, the waters of Massachusetts Bay, where these observations were made, swarmed with small Mackerel. Fifty-five days, or about two months after the spawning had taken place, the young Mackerel were some two inches in length.

There is but a comparatively small interval between the periods when the Mackerel spawn on the Atlantic sea-board of New England or Nova Scotia, and the shores of Prince Edward Island, in the Gulf of St. Lawrence, and in this respect the spawning season approach those of the schools which frequent the European Coast.

75. The late Hon. Joseph Howe, in a Report on 'Sable Island,' dated Oct. 21st, 1850, addressed to the Lieut. Governor of Nova Scotia, ⁽¹⁾ speaks of the countless schools of Mackerel which visited the coasts of that Island. He says:—"The Superintendent informed me that a few days before the 'Daring' arrived, the Mackerel crowded the coast in such numbers that they almost pressed each other upon the sands, and I saw an unbroken school, extending near the landing place for a mile in length, within good seining distance, besides others at various points, indicating the presence, in the surrounding seas, of incalculable wealth." The time of Mr. Howe's visit was the 6th to 14th Sept.

Conso.—"From 1812 to 1830 the abundant catch of Mackerel of the large kind was never known to fail. This fishery commenced in September and continued constantly until the last of October. It was a common occurrence for a seine to haul from 1000 to 1500 barrels at a time, and by different seines many more were hauled in a week than could possibly be cured. The price of Mackerel at that time was only \$2.00 to \$4.00 per barrel." ⁽²⁾

HISTORY OF THE GLOUCESTER MACKEREL FISHERY.⁽³⁾

76. "As early as 1653 a coastwise trade in this fish had commenced, and in later years it seems certain that some were shipped to foreign ports; for we find that, in 1692, the restraints against an order passed by the General Court that no person should haul ashore any mackerel with any sort of nets or seines whatsoever, and that no person should catch any, except for use while fresh, before the first of July; annually, in refutation of the assertion that mackerel will not "save well" in May and June, state that they have shipped mackerel caught in those months beyond sea, and add that they kept as well as those caught in other months. There can scarcely be a doubt, therefore, that this fish was to some extent an article of trade among the early colonists; and we know that before the Revolutionary war, several vessels were employed in this fishery from the harbours on the south side of Massachusetts Bay; but Gloucester fishermen do not seem to have given much attention to it till about 1821, for in the thirteen years immediately preceding that date, we find that, according to the inspection returns, the whole number packed here was only 1171 barrels. From this time, however, the business rapidly increased; the fish became so abundant in our waters that, in 1825, a single jigger, carrying eight men, took over 1300 barrels, and in 1831 the whole catch of the town rose to 69,759 barrels; but after the last named date mackerel began to be scarce on our own coast, and the catch declined so rapidly that, in 1840, it amounted to only 8870 barrels; and in

1. Appen. 24. 'Nova Scotia Journals,' 1852.

2. Prize Essay on the History of the County of Guysborough, 1877.

3. Proctor Brothers—The Fisheries of Gloucester.

that and the four following years the total aggregate taken by Gloucester fishermen amounted to no more than 66,547 barrels. About this time the enterprise of the fishermen led them to pursue the mackerel into their distant retreats in the Gulf of St. Lawrence, and for several years nearly all the vessels of the town engaged in this fishery resorted to that region, and it became the chief source from which the demand for the fish could be supplied. With success widely varying from year to year, the mackerel fishery has continued to be pursued to the present time. Late in the spring months the fishermen start to meet the "schools" when they make their first appearance in the waters south of New England, from which they follow them to our own coast and into the seas of British America; but it is a precarious fishery, and it is agreed that a good deal depends upon luck; for there is often a wide difference in the result of the season's work of men equally diligent and equally skilled in the business. Of late it has become customary to take these fish by seining, and when the net surrounds a "school" there is a chance, indeed, almost a certainty, of a great haul; but it sometimes happens to a fishing crew that no such chance occurs for months, and a bad voyage for the vessel and men is the unfortunate result. The cases of total or partial failure, however, are not sufficiently numerous to create discouragement or to excite apprehension that Gloucester will soon cease to exhibit that preponderance in this fishery it has so long enjoyed. It is true that the last year (1875) was one of poor success, but in the preceding the quantity of mackerel packed in this city was 118,314 barrels, of the net value probably of more than one million dollars."

"During the summer months there are two divisions of the Mackerel fleet, one fishing off the shores of Massachusetts and Maine, and the other making voyages to the Bay St. Lawrence. The Southern and Shore fleets have practically abandoned the old style of hook and line fishing, and are fitted with expensive seines and boats for the capture of Mackerel on a wholesale scale. The success of this department is greatly dependent on the dexterity with which a school of fish can be surrounded and captured, and the employment is an exciting one. The business is an uncertain one, as the mackerel is a capricious fish, and but little calculation can be made of their movements. Weeks may elapse without the discovery of the fish schooling on the surface with the proper conditions for their capture. Immense hauls, however, are sometimes made, more than can be properly dressed by the crew of the "seiner," and if no other vessel is in the vicinity to accept a portion of the catch, large quantities are frequently thrown away through sheer inability to handle them. The seining of Mackerel occasions a great destruction of immature fish, unfit for use, but such is the prolific character of the Mackerel that it has never been clearly demonstrated that this method of fishing has a tendency seriously to diminish the supply. The cost of a mackerel vessel, fitted for sea, is in the neighborhood of \$7700; a 200 fathom seine, of a depth of 30 fathoms, will cost \$900 additional, and a seine boat and dories \$500 more; salt, bait, lines, etc., and the necessary provisions for a five weeks' trip make the total cost, when ready for a fishing voyage, \$9325. The Bay St. Lawrence Mackerel Fishery, once of considerable proportions, has declined largely of late years. The seining of Mackerel is found impracticable in this fishery, owing to the rocky bottom in the waters where it is followed, and the consequent destruction of seines. The number of Gloucester vessels finding em-

ployment in the mackerel fishery in 1875 was 180. Of these, 93 made Southern trips, 117 fished off shore, and 58 visited the Bay St. Lawrence. 618 fares were received, 133 from the South, 425 from off shore, and 60 from the Bay."

CONCLUSIONS.

77. It appears from the foregoing statements that the mackerel come direct from their winter homes to the areas where they were born to spawn in the spring. They come with the film of hibernation still in part lingering over the eye, and are partially blind, poor, and refuse the bait. The habitat or home of different schools extends from Greenland to Cape Hatteras, ⁽¹⁾ and they are taken by United States fishermen south of the 39th parallel of latitude. Their period of approaching the shore for the purpose of spawning varies on the American coast with the latitude; in other words, with the temperature. They show themselves first in Virginia and North Carolina, in the seas about Cape Hatteras, and further north as the temperature advances. They come from their winter homes direct to the coast and spawn in shallow water, generally near the shores of the continent, of islands, as Sable Island, on the coast of Nova Scotia, the Magdalen Islands, in the Gulf of St. Lawrence, Canso Island, in the Straits of Canso. They may also spawn in the open sea, but the young fry, following the law which guides the young of most species of fish, approach the shore and spend the early portion of their lives in coastal waters. They are a wandering fish in the summer months, but their wanderings are limited to a certain sea area around, and not extending very remote from, their birth place. Owing to the fact of their spawn floating on the surface during the period of its development, the schools of this fish are liable to sudden diminution, and during favorable seasons, to equally sudden increase. They are very important as a bait for the deep sea fishery, and are largely used for that purpose. As a commercial fish, they have always formed an important item in the Dominion catch in Dominion waters, and in some seasons, as in 1871, the value of the aggregate catch approaches that of the cod.

The supposed migrations of the Mackerel from warm southern waters to cooler seas during the summer months, like the mythical wanderings of the Herrings to Polar Seas during the winter season, or the equally fanciful migrations of the Cod to spawning grounds on the Norwegian coast, have disappeared before the test of rigid enquiry.

That schools of this fish sometimes wander far beyond the limits of their customary circle is very probable. Such isolated roamings are common to all animals with great powers of locomotion, and in the case of the Mackerel, a constant gentle wind prevailing for several days together, may drive the food they are following far from their accustomed haunts. The same isolated cases of apparent migration occur with the Cod, if reliance can be placed upon the alleged finding of French hooks in fish far removed from French fishing stations. These are said to occur on parts of the coast of Newfoundland where the French do not fish, also on the Nova Scotia coast, and sometimes even as far as St. George's Shoals. But they indicate merely the straying away after food of a comparatively few individuals, but no regular law of migration or movement. The same accidental distribution occurs in the movements of birds, and may continue for several years, or even become with some species permanent,

1. Scomber Scombus—Mackerel—Greenland to Cape Hatteras.—*Theodore Gill*.

if a change in the distribution of their food occurs. Shad have been caught in Herring nets in Notre Dame Bay, Newfoundland, but no one would receive this accident of roaming as proof that the Shad was about to become established on the North East Atlantic coast of that Island.

Mackerel catching is a special industry and requires sea-going vessels. The boat equipment so common throughout British American waters is wholly unsuited to the pursuit of the Mackerel which has been so largely carried on by United States fishermen. Immense schools of Mackerel are frequently left unmolested in the Gulf and on the coasts of Newfoundland, in consequence of the fishermen being unprovided with suitable vessels and fishing gear. It is, however, a reserve for the future, which, at no distant day, will be utilized. If a fishing telegraph system existed on the Gulf and Newfoundland coasts, similar to that which has been established in Norway, exclusively for fishing purposes, the additional catch of Mackerel and Herring, indeed of all kinds of fish, as well as bait, would probably double itself within a very short period. If judiciously controlled the telegraph would become of vast benefit to the fisheries in many ways.

CHAPTER V.

RELATION OF FISH TO TEMPERATURE.

The late Mr. Perley's views, 80; The observations of the Meteorological Society of Scotland, 81; The enquiries of the Dutch Government, 82; Difference between the marine climate of Northern Europe and North America, 83; Admiral Bayfield on the climate of the Straits of Belle Isle, Icebergs in the Straits, Captain Millor's observations, 84; Captain Chinano's observations, Vast numbers of Codfish—Lieut. Commanding Murray's (U. S. N.) observations, 85; Marine temperature in the Gulf, 86; Low temperatures on Banks and Shoals, 87; Temperature of the Sea at different depths, 88; Effects of winds, 89; Effects of Currents, 90; The Gulf Stream, 91; Temperature on St. George's Shoals, off Cape Sable, Le Have Bank, Bay of Fundy, 92; Cold water area off the coast of the United States, 93; Sir Wyville Thomson's description of the Thermal condition of European Fishing Grounds, 94; Marine Life on the Great Banks, The late Mr. Juko's observations, Effect of the Gulf Stream, 97; Admiral Cloué on the French Bank Fisheries; Dependence of their success on winter temperatures, 98; The Relation of the Labrador Current to Fish Life, 99; Professor Nordenskiöld's observations, 100; The Ice Drift, 101; The course of the "Slime," 102; Distribution of Fish ova by Ice Drift, 103; Course of ova drift, 104; Course on the Labrador, 105; Limited area of cold waters off the coast of the United States suited to cold water fishes, 106. Conclusions.

APPENDIX.—Dr. Colding's description of the Arctic Current.

80. Seven and twenty years ago, the late Mr. Perley called attention to the zones of depth at which the Herring might be found. "The fishermen," he says, speaking of the Carruquet Herring grounds, "appeared to have no idea that the herring swims at various depths below the surface, according to the wind, the tide, and the situation of their food. They all fished (100 boats) their nets fastened to a buoy-rope, supported by floats on the surface; if the run of the fish happened to be below the depth of the net, they were of course missed altogether; and although there may be abundance of fish, yet the fishermen from the want of knowledge or skill, must be frequently unsuccessful." (1.)

It will be seen further on that winds and tides in the Gulf of St. Lawrence, in the Bay of Fundy, on the Atlantic coast of Nova Scotia, and, in fact, in every shallow sea, very materially change the temperature of the water, in the neighbourhood of, and over shoals or banks. This change in the temperature is accompanied by a corresponding change in the distribution of the Herring food, and, consequently, in the depths at which the Herring will be found.

81. The recent observations of the Meteorological Society of Scotland, referred to in the foot-note have shown a remarkable relationship between the local movements of the Herring and variations in the temperature of the sea. The results of observations made during 1874 and 1875 showed that the temperature of the sea off the east coast of Scotland, from the middle of August to the close of the fishing season, was considerably and continuously higher in 1875 than in 1874, and that the catch of Herring was continuously and considerably lower during 1875 than during 1874. "The fish prefer, apparently, so far as the enquiry has gone, the lower to the higher temperature." (2.)

1. See Perley's Report on the Fisheries of New Brunswick, page 43.

2. Vide an article in *Sature* entitled 'A contribution to the Natural History of the Herring,' Aug. 24th, 1876. Also, Report by the Commissioners of the Fishery Board, Scotland, 1875.

Quoting from the *Scotsman* of Aug. 25, 1876, 'Nature' states that the report of the Fishery Officer regards the temperature of the sea as determined by the sea thermometer furnished to the fishermen by the Scottish Meteorology Society, to have been from 58° to 59° on the coast, during the week ending Aug. 19th; but on the 21st, when the nets were shot, the temperature had fallen to 55°, and this was the first night the herrings were caught. After that date the catch was very large. The herrings were found *low in the nets* during the prevalence of warm weather between Northumberland and Peterhead.

The Meteorological Society of Scotland have for two or three years had this capriciousness in the movements of the Herring under special investigation, and in the past year the deep-sea thermometers provided to the Society by the Marquis of Tweeddale, its President, for testing the temperature of the sea, were again sent out by the Fishery Board to their officers and the temperature obtained at different periods of the herring fishery. Daily registers of the weather were kept and other particulars furnished to the Society, both by the district Fishery Officers and by Samuel McDonald, Esq., commander of the 'Vigilant,' fishery cruiser. From the registers and the information thus supplied, the following conclusions have in the meantime been drawn by the Committee of the Society:—

From the observations of the catch of herrings and the temperature of the sea off the east coast of Scotland, during the two seasons 1874 and 1875, it is seen:—(1.) That the temperature of the sea from the middle of August to the close of the fishing season was continuously and considerably higher in 1875 than in 1874; and (2.) That the catch of herrings was continuously and considerably lower during 1875 than during the same period of 1874.

Another result is this:—If there be a district where, from any cause, the temperature of the sea is lower than in surrounding districts, in that district the catch of herrings is heavier; and conversely, if there be a district where, from any cause, the temperature of the sea is higher than in surrounding districts, in that district the catch of herring is less. Among the causes which bring about a local increase or decrease of sea temperature, the chief are clouded or clear skies in respective districts, according as these occur during the day or during the night. These local variations in the temperature of the sea in their bearings on the catch of herrings have been shown by the observations both of 1874 and 1875.

Another important point is the relations of surface temperature to bottom temperature, and the relations of the deepest parts of the sea to the positions of the fishing grounds. It is found, for instance, that when the surface temperature is high—higher than lower down—the fish, if any be caught, strike the nets far down in such a way as to lead to the supposition that a good deal of failure may often arise from the nets not going deep enough. The fish, prefer, apparently, so far as the inquiry has gone, the lower to the higher temperature. The Herring Committee are most desirous of carrying out this line of inquiry into greater detail, if some of the fishermen could be induced to take the trouble of observing the temperature of the sea at the surface and also at the depth at which the fish strike the nets.

The influence of thunder-storms was equally seen as in former years. If there is a thunder-storm of some magnitude extending over a large portion of Scotland, good takes may be made on that day, but on the following day few if any fish are caught over that part of the coast, *unless at the extreme verge of a deep part of the sea*, as if the fish were retreating thither. (1.)

Quoting to the shortness of the time over which the inquiry has extended, the Committee wish these results to be considered only as provisional. The results are, however, of the greatest value, not merely as indicating the lines of inquiry to be followed in further carrying on this large investigation, but also as indicating, in some cases not obscurely, the nature of the results which will ultimately be established,—results which, since they lead directly to a knowledge of the localization of the herring, will serve as a guide to the fishermen where to set their nets with the highest probability of success.

82. The Dutch Government have long pursued a series of enquiries relative to temperature in connection with the Herring Fisheries.⁽²⁾ Among the special enquiries which the

(1) It has long been noticed that thunder drives the Dighy Herring in the Annapolis Basin and Bay of Fundy into deep water.

(2) Lieutenant Craft—noticed in Boeck's and Peddersen's papers on "The Norwegian Herring Fisheries." See also O. Jacobson's translation, page 96 of the Report of the U. S. Commissioner of Fish and Fisheries, for 1874-75.

Norwegian Naturalist, Boeck, mapped out for himself, when employed by the Government of Norway to investigate the Herring Fisheries, observations on the temperature of the sea, and meteorological conditions generally formed an important part of the plan. As a result of these researches, prosecuted in different seas and by individuals acting quite independently, the relation of the temperature of different zones of the sea to the movements of the herring and other marine forms, vertical as well as horizontal, appear to be established beyond a doubt.*

83. We must bear in mind that the conditions under which marine life exists on the coasts of British North America differ in one important particular from the prevailing conditions in the seas of Northern Europe. Here we have an Arctic current to consider, in Europe the diminished effects of the Gulf stream. Our northern seas all around Newfoundland, in the Gulf of St. Lawrence and on the coasts of Nova Scotia, are chilled by the unfailing Labrador current,⁽¹⁾ and the annual mean temperature of the seas on British American coasts is very much below the annual mean on the Atlantic coast of the British Isles, or in the German ocean or on the coasts of Norway. The Norwegian fiords are kept open all the year round by the Gulf stream, and ice is rarely seen in British waters, but ice on all our coasts not only prevails during the winter months, but the northern bays are closely sealed. Hamilton Inlet, on the Labrador, takes early in December and remains frozen until June; the deep bays on the north-east coast of Newfoundland are invaded with large ice fields; which stretch seawards for many miles, and often linger for months together. The smaller bays on all British American coasts, north of Cape Breton, and around the Gulf of St. Lawrence, are often frozen over, and some of them remain sealed for many weeks. It is a rare occurrence for the Norwegian bays to freeze, yet when this has occurred, the fisheries have not been injuriously affected.

84. Admiral Bayfield⁽²⁾ called attention many years since to the exceptional climate of the North Shore of the Straits of Belle Isle, where and in the close vicinity of which the famous Cod and Herring Fisheries have so long had their seat. Bayfield, writing in 1832, says: "On our arrival at Chateau Bay on the 25th July, we found the earliest plants just springing up, and the grass only beginning to give a shade of green in the sheltered spots between the hills. The temperature of the sea outside the bay was at 32°, and the air at 43° fah. in the warmest period of the day. The fishermen, however, reported that it is much more cold about Chateau Bay, and the north side of the Atlantic entrance of the Strait

* "The *Shipping Gazette* states that Herr von Freadon, of Hamburg, Director of the German See Warte, has been giving attention to the same points in relation to the herring fishery as those which have occupied the Meteorological Society of Scotland, and that by analysis of the log-books of the huggets engaged in the fishery, he has furnished the Fishery Company of Embuden with elaborate reports upon the influences which affect the fishery, especially upon the influence of winds and the temperature of the sea. Herr von Freadon has come to the conclusion that north-west winds are the best for large catches, and northerly winds better than southerly, westerly better than easterly: also, that moderately strong winds, sufficient to ruffle the surface of the sea, are better than calm weather, and light winds almost as unfavorable as stiff breezes; a ruffling of the sea being, in his opinion of considerable importance to success in fishing. For the temperature of the sea, he regards a temperature from 53 to 57 degree of Fahrenheit as the most favorable, and that the chances of success diminish with higher or lower temperature."—(Report by the Commissioner of the Fishery Board, Scotland, 1875.)

1. App. I. chap. v.

2. Sailing Directions for the Gulf and River St. Lawrence.

of Belle Isle than it is farther to the eastward, and also that fogs are of more frequent occurrence. Our own experience, as far as it goes, confirms the truth of this statement." Wood Island, at the Gulf entrance to the Straits of Belle Isle, is about half a mile from the main land, and is noted for its fisheries, but its exceptional climate is such, owing to the Labrador Current, that Bayfield summarizes it in the following sentence: "The best idea I can give of the climate is by stating the fact that, in the year 1833, the Chanel between Wood Island and the main was frozen across *again* after the winter ice had broken up on the 28th of June. Packed ice remained (in the Straits) till the middle of July, and numerous bergs all the year.

ICE IN THE STRAITS OF BELLE ISLE.

TABLE SHEWING THE DATES WHEN THE STRAITS OF BELLE ISLE WERE CLEAR OF ICE IN DIFFERENT YEARS.

These observations refer to the time when the Straits were seen to be clear of field ice, but have no relation to bergs, which may drift in during every month of the year:

1857—	Clear of field ice.....	April 9th.
1858—	" " "	June 10th.
1859—	" " "	May 12th.
1860—		
1861—		..... June 4th.

In 1853, Admiral Bayfield counted 200 bergs and large pieces of ice in the Straits, and he considers that the Straits *may* be full of icebergs *at any season of the year.*⁽²⁾

This Officer "once found the western entrance of the Strait freeze across in a calm night, on June 20th. Of course, it was only a very thin covering of ice, which disappeared soon after sunrise." It is to be observed, however, that icebergs are much more numerous during some seasons than in others. One may traverse the Straits without seeing half a dozen, at other times they may be in great quantities.

The temperature of the water in the Straits, at the eastern entrance, between Belle Isle and the Labrador, is often at the freezing point. Not unfrequently there is a stream of warm surface water flowing eastward on the Newfoundland side.⁽³⁾

Conditions of low marine temperature prevail even at mid-summer on the northern coasts of Newfoundland and in the Straits of Belle Isle, which are never even approached in the depth of winter on the Atlantic coasts of Europe. The following remarkable sea temperatures, recorded by Captain Miller, R. N., of H. M. S. *Sirius*, in 1873, offer an illustration of these extreme conditions of marine climate which prevail on those coasts.

The temperatures recorded may be thus tabulated, but it will be advisable to give the details in full from Capt. Miller's report:—

1873.	Tem. of Air.	Tem. of Sea.	Wind.
Quirpon Harbor.			
June 24th.	36.	32.	Calm.
26.	53.	34.	W. N. W. Fresh.
27.	68.	36.	W. by N. Strong.
28.	43.	30.	W. N. W. Mod.
29.	54.	28.	
30.			Caplin caught, but no Coal.

1. 1857, 58, 59, 60, on the authority of Captain Ballantine, Nautical Magazine, 1861, p. 475.

2. "Nautical Magazine," 1861, p. 511.

3. Bayfield. ..

QUIRPON.

" Arrived 1 p. m., June 24th, sailed at 5.30 a. m., June 25th. A lovely day, quite calm up to 10 a. m.; a bright sun and clear weather; temperature of sea 32° Fahrenheit, of air 36°; a great deal of ice about. Steamed over to the Labrador shore, intending to go to Red Bay; found the coast blocked up by an impenetrable barrier of ice; went down to Cape Norman and found the Straits completely barred by an impassable wall of ice; turned back to Quirpon about 10 a. m., an easterly wind sprang up, changing to a southerly; a dense fog bank rose to the eastward, and gradually enveloped Belle Isle, and the top of Quirpon Island, but fortunately came no further.

" 26th.—A fresh breeze for part of the day from W. N. W.; ice travelling to the eastward in the Straits; at noon temperature of air 33°, of sea 34°.

" 27th.—Strong breeze part of day from W. N. W.; much ice travelling to the Labrador in the Straits; mouth of harbor by afternoon completely barred by ice, temperature of air at noon 68°, of sea 36°.

" 28th.—Moderate breeze from W. N. W. part of day. By 4 p. m. the harbor became nearly entirely densely packed with ice, (we were entirely surrounded,) drifted in by the mouth, the ice for the most part being more than three or four feet out of water, and the largest pieces about a quarter of an acre; all outside the harbor densely packed with ice. At 3.30 p. m., temperature of air 43°, of sea 30°; rain in afternoon, with fog.

" 29th.—Harbor densely packed with ice, and as far outside as could be seen from the deck temperature at noon, air 54°, sea 28°."

86. In 1867 Captain Chimmo, R. N., who visited the Straits of Belle Isle and the north-eastern coast of Labrador in the interest of the Newfoundland Fisheries, describes a great number of icebergs in the Straits on the 4th August. This year was remarkable for the abundance of fish on the Labrador coast and the large catch early made by the fishing fleet, which, according to Captain Chimmo's estimate, gave employment to about 30,000 persons, chiefly from Newfoundland. About Cape Harrison the catch was so large and early that the fishermen had used all their salt before the 5th August.^[1] He mentions "picking up" a seven fathom bank close to the shore of Occasional Harbour, on which the capelin were in abundance but cod would not take the bait. The capelin season was over. The cod could be seen at the bottom in some places like a wall, but would not bite. The cod and capelin had arrived at Icy Tickle, near Indian Harbour, on the 10th June, but the fishing fleet did not arrive until July. In 1876 the fleet were in general a fortnight later than the fish, owing to ice.

Lieut. Commanding, Alex. Murray, U. S. N., found the surface temperature of the "Labrador Current," in July, coldest where the water was deepest and the current strongest. The voyage was made in 1860, in the month of July, to observe the total eclipse of the sun in the neighborhood of Cape Chudleigh.

On the 1st August, 1860, the Expedition found the surface water of the Straits of Belle Isle to have a temperature of 32° Fah., and during the voyage to Eclipse Harbour the temperature of the sea at the surface was frequently down to 38° or 39° in the middle of July.

1. A visit to the north-east coast of Labrador, during the autumn of 1867, by H. M. S. *Gannet*, Commander W. Chimmo, R. N.—Journal of the Royal Geographical Society, 1868.

In the Gulf of St. Lawrence similar sub-arctic conditions prevail, and to a less extent on the Atlantic coast of Cape Breton Island. In summer, especially on banks, the temperature of the water, within the hundred fathom limit, often descends to and even remains at the freezing point of fresh water. The sea climate, in which the infinite multitude of fish live and thrive in North American seas, influenced by the Labrador Current, is far more severe than the marine climate of Northern Europe, notwithstanding the difference in latitude.

The summer marine isothermal of $54\frac{1}{2}^{\circ}$, which follows the whole length of the coast of Norway, does not touch the most southern part of Newfoundland; and the summer isothermal of 59° , which strikes the south coast of Ireland, passes far south of Nova Scotia and strikes the American coast near Portland. The winter isothermal of 32° starts from the American coast at Cape Breton Island, sweeps past the east coast of Greenland and touches the northern part of Iceland, pursuing a north-easterly course. The winter isothermal of 41 degrees, which includes, south of its limits, all the seas about Scotland, passes far to the south of Nova Scotia and strikes the United States near Cape Cod.^[1] Hence the climatal conditions under which North American marine life finds sustenance differs amazingly from like conditions in Northern Europe, and while one may be regarded as temperate, the other is sub-arctic, and on parts of the Gulf coast, the north-east coast of Newfoundland and the Atlantic coast of the Labrador, it is arctic in winter.

The fishing seasons are in consequence reversed. Winter is the great fishing season for cod in Europe, particularly in Norway. With us, summer is the fishing season. The time will arrive with regard to the herring, when winter fishings will take place to an immense extent on Nova Scotian shores, for it is only within the last few years that the herring have been discovered in winter, "under the land," that is, near the shores on our coasts.

These and other instances of low temperature in coastal waters, show that so far from being prejudicial to fish life, they occur where fish have for centuries been known to be most abundant, and indeed it may be said that there is no known part of the world (the Lofotens excepted) where the Cod are so numerous and constant in their abundance during the summer and autumnal season as in the straits of Belle Isle and the Coast of Southern Labrador, from Belle Isle northwards. The mean monthly temperature of the sea can scarcely be said to rise many degrees above the freezing point of fresh water during the six summer months of the year, and yet the commercial fishes abound there, particularly the Cod and the Herring. When compared with Greenland—for the most part an ice-covered area—the comparison for the same degree of latitude is in favor of Greenland. But this prevalence of low temperatures, concurrently with the abundance of fish, of crustaceans, as well as of lesser forms of life, show how conducive to their development is the lowness of the temperatures which prevails in these seas, and the prominence with which the Labrador Current is invested as a fish food producing area.

1. See Dr. Peterman's chart of the Isothermals of the North Atlantic; also "Further Enquiries on Oceanic Circulation," by William B. Carpenter, M. D., F. R. S. *Cor. Mem. Inst. of France. Pro. Roy. Geo. Soc.*, August, 1874.

LOW TEMPERATURES ON BANKS AND SHOALS.

87. It is a popular error to suppose that the water on Banks and Shoals some distance from the shore preserves a higher temperature than the surrounding sea. Generally its temperature is considerably less, and this law applies not only to Banks, but also to shoaling seas on approaching land, and the variation is especially manifest on the North American coast within the influence of the Arctic current, or on a narrow strip as far south as Cape Cod, or even New York. The best illustration is of course the Grand Banks of Newfoundland. Here Humboldt found the surface water of the Grand Bank 9° cent., or 16 Fah. lower than the surface of the neighbouring sea, and 21½° Fah. lower than the Gulf Stream which flows North-easterly past the Great Banks.

When the survey of the Gulf of St. Lawrence was made some forty years ago, by Admiral Bayfield, Dr. Kelly, who had charge of the temperature observations, states generally, that "Wherever we had occasion to observe the temperature of the surface over banks and shoals, away from the land, we found it always less than where the water was deep; but in approaching land from the centre of the Gulf, though we generally found the surface colder, yet it was not invariably so; and in some cases it was warmer near the land, than at a distance from it."¹

88. Extraordinary variations of temperature take place in Harbours on Dominion and Newfoundland coasts, arising from the influence of the Labrador current, which is everywhere felt to a greater or less degree. The Sea temperature on European coasts cannot be compared in point of sudden differences and extreme cold, with the temperatures which prevail with us. These remarkable variations are so intimately connected with fish life and the movements of fish that they merit the closest scrutiny and study.

The great mass of the water of the Gulf of St. Lawrence has a temperature of about 35 degrees, or three degrees above the freezing point of water; it is always warmer at 100 fathoms, according to Dr. Kelly, than at 50 fathoms, and in this particular it differs much from the open Atlantic.

TEMPERATURE OF THE SEA AT DIFFERENT DEPTHS

THE GULF OF ST. LAWRENCE.

Cold and Warm Strata.

88. Dr. Kelly⁽²⁾ has shown that the water of the Gulf of St. Lawrence can be divided into 'strata' as regards temperature. A zone of water of a certain degree of warmth is superimposed upon a zone of less and sometimes higher temperature, and these zones are cup or saucer shaped, being disposed towards the deeper portions of the Gulf, and sometimes coming to the surface at variable distances from the coast. Dr. Kelly records the somewhat remarkable observation, that in the deeper portions of the Gulf the water was found, "in every instance," warmer at one hundred fathoms of depth than at fifty fathoms. The specific gravity of the deeper portion being always greater at the greater depths, "the saline contents of the strata thus giving them a relative position different, in some instances, from that which they would occupy, if their specific gravities were influenced by the temperature alone."

1. On the temperature of the surface water over the banks and near the shores of the Gulf of St. Lawrence.

2. On the temperature of the surface water over the banks, and near the shores of the Gulf of the St. Lawrence: by William Kelly, M.D. Transactions of the Literary and Historical Society of Quebec, May, 1837. (These observations were made during the Admiralty Survey of the Gulf of St. Lawrence in 1830-36.)

It is well deserving of notice that this discovery of zones or strata of water having different temperatures should have been made in Dominion waters more than forty years ago, and first recorded in the Transactions of a Literary and Scientific Society at Quebec. It is only within the last few years that the law has been found to extend to all seas. The wide Atlantic on approaching the American coast, shows the temperature strata in a marked degree, and the discovery forms one of the very many new and beautiful laws which are the result of the "Challenger's" voyage around the world. Dr. Carpenter has discussed the 'Challenger's' observations at length in the proceedings of the Royal Geographical Society, (1874) In the preliminary report of Professor Wyville Thomson, published in the proceedings of the Royal Society, (1876), there are diagrams showing the cup shaped arrangement of the temperature strata in the Atlantic. In Petermann's "Mittheilungen" for 1870, two large maps showing the summer and winter isothermals over the surface of the Atlantic, indicate roughly the edges of these saucers shaped strata, derived from a vast number of surface observations and having no reference to temperatures at different depths, yet strikingly coinciding with the sub-surface results attained by the 'Challenger' expedition, in general outline.

89. The effect of winds on the coastal waters is remarkable. On the Labrador (Gulf) coast, Dr. Kelly found the easterly sea winds generally raised the temperature of the surface sea waters, the westerly winds cooled it; and these changes have no relation to the temperature of the winds, for the moist, easterly sea winds are generally colder than the dry, and often, warm winds, crossing from the land.

Banks are cold because they oppose an obstruction to the tides and currents, which brings the cold substratum of water to the surface. Winds, as will be hereafter shown affect the temperature by mixing the waters and by producing evaporation. It is thus that warm, but dry, land breezes cool the surface of the sea, by evaporation. In the Straits of Belle Isle the water is always cold, on account of the Labrador current which flows through it, nearly filling the channel, but it is colder on the Labrador side than on the Newfoundland shore, because an eddy current from the Gulf flows easterly, near that shore, and ice-bergs, coming round the north side of Belle Isle, and entering the Straits, often pass out south of Belle Isle, being carried by this current from, instead of towards, the Gulf.

The temperature of the surface water in the bays and harbors of the Gulf is rapidly and markedly affected by winds. In August Dr. Kelly found the surface water of Kegashka Harbor fluctuate from 38° to 52° between the 18th and 28th of that month, according as the winds were more or less fresh off on the shore.

Off Mingan on the 31st August, the surface water was 51°, the air being 56°, but the next day, owing to a change in the wind to the northward, the surface sank to 39°, the air being 52°. At the same place, in passing a shoal on the 29th June, 1832, the temperature of the surface was only 33°, the shoal bringing the cold substratum to the surface, it lying in the course of the current.

The effect of tides and winds in cooling the water on and near shoals by bringing up the cold water stratum from greater depths is well known, and in the bay of Fundy the low temperature is produced by the mixing action of the high tides of that Bay.

These observations have a direct bearing upon the effect of winds on the catch of surface-feeders, referred to in the foot-

note on page 82, just as the preceding remarks on the effect of temperature strata are illustrated by the observations conducted under the auspices of the Meteorological Society of Scotland, referred to on page 91.

In illustration of the difference in the temperature of sea water taken from different depths in the Gulf, Dr. Kelly instances a series of observations off the Island of Anticosti on the 10th August, 1831.

Temp. of surface water,.....	54°
At depth of 10 fathoms.....	46
“ “ 30 “ (cold stratum).....	34.5'
“ “ 50 “ “ “.....	34
“ “ 100 “ (warm stratum,).....	37

Specific gravities decreasing regularly from 1.0225 to 1.0270 at the greatest depth.

Off Point de Monts, on the 19th June, 1832:—

Water at the surface,.....	43°	sp. gr. 1.019
At depth of 10 fathoms, (cold stratum,)....	37° 5'	“ 1.053
“ “ 20 “ (warm stratum,)..	39	“ 1.0246
“ “ 47 “ (cold stratum,)....	33	“ 1.026
“ “ 104 “ (warm stratum,)..	36	“ 1.0275

At the same place, 9th July, 1831:—

Temp. at surface,.....	57°	sp. gr. 1.017
At depth of 3 feet.....	44	...
“ “ 4 fathoms.....	40	...
“ “ 10 “	38	...
“ “ 100 “	35	“ 1.0275

The effect of winds is to mix the strata of water and to produce a uniformity of temperature as deep as the mixing occurs. Tides will also produce the same result, though perhaps in a minor degree, but when tides and winds act together they may reduce the temperature of a zone of water to a considerable depth, especially on and in the neighbourhood of banks and shoals.

Dr. Kelly further states that “ whenever we had occasion to observe the temperature of the surface over banks and shoals away from the land, we found it always less than where the water was deep, but in approaching land from the centre of the Gulf, though we generally found the surface colder, yet it was not invariably so, and, in some cases, it was warmer near the land than at a distance from it.

On the 17th June, 1836, Dr. Kelly registered the following temperatures, when becalmed, on a point 12 miles south east of Point des Monts, in the estuary of the St. Lawrence :

	Temperature.	Sp. gravity.
Surface.....	51.....	1.0180
5 fathoms.....	42.5.....	—
10 “	38.....	—
30 “ <i>cold stratum</i>	32.5.....	1.0261
50 “	33.....	1.0266
80 “	34.....	1.0266
110 “	35.....	1.0271
150 “	35.....	1.0278

Below the depth of 100 fathoms the temperature of the water did not change, but its specific gravity continued to increase.

Comparing this table with a serial table of temperatures, taken 11th Feb., 1874, in Lat. 60° 52' South, it will be seen that a somewhat similar series of layers of cold and warm water occur in the deep sea where the lead records many hundred fathoms. (Challenger, J. E. Davis.)

		Temperature.
Surface.....		34.5
10 fathoms...		34
20 ".....		33.5
25 } " Cold Stratum.....	{	31.2
30 } " " ".....		30
40 } " " ".....		30.2
50 ".....		32.2
100 ".....		32
200 ".....		35.5

It may be asked what practical bearing have these strata temperatures on the great Sea Fisheries. The answer can only be adequately expressed by the expression, 'an all-important bearing.' They determine the vertical positions in the sea of zones of minute and microscopic life which form the source of the food of the higher forms, up to those of the fish which feed either directly or indirectly upon them. The Herring sinks and rises with its food, so does the Mackerel, and the toll bait used by the fishermen of the United States, brings the schools to the surface from zones where they have been probably feeding or resting. These points will be better and more fully illustrated in subsequent paragraphs.

In the "Lightning Channel" between the North of Scotland and the Farøe Islands, the temperature of the water over a large part of the bottom ranges to two degrees or even more, *below* 32°, the freezing point of fresh water. (Dr. W. B. Carpenter on Physical Investigations on board the "Valorous" in August, 1875.—*Proc. Roy. Soc.*, Vol. XXV. No. 173. P. 233).

The occurrence of sheets of water of very different temperatures overlying one another, is well illustrated in a paper by Dr. Carpenter, published in the *Proc. Roy. Geog. Soc.*, Aug. 1874. A mixing of similar sheets on the Labrador, by currents on that shoal coast, and particularly among the Islands rapidly reduces the temperature so that in a cold calm after a storm in December, all the conditions for the rapid formation of Anchor Ice are present. The sea on the shoals is uniformly cooled, a clear sky and a gentle north wind assists the radiation of heat, and ice spiculae form with great rapidity in the Labrador current, often increased in local intensity by tides. The causes which give rise to the various sheets of water of different temperatures in the Polar seas, are thus briefly expressed by Dr. Carpenter: "It is quite true that the surface water is often found to be colder than the stratum which immediately underlies it, the temperature of the former being reduced by the melting of the ice, whilst the colder water continues to float in virtue of its *inferior salinity*. But the warm *sub-surface* stratum may now be affirmed with certainty to be upon a bed of glacial water, the temperature of which has been found in some instances to descend as low as 25°."

EFFECTS OF CURRENTS.

Admiral Cloué, in the "*Pilote de Terre-Neuve*," states that the currents are very strong and irregular in the vicinity of Newfoundland, and that while the current between the Grand Banks and Newfoundland is commonly to the south-west at the rate of a mile an hour, yet this is not invariable.

90. Admiral Lavand, quoted by Admiral Cloué, describes the currents on the south coast of Newfoundland as very irregular, and often more violent near the shore than at a distance from it, so that it becomes almost impossible to indicate with precision their direction and influence.

With regard to winds, Admiral Cloué says that there are few countries where the weather is more changeable than on the coasts (parages) of Newfoundland. Frequently during the same day the wind will make the round of the compass. After having blown fresh from the east in the morning, it will blow with the same force in an opposite direction during the afternoon. Generally, however, westerly winds prevail.

Owing to the action of the tides, the currents in estuaries, inlets and bays, and through islands, are of a complex character, and very frequently the surface current offers no indication whatever of the general movement of the water even five fathom below. Indeed, without careful observations, the direction of the under currents cannot be determined, and all attempts to draw conclusions from surface indications are liable to much error.

In looking for fish which necessarily at most seasons follow the bait, we must be guided by the under currents, which also guide and direct the bait and thus determine the movements of the fish.

Admiral Bayfield instances many examples in the Gulf and estuary of the St. Lawrence of a thin superstratum of comparatively light and warm water moving down the estuary or remaining stationary, the under current taking another direction.

This, we know from the recent observations by the scientific staff of the Challenger, the Valorous, and other of H. M. vessels, takes place on a grand scale in the open ocean, and the case most interesting to Newfoundland is that of the warm, thin superstratum moving up and towards Davis Straits, near the Greenland coast. The current has probably an influence upon the movements of seals on and towards the Greenland coast.

THE GULF STREAM.

91. Although for all practical and even theoretical purposes it might be considered that the irregular curve representing the one hundred fathom line of soundings embraced the whole of the available area in which deep sea fishing is practised in American waters, yet it will be far more satisfactory first to indicate the appropriate distance of the Gulf Stream from the American coast north of the 39th parallel of latitude, as determined by the United States Coast Survey. North of the 39th parallel the course of the Gulf Stream according to the chart in volume for 1860 of the U. S. Coast Survey, lies wholly outside or beyond the 100 fathom line, but spurs or offsets nearly touch that line on the parallel named, abreast or due east of Cape Henlopen.

The distance of the "cold wall," a well defined boundary between the warm water of the Gulf Stream and the cold water lying between it and the coast, is thus stated by the Superintendent of the U. S. Coast Survey (A. B. Bache).^{1,1}

DISTANCE OF COLD WALL FROM SHORE, IN MILES.

	Miles.
Cape Hatteras Section	50
Cape Henry "	95
Cape May "	125
Sandy Hook "	240

1. United States Coast Survey, 1860.

But between the "cold wall" and the shore there are warm bands, also an overflow of the Gulf Stream, which greatly limits the area and volume of the cold water. ^[1]

South of New York, the coldness of the waters between the coast and the Gulf Stream is due to the surging up of the great bed of nearly ice cold water which underlies the Gulf Stream, and there is no south-westerly movement observed. This is fully explained by Dr. Carpenter, in his "Further enquiries into Oceanic circulation"—p. 357, Jour. Roy. Geogr. Soc., June, 1874.

The edge of the Gulf Stream south-east of Nova Scotia is represented on the Admiralty chart at about 150 geo. miles distant from the coast, 100 miles due south of Sable Island, and in its summer extension sweeping over the extreme southern edge of the Great Bank of Newfoundland during August and September. In all cases, except where it touches the southern end of the Great Bank, it lies beyond the hundred fathom line of soundings. Its northerly swing during the summer months carries it a variable distance beyond the limits assigned to it as a surface current, and prevailing southerly winds not unfrequently bring a surface film near to the coasts of New England, Nova Scotia and Newfoundland, with the peculiar marine life which belongs to the waters of the Gulf Stream. But beneath this surface film there always rests and flows southerly and south-westerly the cold waters of the Labrador current. ^[2]

It is needless to state that the seas lying to the north of the Gulf stream are partly sub-arctic and arctic in their character, and that the whole of the Gulf of St. Lawrence is included within the limits occupied by cold waters, the summer surface coastal film of warm water being very shallow and unstable. As far south as New York the cold coastal waters are derived from the arctic or Labrador current. South of New York the surging upwards of the cold glacial bed of the Gulf stream is apparent. ^[3]

92. One of the most important fishing grounds for cod within the waters off the coast of the United States is Saint Georges' Bank and its vicinity. Professor Verrill, speaking of the Fauna obtained by dredging there, states that it is essentially the same as found in the deeper muddy parts of the Gulf of St. Lawrence, ^[4] and the life indicates a temperature "not above 40°², and perhaps considerably lower." ^[5] In the deeper waters outside of Casco Bay, 15 to 30 miles southwest from Cape Elizabeth, the bottom temperatures were found to be remarkably low, varying from 36°² to 40°² Fah., while the surface was usually between 55°² and 65°², or even higher. In the deep part of the Gulf of Maine, styled by Prof. Verrill, St. George's Gulf, the water is icy cold, but "whether the nearly ice-cold water filling the deeper parts of the cold area can be regarded as constituting a definite current or offshoot from the great arctic current, flowing southward along our coast in deep water off shore, or whether it is a portion of the great body of cold water filling the ocean basin at great depths, which is brought into this partially closed basin by the powerful tidal currents, is still uncertain. But it is important to have established the fact that this body of cold water approaches so closely to the coast of Maine as to manifest itself most dis-

1 Page 171 U. S. Coast Survey, 1860.

2 See "Challenger" Observations--Halifax to Bermuda.

3 P. 357, pro. Roy. Geo. Soc., June, 1874. Dr. Carpenter on the "Challenger" Temperature Observations.

4 Dredgings on the Coast of New England. American Journal of Science, 1873.

5 Ibid page 14. See also page 438, vol. VI., 3rd Series.

tinety within 12 or 15 miles of Cape Elizabeth, both by its highly arctic fauna and its icy temperature, even in midsummer. Moreover, there can be no doubt but that the constant admixture of this cold bottom-water with the warm surface-waters, by means of the strong tides and local wind currents causes the remarkably low temperatures observed in the shallow waters of these shores, and even in the small bays and harbours along the entire eastern and northern coast of New England." (1.) The influence of the Labrador Current is felt inshore as far south as Long Island Sound, in the vicinity of New York. In 1875 Prof. Verrill writes:—"Our investigations show conclusively that there is a very decided flow of cold currents through Fisher's Island Sound and Block Island Sound into Long Island Sound and along the deeper part of the latter for a great distance, especially towards the southern and deeper side. The influence of this cold current is very apparent as far west as New Haven, in the deeper parts of the Sound. This cold water is doubtless derived, directly or indirectly from the arctic current that flows southward along our Atlantic coast; but its flowing into Long Island Sound may be due largely to the influence of the tidal currents modified by the local wind currents." (2.)

The following temperatures were observed by Professor Verrill off the coasts of Nova Scotia, showing the great difference which exists between the warm surface waters and the cold substratum in which the bottom feeding fishes find their food, such as the Cod, Haddock, Halibut, &c. :—

Off Cape Sable (3.)	Lat. 43°.20
	Lon. 65°.21
Depth	45 fathoms.
Temperature of bottom	35°
" surface	56°
" air	58°
Le Have Bank	Lat. 42°.56
	Lon. 64°.51
Depth	45 fathoms.
Temperature of bottom	36°
" surface	61°
Bay of Fundy—East of Grand Manan.	
Depth	106 fathoms.
Temperature of bottom	37.5°

93. The area embraced within the hundred fathom line of soundings on the coasts of the United States, estimating from Cape Hatteras towards Cape Sable in Nova Scotia, does not exceed 45,000 square miles, which is about half the entire area of the Gulf of St. Lawrence.

The area of Nova Scotian waters within the hundred fathom line of soundings is about 48,000 square miles. Of the Great Bank of Newfoundland, including the waters within 100 fathom line, 60,000 square miles. The north-east coast of Newfoundland and the Labrador as far as Nain, 20,000 square miles. The Gulf of St. Lawrence, 60,000 square miles

These areas tabulated stand thus :—

	Sq. M.
Area of United States coastal waters within hundred fathom soundings	45,000
Area of Nova Scotian coastal waters within 100 fathom soundings	48,000

1. Page 438, vol. VI., 3rd Series—Am. Jour. of Science.
 2. A. E. Verrill—Results of Recent Dredging Expeditions off the Coast of New England.—American Journal of Science, 1875, p. 201.
 3. Prof. A. E. Verrill—American Journal of Science, Jan. 1873, p. 10.

Area of Grand Bank within the same limits.	60,000
Area of Gulf of St. Lawrence within the same limits.	60,000
Area of North-east Newfoundland and Labrador, as far as Nain, within 100 fathom soundings	20,000
Area of Bay of Fundy, part of the Estuary of the St. Lawrence, and other inland marine waters within 100 fathom soundings.	12,000
Total area of British American Sea Fisheries within the 100 fathom line of soundings.	245,000
United States waters.	45,000

94. Sir Wyville Thompson briefly describes the present condition of the great fishing grounds in Europe in pages 398 and 399 of the "Depths of the Sea," showing, when compared with the condition which prevail in the North American Fishing Grounds, the differences which exist in the marine climate of the two areas, and the probable reason why the fishing seasons are in a measure reversed.

The Norwegian "Winter Cod" caught on the Lofoten Banks retires during the summer to the edge of the "Polar Deeps," where cold water prevails. It is only in the Northern parts of Norway, towards and beyond Cape North, that the Cod is taken to a large extent in spring and summer. Here the Gulf Stream exerts a minimum effect.

"It is scarcely necessary to say that for every unit of water which enters the basin of the North Atlantic, and which is not evaporated, an equivalent must return. As cold water can gravitate into the deeper parts of the ocean from all directions, it is only under peculiar circumstances that any movement having the character of a current is induced; these circumstances occur, however, in the confined and contracted communication between the North Atlantic and the Arctic Sea. Between Cape Farewell (Greenland) and Cape North (Norway) there are only two channels of any considerable depth, the one very narrow along the east coast of Iceland, and the other along the east coast of Greenland. The shallow part of the sea is entirely occupied, at all events during summer, by the warm water of the Gulf stream, except at one point, where a rapid current of cold water, very restricted and very shallow, sweeps round the south of Spitzbergen and then dips under the Gulf stream water at the northern entrance of the German Ocean. This cold flow, at first a current, finally a mere indraught, affects greatly the temperature of the German Ocean, but it is entirely lost, for the slight current which is again produced by the great contraction at the Straits of Dover, has a summer temperature of $7^{\circ}5c.$, ($45^{\circ}1$ Fah.)

The path of the cold indraught from Spitzbergen may be readily traced on the map by the depressions in the surface isothermal lines, and, in dredging, by the abundance of gigantic amphipodous and isopodous crustaceans and other well known Arctic animal forms."

-- From its low initial velocity, the Arctic return current or indraught, must doubtless tend slightly in a northerly direction, and the higher specific gravity of the cold water may probably even more powerfully lead it into the deepest channels; or possibly the two causes may combine, and in the course of ages, the currents may hollow out deep south-westerly grooves. At all events; the main Arctic return currents are very visible on the chart taking this direction, indicated by marked deflections of the isothermal lines. The most marked is the Labrador current, which passes down inside the Gulf Stream along the coasts of Carolina and New Jersey, meeting it in the strange, abrupt "cold wall," dipping under it as it issues from the Gulf, coming

to the surface again on the other side, and a portion of it actually passing under the Gulf Stream, as a cold, counter-current, into the Gulf of Mexico."

The mean temperature of the surface of the sea in the month of July off the Hebrides, in lat. 58 N, in the path of the Gulf Stream; is 13° C. (55°·4 Fah), while in the same latitude, off the coast of Labrador, in the course of the Labrador current, it is 4°·5. C. (40°·1) a difference 15°·3 Fah." ^[1.]

MARINE LIFE ON THE GREAT BANKS.

95. Centuries of incessant attacks appear, it is said, to have made but slight impression upon the numbers of fish which form the staple of the Newfoundland Bank Cod Fishery.

If this be true, we may find the reason in the extraordinary fecundity of the cod, in the great extent of its feeding ground, and the suitability of the marine climate to its habits. Its mode of spawning and the manner in which the spawn is hatched are conducive to its preservation, notwithstanding the destruction to which the different schools of fish are subjected by the methods employed to take annually the largest possible quantity.

The sounding-lead shows that the bottom is commonly covered with shells, ^(2.) and small fish abound in the waters covering the banks, which are regarded as among the sources of the food of the cod.

The late Mr. Jukes, in his "Excursions in Newfoundland," notices the abundant life in the Newfoundland seas. He says "Myriads of individuals, referable to the genus *Medusa* *Beræ*, and others of the *Acalephæ*, swarm in the seas around Newfoundland, and spaces, many square miles in extent, are sometimes filled with them. Doubtless there are corresponding multitudes of those microscopic animalcules which form the food of those animals, and the phosphorescence of the sea-points to the same fact."

As might be expected, the marine life on the debateable ground, near the southern edge of the Grand Bank, is characterized by what was known some years since as a mixture of supposed sub-tropical and sub-arctic forms. Jukes says:—"Professor Stuwitz informed me that on the southern part of the Bank, and also to a certain extent on the southern coasts of Newfoundland, the shells and animals had a more tropical character than would be supposed from the latitude, and from the existence of other animals of an arctic character. He attributed this to the action of the Gulf stream, not so much from its raising the temperature of the surrounding water as from its current sweeping the animals further north than they would otherwise reach." ^[3.]

96. On the coasts of the United States, in the winter months, the proximity of the Gulf Stream to the Atlantic seaboard has the effect of elevating the temperature in the vicinity of the ocean, the amount being 0° in Florida, about 4° in North Carolina, and about 8° or 10° in Massachusetts; in the summer months the effect is reversed, as shown by the isothermals curving southwards; this is due to the cold current running southwards between the coast and the Gulf Stream, and the depression produced would be still greater but for the circumstance of the prevalence of westerly winds, which carry the heated air seawards. The depressing effect, however, in amount, is less than one half that given for the opposite season." ^(4.)

1. "The Depths of the Sea."

2. Sailing Directory for the Island of Newfoundland, by James F. Inray, F. R. G. S., 1873, p. 8; also, Sailing Directions for the East Coast of North America, published by Charles Wilson, 157 Leadenhall Street.

3. "Excursions in Newfoundland," vol. II., p. 191.

4. Smithsonian Contribution, vol. XXI.

The effect of the Gulf Stream is sometimes felt in a remarkable manner on the south shore of Newfoundland, probably arising from a continuance of south-easterly or southerly winds. Bonnycastle records that early in January, 1842, the water in the ocean was so warm that sailors enjoyed bathing in it. The thermometer on shore was frequently at zero about the time with chilling N. and S. W. winds. But the winter of 1842 was remarkable for its extraordinary gales in January.

97. Admiral Cloué states that the importance of the French Bank Fisheries is subject to considerable fluctuations, and that after one or two unsuccessful years the fleet diminish in numbers; but he also says, writing about the year 1868, that since the great losses on the East coast (Newfoundland) which led to the abandonment of about two thirds of the stations there, the bank fishery appears to have revived, but not in proportion to the decline of the fishery on the east coast of Newfoundland.¹¹¹

In 1861 the FRENCH BANK FLEET, including all those vessels which *dried their fish* at St. Pierre and Miquelon, as well as on the north-east coast of Newfoundland and in France, amounted to 122 vessels, carrying 3,853 men.¹¹¹ In 1862 the number of ships fell to 92, and of men to 2,518; in 1863 the number of vessels sank to 87, and of men to 2,436; but the winters of 1861-2 and 1862-3 were severe in the extreme in Newfoundland, and this unusual severity probably affected part of the supply of pelagic or wandering food which indirectly forms the source of the food of Cod; and secondly, the severity of winters may have compelled the fish to retire from their ordinary wintering grounds, to deeper and more distant areas on the slopes of the Banks, and the 100 fathoms line of soundings which surround Newfoundland.

In this case the movements would be similar to those which have been recognized for many years in the North Sea. The Silver Pits there, mentioned by Holdsworth, are a great winter resort for fish during extreme seasons, and no doubt there are many deep and sheltered homes,—sea valleys or deep sea zones,—to which fish retire during exceptionally inclement periods.

98. A comparison between the number of vessels employed by the French on the Great Banks and on the East Coast during a series of years, when compared with what is known of the character of the seasons during the same period, throws some unexpected light upon the meteorological condition to which the cod fisheries of Newfoundland are subject, and points to a cause affecting the movements of fish of the utmost importance. Unfortunately, there is at present available data only for the years 1860 to 1867, both inclusive, and the tabulated results during this period are as follows. About eighty sloops or small vessels, belonging to St. Pierre and Miquelon, which also resort to the Banks, are not included in the following enumeration.

1. Pilote de Terre Neuve.

1. Pilote de Terre Neuve.

Year.	Bank Fishing.		N. E. Coast Fishing.		Character of Water.
	No. of Ships.	No of Men.	No. of Ships.	No. of Men.	
1860	123	3,873	105	6,180	1858-59 very severe. ⁽¹⁾
1861	125	3,853	105	6,058	1861-62 " " "
1862	92	2,518	112	9,593	1862-63 " " "
1863	87	2,436	116	5,493	season cold, wet and dark. ⁽²⁾
1864	91	2,512	58	3,264	
1865	103	2,714	55	3,118	
1866	128	3,269	57	2,758	
1867	137	3,611	34	2,068	

From the foregoing table it will appear that during the severe period, extending from 1861 to 1863, the French Bank Fishery declined and the North East Coast Fishery increased rapidly. 1863 was a period of general depression, both on the Bank and on the North East Coast, but in 1864 the Bank Fishery improved and the shore fishery declined, and this continued to 1868, as far as the available records go.

THE RELATION OF THE LABRADOR CURRENT TO FISH LIFE.

99. In a paper entitled "Notes on the Northern Labrador Fishing Grounds," the writer has briefly referred to the unfailing supply of Arctic food brought down by ice and accumulated on the continuous range of Banks which extend from Cape Aillik to Cape Chudleigh.

It may be well to describe with some detail the character of the Arctic waters as food producers, for it is a popular impression that the cold of the Arctic Seas is prejudicial to life. In truth the Arctic waters and the great currents flowing from them, are in many places a living mass, a vast ocean of living slime, and the all-pervading life which exists there affords the true solution of the problem which has so often presented itself to those engaged in the Great Fisheries, where the food comes from which gives sustenance to the countless millions of fish which swarm on the Labrador, on the coast of Newfoundland, and in Dominion and United States waters, or wherever the Arctic current exerts an active influence.

100. Professor Nordenskiöld reminds us, in an account of "an Expedition to Greenland in 1870," that Hudson and other veteran mariners of the Arctic Seas mention the variety of colors characterizing the water in certain parts of the Polar Sea, which are frequently so sharply distinguished that a ship may sail with one side in blue water, and the other in greyish-green water.

It was at first supposed that those colors were indicative of different currents—the green of the Arctic and the blue of the Gulf Stream. Later, Scoresby affirmed that the phenomena arose from the presence of innumerable organisms in the water. Subsequently, Dr. Brown, during a voyage made by him as surgeon in a whaler, continued the observations, and more recently Professor Nordenskiöld himself.

The sea water in the neighborhood of Spitzbergen he de-

1 Severe winters, according to the Rev. Julian Morton:—1848-49, 1853-54, 1858-59, very severe; 1861-62, 1862-63, unprecedentedly severe.

2. According to the author of "Frost and Fire," the summers of 1863 and 1864 were remarkable in Great Britain and Canada for their unusual warmth: in Labrador and Newfoundland they were unusually cold, wet and dark. In July and August, 1864, many of the harbours were frozen, and heavy pack ice reached to the horizon opposite to Hamilton Inlet, on the 1st August, 1864.

scribes as marked by two sharply distinguished colors, greenish-grey and fine indigo-blue.

In the Greenland Sea there is water with a very decided tinge of brown. The grey-green water is generally met with *in the neighborhood of ice*; the blue where the water is free from ice; the brown, as far as Professor Nordenskiöld's observations go, chiefly in that part of Davis' Straits which is situated in front of "Fiskernaes" (Lat. 53°.1'; Long. 50°.1') on the Greenland coast, opposite the mouth of Hudson's Straits.

When specimens of the water are taken up in an uncolored glass, it appears perfectly clear and colorless, nor can the unassisted eye discover any organisms to account for the color. But if a fine insect-net be towed behind the ship, it will soon become covered with a film of green in the green water, and with a film of brown in the brown water. These films are of organic origin. It is a living slime, and where it abounds there are also to be found swarms of minute crustaceans which feed on the slime, and in their turn become the food of larger animals.

Dr. Brown shows that the presence of this slime spread over a hundred thousand square miles, is a condition necessary for the subsistence, not only of the swarms of birds that frequent the Northern Seas, but of the large marine animals even up to the giant whale.

During the recent voyage of the "Valorous" to Disco, Dr. J. Gwyn Jeffrey's, when between 200 and 300 miles east of Cape Farewell, caught with the towing-net some floating masses of pulpy, greenish matter, which was found to consist of a vast assemblage of Diatoms, each individual being about a tenth of an inch in length. This Diatom was subsequently found to have a very wide range, and to extend over some thousands of square miles. Professor George Dickie, F.L.S., who described this organism, states that "the countless multitudes of this Diatom, and of others of the same family, and the extent of the sea over which they extend, are points of much interest, contributing directly as they do to the support of various smaller marine animals, and these in turn to a larger form, adding also to deposits taking place at various depths." (1)

In Southern Seas the "slime of the ocean" is equally abundant. On the 4th February, 1873, in lat. 52.20 south, long. 71.36 east, Sir Wyville Thomson found this "slime" a little to the north of the Heard Islands. The tow-net, which was dragging a few fathoms below the surface, came up nearly filled with a pale, yellow gelatinous mass, which was found to consist entirely of Diatoms and of the same species as were found at the bottom. Sir Wyville Thomson expresses surprise that the diatoms on the surface did not appear to be in large numbers over what he has termed the diatom ooze, as in some other localities, where he found them near the surface and beyond or south of the diatom ooze belt; but he explains their apparent absence by stating that "this may perhaps be accounted for by our not having struck their *belt of depth* with the tow-net, or it is possible, &c."* The "belt of depth" at which these minute but infinitely numerous organisms live, appears to vary with changes in the pressure of the atmosphere and the temperature, as well as with changes in the currents. But the myriads of minute crustaceans which feed on the "slime" rise and fall with it. Now they may be at the surface, in an hour a fathom below, and in a day the zone of life may be five fathoms below the

1. Proc. of the Roy. Soc., June, 1876. P. 227.

* "NATURE," December 10th, 1874.

the surface, and with it the minute crustaceans and the hosts of other marine animals which prey on these. Hence it is that the "herring bait," the "mackerel bait," the "red," "yellow" and "black herring meat" of the Norwegian fishermen, are found at variable depths, following their food, and thus leading the herring and mackerel to different zones below the surface of the ocean, all of which may be comprised within a score of fathoms. These facts are the key to mysteries which have hitherto shrouded the movements of these fish.

But this "slime of the ocean" appears to live most abundantly in the coldest water and in the neighborhood of ice. How may it be brought on to the Labrador in such an unfailing stream as indirectly to afford an endless supply of food to the cod on the Labrador banks? The answer to this question leads at once to a brief description of the "ICE-DRIFT," whose "wanderings" according to Dr. R. Brown, are in a measure followed by the great "Right Whalebone Whale," (*Balena Mysticetus*), which feeds upon *Medusæ*, the *Pteropoda*, and numerous other small living forms nourished by the Diatoms coloring the Northern Seas in huge patches, thousands of square miles in area. These *Medusæ*, &c., are termed "whale's food," and where the Diatoms are most abundant there also are the other minute creatures feeding on them, and on these the huge Right Whale. Dr. Brown, before quoted says,⁽¹⁾ "The 'Whale's Food' is found all over the wandering ground of the *Mysticete*, and in all probability the animal goes north in the summer in pursuance of an instinct implanted in it to keep in the vicinity of the floating ice fields (now melted away in southern latitudes,) and again it goes west for the same purpose, and finally goes south at the approach of winter—but where, no man knows." * * * * * "I know nothing stranger than the curious tale I have unfolded: the Diatom staining the broad frozen sea, again supporting myriads of living beings which crowd there to feed on it, and these again supporting the huge whale."

These Diatoms, which swarm so abundantly in northern seas, sink and rise with atmospheric changes, and with them the *Medusæ* and other forms feeding on them. They accumulate under the winter ice to a thick film, which is turned up by the prow of the whalers in June, and they are the food of the shell fish which are found in the deeply sheltered nooks on the Labrador and Greenland coasts. Dr. Brown suggests also another office which the slime fulfils—it assists in melting the ice in winter. The infinite hosts of these microscopic forms generate a certain amount of vegetable heat under the ice and honey-comb its under surface.

The sinking and rising of fish at different seasons of the year, and during changes in the weather, and at different periods, in search of food, is a most fertile and important subject of enquiry. It appears to be characteristic of many fish, and notably of the Herring, and, at certain seasons, of the Cod and Mackerel among edible fishes. The terms, surface feeders, and ground feeders, are wholly inapplicable when applied to all seasons of the year. The Norwegian fisherman knows that the Cod has its zone or depth in the sea at different periods, and sets his nets or his baited hook accordingly. This is a subject about which we have much to learn in American waters.

1. "On the Nature of the Discoloration of the Arctic Seas," by Doctor Robert Brown, F.L.S. Transactions of the Botanical Society of Edin., 1867.

THE ICE DRIFT.

101. This has been stated to be one of grandest phenomena on the face of the globe. It is so vast, so uniform, and so unceasing, that, with the exception of the Gulf-stream, from its initiation to its close, nothing on earth can compare with it.

Coming from the Spitzbergen Seas, and hugging the coast of East Greenland, the Polar ice-laden current creeps south-westerly past Iceland, past Greenland, and the known East Coast, towards Cape Farewell. Its rate of progression is about four miles a day, the breadth of the ice-burdened stream about 200 miles. After Cape Farewell, the most southern part of Greenland, is reached, the grand procession of ice-bergs and ice-floes turns slowly to the west, then in a wide curve to the north-west and towards Davis' Straits. Augmented by additions from Western Greenland coming down Baffin's Bay, the mighty stream begins to turn to the westward in the life teeming seas off Fiskernes, and approaches Frobisher Bay and Hudson's Straits. Here it receives fresh accessions of bergs and floes, the united armies trending southerly, then south-easterly towards the Labrador, and on the banks off this coast countless thousands ground, bringing with them their "slime." Others drift on past the Newfoundland coast until they are lost in the Gulf stream, but paving the bottom of the ocean with the skeletons of the Diatoms they have brought from the north. Recent high authority confirms the view of this course of the northern ice stream advanced some years since by Hayes, Colding, and others. Admiral E. Irminger, of the Danish Navy, in a recent paper on "the Arctic Current around Greenland*" adopts the generally received conclusion that the current from the ocean around Spitzbergen which carries the icebergs and floes, after it has passed along the east coast of Greenland, turns westward and northward around Cape Farewell, *without detaching any branch to the south-westward directly towards the Banks of Newfoundland.* The current afterwards runs northward along the south-west coast of Greenland, until about latitude 64 degrees north, and at times even as far up as 67 degrees. Afterwards turning westward, it unites with the current coming from Baffin's and Hudson's Bays, running to the southward on the western side of Davis' Straits, along the coast of Labrador.

102. It is thus that the slime which accompanies the icebergs and ice floes of the Arctic, accumulates on the Banks of Northern Labrador, and renders the existence possible there of all those forms of marine life,—from the diatom to the minute crustacean,—from the minute crustacean to the prawn and crab, together with molluscous animals and starfish in vast profusion,—which contribute to the support of the great schools of cod which also find their homes there.

Speaking of the Faroe Island Banks, Dr. Carpenter states ¹¹ that these banks abound with a particular kind of starfish, on which the cod feed largely, as is known by an examination of the contents of their stomachs. The starfish in their turn feed upon the Globigerinæ which cover the North Atlantic sea bottom, as is known by an examination of the contents of *their* stomachs, and the Globigerinæ are said to support themselves on the organic matter present in oceanic waters.

*Vide—A collection of papers on the Arctic Geography and Ethnology, reprinted and presented to the Arctic Expedition of 1875, by the President, Council and Fellows of the Royal Geographical Society.

1. "Further Enquiries into Oceanic Circulation."—Proc. Roy. Geo. Soc., No. iv., 1874, p. 382.

DISTRIBUTION OF FISH OVA WITH THE ICE DRIFT.

103. It will not escape notice that the same ice drift which brings the "slime" and the myriads of minute crustaceans must also carry with it codfish spawn. The never-failing stream of bergs and floes sailing so grandly past the numerous cod banks on the Greenland coast, and crossing with semi-circular sweep to the American side of Davis Straits and then to the Labrador, can scarcely fail to *convey* innumerable cod ova, together with the original diatom source of the food of young fish, and of adults, after multitudinous transformations.

The discoveries of the late Professor Sars and of Professor G. O. Sars, of Christiania, Norway, have been known for several years, and they were brought under the notice of the English reading public in Gunther's *Zoological Record* for 1868. The embryo, as observed by Sars, was noticed to leave the egg on the 16th day. The average speed of the Arctic current on the coast of Labrador is stated to be a knot an hour over the inner range of Banks, this speed, if uninterrupted, would cause the floating codfish spawn to drift 334 geographical miles south-easterly during this period of its development. But it would also be subjected to the influence of local currents and winds, hence much of the ova would be driven in different directions, but the resulting direction would always be south-easterly on the Labrador for the great mass of the spawn, and to greater or less distances from the original spawning area according to the strength and direction of the prevailing currents and winds.

Cod ova appear to find the *coldest surface water* most suitable for their development, for the spawn is shed during the coldest months of the year in those waters where ice does not prevail to ensure the requisite degree of coldness. On the coast of Nova Scotia in October.* On the well-known George's Bank, off New England, in February and March.† In November and December in the Bay of Fundy.‡ In August and September in the Straits of Belle Isle. In May and June on the Southern Newfoundland coasts, &c. In Norwegian waters in winter. Probably, however, the season of each local school is determined to a greater or less extent by the coldest mean temperature of the surface water near its *habitat*—or home—as long as new ice does not interfere. Every drop of surface sea water as it cools descends, and in the fall of the year the surface water is the warmest, the coldest stratum being at the bottom. This, as is well known, is not the case with fresh water below a temperature of forty degrees.

104. According to the views here presented, some of the ova supplied by the cod schools, whose *habitat* is the Lorsche Bank, off Sukkertoppen, and banks lying south of those celebrated cod grounds on the coast of Greenland, float with the ice-laden stream toward Cumberland Sound and Frobisher Bay, and is hatched on its journey, the young fish fry finding a new home in mid ocean or on the western coast of Davis Straits. Some of the ova from the schools described by Davis on that coast, float with the ice stream in the track Davis followed towards the Labrador, and is hatched, it may be, near Cape Chudleigh. Some of the ova from the Cape Chudleigh schools—and these are numerous—float with the iceberg stream

* Rev. T. Ambrose—"Some observations on the Fishing Grounds and Fish of St. Marguret's Bay, N. S." *Trans. N. S. Inst. Nat. Sci.*, 1866.

† T. F. Whiteaves—*Canadian Naturalist*, Vol. VII.

‡ *Ibid.*

§ The spawning periods of Cod in British American waters, are described in Chap. II.

along the coast of Labrador and are hatched on the Southern Labrador. Southern Labrador fish supply ova which is carried by the same unfailing ice-encumbered stream partly into the Gulf and partly along the north-east coast of Newfoundland towards the Grand Banks, and so on, as far as icebergs travel, and cool the surface water sufficiently for the proper development of the ovum. It is needless to say that the presence of ice in the Labrador current is the cause of the low temperature. But the surface water during August will only have the temperature of ice in its immediate vicinity. Inside of the great line of Bergs, stranded on the banks of the northern Labrador and within or just beyond the Island fringe, is a broad zone for hundreds of miles where neither the temperature of the zone is reduced below what was found by the United States Eclipse Expedition in 1860, nor is its salinity and consequent specific gravity lessened appreciably by the melting of the bergs on the inner range of Banks.

105. It has been shown by Sars that Cod ova float in sea water, but sink in fresh water, and the surface film in the immediate vicinity of large masses of melting ice would doubtless possess less salinity and specific gravity than that of undiluted sea water. But on the Labrador there is a zone between the inner range of banks and the main shore from twenty-five to thirty miles in breadth, in which all the conditions may be said to prevail for the floating of the ova and its hatching during the short summer. ¹¹

The relations of the Labrador current to the distribution of ova, and cold water fish do not stop here. What is true of the Cod, is true also of all fish whose ova float and are hatched at the surface of the sea. Hence, all fish found on the coast of Greenland, such as the Cod and Halibut, or the Gadidæ and the Pleuronectidæ, will be subject to the same law, and their distribution will be from north-west to south-east, or rather, in the direction of the Arctic current

106. Submarine banks and sea bottoms some distance from the coast line affect marine life to a degree far beyond what one would be led to expect from a superficial examination of the subject. Illustrations have been given of the influence of banks and shoals in bringing cold water nearer to the surface and creating, by this means a suitable feeding ground for the cold water fishes. Practically, such Banks as Georges' Shoal, Jeffrey's Bank, &c., more or less celebrated cod and halibut grounds, are suitable areas, in point of marine climate, to these fish, where they find the food which suits them best and a temperature adapted to their nature and habits. The resistance these banks offer to the southerly flow of the Labrador under current, brings the cold water near to the surface. Under these combined influences many sub-arctic forms, which are the food of the cod, thrive there, even far south of the area where they are best developed, and these banks bear the same relation to the surrounding sea area, with regard to certain forms of marine life, as does the oasis in the desert to various species of land animals. But the area of these banks off the United States is very limited, and reduces the summer fishing grounds, as the temperature rises, to, practically, an insignificant field. The coastal waters may be rich beyond expression in the varied forms of marine life, but if these forms are not suited to the habits of the cod, or presented to this fish in a temperature favourable to its development, when decline in

1. See Notes on Northern Labrador Fishing Grounds.

numbers has once set in, its progress must be rapid and decided. The existence of the cod on the shores of New England, in great abundance formerly, when the country was unsettled, is easily understood, for the schools had the deep waters of St. George's Gulf to retire to during the summer months, and there are very probably numerous schools there yet, as well as in many parts of the Gulf of St. Lawrence, on the edge of the sixty fathom line of soundings, which have never been diminished by the hand of man, but if they are inaccessible they are practically of no value. Considering the manner in which cod spawn, it is not likely that the ova from schools in St. George's Gulf would drift towards the shore and assist in repopling deserted waters, they would be carried with the current and in the direction of the prevailing winds, which are westerly or off shore. As far as the cod and the herring are related to the deep sea fisheries,—and they are really their mainstay,—the cold water area subtending the coasts of the United States may fairly be considered as quite insufficient to support the continued drain to which it is subjected.

APPENDIX CHAPTER V.

I. "Let us now direct our attention to the polar currents, and especially to that one which from Spitzbergen proceeds to the south-west, along the coast of Greenland, as far as Cape Farewell. It will be perceived that this current has received an impulse from the force of rotation, and rises about one foot towards the east coast of Greenland, an effect which however ceases as soon as it has passed the southern point of that country. As soon as the resistance which compelled the current to follow the line of the coast in proceeding to the south-west disappears, it can no longer continue in the same course, but takes a westerly course towards Labrador, partly in consequence of the rotation of the earth, partly because the level of the current is then higher than that of the waters of Davis' Straits. After having advanced a little into the Strait the polar current encounters the currents coming from the north by Baffin's Bay, and joins them in their progress to the south-east along the coast of Labrador, towards which it slopes in virtue of the rotation of the earth. During this passage, and until its arrival in the neighbourhood of Newfoundland, this current is stemmed by the force of rotation, and ought, consequently, to present a slope all along Davis' Strait and the east coast of Newfoundland as far as the Gulf Stream. During its course southward along this course, the polar current is elevated towards the land by the earth's rotation, but as soon as it has passed Cape Race, this resistance suddenly disappears, and the same phenomena is reproduced as at Cape Farewell. The current bends suddenly to south-west, and follows the coast as far as Florida, while its breadth and the volume of the water continue to diminish" (1.)

1. Colding "On the Laws of Currents in ordinary conduits and in the sea."—NATURE, Dec. 1871.

CHAPTER VI.

BAIT AND BAIT FISHES.

Importance of Bait, 107; The French Bank Fleet, The Measurement of Fish, Green and Dry, 108; Bait for the French Fleet, 109; Importance of Bait to the American Fleet, 110; The Wintering of Herring in relation to Bait, 111; Supply to the American Fleet, 112; Uses of the Herring as an Article of Trade, 113; Effect on British American Fisheries, 114; Effect of an Abundant Supply of Bait on the Commercial Marine, 115; Construction of Ice Houses, 116; Living and Dead Bait, The Shell Fish of United States and British American Waters Compared, 117; Dead Bait in Europe, 118; In Iceland, 119; In Irish Waters, 120; In American Waters, 121; Bait on the Newfoundland Coasts, 122; The Whelk, 123; Taking of Spawning Cod with Bait in European Seas, 124; The HERRING as Bait, 125; The CAPLIN as Bait, 126; The Cucumber Odour of the Caplin, 127; Caplin Spawning, 128; Winter Homes of the Caplin, 129; Variations in the Appearance of Caplin and Squid on the Coasts, 130; Food of the Cod, 131; Importance of Crustaceans as a Source of Food, 132; Other Forms of Food, 133; Scantiness of the Cod in American Waters, 134; the George's Cod Shoals, 135; Dangers and Loss of Life on the George's Shoals, 136; The Object of Different Fisheries in the United States, 137; The Menhaden Industry, 138; The Interests Sub-served by the United States Fisheries, 139; The Manner in which Laws to Regulate the Fisheries are observed in Canada and the United States, 140.

107. Wherever deep sea line fishing forms a prominent industry, it is a saying among fishermen, that 'no bait means no fish,'—in other words, that without an abundant supply of suitable bait, it is hopeless to attempt to pursue sea fishing as an industry. It appears almost incredible to those whose attention has not been drawn to the subject, that the fishermen on the Atlantic coast of Nova Scotia should be compelled, during some seasons, to go to the Magdalen Islands, in the Gulf of St. Lawrence, to get bait, none being at the time attainable on their own shores; still more, that the people of the Magdalen Islands should themselves be put to great straits to procure the necessary bait, and have to search for clams on the shores of seas renowned for their abundance of fish of all kinds, each in its season.

For the same reason, namely, the want of suitable bait, the American fishermen are accustomed to make regular winter voyages to Newfoundland for Herring bait. Indeed, the great Cod fishery on the Georges' Banks is in a measure dependant upon Herring for bait procured either from Newfoundland or more recently, from Nova Scotia and the Bay of Fundy. A description of the trade carried on by the United States fishermen with Newfoundland in winter for Herring bait, wherewith to pursue their "Georges' Codfishery," is given in section 52, Chapter III. But the details there introduced faintly outline the intimate dependence which exists between the successful prosecution of the Codfishery by the fishermen of the United States, and the facility with which they can procure bait on the British American coast. The quantity of Bait required for Cod and Halibut fishing is enormous. The catch of the French on the Grand Banks during the last three years, compared with the supply of bait they obtained from Newfoundland, enables us to form some conception of the relation between bait and catch as regards quantity, but it does not tell us anything about the equally important feature in the industry which relates to the kind of bait supplied.

108. The French Bank Fleet assembling at St. Pierre, and Miquelon, in 1874 to 1876, both inclusive, made the following catches as stated in the Official Exportations of the Colony for those years. ⁽¹⁾ This does not comprehend their Newfoundland so-called "French Shore" catch:

Year—1874.	Kilogrammes.	Quintals.
Morue Seche (dry cod).....	5,767,614	115,352
Morue Verte (green cod)....	12,428,898	226,000
Cod Liver Oil.....	Tons.....	140
Cod Roes.....	Barrels.....	900

1875.	Kilogrammes.	Quintals.
Morue Seche (dry cod).....	4,331,161	86,623 ^(3.)
Morue Verte (green cod)....	10,305,184	187,304
Cod Liver Oil.....	Tons.....	101
Cod Roes.....	Barrels.....	1301

1876.	Kilogrammes.	Quintals.
Morue Seche (dry cod).....	2,562,607	51,252
Morue Verte (green).....	11,271,856	205,000
Cod Liver Oil.....	Tons.....	181
Cod Roes.....	Barrels.....	1371

The whole of the Morue Verte or Green Cod is sent direct to France, and made, or manufactured, or sold there. The Dried Cod goes chiefly to the Colonies.

In 1862 and 1864 the following tables represent the catch as determined by exports:

1862.		1864. (3.)
Dried Cod....	10,327,283 Kilog.	9,849,871 Kilog.
Green Cod....	1,004,380 Number.	4,694,063 Number.
Cod Liver Oil..	570,596 Kilog.	464,253 Kilog.
Cod Roes.....	25,502 do.	40,377 do.

: During the year 1864 there were exported from Newfoundland to St. Pierre not less than 70,000 barrels of Herrings, and 40,000 hogsheads of Caplin for BAIT. ⁽⁴⁾

The tables just given, which are those of official returns, are exceedingly delusive. The dried cod and the green cod are both given in kilogrammes and the kilogrammes are reduced to quintals, but with no reference to the fact that a quintal of green fish is a very different thing to a quintal of dried fish. It would be a fair estimate to state that at St. Pierre, considering the mode of curing fish adopted there, 250 lbs. of green fish are equal to 112 lbs. of dried fish.

Hence, when reduced to a uniform standard of dry fish, and accepting the rate of 2 cwt. and 28 lbs., or 252 lbs. French cured green fish, as equal to one quintal dried fish, the actual French catch on St. Pierre and Miquelon in 1874, '75 and '76 was as follows:—

Year.	Quintals Dried Cod.
1874.....	215,796
1875.....	169,867
1876.....	142,363

The difference in the mode of measuring green and dry fish in their relation one to the other, varies to a great extent in different localities. The following are a few illustrations of this variation, from which it will be seen that in general a quintal of dried fish means about 300 lbs. of green fish.

1. Official Documents—Saint Pierre.
 3. Fifty Kilogrammes is considered equivalent to one Quintal. One Kilo. is equal to 2,0416 lbs. avoirdupois.
 4. Newfoundland Journal of the Council, 1866. P. 145. Mr. Hayward's reports is an exhaustive and valuable document.

MEASUREMENTS OF FISH.

Great Jervis Harbour, (Newfoundland) south coast, ⁽¹⁾ one quintal dried fish, 112 lbs.

One from the knife, 322 lbs.

One quintal split and lying in salt, 280 lbs.

One barrel pickled fish of any kind, 200 lbs. to the quintal.

One barrel of herring fresh from the net is equal to 32 gallons of fish.

At Channel, (Newfoundland) in 1837, the rule for fresh fish was then that 308 lbs. of fresh fish from the knife make one quintal when dry. ⁽²⁾

Perley states the quintal to be 112 lbs. of dry fish. When first caught, 112 small fish and 30 large size are reckoned to the quintal, (Gulf of St. Lawrence, 1852.) 252 lbs. green fish in the Bay of Chaleur, salted and drained, are given to a curer to return 112 lbs of merchantable fish.

On the Nova Scotian coast the rule is as follows:—

275 lbs. large green fish make one quintal.

300 " of medium sized fish " "

325 " of small fish " "

HERRING BAIT FISHERY.

The Winter and Spring Herring Fishery on the south coast of Newfoundland has long been vigorously prosecuted for the purpose of supplying the French and United States Fishermen with bait, and from recent arrangements made to store the fish in ice it is rapidly increasing. That it is a suicidal industry as now pursued, there can be but little doubt but the circumstances under which it is prosecuted are peculiar, and furnish some mitigating offsets to its entire condemnation. These will be noticed elsewhere.

The following table given by Mr. Hayward (Journal of Council, 1866) shows the probable quantity of Herrings and Caplin exported from each District in 1864 for Bait for the French:

	Bar. Herring.	Hhds. Caplin.
District of St. Mary's	3,000	
Little Placentia	1,100	
Placentia	3,000	
La Mambe		
Burin		
St. Lawrence	290	1,030
Lamaline	4,000	12,000
Fortune, Grand Bank and neighboring places	62,110	36,970
English Harbor	10,000	
Pass Island	10,000	
Push Through	1,500	
Burgeo	1,000	
Rameau Islands	2,000	
	100,000	50,000
Probable quantity thrown overboard	30,000	10,000
Prob. quan. export. to St. Peter's	70,000	40,000

The great variations in price received, are drawbacks to trade, and lead to very prejudicial system. A franc, or twenty cents a barrel, when the supply is abundant; thirty francs, or five dollars a barrel, during portions of the season when the supply is scarce. Enormous waste results from such an irregular market, which the construction of ice houses will, in a measure lessen.

1. Fishery Report, 1871, (Newfoundland.)

2. App. Journal of Assembly, Newfoundland, 1857. page 367.

The valuation of the French catch on the Grand Banks for the year 1864 was as follows:—

Dried Cod.....	4,727,941 francs.
Green Cod.....	1,502,100 "
Total.....	6,230,041 "

The price paid for herring bait in 1864 varied, as already stated, from one franc to thirty francs a barrel. Putting the average at 10 francs a barrel, the value of the herring bait would be 700,000 francs. The value of 40,000 hogsheds of capelin, at 10 francs a hogshhead, would amount to 400,000 francs. This gives, for the total cost of bait, 1,100,000 francs. But the value of the catch was 6,230,041 francs, hence the cost of the bait amounted to about one-sixth of the value of the catch. This, however, is a low estimate, for during the same winter 46 United States vessels took 24,908 barrels frozen herrings from Fortune Bay, and the average price they obtained in the States was \$5 gold per barrel. In 1865 twenty-two vessels carried 12,000 barrels from Fortune Bay, and the average price these sold for was \$8 gold per barrel; some cargoes sold for \$12. [1.]

In 1855 there were employed in the so-called "French Bait Trade" the following numbers of vessels and men, between Cape Ray and Trepassy,—south shore. [2.]

Schooners carrying bait.....	40
Men.....	160
Boats carrying bait.....	684
Men.....	2,336

Quantity of bait supplied to the French by British subjects from Placentia and Fortune Bay. [3.]

Herring.....	57,130 barrels.
Capelin.....	60,000 hogshheads.
Squid.....	80,000

110. Elsewhere is shown (Chapter III. Page 59) the importance of the Newfoundland, New Brunswick and Nova Scotia winter Herring bait trade to the United States fishermen for the prosecution of their Cod fisheries on George's and Le Have Banks, and on the Nova Scotian coast. Their summer fishery on the Grand Bank is also almost exclusively dependant upon bait procured fresh in Newfoundland, or stored in ice for their use. But the real importance of these facilities for procuring bait only stand out in their true relief when compared with what would be the condition of affairs if the fishermen of the United States did not enjoy these great privileges.

It has been already stated that what is "bait" during one portion of the year is almost worthless during another portion, because it is "out of season." The Herring appear to be always in season more or less, except, perhaps, during the "schooling" of the capelin, that is during that brief period when that fish approaches the shore to spawn. But the capelin is not found south of Cape Breton, and in the more southerly waters the herring is always acceptable to the cod. To supply the place of the herring, a large bait industry exists in the United States, which has for its object the procuring of clams and menhaden for bait, the last named being chiefly used for mackerel fishery, the first named for cod and halibut.

When herring and mackerel cannot be procured for bait,

1. Report of James S. Hayward, Landing Surveyor, St. John's, of a visit on the Revenue Service to the western portion of Newfoundland, with various statistical and other information in relation to the trade and fisheries of these localities, St. John's, 1865.—Appendix Journal of the Council, 1866.

2. Report of John Canning, 1856.—Appendix Journal of Assembly, 1857.

3. Ibid.

clams (*Mya Arenaria*) are largely used, and so far back as 1840 not less than 40,000 bushels of clams were estimated to be consumed in that year in the preparation of salt bait. In 1862, Lieut. P. de Broca, in an article prepared for the French Government, ^(1.) stated that many thousands of barrels of clams are salted down annually in Massachusetts for the use of the fisheries on the banks of Newfoundland. Along the coasts of Nova Scotia the United States fishermen procure clams from the residents for bait, when herring or mackerel cannot be procured in the summer season. The annual reports of Captain Fortin contain occasional notices of the clams being eagerly sought for by American and native fishermen in the Gulf when other bait is not to be procured. Indeed, so urgent is the demand for bait, and so entirely dependent are the cod and halibut fisheries upon a sufficient supply, that the fisheries may be said to be altogether dependent upon its being available, either naturally, or stored near at hand in a fresh and suitable condition.

(1.) EXTRACTS FROM THE REPORT OF NAPOLEON LAVOIE, ESQ.

1869. *Point St. Pierre*.—Summer fishing excellent, but bait becoming scarce towards July, codfishing decreased. *Perce*.—Codfishing began about 26th of May, with a fair yield; towards the middle of July, however, bait failing considerably, fishing consequently fell off.

(1.) Report of the Government Schooner, "La Canadienne."

1870. *Gaspé and Bonaventure*.—Although capelin and squid failed during the fishing season, herring and mackerel, in the shape of bait, were plentiful enough to ensure the fishermen a season's return larger than any during the past ten years.

1873. *Labrador Division*.—At Natashquan, Sand Point, Saint John's River, Magpie, Thunder River, and Shelldrake, the fishing was not, however, so good. Still, it cannot be said the cod was less abundant, but bait failed.

1874. *Gaspé*.—Bait, which had been abundant at Perce until August, unfortunately failed all at once, and, with the want of bait, fish disappeared. Bait, which is of primary importance in this fishing, and the greater or smaller abundance of which determines its success, comprises mostly all the fish smaller than cod. Early in the spring herring are used, and during the month of June, capelin; later in the season, fall herring and squid are the best baits. Smelts are also sometimes employed; and when these fail, recourse is had to clams.

Labrador.—Bait and cod failed on the western part of this division, but both were abundant on the coast of Labrador, so much so that it is presumed cod had too much to feed upon, and that this was the reason why the fish did not bite.

1875. On the coasts of Newfoundland and Labrador, as well as on those of Anticosti, where the ice remained until the month of June, bait kept in deep water in consequence of its being warmer than at the surface, and appeared only in August, along with the cod, when the water grew warmer.

Anticosti Island.—Cod-fishing this season was poor. Fish abundant enough on the banks around the Island, but bait was scarce, owing to constant bad weather.

In 1867 "there were no cod on the North Shore or on the coast of Labrador, (Gulf) owing to the scarcity of bait. During that season a sort of disease prevailed which destroyed bait in such quantities that vessels and steamers would meet with banks of them in a dead state." ^(2.) The bait here alluded to is the capelin and lance.

111. It has only within the last ten years been ascertained that the Herring lie under the land during the winter, probably from Cape Sable all the way to the extremity of Cape Breton. They can be obtained in waters of certain depth along much of the coast if looked for. Already, at many points, advantage is taken of this habit of the Herring, and bait is procured for the spring fishery.

On the coast of Maine and up the Bay of Fundy, as far as Point Lepreau, Herring fishery is carried on during the winter months by means of gill nets. The nets are sunk to the bottom

1. This article has been translated and reprinted in the last Report of the U. S. Commissioner of Fish and Fisheries, for 1874-75.

2. Report of N. Lavoie, Esq., Dominion Fishery officer, 1875. "Schools of dead caplin or lance were met with by vessels sailing on the coast."

in water varying from fifteen to thirty fathoms. It is stated that some schools remain in shallow water on the coast of Maine throughout the summer, but it is remarkable that if this be the case to any considerable extent, that the Cod are not found there in such abundance as to give rise to a productive fishery: Indeed, when it is known that the Herring actually winters under the land from Eastport in Maine to the east coast of Newfoundland, in comparatively shallow water, it appears curious that the Cod should not more generally be found on the outskirts of the schools. Temperature, leading other forms of life, and among them young Herrings, into deeper water, which form, as already stated elsewhere (page 49) part of the winter food of Cod, is probably the true explanation of this separation. The spawning season develops an odour, which is doubtless the attraction to the Cod, and serves as a scent, carried far and wide by currents, which indicates the whereabouts of the Herring schools. As far as the writer has observed, the movements of the Cod at certain seasons, are generally against the current, especially during the caplin season in Newfoundland. The current carries the odour of the bait, and the Cod follows up the scent just as land animals hunt their prey in a similar manner.

112. The fishermen of the United States procure an immense quantity of bait for summer fishing on the coasts of Nova Scotia, all the way from Cape Sable to Louisburg and Ingonish. Among other noted bait grounds where Herring, Mackerel and sometimes clams are procured, may be mentioned Margaret's Bay, Prospect, Catch Harbour, Portuguese Cove, Dover, Shad Bay, Beaver Harbour, Marie Joseph, Jeddore, Country Harbour, Arichat, Straits of Canso, on to L'Ardoise and Louisburg, Ingonish and Cape George.

The Straits of Canso are, however, not only a great bait station, but also a most important depot for the transshipment of fish; so that it is very difficult to arrive at any conclusions as to the number of fares taken by fishing crafts off that part of Nova Scotia or Cape Breton Island. The same vessel may tranship her cargo several times during the season, the steamers taking them on to United States Ports, or they may be forwarded by regular sailing vessels; indeed, a systematic transshipping business has been carried on for some years, partaking of the character of a regular forwarding business. Similarly, at several of the stations above named, the bait business is pursued in a thoroughly organized business way. From all the details at command it appears probable that the ratio of bait to catch is about one to seven, that is, to say, the value of the bait consumed on an average is about one-seventh part of the catch with respect to Cod and Halibut. In Europe, the purchase of Cod roes for bait in the Sardine net fishery reduces the profits of the owners of large fishing establishments one-half. The Norwegian barrels containing Cod roes contain about 180 lbs. of roe, and the annual export amounts to 9,000,000 lbs., valued at 3,000,000 francs.

113. If the Herring are so abundant on the Coasts of Maine throughout the year as has recently been alleged, why it may be asked, do not the United States fishermen procure Herring bait from their own shores. The answer appears to be that it pays better to dispose of the Herring thus caught as food, or in some other way, rather than use them as bait for the capture of another kind of food. The herring caught on the coast of the United States are too valuable to be used as bait in consequence of the ready market which exists for

the fresh or frozen fish in the inland or southern cities, or from the oil and guano produced from this fish. (1.)

But the Newfoundland herring, cheaply obtained, have sustained the George's Winter Cod Fishery, and this will receive a new impetus from the now known facility with which herring can be procured in Nova Scotia. The dependence of the George's Winter Fishery on herring is thus described in the "Fisheries of Gloucester," 1876.

"Besides the fishery for halibut, George's Bank has also contributed in another way and to a much greater extent, to the recent prosperity of Gloucester. The great abundance in which Cod is sometimes found recalls to mind the "pestering" of Gosnold's ship with them off Cape Cod, and the "strange fish-pond," where Capt. Smith found them so plenty, near Monhegan. This abundance, and the introduction of fresh herring from Newfoundland to be used for bait, induced our fishermen to engage actively in a winter fishery on that Bank. The success of the trip depends mainly upon wind and weather. Sometimes the whole fleet return to port with the loss of cables and anchors and with other damage and without fish to compensate. Often better luck attends them, and occasionally a few favorable trips in succession yield a generous but still hardly adequate reward for the risk, labor and suffering of the employment."—"The Fisheries of Gloucester," 1876.

It is thus that the herring fishery becomes a powerful in-

I. HERRING SCRAP—ITS MANUFACTURE AND USE.

"Along the bays and coves of the extreme eastern coast of Maine, in Jonesport, Cutler, Machiasport, Perry, Pembroke, and other towns, are numerous small works for the manufacture of oil from the herring. The scrap or refuse from these works is used as a fertilizer, but from the small amount to be obtained at any one point, it is not shipped to any extent. At Treat's Island, Eastport Harbour, Messrs. Treat, Staples & Co. are, however, quite largely engaged in the herring fishery, and in the manufacture of a fish guano from the refuse of their oil works, and from the small herring which are not utilized in any more profitable manner. These gentlemen have been engaged in this business for twenty-five or thirty years, and in that time have learned to take advantage of all fluctuations and make the most of its ups and downs. When oil is dull, the herring are smoked and prepared for the market as food; and when their abundance breaks down the market, oil generally "goes up;" and in order to get the advantage resulting from both these extremes, the business is changed to suit the times, or both branches are followed to some extent at the same time. The scrap, which is produced at the different oil works about Eastport and Lubec, is purchased chiefly by fertilizer companies out of the State, considerable quantities being bought by the Pacific Guano Company, Wood's Hole, Mass., and the Bradley Fertilizer Company. That which is taken in bulk as it comes from the press usually brings \$12 per ton, and when dried more, and if packed in barrels, brings a still higher price. Messrs. Treat, Staples & Co. manufacture a fish guano which has been sent abroad some, and also used by our inland farmers to some extent, that has given good satisfaction. The scrap is thoroughly dried on elevated racks until nearly all the water is expelled. It is not allowed to remain out nights while being dried, nor is it exposed to fogs or dews; so that it contains not more than 20 per cent. of water, and will show 12 per cent of ammonia on analysis. This is ground and packed in barrels, and finds a ready sale. Mr. Treat, the senior member of the firm, says that when first putting their fish guano upon the market he sent samples to parties at Wood's Hole, Mass., to Philadelphia and other places for trial. From the former place no returns as to its value were ever received; but instead he received word: "We don't want a manufactured article here, but will purchase all the fish scrap you have for sale." At Philadelphia and in Connecticut the article gave excellent satisfaction, and large orders were forwarded for it. Among our own farmers it has been growing in favor wherever used. Barrelled, this fish guano sells for \$33 per ton. Messrs. Treat & Co. are also engaged in the manufacture of a manure from rock weed, which has given good satisfaction as a fertilizer for potatoes. The rock weed is first reduced by steam, then ground, and dried by the addition of 10 per cent. of quicklime. With some of it a portion of fish scrap is also added. From the fact that the herring are salted before the oil is expressed, the scrap will keep longer without deterioration, than will that of the menhaden, in which no salt has been used. It is, in consequence, better adapted for transportation in bulk or in barrels, being inoffensive."—(Twelfth annual Report of the Secretary of the Marine Board of Agriculture, 1875.)

strument in assisting the manufacturing industries as well as the agriculture of the United States, and with the well known remarkable development which has taken place in the menhaden industry, it is but reasonable to suppose that now the herring are supposed to be in such vast abundance on the Nova Scotian shores during the winter season, and the occupation of the strand assures the means for taking these fish, no efforts will be spared by the enterprising citizens of the United States to utilize to the utmost the means placed at their disposal by the fishery clauses of the Washington treaty.

It is stated that since the recent decline in the Herring fishery in Norway, United States vessels are engaged in taking Herrings direct from the Magdalen Islands, Canso, Halifax, &c., to Swedish Ports, where they find a ready and lucrative market. This might appear to be an industry open to British Americans to a greater degree than to those who have to come many hundreds of miles to get their cargoes. But whether owing to causes into which it is not necessary to enquire, advantage is taken of the opportunity, or the reverse, one result is evident, namely, that the price of Herring bait, taken on their own shores, to the Nova Scotia fishermen, is liable to become suddenly increased, and may affect their deep sea line fisheries to a considerable extent. It will also affect the deep sea line fishery of the Americans on Georges, Le Have and the Grand Banks, in like proportion, for they must have Herring bait to pursue these fisheries with success. The fish caught in those waters fetch a better price than the smaller fish caught inshore of the Banks, and while a small sized class of fish would cost more than they were worth to catch with herring bait at a certain price, the large Bank fish, from the higher price they command, can bear the extra cost. The pursuit of the fishery on the Banks requires a class of vessels which the Americans possess in abundance, but which are comparatively rare among the Nova Scotians, who most approach, if in some cases they do not equal, their enterprising rivals.

The Americans could not engage in this trade directly unless they enjoyed free access to our coastal waters. It is impossible to foresee the extent to which this new commerce may be developed, for, although, in the opinion of Sars, the Norwegian Herring, which has ceased to be caught on its usual grounds, is probably only lying a little further removed from the coast, yet that very removal may put it beyond reach for ordinary commercial purposes.

114. It is an important result of a scientific enquiry to ascertain the extent of the movements of a class of animals which have suddenly disappeared from accustomed haunts and thrown into hopeless confusion an enormous industry upon which hundreds of thousands are dependant for their daily bread, but what immediate relieve does it afford, if the discovery establishes the fact that the small downward movement to deeper water, or outward movement to equally inaccessible wintering or spawning grounds, has just placed them beyond reach with the ordinary means possessed by fishermen for securing their accustomed fares?

If the wintering of the Herring under the land, in water of a certain depth all the way from the Bay of Fundy to the north-east coast of Newfoundland, gives rise to a great trade between these coasts and Europe, in what way will the British American fishermen benefit by it?

Suppose that he gets an equal share of the catch and of the carrying trade, what becomes of his Cod-fishing industry? We have only to turn to the results of experience to find a

suitable and, no doubt, a correct answer to the question. It would be the decline of the New England Cod Fisheries repeated on Nova Scotian shores, with all its ruinous effects. The deep bays and indents which form so characteristic a feature of the Nova Scotia coast, and which have been, and still are, the productive nurseries of fish, would become like the upper Herring ground of the celebrated Bay of Chaleurs, which drew its original Indian name, "The Sea of Fish," from its apparently inexhaustible supplies of all kinds of fish life. Let the present poverty of the head of the Bay of Chaleurs be contrasted with its former teeming wealth and the relation of the Cod fisheries to Herring spawning grounds becomes strikingly illustrated.

"There has been great complaint of late years in the upper part of the Bay of Chaleur, of the falling off in the cod fishery, which is said to be every year decreasing. At Carleton, Maine, New Richmond, and other places on the Gaspé shore, the fishing establishments are deserted and going to ruin. At these places there was formerly an abundant supply of fish; but the inhabitants now barely catch enough for their own winter store.

This decrease is also felt on the New Brunswick shore. The settlement of Petit Rocher sends out about 500 boats only, which average a catch of 50 quintals each, during the season. The Pockshaw coast sends out a few boats but they only fish occasionally. The Caraquet and Shippagan boats further down the Bay take more than 100 quintals each during the season, which are of better quality than those taken off Petit Rocher. The decline of the cod fishery in the upper part of the Bay is attributed to the wanton destruction of the proper and natural food of the cod,—herring and capelin—which are taken in immense quantities, not for immediate eating or for curing, or for bait—but for MANURING THE LAND!" (1.)

Another illustration is afforded by the Herring Grounds about the Island of Grand Manan, which have been noticed by the U. S. Commissioner of Fish and Fisheries, as illustrating the relation between the Cod fisheries and Herring spawning grounds.

115. The vessels in which the fishermen of the United States pursue the deep sea fishery off the coast of Nova Scotia and the Grand Banks, differ in many particulars from the Bank craft owned in general by Nova Scotians and Newfoundlanders. Their vessels are large and well found in every particular, and from 70 to 120 tons burden. They are capacious enough to permit them to remain for several months at sea. They form an important item in the commercial marine of the country and their maintenance and increase tend to foster all those industries which are connected with ship-building and the employment dependant upon this influential branch of enterprise and commerce. The stir and bustle of many of their seaport towns owe the stimulus they receive from that lucrative industry. Yet much of it depends upon the supply of bait the fishermen are enabled to produce on British American shores. If by any unforeseen event this supply were suddenly to become inaccessible, and with it the means for taking the Cod the Halibut and the Hake which forms the object of pursuit, a check of a serious character would be given to their mercantile marine. Fishing on the Northern Banks and in Northern waters is assured to the Fishermen of the United States by the ample supply of bait generally provided, which enables them to follow a similar winter employment in their own southern waters. But a curtailment of the one would disastrously effect the other in a com-

1. Pebley - Report on the Sea and River Fisheries of New Brunswick, 1852

mercial sense, for in the full years employment of their well appointed vessels lies the great profits of the deep sea fishing industry as now pursued by them.

The Deep Sea fishing States of the Union are Massachusetts, Maine and Connecticut, whose capital and marine are largely directed to the Cod and Mackerel. Although the returns indicating the number of ships and tonnage engaged in the fisheries are—to use the language of the U. S. Census Commissioner—“distressingly inadequate to the known facts of the case.” Yet, incomplete as they are, they supply important information respecting this industry. A total of 80,000 tons of shipping employed in the pursuit of the Cod and the Mackerel alone, is an exhibit of the value of the industry. It is very considerably more than the total tonnage employed by the Newfoundlanders in the prosecution of their enormous fisheries, and it represents nearly double the amount of tonnage employed in the entire fishing industry of the Dominion of Canada. Yet it may be truly said that the existence of a large portion of this great fleet of vessels is dependant upon facilities for procuring cheap bait on the shores of the British American Provinces. It is only the combined industries involved in different kinds of deep sea fishing in American waters which enables the business now to be prosecuted with success. The George’s Bank Cod fishing succeeds the northern Herring fishing, Mackereling succeeds the Bank Cod fishing, warm water fishing far to the South succeeds the Mackerel industry; and it is only this continued chain of different varieties of the same industry which enables the whole to be firmly knit together and result in a profitable year. But enfeeble or destroy one of the links in this chain, and the stability of the entire marine whose details are given below, becomes at once endangered. But it is the Herring bait on British American shores which is the most important link in this chain; let this be weakened by any chance, and the result is inevitable. The use of the Strand, however, assures its maintenance for some years to come, and the position to which it has a powerful tendency to reduce the Nova Scotian and Newfoundland fishermen, is to that of mere bait catches to support a foreign fleet. But it has been already shown (Sec. v; xx; xxi) that the indiscriminate taking of bait is the certain precursor of the decline and ultimate ruin of the deep sea fishery; and this is a contingency to which we must look if the most stringent efforts are not made to protect the Herring from undue spoilation.

Statement showing the Number and Tonnage of Vessels employed in the Cod and Mackerel Fisheries, on June 30, 1875.

States.	Vessels above 20 tons.		Vessels under 20 tons.		TOTAL.	
	No.	Tons.	No.	Tons.	No.	Tons.
Maine	324	14,934.45	356	5,431.70	680	20,366.15
New Hampshire	12	836.50	12	125.53	24	962.15
Massachusetts	830	48,848.57	238	2,515.31	1068	51,363.88
Rhode Island	15	698.73	89	836.74	104	1,535.47
Connecticut	70	2,524.25	103	1,232.71	173	3,756.96
New York . . . . .	.....	.....	116	1,159.21	116	1,159.21
Pennsylvania . . . . .	.....	.....	3	24.12	3	24.12
California	8	860.66	12	148.20	20	1,008.86
Total	1259	68,703.16	929	11,503.52	2188	80,206.68

United States Tonnage.....;	80,206.68
Dominion Tonnage.....	44,881.00
Newfoundland Tonnage ^(1.)	61,551.00

The following table shows to what an important amount the tonnage engaged in the Deep Sea Cod and Mackerel fisheries may swell in a great maritime country, and how rapidly it may decline with the decline of its fisheries.

Table showing the amount of United States tonnage engaged during each fifth year since 1855 in the Cod and Mackerel fisheries.

Year.	Tonnage.
1855.....	124,552.56
1860.....	162,764.20
1865.....	100,437.00
1870.....	91,459.99
1877.....	80,206 68

To restore the tonnage of 1875 to the condition it occupied but fifteen years previously, would be to restore vitality and elasticity to the shipbuilding interest throughout the New England States. One potent aid in effecting this desirable resuscitation is the Herring, which has been ascertained to lie under the land during the winter months off the shores of Nova Scotia, either for bait in the Cod and Halibut fisheries or for direct shipment to Sweden.

CONSTRUCTION OF ICE HOUSES.

116. The first effect of the concession to use the strand and take bait, was the construction of ice houses in Newfoundland to preserve the means by which the fish are taken, and the fish themselves when caught. The instruments naturally employed are the resident fishermen on the coast who have thus become, in many instances, mere purveyors to their more fortunate partners.

It must be borne in mind, too, that the recent construction of ice houses for the supply of the American fishing fleet, not merely for the purpose of preserving their fish on board, but for the storage of bait on shore, is leading to a systematic bait industry, which must tend to diminish the supply with great rapidity, and will convert many of the British American fishermen into mere bait catchers.

Commander T. A. S. Luttrell, of H. M. gun vessel "Woodlark," under date 23rd August, 1873, reports as follows:

"At Trepassay, St. Mary's and Burin, fishing had been very good up the date of my arrival, the caplin having made their appearance two days before; the averages at the latter place have exceeded the last few years by from 30 to 40 per cent., but this was accounted for in a great measure by the erection of an ice house in the place by Mr. George Frecker, an American merchant at St. Pierre, which enables the fishermen to take ice to sea to preserve their bait in, and remain out a week instead of having to return for a fresh supply as has hitherto been the case."

Since 1873, ice houses for preserving bait have multiplied greatly at the instance of United States fishermen, who have, as it were, created the trade. What the effect of all this will be can be best seen after a brief examination into the character of the food of the Cod, and of the different kinds of bait used in different seas to effect the capture of the largest quantity of this fish. It will then be seen that among all the means hitherto adopted, none can compare in importance with

1. This statement includes the sealing vessels, which are not engaged in the fisheries proper. A very considerable deduction must be made from the numbers of tons stated in the text.

the artifice which the freedom of the strand secures in taking and preserving in ice the two forms of bait most advantageous in the Cod fishery.

According to the statement given below the number of trips made in a season depends upon the manner of marketing the fish, whether fresh or cured, but in either case the amount of bait required will be about the same. The estimated cost of the bait, ice, salt, &c., is about one-eighth of the whole cost of the vessel.

"The Grand and Western Bank Fishery is pursued to a greater or less extent during every month of the year. Last year this business employed 175 vessels, and 499 fares were landed. The business may be classed in two departments, a portion of the first making short trips and bringing in their fares fresh, to supply the fresh fish trade, and the rest of the fleet making longer trips and dressing and curing their fish as they are caught. This business employs the best class of fishing vessels known to the waters of the coast. A modern "banker," of average tonnage, costs about \$8,800. Such a vessel, manned with a crew of twelve men and making nine trips to the Banks, being at sea 302 days, will require an expense of \$1023 for trawl gear, \$1824 for vessel's expense, \$1426 for provisioning, and \$1135 for general charges, such as ice, bait, salt, etc." (1.)

The storage of bait in ice will greatly improve the Bank fishery, in the hands of United States fishermen, and the fact that small fish, under 22 inches, are sold to the Newfoundlanders, is another great advantage in the modern modes of prosecuting this fishery, adopted by the Americans.

While the coastal waters of the United States are in a great measure unfitted, from their temperature, for the maintenance of the cold water fishes in commercial abundance, they are wholly unparalleled, from their geographical outline, orographical features and marine climate, from the southern portion of Maine towards Chesapeake Bay, for the natural growth and artificial cultivation of different species of shell fish. It is elsewhere stated that enormous quantities of one species of shell fish is used as a bait for cod; other species are used as food.

The oyster industry in the United States is stated far to exceed in value the combined industries of all the deep sea fisheries, and its great mainstay and support are the natural waters of Chesapeake Bay. The shell fish in the cold British American waters are comparatively utterly insignificant as a commercial product, and the restrictions in the Treaty of Washington, limiting the taking of the shell fish to the citizens of the nationality when they are found, is entirely one sided in its effect, and of no value whatever to British American fishermen, but of immense value to the fishing interest, manufactures and commercial marine of the United States. It is true that the two industries can not go on with continued commercial success in the same waters, for the marine climate, orographic features and coast line favorable for the one are unsuited to the other, but it is just this which makes the restrictions or freedom of action with regard to shell fish the more remarkable. It is of no use conceding to the British American the entire and exclusive right to the oysters on his own coasts, for there are practically none, in a commercial sense, to concede. The coasts of the United States are the natural home of the oyster, and in their unrivalled productiveness and value there, they are exclusively reserved by the Treaty of Washington for the sole use and advantage of the

1. "The fisheries of Gloucester,"—Procter Brothers.

United States fishermen and citizens. This is one of the stipulations by which one side of the fishery clauses of the Treaty is so overweighted, and like the limitation in the pursuit of the anadromous species south of the 39th parallel, it derives its force from the conditions resulting from marine climate.

M. DeBroca, in a communication to the French Government has drawn special attention to the enormous development and importance of the Shell fish trade, in its relation to food, manufacturers and the commercial marine.

"It was estimated, in 1857, that the pecuniary profits derived from the shells from the various oyster establishments in Baltimore alone amounted to more than \$120,000. Before the war, the limepits of Mr. Burns, at Fair Haven, burned annually more than 250,000 bushels. At the present time there are upon the coasts of the United States a great many mills employed in this branch of industry. A bushel of oyster shell lime sells at from 12 to 13 cents."

"The effect produced upon navigation by the culture of oysters is very important. According to the information furnished me, the plantations of the bay of New York and of that vicinity employ one hundred vessels, and those of Boston and Cape Cod from thirty-five to forty. Before the war, from one hundred and fifty to two hundred schooners were employed during six months in the year, either in transporting oysters for plantations or in supplying the merchants of Fair Haven during the winter."

Again:

"The oyster of the Chesapeake, in consequence of the favorable conditions in which it lives is in its natural condition so large that, for the most part, it does not need culture, but can enter the market immediately. At Fair Haven, and at Boston, where, on account of the thickness of ice, it is impossible to secure a supply in winter they are, during that season, brought from Virginia in sufficient quantity to supply the needs of commerce. The schooners which transport them manage their voyages in such a manner that the merchants are regularly supplied; and the mollusks ordinarily remain in the hold of the vessels until the cargo is sold. However cold it may be they will live for several days, provided the hatchway is not opened until the hour of removal. They have been known to live in this way for a month.

"With a few exceptions, we may say that a large part of the cultivated oysters in the Northern States come from the Chesapeake and the mouth of the Delaware, where the planters can procure them at so low a price as to make it unnecessary to take part in the local fisheries."

In reference to the Chesapeake Bay, from which British American fishermen are now excluded, he says: "Chesapeake Bay, from which is gathered a large proportion of the oysters cultivated in America, is a magnificent basin in which Providence seems to have accumulated every necessary condition for forming an admirable locality for the fishery. Its entrance, between Capes Charles and Henry, opens from the east to the west; but the bay soon changes in direction, and extends toward the north for a distance of one hundred and fifty miles, with a width of from twenty to thirty miles in the southern part, and from ten to fifteen in the northern. It is accessible to the largest vessels. A number of rivers empty into it, of which the most important are the Potomac, the Rappahannock, the York, and the James. The amount of fresh water which flows into this bay daily from these streams, the smallest of which admits

the rising of the tide, renders the waters of the Chesapeake less salt than that of the ocean, a circumstance which we have already mentioned is favourable to the natural production of the oyster. The shores of the bay are indented by a multitude of gulfs, creeks, small bays, &c., in which are numerous islands. The extent of shore is thus greatly increased and innumerable places of shelter afforded for the multiplication of fish and mollusks."

The quantity of fish furnished by these fisheries is very great; and before the war the annual estimate at Baltimore was four hundred thousand barrels of salt fish, principally herring and shad." *

For an enumeration of the enormous quantity of fish taken in the estuaries of the rivers flowing into Chesapeake Bay, and for a description of the gigantic "steam seines" used in their capture, the vast waste of fish, the inefficiency of existing regulations to control the fisheries, and their gradual decline, reference can be had to the "Report of the Triana Trip," published in the Report of the United States Commissioner of Fish and Fisheries for 1874-75.

118. LIVING AND DEAD BAIT.—EUROPE.

LIVING BAIT.

Bait may be divided into two classes, living and dead. Among the most important baits used living are, 1st. Sand Eels; 2nd. Small fish, caught by small sized hooks, which, by their movements and struggles, become living bait for larger fish.

The living sand-eel, as a bait, has been used at Guernsey from time immemorial. It is found to be a most killing bait for every kind of line fish. (1.)

The use of living bait does not appear to be practised in British American waters. In Europe it is not unusual, in some districts, to see small sized hooks provided with bait to catch small fish, which, by their struggles when caught form a strong attraction to the larger cod roaming about in the neighbourhood. The artifice is a cruel one and not to be commended.

DEAD BAIT.

Dead bait for Cod includes many kinds of fish, and shell-fish. In the order of repute for Cod fishing they may stand as given below in European estimation.

1. Herrings.
2. Whelk.
3. Mussels.
4. Limpets used by the Dutch. (2.)

Then follow in order, according to the facilities for procuring them:

Squid, Sand Eels, Conger Eels, Sprats, Crabs, Mackerel Finches, Halibut, Gurnards, Plaice, Small Haddockes, Small Flounders, Limpets, Lugworm, Pieces of Dogfish, and Sea Anemones.

The Lugworm (Lob-worm) of the fishermen is probably the Annelid, *Arenicola*.

The Herring is the principal bait and the most esteemed.

At Cullercoats 16,000 bushels of mussels are used per annum for the Cod Fishery; and at Eyeworth between 1800

* Chesapeake Bay abounds in fish of all kinds—mackerel, herring, perch, eels, red mullet, catfish, shad of every variety, &c. In the Potomac, James and other rivers, enormous sturgeon are taken, weighing from 150 to 200 pounds.

1. Deep Sea Fishing.
2. Sea Fishery Commission, 1865.

Long-Clam, Sand Clam—(*Mya arenaria*), largely used by American fishermen in the Cod Fishery on the Banks of Newfoundland. Largely also on the Atlantic Coasts of Nova Scotia, where it is styled "Clam-Bait," and is extensively collected for that purpose. ^(1.) It occurs, according to Packard, in abundance on the southern Labrador.

The Mussel.

Both species (*Mytilus edulis*, and *Modiola modiolus*) are abundant on the Nova Scotia Coasts. But they appear to be rarely used as bait.

NEWFOUNDLAND.

Herring, capelin, squid, launce and, to a small extent on the south coast, cod roes and shell fish.

NEWFOUNDLAND NORTH EAST COAST.

122. About the year 1778 Monsieur Cassini, according to Anspach, ^(2.) visited Saint Pierre and described the capelin schools which then frequented the sand beaches of that Island, but which are now in a manner exhausted.

Anspach gives the following order for bait in Conception Bay.

1. Herrings arrive generally about the beginning of May and continue until the end of June.
2. Launce or sand-eel appears in June.
3. Capelin, June.
4. Squid, beginning of August, continues to the end of the fishery.
5. Mackerel, used for bait.

This author notices the fact of cod remaining "in the southern and many other parts of the Island during the whole year," and he also mentions their being taken through the ice during the winter months. ^(3.)

The squid is generally supposed to follow the capelin, but this is not always the case. In the meteorological notes, published by Mr. Henry Clift, at Harbour Grace, in 1872, the appearance of large numbers of squid, on the 22nd June, in Conception Bay, is noticed, and the remark added, "This arrival of squids before the capelin not known for 75 years past."

THE WHELK.

123. It is somewhat remarkable that the whelk, which is so important a bait for cod in British seas, and so extensively employed for that purpose, should not be used in America to any degree commensurate with its importance.

The whelk (*Buccinum undatum*) of America is identical with the British species, but as this shell varies considerably in form in both European and American seas, according to its feeding ground, mistakes are likely to be made. It is not common, according to Verrill, south of Cape Cod, except on the outer Islands and in deep water. But it is very abundant on the coast of Maine and northward to Greenland. It is found in water varying from low tide to a depth of 650 fathoms or 2,100 feet, more than the third of a mile, and far below the deepest cod fishing grounds known. In the Bay of Fundy it is abundant from above low water mark to 100 fathoms. ^(4.)

On the Atlantic coast of Nova Scotia it occurs abundantly, and yet, notwithstanding the alleged scarcity of bait in certain seasons, this common and ever present mollusk is not used on the coast, although it is the mainstay of the long line fishermen in the North Sea. It is most abundant, according to

1. J. R. Willis, Halifax.

2. Page 319.

3. Page 412.

4. Verrill - in Report of U. S. Commissioner of Fish and Fisheries, 1871-2.

Packard, ⁽¹⁾ in the Straits of Belle Isle, and is found just below low water mark, so that it is in many localities quite accessible. There may be practical objections to their use.

"Whelks," or "Buckies," as they are called in Scotland are extensively used as bait on the long lines by the Cod smacks, on account of their toughness and the good hold they consequently give to the hook." ⁽²⁾ Mr. Holdsworth ⁽³⁾ says that mussels, which are an excellent bait for almost all kinds of fish, and are in general use with long lines worked from small boats, are not found to answer for the smacks, probably because the smack works in rougher water, and the rapid drag on the line washes the soft mussel bait off. When used from a boat which is under control, mussel bait answers well.

The Whelks are preserved alive in bags made of netting, and are kept until wanted, when the shells are broken and the animals extracted. The procuring of Whelk bait is a regular trade, in which many small craft, from 12 to 15 tons, are constantly employed. ⁽⁴⁾ This bait is also used at the Faroe Islands for Cod-fishing.

"The bait most in favor with the North Sea Cod Fishermen is the common large Whelk, but on many parts of the coast Herrings are by far the most attractive, and at certain seasons the only killing bait for Cod. Mussels are perhaps more commonly used as bait than anything else for general line-fishing." ⁽⁵⁾

124. According to the experience of fishermen in European seas, the taking of spawning cod with bait is by no means uncommon, but it requires generally the most killing bait, the herring.

In evidence obtained by the Royal Commission at Greenwich, a witness stated:—"If I were to shoot a line with buckie (whelk) bait at the time the fish were spawning, I would not catch many of them, but I could get a great many with fresh herrings. I think that a buckie, on the whole, is as good a bait for a cod as a herring, when they are not spawning." (Page 1122 Qu. 50,701.) Again, at Lerwick a witness stated that "as a general rule they do not fish in February. The fish come in shore to deposit their spawn but they are sometimes taken up by the fishermen when they are inshore."

Use is made of cod roes for bait to a small extent on the southern coast of Newfoundland. In the neighbourhood of Cape Ray the fishermen sometimes use the roe for this purpose, but find a difficulty in keeping it on the hook. As the attraction of all bait for cod is probably, in the first instance, due to the sense of smell, which is evidently the chief guide in deep water and during the night time, a method for enclosing cod spawn in a small lace net is suggested.

HERRING AS BAIT.

125. First in importance among all kinds of bait stands the herring. Its universal application for this purpose appears to be everywhere acknowledged, and this fact alone points to the advantage of, and in some cases the necessity for, preserving, by all reasonable means, the spawning grounds of this fish, together with its winter homes, where these are found in secluded and land locked bays.

It has been commonly stated in the United Kingdom and in Norway that if the fishermen were prohibited from taking herring for bait they could not make a living.

1. Recent Invertebrate Fauna of Labrador.

2. Deep Sea Fishing.

3. *Ibid.*

4. Appendix to Report of Commissioners appointed to enquire into the Sea Fisheries of the United Kingdom.

Mr. Frank Buckland refers to the subject in his recent report on the Fisheries of Norfolk. [1.]

"A large proportion of these spring herrings are sold for bait by the Low stoft man to the Dutch and French fishermen, who come over to Lowestoft on purpose to buy them. These spring herrings are used by the Dutch and Frenchmen to bait the long lines to catch halibut, turbot, etc."

"The argument of the Lowestoft men was concluded by the statement that if the Lowestoft, Yarmouth and Georgetown men were prevented from catching spring herring and selling them to the Dutchmen and Frenchmen, the Dutch and Frenchmen would come in and catch the spring herrings for themselves, as somehow or other they must have this class of fish to enable them to carry out their deep sea fishery with success."

In the exhaustive report of Axel Vilhelm Ljungman, [2.] the author refers to the importance of the herring as bait, as well as to the "oft repeated saying of the fishermen, before quoted, that they would not be able to make a living if they could not catch herring." "The larger portion of the demand for bait is supplied by the large herring nets, from which bait can usually be obtained all through the winter. When the great herring nets are laid up, bait-herrings are obtained from the two-men's nets and from other small nets used for catching spring herring."

The herring in many seas is the most killing bait known, and the abundance with which the fishermen are supplied with it determines in a great measure their catch of cod and other deep sea fish at certain seasons of the year. If the supply of bait be small or stinted, the catch is in proportion small. In brief, not only does the presence of herring on the American coast determine the presence of cod in many coastal waters, but the measure of accessible bait of this description is an index, under ordinary conditions, of the catch of deep sea fish. The French Bank Fishery without herring bait would be a constant failure, and in the present day wholly impracticable as a commercial enterprise.

THE CAPLIN AS BAIT.

126. Lieut. Edward Chappell, R. N., writing in 1813, describes the swarms of Caplin as so numerous as to darken the surface of the sea, and he also states that "the beaches of the Labrador are frequently covered with dead caplin." [3.]

Bonnycastle, in "Newfoundland, in 1842," notices the extraordinary abundance of life on the Grand Banks off the coast of Newfoundland. He speaks of the incredible shoals of Lauce, of Herring and of Caplin which "cause the seas to boil and glitter in their rapid paths, producing the effect of currents upon the bosom of the tranquil deep." [4.]

This author states (p. 269) that he has "seen on the Banks the sea alive with this little creature, (the Lauce, *Annodytes tubinus*) pursued by its voracious enemies and rushing to the side of the ship"

This "rushing to the side of the ship" is evidently an attempt to escape to the supposed shore, out of the reach of its pursuer, and is stated to be the cause why the Caplin attempts to reach the shore to spawn instead of spawning on the sloping sandy bottom in from 5 to 25 fathoms, which they do under certain circumstances as described in another place.

1. Report on the Fisheries of Norfolk, 1873.

2. See the Report of the U. S. Commissioner of Fish and Fisheries for 1875-76.

3. Voyage of H.M.S. Resound to Newfoundland and the Southern Coast of Labrador by Lieut. Ed. Chappell, R. N., London, 1813.

4. "Newfoundland in 1842," p. 239.

Anspach thus describes the appearance of Conception Bay about the year 1818 :

"It is impossible to conceive, much more to describe, the splendid appearance of Conception Bay, and its harbours on such a night, at the time of what is there called the Capelin-Skull. Then its vast surface is completely covered with myriads of fishes of various kinds and sizes, all actively engaged either in pursuing or in avoiding each other; the whales alternately rising and plunging, throwing into the air spouts of water; the Cod-fish bounding above the waves, and reflecting the light of the moon from their silvery surface; the Capelins hurrying away in immense shoals to seek a refuge on the shore, where each retiring wave leaves countless multitudes skipping upon the sand, an easy prey to the women and children who stand there with barrows and baskets ready to seize upon the precious and plentiful booty; while the fishermen in their skiffs with nets made for that purpose, are industriously employed in securing a sufficient quantity of the valuable bait for their fishery."¹

Again, "These amazing overflowings of Capelins and Squids on these coasts and at the river-head of harbours, are sometimes still greater in some places than in others, and particularly so when those shoals arrive at an earlier period than usual, as if their motions were accelerated by the unusual number and rapid pursuit of their voracious and famished enemies."²

THE CUCUMBER ODOUR OF THE CAPLIN.

127. Many writers have noticed the remarkable cucumber odour of fresh Caplin, fresh Smelt, and the Launce. The writer has observed in Newfoundland that the odour of the Caplin, when newly caught, is very perceptible, and when the fishermen are engaged in carrying baskets or sacks full of this fish to their "gardens" as manure, the cucumber odour can be perceived at a considerable distance. Fishermen say that they can smell the Caplin when they come into the bays before any have been taken. It is very probable that this cucumber odour is more strongly developed in the Smelt and in the Caplin during the spawning season than at any other time; indeed it is doubtful whether it is common to them at all seasons of the year. If it should be developed at the spawning season only, which one from analogy would suppose to be the case, we may discover in it the reason why the Cod follow the Caplin in shore during the spawning season. They may be attracted by the cucumber odour, and guided by it to the place where the Caplin are to be found. It is not easy to understand why the Caplin should approach the shore during certain seasons without being followed by the Cod, or that the Cod should be before the Caplin schools, or several days after them, as is frequently observed. Then again, those parts of the coast of the Gulf and the coasts of Newfoundland which are not exposed to drift ice during the spring months, are visited by schools of Codfish at a much earlier period than other districts liable to an invasion of drift ice. In the Gulf of St. Lawrence the Cod banks of Natashquan have always being distinguished by the early approach of Cod. This arises from the current there setting south-easterly and keeping the ice off the coast in the vicinity of the banks. The direction of these currents are marked on the charts of the Gulf. The same observation applies to some parts of the north eastern coast of Newfoundland, where Cod are always observed, although geographically farther north, than in more

1. Page 385.

2. Page 408.

south-eastern localities. The position of the ice appears to determine the movements of this fish in their approach to the shore, and it does not always follow the Caplin as is commonly alleged, but comes in sometimes before, and sometimes after that fish, as may be seen by an examination of the tables showing the separate first arrivals of Cod and Caplin.

128. Instances are common of vast numbers of Caplin being found dead or in a dying state, where the schools come in shore to spawn. The sandy bottom of the sloping beach is not unfrequently strewn with dead fish, and dying Caplin may be seen wandering about and spasmodically gasping in the water from which millions of the species had abstracted the oxygen necessary for their existence.

The Caplin spawn, as is well known, on sandy sloping beaches, but they also spawn in waters of different depths when the bottom is composed of sand.

The fishermen take Caplin with their casting nets in from fifteen to thirty fathoms, and probably also in water of much greater depth, the needed condition being a smooth sandy bottom, over which the trio engaged in spawning may 'run' touching the bottom.

In the neighbourhood of Baccalieu Tickle, Mr. Jabez Tilley, relates, that in 1864 the fishermen took Caplin for a month, from the 3rd week in June to the 3rd week in July, in water varying from fifteen to thirty fathoms, with the casting net. In the 2nd week of July, Caplin spawn was brought up from the bottom in 27 fathoms of water.

The spawn is said by fishermen to require about fifteen to eighteen days to arrive at maturity. The young fish leave the egg after that period. They are found near the coast until about the end of December, according to the season, and the contents of the stomachs of "Murrs" and "Puffins," according to Mr. Jabez Tilley, are often full of young Caplin at that season.

At the Fishot Islands in 1876, the Caplin were taken in deep water about the 20th June before they "came in." (1.)

The appearance of schools of Caplin coming in to spawn in May, June or July, according to the latitude of the place, has always excited astonishment at their numbers, and often in the present day in Conception Bay and some other noted spawning grounds, remarkable scenes may be witnessed.

An idea may thus be formed of the extraordinary number of fry serving as food, which swarm even now in the Newfoundland seas. Nor is it less easy to conceive how greatly these innumerable hosts have contributed to the drawing inshore of the deep sea-fish. First, the adult fish forming the attraction, next the spawn, then the young fry, and thus continuing to the approach of winter. So great has been the importance attached to the preservation of the Caplin, that legal enactments have passed the Legislature of Newfoundland prohibiting the use of this fish as manure, and the public documents abound with remonstrances against this palpable abuse of one of the most important means for preserving the Newfoundland Fisheries. (2.)

129. Trials are sometimes made through the ice to catch cod in the different bays of Newfoundland during the winter season. In 1852 numerous fish were taken in January through holes cut in the ice at St. Mary's Bay, and in their stomachs un-

1. Fishery Report, 1876. Capt. Erskine, page 73.

2 See Appendix to Journal of Assembly, 1857, page 337, et al. Also Perley's Report on the Fisheries of New Brunswick. Also Reports by Capt. Fortin, and of various Fishery Officers of Canada previous to Confederation, and subsequently in the Official Reports of Dominion Fishery Officers.

digested and partially digested caplin were found. Elsewhere it is stated that caplin are occasionally seen on the Labrador throughout the winter where cracks occur in the ice, and in the Rapids of Kypokok Fiord, about three miles above the Hudson Bay Company's Post, the officer in charge, as well as the men, informed the writer that caplin were seen there during the winter. They probably spend a considerable portion of the winter in the deep water opposite Kyrokok, where fifty fathoms have been measured, and come to the Rapids, which never freeze, for air. The same demand for air, or rather oxygen, may account for their being noticed in the cracks of the ice off the coast of Labrador. Among some of the more intelligent fishermen the impression prevails that schools of caplin with schools of cod winter in the deeper portions of the great bays of Newfoundland and the Labrador, and that such is the case there appears to be little reason to doubt, but in different zones of water.

Mr. Bennett, ^[1] writing in 1876, says: "Our people much oftener complain that caplin remain in deep water, where the fish get gorged with them, than of actual scarcity of the schools that visit the coast."

130. The variations in the appearance of such fish as the caplin are remarkable; and the squid is also notably erratic in its movements. Since the year 1869, until 1875, not only the shores of Newfoundland, but also the Grand Banks, are said to have been teeming with squid. They arrive on the west coast about the 1st August, and are then about four or five inches long, and by the 10th December, when the last are taken in Bay de Nord, in Fortune Bay they are from 12 to 15 inches long.

Caplin and squid were scarce throughout Newfoundland and Labrador in 1875. They were alleged to have been abundant on the shores of Nova Scotia and Cape Breton during the same year;—a very unusual circumstance.

Most northern fishermen have *seen* the caplin spawn and witnessed the young fry in the summer "filling" the coves. Probably no human eye has *seen* the mackerel spawn, this operation taking place in mid-water, and the spawn floating instead of, like that of the caplin, adhering to sand. But many fishermen have seen the mackerel *fry* sporting in waters on the north side of Prince Edward Island, ^[2] about the Magdalen Islands, ^[3] in the Bay of Chaleurs, ^[4] and in Massachusetts Bay, ^[5] all being hatched about the same period of time; yet, while fishermen entertain no doubt about the caplin wintering comparatively near their spawning grounds, yet they attribute to the mackerel extraordinary migrations from the south to the north, similar to those described and disproved by Professor Baird in relation to the herring, the shad, the alewife and the salmon. ^[6]

SEINING.

During what the French term the caplin season, that is from the end of May to the 10th or 15th of August, the fishery on the north east coast is carried on by means of enormous seines 333 to 336 metres in length, to 28 metres in depth. With these immense engines of destruction Admiral Cloué states he has seen thirty thousand codfish taken at a single haul. The

1. Page 682. Journal of Assembly, Newfoundland.

2. Capt. Campbell, page 86.

3. Mr. Tetu—Official Report, 1868.

4. Mr. Whiteaves—Official Report, 1873.

5. Mr. Atwood, page 86.

6. Page xxx., Report of Commissioner of Fish and Fisheries, 1871-72.

Admiral Cloué remarks that this method of seining is strongly condemned by some persons, who suppose that it destroys the spawning fish, and that it is the cause of the decline of the fish, which has manifested itself for some years, even to the extent of so far injuring the fishery as to lead to a notable diminution in the numbers engaged in its pursuit. He considers, however, that it is difficult to see how this result can arise from seining, in consequence of the wonderful fecundity of the cod, but he is disposed to assign to other causes, which have hitherto eluded observation, the conditions which drive the fish during one or two seasons from certain shores. (1.)

On these and many other important points bearing upon the preservation of the Dominion Fisheries, reference may be had to the excellent and comprehensive summaries which are to be found in the Annual Reports of Mr. Whitcher, the Dominion Commissioner of Fisheries.

FOOD OF THE COD.

THE GULF OF ST. LAWRENCE.

Mr J. F. Whiteaves, F. G. S., enumerates, in a Report on a deep sea dredging expedition to the Gulf of St. Lawrence, addressed to the Minister of Marine and Fisheries, the following interesting results:—

“I have examined the contents of the stomachs of more than 500 cod fishes, taken in Gaspé Bay, in many places on the north shore of the St. Lawrence, near the Magdalen Islands, &c. The following list will give an idea of the food of this fish, that which occurs most frequently being placed first. Of course, objects, such as sea anemones, which are entirely soft, cannot be readily identified.

1. Other fish, such as sand launces, capelin, &c.: I have found a small sea-lamprey in a cod's stomach.
2. Crabs, of the genus *Hyas* mostly.
3. Squid, at certain seasons.
4. Bivalve shells, especially the following: *Glycimeris siliqua*, *Cardium Islandicum*, *Serripes Groenlandicus*, *Yoldia myalis* and *limatula*, and occasionally other species.
5. Brittle stars, very rarely, generally *Ophiopholis aculeata*.”

“Cod banks, or as the Gaspé fishermen call them “reefs,” are submarine elevations of the bottom of the sea. One of these banks (between Capes Gaspé and Bon Ami) I examined in 1869, and was amazed at the extraordinary numbers of the minute shells of the foraminifera brought up in the sand from the bottom. It may be that in some cases the abundance on the banks of these microscopic creatures, upon which other marine animals feed, may be the primary cause of the presence of cod in such numbers at these places. Farther up the St. Lawrence, opposite Rivière du Loup, Principal Dawson informs me that cod feed largely on shrimps”

THE ATLANTIC COAST OF NOVA SCOTIA.

Dr. Bernard Gilpin, of Halifax, states that the stomach of the cod taken on the Nova Scotia banks are usually filled with herring, young cod fish, Norway haddock, small mackerel, various mollusks, the glycemeris, a large black coquog and star fishes. (2.)

Professor Verrill found the stomachs of cod, taken from the cod ledges, off Cape Elizabeth, Maine, filled with crabs,

1. Pilote de Terre Neuve, p. 397.

2. Transactions of the Nova Scotia Institute of Natural Science, 1866-7.

shrimps, and smaller species of crustaceans, with more or less mollusca, holothurians, ophiurans, etc. ⁽¹⁾

From this circumstance Prof. Verrill concludes that the cod caught here feed chiefly on crustaceans.

132. Sir Wyville Thomson tells us in that most instructive and interesting work, "The Depths of the Sea," that the Farøe Banks (lat. 61, long. 9°) are frequented during the fishing season by numerous English and foreign fishing vessels, whose chief pursuit is the Cod. These banks are about 160 miles north-west of Scotland. The Cod abound on the banks and are chiefly of large size. The depth of water varies from 45 to 100 fathoms. "The banks swarm with the common brittle star (*Ophiothrix fragilis*), with the Norway lobster (*Nephrops norvegicus*), large spider crabs, several species of the genus *Galathea*, and many of the genus *Crangon* (shrimp). So ample a supply of their favorite food readily accounts for the abundance and excellence of the Cod and ling on the Banks." *

Passing to Davis' Straits and the coast of Greenland, Dr. Robert Brown states that "the invertebrata of Disco Bay (lat. 69) are numerous, mollusca, echinodermata, crustacea, polyzoa, hydrozoa, &c., abounding, though to nothing like the extent the lower forms of animal life swarm on the Riskoll Cod banks." †

Dr. Sutherland ‡ states that the limits of the Riskoll Bank can be defined almost at all times by the clusters and groups of small icebergs that take ground upon it, and this bank, "like other banks of a similar character, but less extensive on the same coast, is exceedingly fertile in schools of Collish and Halibut which frequent it in the months of May, June, July and August."

This description of the icebergs on the Riskoll Cod Bank applies exactly to the banks off the coast of Northern Labrador.

133. The following observations, out of many that might be instanced, appear to show that the absence of food is not the chief cause of the temporary absence of cod from the Newfoundland coasts during certain seasons. Their advent is by no means cotemporary with that of the caplin. In 1865 the supply of caplin was abundant on the South Shore, from Trepassy to the Burgeo Islands, but the cod fish "had not followed the bait in any numbers to the coast." ⁽¹⁾ The season of 1865 was below the average in the exports of cod fish from Newfoundland. Nor do the fish always take the caplin when it is within their reach, for according to the statement of Commander Preston, of H. M. S. *Medea*, 1864, ⁽²⁾ "the cod were later than usual in making their appearance in numbers on the coast; (between Battle Harbour and Cape Harrison, Labrador.) The caplin were abundant for a week before them, and when first the cod fish became plentiful (about 16th July) they seemed glutted with what the fishermen call herring-bait, which is a sort of jelly fish, full of black slimy matter, which so discolors the cod fish that eat it, and gives them such an offensive smell, that it makes them unfit to eat fresh. There was a great quantity of it along the coast this year, and the cod fish seemed to take it in preference to the caplin."

1. A. E. Verrill—Results of Recent dredgings on the Coast of New England.

* "The Depths of the Sea," page 60

† Geological Magazine—Feb., 1875.

‡ Proceedings of the Geological Society—London, 1853.

1. Report of Captain Hood, R. N., H. M. S. *Pylades*, 1865.

2. Report of Commander Preston, R. N., Oct., 1864, H. M. S. *Medea*.

At certain seasons of the year, Herring is the natural food of the Cod, and it is difficult to catch this fish during those seasons with any other bait. The Royal Commissioners (1863) state in their report that "Cod and Ling and other fish live at certain periods of the year almost exclusively on Herring, and they can be caught with difficulty by any other than Herring bait."

A statement to the same effect will be found in a letter embodied in the Miscellaneous Correspondence (page 135) of the United States Commissioners report. "Cod live on Crabs, Scallops, and the jellies on the bottom, and a small fish in the form of a Shrimp, but from four or five times as large. Large Cod eat small Flounders, small Pollock and Hake, small Salmon, Sea Perch, Cunners, and a great many things found at the bottom of the water, but always prefer the Herring. Some come in schools and eat the Herring spawn." At Peterhead, Scotland, one witness ⁽²⁾ alleged that unless they got Herring they could not catch Cod in the winter season.

Professor Merrill, in a "Report upon the Invertebrate Animals of Vineyard Sound, and the adjacent waters, with an account of the Physical Characters of the Region," ⁽³⁾ enumerates (page 516) the different kinds of food found by him and others in the stomach of the Cod, such as mollusks, crustaceans, annelids, star-fishes, &c. "They swallow large bivalve shells, and, after digesting the contents, spit out the shells, which are often uninjured. They are also very fond of Shrimps and of Crabs, which they frequently swallow whole, even when of large size. The brittle star-fishes (*Ophiurans*) are also much relished by them. I have taken large masses of the *Ophiopholis aculeata* from their stomachs on the coasts of Maine and Labrador; and in some cases the stomach would be distended with the one kind unmixed with any other food."

134. It appears from the experience of all countries, where cold water fisheries are extensively carried on, that the herring and the caplin are essential to continued success, and that when these bait fish are not found in abundance, there the cod fisheries will gradually dwindle into insignificance. But the converse proposition is by no means true, namely, that when the herring is found there the cod fisheries will be abundant also, for on the coasts of northern Maine the herring is abundant, yet the cod scarce. This probably arises from the fact that the cod require in their season other forms of food, which the coastal waters of New England do not now produce, otherwise there could scarcely be such a dearth of cod as is stated to exist. These are doubtless the anadromous species which have been destroyed in the manner described in official papers. It must be borne in mind, too, that the cold water sea area on the coasts of New England are not sufficiently extensive to admit of recuperation in the face of a constant drain. It requires the inexhaustible and ceaseless supplies of food which come through such favorably situated localities as the Straits of Belle Isle, the Gut of Canso and on the south shore of Newfoundland, to keep up a perennial supply when subjected to ceaseless attacks. Two and even three hundred years of such attacks upon the schools of cod frequenting those favored breeding and feeding grounds, have not succeeded in making much impression there, when the increasing number of fishermen and the improved nature of their implements of destruction are considered. But this power to

1. Report of the Royal Commissioners on the operation of the Acts relating to Trawling for Herring on the east of Scotland, 1853.

2. Sea Fisheries Commission.

3. Report of U. S. Commissioner of Fish and Fisheries, (Prof. Sp. F. Baird) 1871-72, page 295.

resist the drain arises from a peculiarly favorable geographical position which brings *ova* and *food* from distant sources in one continued and apparently undiminished stream. But these favored spots offer no excuse for adopting the opinion that other localities, less favored, should not be liable to rapid depletion, and when once destroyed, incapable, from the conditions surrounding them, of ever again becoming commercially valuable.

It is shown on page 124 that a continued and well-linked chain of different kinds of industries alone enables the United States fishermen to pursue a profitable occupation throughout the year. If the enormous shell fish industry were notably and suddenly to decline, the effect would immediately be felt on the deep sea fishing industry, by the diversion to it of unemployed craft, labor and capital; or if the menhaden industry should show a more sudden falling off than is generally expected, the effect would be similar, for its vast fleet must find employment; a similar result would follow the decline of the inshore fresh fish trade and the enormous estuary and bay fresh fish trade south of the 39th parallel, as well as north of it. The aggregate annual value of all the United States fisheries on the Atlantic coast does not fall short of forty three million dollars, of which the annual value of the deep sea fisheries does not reach one-fifth part, the other four-fifths being the income of shell fish, oil and fish guano industries, and coastal fresh fish industries. These different fisheries are pursued with the ability and energy which distinguish the American people, and with the enterprise and capital they throw without stint into a promising field of industry. But the end of all this is clearly pointed out by the officers employed by the United States and the several States Governments to examine into the causes of local decline, which has for many years been going on and is now infecting the whole coast. The use of gigantic seines, worked by steam power, gathering everything within their vast embrace, can lead to but one result, and that is depletion. Similarly the use of huge purse seines, for taking menhaden and mackerel, often destroy millions more than can be utilized, and what is far worse, take the spawning fish in the spring.^(1.) Four years since a Dominion officer^(2.) drew the attention of the Government to the use of purse seines for catching mackerel, and suggested the prohibition of the taking of spawning fish. The employment of purse seines on such an enormous scale as is done by the American fishermen is, to use Professor Baird's apt simile, before quoted, (page xiii.) 'taking the larvæ out of the bucket with such huge scoops that there will be soon none to take.' But the use of purse seines in taking mackerel in the spring is doing a double injury. At this season of the year the schools are "taking up their line of march at successive epochs,"^(3.) according to temperature, and approaching the coast to spawn. It is the boast of the American fisherman that he can begin in spring in Virginian waters and follow up the approaching schools all along the coast to the Gulf of St. Lawrence and the Bay of Chaleur, and take with his purse seines the fish about to spawn; and it was Professor Baird's privilege in 1872 to expose—using his own words—"all the evils following in the train of such thoughtless destruction, precisely equivalent to killing off all the mature hens in a farm-yard before they

1. See page 88 for a notice of the great destruction of immature mackerel by the Seine.

2. Mr. Whiteaves—"Notes on the Marine Fisheries," page 193: Sessional Papers, No. 4, 1873.

3. See U. S. Commissioner of Fish and Fisheries' description of the successive spring march of the herring, shad, alewife and salmon, page xxxv. Report for 1871-73.

have laid their eggs, and then expecting to have the stock continued indefinitely." "As well might the farmer expect to keep up his supply of wheat year by year, while he consumed all his grain, reserving none for seed, and without the possibility of obtaining it from any other source." (Page xxx., Report for 1871-72.)

135. The recently celebrated Georges' Cod and Halibut Fishery is no exception to the rule of depletion. As a fishing ground, the George's Shoals are but of yesterday. It does not embrace in its history as a business enterprise, a greater number of decades than the cod fisheries of Belle Isle, Canso and the Grand Banks comprehend of centuries. Its beginning dates from the close of the generation just passed away. It is not much more than thirty or forty years old, and in the first few years of its existence halibut formed the chief catch ⁽¹⁾ It is not improbable that the cause of the increasing wealth of cod fish on George's Shoals after the year 1848 arose from the destruction of the halibut, which gave the cod a better chance. With the decline of the halibut the cod have increased, and so has the winter fishing fleet. In 1846 this fleet comprised but twenty-nine vessels; in 1873 two hundred and fifty sail were engaged in the business, but the returns compared with those from the Grand Banks are very small. The average valuation of the fleet now engaged in the George's winter fishery is \$6,000. "The trips brought in during the best part of the season will average \$7,00, and stocks of from \$1,500 to \$2,000 are not unfrequent, while the Grand Bank Fishery, comparatively a new branch of business, often discounts from \$3,000 to \$4,000 on a single trip." ⁽²⁾

136. The George's Fishery is pursued at fearful risks, (page v.) Ninety-three vessels and 708 lives lost in 42 years, in one isolated branch of fishing industry, is a sad but speaking record. The loss of life and property on George's Fishing Shoals is upwards of one half of the entire loss of the fishing industry of the port of Gloucester. The Shoals are ninety sea miles from the nearest land. February, March and April are the chief fishing months, and at the best it is an industry pursued under great difficulties, privations and risks. ⁽³⁾

1. "Fisherman's Memorial and Hand-Book," George H. Procter, Gloucester, 1873.

2. *Ibid* page 70.

3. "In another place, in these pages, interesting particulars in relation to this fishery may be found, and among the statistics of the business the mind will dwell with painful emotions upon the list of those who have found in it a watery grave, and also an unknown end; for no tidings ever came from the missing Georges fishermen. An unusual absence gives rise to fearful apprehensions, and anxious friends at home watch from the hills in agonizing suspense for the returning sail; but nothing comes save the moan of the sea which sounds their requiem. None but the stoutest hearts will brave the perils and hardships of such an employment, or of the dangerous trawling on Grand Bank; and the mortal losses, with all their sad consequences, constitute a serious drawback upon the otherwise happy prosperity of the fisheries of Gloucester."—"*The Fisheries of Gloucester*."

"Notwithstanding the large number of men from this town (Gloucester, Mass.) who served in the army and navy during the rebellion, the loss of life from the casualties of war were far less than the losses at sea for the same period of time. There were two hundred and eighty-two lives lost in the fishing business from this port during the four years of the war, while the record of those who have been killed, or died in the service, is less than half that number. It thus appears that our town suffered more from the perils of the ocean than the ravages of war—a fact which would hardly be credited did not the statistics prove it."

"These perils have made of Georges a vast burial ground, where the bones of the fishermen are moved with the changing tide, or lie buried far beneath the sands of her treacherous shoals. A vast sepulchre, swallowing up many a young man in the pride of his youth, many a middle-aged toiler, upon whose earnings a loving family were dependent, and many an aged one, whose voyage of life, at last, would have continued but a few years longer."—"*Fisherman's Memorial and Record Book*."

With such a record of sorrow and suffering as the history of the George's Cod and Halibut Fishery presents, it is not surprising that strenuous efforts should have been made to secure an equal partnership in the fishing grounds of British America, with their freedom from unusual risk, their proximity to safe harbours and an abundance of bait always on hand, if means are taken to secure and preserve it. The extracts given in the footnotes painfully but truthfully express the feelings of those who have anything to do with the perils and risks inseparable from the daily life of the George's Fishermen.

THE OBJECT OF DIFFERENT FISHERIES IN THE UNITED STATES.

137. The pursuit of those fisheries which affect the bait supply in the United States waters is not so much an industry which has for its object the procuring of food for home consumption or export, as an aid to agriculture and manufactures wholly unconnected with the calling of a fisherman.

In carrying out this object, the Cod and Mackerel fisheries as a source of food, are of less importance than the Menhaden fishery as a source of oil and fish guano, or the Herring fishery as a source of fresh food, fish oil and guano, but as one is dependant upon the other, the destruction of the supplies furnished by the Menhaden and the Herring, destroys the accessible supply of the class of fishes nourished by them.

The cold water sea area subtending the coasts of the United States is quite insufficient to supply the demands of the agriculturist, the manufacturer and the fishermen, and in relation to the cold water commercial fishes, the interests of the fishermen are sacrificed to those of more powerful industries represented by agriculture and manufactures. Animal oil is essential to many manufacturing processes, artificial manure is necessary for worn out soils, and these are supplied by the coastal waters of the United States, the fishing interests looking to the coastal waters of British America to recoup them for the sacrifice of the original wealth of their seas in the products which were formerly so abundant there. The international legislation, which is now being concurred in by the English and Norwegian Governments, for the protection of the Harp Seal, is not based upon a humane "Prevention of Cruelty to Animals," but upon the wants of the jute manufacturers, who are dependant upon animal oil for the carrying out of one of the processes involved in their industry. In the United States the lumberer and the manufacturer unwittingly initiated the ruin of the New England Cod fisheries; the manufacturers of artificial manure and fish oils are extending this evil in a totally different direction, and, in part, nullifying the efforts made to restore the coastal waters to their original wealth of cold water fish.

Just as the lumberer has destroyed the anadromous species, with the effect so well described by the United States Commissioner of Fish and Fisheries, so are the 'fish guano' and fish oil manufacturers enriching themselves, not only at the expense of the Menhaden and Herring, but of the other species which depend on these for food, whether in the form of the adult fish or as spawn or fry. The industry is, as were, but of yesterday, nevertheless, it has already reached gigantic proportions, and employs an amount of capital and labour bearing no inconsiderable ratio to that employed in the deep sea fisheries. The trade is extending to foreign countries and exports of fish guano have already been made from ports in Maine. [1] It can not be said that this has no bearing upon the value of the

1. Report of the Commissioner of Agriculture, 1875.

concession made to the United States of the freedom of our coastal waters and the liberty to occupy the strand to take fish. If it makes the United States Fishing Industry in British American waters profitable, and at the same time permits the fish oil and fish guano manufacturers to pursue an eminently remunerative business, the value of the concession on this ground alone must be enormous.

The forbidding of the introduction of seal oil, although it is a product of the sea, because the creature yielding it is not technically a fish, shows the importance attached to animal oil from whatever source derived, and may be regarded as an index of the value assigned to the efficient protection of the fish oil industry.

THE MENHADEN INDUSTRY.

138. The following table shows the condition of the menhaden fish oil and guano trade, ^[1] as represented by one Association, namely, "The United States Menhaden Oil and Guano Association."

Year.	Fish caught in barrels.	
1873.....	1,193,100	
1874.....	1,478,634	
1875.....	1,877,767	
	Tons of Guano manufactured.	
1873.....	36,299	
1874.....	50,976	
1875.....	53,625	
	Oil made—in gallons.	
1873.....	2,214,800	
1874.....	3,372,837	
1875.....	2,681,484	
	1874.	1875.
Factories.....	64	60
Men employed.....	2438	2643
Sailing Vessels.....	283	304
Steamers.....	25	39
Capital invested.....	\$2,500,000	\$2,650,000

It is not the fishermen who alone diminish the value of the waters of the United States as food producers, it is the agriculturist, the manufacturer, and the lumberer. If the supplies directly or indirectly afforded by British American coastal fisheries were suddenly annihilated, the effect of the enquiries instituted under the direction of the United States Commissioner of Fish and Fisheries, would be at once diverted against the Fish Oil and Fish Guano manufacturers, as well as the lumbering and other interests, which have so diminished the anadromous species, and destroyed the Cod Fisheries on the New England coast. What with the ravages of the blue fish and the demands of the Industrial interests named, the drain upon the United States waters is far beyond the natural resources of the limited area in which the Cod, the Hake, the Halibut and other deep sea fish are sought. Hence recourse must be had to British American waters, or the open sea remote from the coasts of the United States, and bait must be obtained to secure remunerative fares. Without this bait, the fishery would be commercially impossible, with it, it becomes not only remunerative but permits those special fisheries which have fish oil and fish guano as their object, to go on without that legislative interference which would otherwise be invoked by a powerful interest contemplating impending ruin and discerning its cause

1. Report of the Commissioner of Agriculture, 1875. See also the Reports of the "United States Menhaden Oil and Guano Association."

THE INTERESTS SUBSERVED BY THE UNITED STATES FISHERIES.

139. It appears from preceding paragraphs that the numerous interests which the United States have to succor and sustain are :—

First,—Those of the fishermen, whose object is to obtain deep sea fish for food as a commercial product, and who, in consequence of the insufficient and unproductive sea area adjacent to their own coasts, are compelled to seek their fares in distant waters, and their supply of suitable bait from foreign coasts.

Second,—Those of the fish oil and fish guano manufacturers, who supply the imperative demands of the agriculturist and of the industries to which animal oil is a necessity.

Third,—Those of the lumberer and manufacturer, whose operations involve to a considerable extent the destruction of the anadromous species of fish.

Fourth,—Those of the shell fish Industries and the winter fisheries south of the 39th parallel, which are closed to British American fishermen, and whose privileged enjoyment by United States fishermen makes their summer fishery in northern waters, possible as a commercial enterprise.

Fifth,—Those of the State, which call for aid to maintain the present status, and resist the gradual decline, of that portion of the commercial marine which is sustained by the deep sea and coastal fisheries.

The object and effect of one part of the fishery clauses of the Treaty of Washington, are to concede to the United States those privileges and opportunities which are best fitted to extend this succour and sustaining power to the several interests named. These are embodied in the concession of the use of the strand and the enjoyment of an equal participation in the strand fisheries; also, in the concession which secures the enjoyment of the coastal fisheries, and the economical prosecution of the deep sea fisheries, with the means provided by the use of the strand and the strand fisheries, together with bait procured in coastal waters.

The first and fifth of the interest specified are dependant upon foreign seas for their maintenance. The cold water sea area confronting the United States is altogether insufficient to support the great deep sea industry which must be sustained. The fishing ground for Cod and its tribe, Halibut and Herring, are very limited and local in United States waters, or in waters off United States coasts. But as has been shown on pages 19 to 23, the entire British American coast line from the Moravian Missionary Station at Hebron to Cape Sable in Nova Scotia, and all around the Island of Newfoundland, is one continuous fishing ground for Cod. On pages 52 to 62 it is also shown, that with the exception of the northern portions of the Labrador, it is one continuous fishing ground for Herring. It is also a continuous strand fishery, except when the shore is steep-to, along this entire coast line, which in length is more than double the distance across the Atlantic between Newfoundland and Liverpool. For the purposes of a strand fishery and the procuring of bait in all its forms during different seasons, the entire length of available coast line, may include all indentations, and these will swell its aggregate length to considerably more than double the distance between Halifax and San Francisco, or more than equal to the space which separates New York from Constantinople.

It is shown also on pages 29 to 32 that the greater portion of the waters washing this coast line, or subtending it, is the spawning ground of the Cod, and on page 52 it is also shown that much of it is the spawning ground of the Herring. From

the manner in which the Cod tribe and the Flat Fish tribe spawn, there can be no doubt that the Labrador current, which is pressed on the coasts of Northern America, by the rotation of the earth, insinuates itself into every inlet and bay, and is freighted with the fish ova of those species whose spawn floats, so that during the several spawning seasons it brings down with its current a continuous stream of ova, not only from accessible fishing grounds, but also from off-shore sea areas when it is more than probable numerous schools of fish spawn in outside waters.

The fishermen of the United States affect to consider the ordinary methods of line fishing as belonging to an obsolete period, and deservedly relinquished for the superior and more effectual trawl or bultow. Professor Baird has well exposed the amazing folly of killing the spawning fish, and the abundant testimony introduced in the chapter on "The Cod" shows how largely spawning fish are taken by the trawl or bultow system. It may be an improvement in catching the fish, but it ruins the schools, when used during their spawning season. It is like the traps on the New England coast; enormous quantities of fish are taken by these engines of destruction, but these, jointly with the barring of the rivers, have ruined the cod fisheries. It resembles the use of purse seines for taking Mackerel in the spring. All that period of the year they not only encircle and destroy innumerable spawning fish, but also vast quantities of immature fish and reduce the schools to such an extent that a rapid diminution must follow. No one can rebel against the laws of nature without injuring nature's gifts, and to destroy the breeding fish is surely against the laws of nature and common sense, because, for the sake of present gain, it cuts off future supply. The causes which in 1870 led the United States Government to appoint "one person of proved scientific and practical acquaintance with the fishes of the coast, to be Commissioner of Fish and Fisheries," were sufficiently stated in the preamble to the "joint resolution for the protection and preservation of the food-fishes of the coast of the United States," which became law on the 9th February, 1871. The preamble states:—"Whereas it is asserted that the most valuable food-fishes of the coast and the lakes of the United States are rapidly diminishing in numbers, to the public injury, and so as materially to affect the interests of trade and commerce:—Therefore," &c. The results of the enquiry are stated in the general summary of results given on page xxxviii. of the Report of the Commissioner of Fish and Fisheries. It will suffice to give two of these conclusions:—

I. "The alleged decrease in the number of food fishes in these waters within the past few years has been fully substantiated."

II. "The shore-fishes have been decreasing during the past twenty years, gradually at first, but much more abruptly from about the year 1865, the reduction by the year 1871 being so great as entirely to prevent any successful summer fishing with the hook and line, and leaving to the traps and pounds the burden of supplying the markets. This statement applies also, but perhaps to a certain extent, to the blue-fish. The decrease in their numbers first manifested itself about ten years ago, and is going on quite rapidly until now."

A mode of fishing may become obsolete when it is superseded by one that is better adapted to the end in view, but a ruinous method is not a better method, although it may secure temporary gain. The use of fresh herring bait in place of

salted menhaden bait, or of fresh herrings in place of salted clams, is an improvement in the right direction.

Formerly, the so-called "slivers" of the menhaden, salted down, were largely used as bait for cod and halibut, but the superior efficiency of fresh bait, and of bait packed in ice, has thrown the salted menhaden "sliver" bait into disuse. It cannot be obtained in sufficient abundance, in a fresh state, for the George's winter cod fishery, which begins in February, long before the menhaden have come from their winter quarters in the deep water off the coast. It is to Newfoundland and New Brunswick that the United States fishermen are indebted for the bait which now makes their George's and Bank Fishery profitable.

THE MANNER IN WHICH LAWS TO REGULATE THE FISHERIES ARE OBSERVED IN CANADA AND THE UNITED STATES.

140. It remains now to epitomize the extent and manner in which the interests of the British American fishermen are affected by the concession which opens this vast fishing ground, bait ground and strand, to the energies and enterprize of the fishermen of the United States. It is needless to recapitulate what has already been said about the probable change which will result in the special industry to which large numbers are now devoted and limited (page xv.), or the reduction of many of them to the condition of mere purveyors of bait to their better equipped and more fortunate rivals, (page 125) who have a certain market for their fares as soon as they reach their homes. It will suffice to conclude with a quotation from the Report of Mr. James W. Milner, addressed to Professor Baird, and published in the Commissioners' Report for 1874-75 :

"The great reason for failure in the effect of Fishery laws has not been their character, but the fact that they were not enforced. This has been the almost universal history of the laws *except* in CANADA, SCANDINAVIA and portions of RUSSIA. It has been notably so throughout the United States." (1.)

No comment is necessary on the foregoing brief exposition of the vast difference which exists between the United States and Canada in respect to the preservation of the Fisheries. Coming from the source it does, it teaches a lesson which cannot be overlooked or forgotten. It is a distinct recognition that necessary laws established by Governments tending to preserve the Fisheries are respected by one class of men and often disregarded by another. The only conclusion which can flow from this avowal, is, that by the Treaty of Washington the British American Fisheries are in future to be shared by men of great energy and resources, acknowledged force of character and undaunted courage, but who are governed in the pursuit of their calling, rather by the suggestions of their own private interests, than by laws which aim at securing the general good.

1. Page 300--Report of the "U. S. Commissioners of Fish and Fisheries," for 1873-75.

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ERRATA.

Page.		
v.	17 lines from top—	For "United States Fishory," read "United States Fishing."
vi.	12 "	For "60,000 tons," read "50,000 tons."
vi.	16 "	For "(12.," read "(13.)"
vii.	9 "	For "(28.," read "(xxviii.)"
vii.	25 "	For "(16.," read "(19.)"
viii.	12 "	from bottom—For "chap. i., ii.," read "chap. ii."
ix.	32 "	from top—For "involve," read "involves."
x.	10 "	For "(16.," read "(19.)"
x.	15 "	For "Appen. iv., chap. ii.," read "Appen. i., chap. ii."
x.	23 "	from bottom—For "Appendix i., chap. i.," read "Appendix vi., chap. ii."
xi.	24 "	from top—For "Appendix iv., chap. ii.," read "Appendix i., chap. ii."
xiii.	25 "	For "indigenous to a given sea area is so intimate," read "indigenous to a given sea area, the coast line, is so intimate."
xv.	6 "	For "difference on," read "difference in."
xix.	21 "	For "and is in most," read "and in most."
5.	19 "	from bottom—For "in a limitless," read "is a limitless."
6.	23 "	from top—For "fords," read "flords."
11.	32 "	For "and," read "any."
12.	14 "	For "printed is in," read "printed in."
14.	14 "	For "T. W. Whiteheaves," read "J. F. Whiteheaves."
14.	14 "	For "1761—1892," read "1761—1792."
25.	27 "	For "Professor Sars are our," read "Professor Sars are of our."
25.	9 "	from bottom—For "to which it is," read "to which the fish is."
29.	17 "	from top—For "long line," read "hand line."
29.	19 "	For "long line," read "hand line."
31.	29 "	For "80 to 100 fathoms," read "80 to 180 fathoms."
63.	8 "	from bottom—For "National," read "Nautical."
65.	10 "	from top—For "equally essential," read "essential."
67.	2 "	For "disposal," read "dispersal."
67.	12 "	from bottom—For "of the British," read "off the British."
67.	6 "	For "to natural," read "the natural."
94.	41 lines from top—	for "never ever," read "rarely."
96.	5 "	—for "descends to and even remains at the freezing," read "descends to the freezing."
99.	1 "	—for 82, read 92.
99.	4 "	—for 92, read 93.
100.	8 "	bottom—for "to be upon," read "to lie upon."
101.	18 "	—for "appropriate," read "approximate."
104.	31 "	—for "Cape North," read "North Cape."
104.	18 "	—for "7° 5c. (45°, 1 Fah.)," read "7° C. (45°, 5 Fah.)"
104.	11 "	—for "Northerly," read "Westerly."
106.	17 "	top—for "fleet including," read "fleet not including."
108.	26 "	—for "Dr. T. Gwyn Jeffrey's," read "Dr. T. Gwyn Jeffreys."
108.	37 "	—for "to a larger," read "to a large."
120.	50 "	—for "180 lbs.," read "250 lbs."
122.	14 "	bottom—for "relieve," read "relief."
123.	21 "	top—for "500," read "50."
125.	16 "	—for "1677," read "1875."
135.	8 "	—for "Kyrkok," read "Kypokok."
136.	6 "	bottom—for "Mollucks," read "Mollusks."
140.	26 "	top—for "\$7.00," read "\$700."
141.	7 "	bottom—for "as were," read "as it were."
143.	27 "	—for "interest," read "interests."
144.	24 "	top—for "all that period," read "at that period."

APPENDIX TO CHAPTER II.—(Continued.)

VI.—(Continued.) LINEAL EXTENT OF COAST LINE AND AREAS OF THE PROVINCES.

NOVA SCOTIA.

Lineal extent of the sea coast, not including indentations; i. e., measuring from headland to headland, is computed at 1170 statute miles.

Area territorial of Nova Scotia (land and inland waters) is computed at..... 13,907,603 acres.
Deduct inland waters (Minas Basin and Cape Breton inland waters)..... 525,600 "

Land area..... 13,382,003 acres.
or, 20,909 sq. miles.

Population (total) 1871..... 387,800.
(Vide Dominion Census 1871, Vol. I, p XX., Introduction.)

NEW BRUNSWICK.

Lineal extent of sea coast, not including indentations; i. e., measuring from headland to headland, is computed at 545 statute miles.

Area of the Bay of Chaleurs between Provinces of Quebec and New Brunswick is 1923 square statute miles or 4980 kilometres.

Area of Bay of Fundy between Nova Scotia and New Brunswick is 5403 square miles or 13,994 square kilometres.

Area territorial of New Brunswick (land and inland waters) is computed at..... 17,486,280 acres.
Deduct inland waters (Bay Miramichi)..... 92,870 "

Land area..... 17,393,410 acres.
or square miles, 27,177.

Population (total) 1871..... 285,594.
(Vide Dominion Census 1871, Vol. I, p. XX. Introduction.)

QUEBEC.

Lineal extent of sea coast, not including indentations; i. e., measuring from headland to headland, is computed at 1164 statute miles.

Area of the mouth of the St. Lawrence from Pointe des Monts to Anticosti is 9201 square miles, or 23,830 square kilometres.

Area territorial of Quebec (land and inland waters) is computed at..... 123,747,140 acres.
Deduct inland waters..... 3,728,176 "

Land area..... 120,018,964 acres.
or square miles, 187,529 miles.

Population (total) 1871..... 1,191,516.
(Vide Dominion Census, Vol. I, p. XX, Introduction.)

Total lineal extent of Quebec, Nova Scotia, and New Brunswick, from headland to headland, 2879 statute miles or 4633 kilometres.

Extent of marine league of maritime jurisdiction and exclusive rights to sea fishing grounds which follows it. (jurisdiction) covers (1871) an area of about 9947 square statute miles, or 25,761 square kilometres.

Area of the Gulf washing the shores of Quebec, New Brunswick, Nova Scotia, P. E. Island, Newfoundland and Miquelon, is computed at 78,300 square miles, or 202,789 square kilometres.

Land area of three Provinces, of Quebec, Nova Scotia and New Brunswick, deducting inland waters, is computed at 152,794,377 acres, or 238,741 square miles.

Population (total) Quebec, N. Brunswick, Nova Scotia, (1871) is computed at 1,864,910.
(Compiled from Dominion Census, Vol. I, (1871) p. 82-3.)

VII. THE DIFILEURS.

The French fishermen of St. Pierre et Miquelon, or even from France, arrive in the vicinity of Cape Ray towards the end of April. Those whose stations are fixed at Petit Port or Port aux Choix go there as soon as the ice permits them, the others move towards the north in the vicinity of the coasts of Newfoundland as fast as the ice disappears, and fish in Baie St. George or in Port a Port. As soon as the Caplin appear they are said to be soon driven to the north by schools of Cod, and the fishermen following them, abandon the south part of the Gulf.

These are the "defileurs," and the french fishermen style the process "defiler la Golfe." Petit Port is abandoned by the end of May.—(See Pilote de Terre-Neuve.) The true explanation is to be sought in the approach of different schools of Cod to the shore following distinct schools of Caplin, when these approach the shore later and later as the temperature advances towards the north-west. These movements resemble those of the Shad, Alewife, Salmon, &c., &c.

VIII. STATISTICS OF FISHERIES OF DIFFERENT NATIONS IN NORTH AMERICA.

STATISTICS OF NEWFOUNDLAND IN 1696. (1)

Residents.....	293
Fishermen.....	2,028
Total Population.....	2,321
No. of Boats.....	431
No. of Quintals of Cod caught in the Harbours occupied by the British in 1696, 1697.....	220,700

1. Census of Canada, Vol. IV, p. 33.

n. State of the Newfoundland Fishery from 1699 to 1792, taken from the Returns of the Admirals who commanded on that station: ^(1.)

AVERAGE OF YEARS FROM 1699 TO 1792.

Average of Years.	No. of Ships.	Burden of Ship.	No. of Men belonging to the Ship	No. of Boats.	Quintals of Fish made.	Quintals of Fish carried to market.
1699, 1700, 1701.	192	7,991	4,026	1,814	216,320	154,370
1714, 1715, 1716.	161	9,198	2,119	982	97,730	102,868
1749, 1750, 1751.	288	33,512	4,108	1,970	432,318	422,116
1764, 5, 6, 7, 8, 9, 1770, 1, 2, 3, 4. }	516	40,691	5,435	2,163	626,276	524,296
1784, 5, 6, 7, 8, 9, 1790, 1, 2. }	480	48,950	4,422	2,255	687,955	622,108

1. Appendix No. 6, (II), Newfoundland Report, 1793.

STATISTICS OF FISHERIES, 1763 TO 1795.

b. In 1763 the population of Newfoundland consisted altogether of 13,112 inhabitants, including women and children. During that season there were made 386,274 quintals of cod fish, 694 tierces of salmon, and 1598 tons of Train Oil. Of the number of cod fish above stated, 235,944 had been caught and cured by the resident inhabitants of the Island. (Anspach, page 155.)

The increase in the fish catch during the following years was remarkable, and is thus stated by Anspach:—

Year.	Quintals Exported.
1763.....	348,204
1764.....	470,118
1765.....	493,654

Contrasted with the Exports ten years later, ^(1.) these exports being to foreign countries exclusive of Britain, the progress is steady.

Year.	Quintals Exported.	Year.	Quintals Exported.
1764.....	470,118	1765.....	493,654
1784.....	497,884	1785.....	591,276
		1795.....	500,000

INHABITANTS AND FISHERIES, FROM 1699 TO 1792.

c. The average number of inhabitants of Newfoundland remaining in the country in the winter between 1699 and 1792 was as follows:— ^(1.)

Years.	No. of Inhabitants.
1699—1701.....	3,506
1714—1716.....	3,501
1749—1751.....	5,855
1764—1774.....	12,340
1784—1792.....	15,253

In 1787 to 1789, inclusive, the following quantities of cod fish were made by the British in Newfoundland, fully one-half being made by the inhabitants, the remainder by the fishing ships.

Year.	No. of Quintals.
1787.....	732,015
1788.....	948,970
1789.....	771,569

The following number of people wintered on the Island:—

Year.	No. of People.
1787.....	18,162
1788.....	18,209
1789.....	19,106

The No. of Fish Stages in 1792 amounted to 2,356. ^(2.)

1. Anspach—page 281 and 225.

1. Appendix No. 6, (II.) Newfoundland Report, 1793.

2. This may be a printer's error, and the true No. would be 1,356; the No. in 1790 was 1,334, and in 1791, 1,380.

A statement of the Number of Quintals of Fish made by British Fishery Ships, Ships from Colonies, by Boatmen and Inhabitants in Newfoundland from 1784 to 1792 inclusive. (Returns of the Admirals.)

Year.	Quintals of Fish made by British Fishermen.	Made by Inhabitants.
1784.	437,316	212,616
1785.	544,942	262,576
1786.	569,142	257,547
1787.	732,015	341,820
1788.	948,970	457,105
1789.	771,069	339,260
1790.	649,092	302,974
1791.	536,287	229,770
1892.	552,260	395,000

LABRADOR CATCH IN THE YEAR 1820.

d. Capt. Robinson, R. N., states that in 1820 there were 530 sail of American schooners, with a few brigs and sloops among them, engaged in the Labrador fisheries. He estimated the number of men employed in these vessels to be 5,530. One hundred quintals of fish is a full average catch, with oil in proportion of one ton to every two hundred quintals.⁽¹⁾

In 1820 the English Fishery on the coast of Labrador was represented as follows from Cape Charles to Sandwich Bay.

No. of Vessels.....	49
Tonnage.....	4,169
Men.....	979
Boats.....	152
Men.....	326

LABRADOR CATCH, 1820.

Whales.....	1
Seals.....	3,100
Tons of Seal Oil.....	66
Tierces of Salmon.....	417
Quintals of Cod.....	134,580

The proportion of English (Newfoundlanders chiefly) and American (U. S.) fishermen on the Labrador in 1802 would stand thus:

United States Fishermen.....	5,830
British Fishermen.....	1,305
United States Catch.....	580,000 quintals.
British Catch.....	134,580 "

This is allowing the full average of 100 quintals per man. But Capt. Robinson thinks that fully 20,000 quintals should be added to the British estimated catch, in consequence of the desultory fishing carried on by Newfoundland and Nova Scotian vessels. Under all circumstances, it appears that the great catch was then made by the Americans.

EXPORTS FROM LABRADOR IN 1832.

e. John Macgregor⁽²⁾ gives the following details respecting the Exports from Labrador in 1832.

1833.	No. of Quintals of Cod fish.
I. JERSEYS HOUSES,	
Exported to the Mediterranean, direct.....	54,000
II. By Newfoundland Houses.....	27,500
III. Sent direct to Newfoundland from Labrador.....	312,000
IV. Fish sent to Canada, ⁽³⁾	24,000
V. To Nova Scotia and New Brunswick.....	104,000
Total.....	521,500

Macgregor remarks also that from 16,000 to 18,000 Seals are taken at Labrador in the beginning of winter and spring.

NEWFOUNDLAND.

F. ENGLISH COD FISHERY.

Year. (4)	Exports of Fish in Quintals.
1716.	106,952
1724.	111,000
1732.	210,000
1763.	493,654
1774.	759,877
1785.	591,276
1790.	684,421
1795.	500,000
1799.	453,337
1800.	382,000

1. Private Journal, kept on board H. M. S. *Favourite*, on the Newfoundland Station, by Captain H. Robinson, R. N., 1820.—Journal of the Geographical Society; 1834.

2. "British America," in two volumes, Edinburgh and London, 1833.

3. £12,000 value, at 10s. a quintal, the highest price that year. 24,000 quintals—£52,000 worth—to N. S. and N. B.

4. From the year 1716 to 1800 the numbers are taken from Lorenzo Sabine's Report on the Principal Fisheries of the American Seas—Ex. Doc. Washington. 1852-3, as are also the exports for 1814, 1825, 1832, 1833, 1834, and 1842; on the next page.

Exports of Quintals of Cod from Newfoundland during the years 1804 to 1815 inclusive. (1.)

Year.	No. of Quintals.
1804.	661,277
1805.	625,519
1806.	772,809
1807.	674,810
1808.	576,132
1809.	810,219
1810.	854,474
1811.	923,540
1812.	711,059
1813.	891,360
1814.	947,762
1815.	1086,266

NEWFOUNDLAND.

Year. (2.)	Exports—Quintals of Fish.	Tons of Cod Oil—Crude and Refined.	No. of Quintals to a Ton of Oil.
1820	901,159		
1822	881,476		
1823	864,741		
1825	973,464		
1826	963,942		
1832	619,177		
1833	683,536		
1834	674,988		
1835	712,558		
1836	860,354		
1837			
1838	724,515		
1839	865,377		
1840	915,795		
1841	1,009,725		
1842	1,007,980		
1843	932,202		
1844	852,162		
1845	1,000,233		
1846	879,605		
1847	837,973		
1848	920,366		
1849	1,175,167		
1850	1,089,182		
1851	1,017,152		
1852	972,921		
1853	922,713		
1854	774,117		
1855	1,107,388		
1856	1,268,334		
1857	1,392,322		
1858	1,038,089		
1859	1,122,244	4,354	253
1860	1,379,804	4,565	302
1861	1,224,326	3,318	369
1862	1,241,740	3,978	320
1863	1,012,321	2,930	347
1864	1,013,037	2,211	458
1865	861,339		
1866			
1867	1,066,215	4,455	239
1868			
1869	1,159,780	4,684	247
1870	1,164,535	4,035	288
1871	1,329,726	5,551	239
1872	1,221,156	4,354	278
1873	1,369,205	4,275	321
1874	1,609,724	3,161	509
1875	1,136,235	3,079	368
1876			

Mild winter.
Mild winter; spring severe.

Very severe winter.

1. Thomas Luck—Office for Trade, Whitehall, 24th June, 1817.

2. N. B. The data from 1820 to 1858 are from Perley's History of Newfoundland, subsequently from official statements.

STATISTICS OF FRENCH NEWFOUNDLAND FISHERIES.

a. Table showing the average annual number of small vessels, (sloops, fore and after schrs.) belonging to the Islands of St. Pierre and Miquelon, employed on the Banks and in the Gulf of St. Lawrence, 1867:

Number of Sloops engaged on the Banks fisheries.....	80
Number of Men.....	650
Number of Sloops engaged in the Gulf fisheries.....	15
Number of Men.....	120
Number of smaller vessels, boats, (embarcations).....	350
Number of Men.....	750
Sloops, (Total).....	95
Men. ".....	770
Boats, ".....	350
Men. ".....	750

b. According to Perley, (1852) "the French employ 360 vessels, from 100 to 300 tons each, with crews amounting to 17,000 men, in the Newfoundland fisheries. Their annual catch averages 1,200,000 quintals. In 1848, Capt. Loch, of H. M. S. *Albatross*, stated that the Annual Great Bank Fishery averaged 1,200,000 quintals, and nearly the entire quantity was then sent to the West Indies. Perley evidently derived his authority from this source.

In 1857, Mr. T. L. Prendergast, in a report on the French fisheries on the coast of Newfoundland, estimated the yield of the North-East Atlantic Coast, from Cape St. John to Cape Norman, to be 265,000 quintals. The resident population caught and consumed or sold about 12,000 quintals, making a total yield for that part of the coast, during an average year, about 277,000 quintals.

c. RETURN SHEWING THE NUMBER OF FRENCHMEN AND VESSELS EMPLOYED AND SAILING FROM ST. PIERRE, BETWEEN 1867 AND 1874—FISHING ON THE BANKS AND OFF ST. PIERRE. (1.)

	No. Vessels.	No. Men.
1867.....	804	7178
1868.....	774	6552
1869.....	806	6452
1870.....	833	6397
1871.....	665	5295
1872.....	865	5620
1873.....	899	6036
1874.....	847	5621

In the list of vessels are included the schooners from St. Pierre, and boats not decked, employed at the local fishery about St. Pierre.

d. MEMORANDUM SHEWING NUMBER OF VESSELS AND MEN EMPLOYED IN FISHING FROM ST. PIERRE AND MIQUELON DURING YEARS 1872-3-4 INCLUSIVE.

1872		Vessels.	Tonnage.	Men.	Total Vessels.	Total tonnage.	Total men.
Principally square rigged vessels.	Dieppe.....	5	1277	157			
	Fecamp.....	21	5087	434			
	St. Valery.....	4	830	80			
	Granville.....	41	6582	1075			
	St. Malo.....	33	4512	841			
	St. Martin.....	2	339	38			
	St. Pierre, schooners.....	155	5270	1711	865	25,552	5620
	Local boats, not decked.....	601	1655	1284			
1873.							
	Dieppe.....	9	1431	175			
	Fecamp.....	22	5150	449			
	St. Valery.....	3	640	60			
	Granville.....	43	6776	1036			
	St. Malo.....	35	4574	919			
	St. Pierre—Schooners.....	197	5825	2051	829	26,086	6036
	Local boats.....	590	1346	1346			
1874.							
	Dieppe.....	10	1516	192			
	Fecamp.....	19	4697	399			
	St. Valery.....	2	384	40			
	Granville.....	41	6696	1011			
	St. Malo.....	40	4171	742			
	St. Pierre—Schooners.....	181	5994	2031	847	24,965	5621
	Local boats.....	554	1507	1206			

The following table shows the condition of the French and English Newfoundland Codfishery in 1765 :—

No. of ships	339	203
" men	14,952	17,876
" tonnage	40,795	31,621
" boats	1,765	1,823
" seines.....	617	.....
Quintals of fish caught.....	488,790	522,512
Hhds. of oil.....	6,840	.....
Stages	109	1,005
Tuns of oil	1,760	2,384 ¹
Tierces of salmon.....	.....	1,172
Sea Cows (Madelaide Island).....	.....	1,990
Tons of oil .....	.....	125
Value of seal oil taken last winter .....	.....	£5,109

The discrepancy between the number of men employed by the English as compared with the French is explained by Governor Paliser to arise from the employment of 9,976 inhabitants, which are included in the general enumeration.

ANNUAL VALUE OF THE FISHERIES OF DIFFERENT COUNTRIES.

AGGREGATE VALUE OF FRENCH FISHERIES.

France, 1871	70,000,000 Francs.
1872.....	74,000,000

The French Newfoundland fisheries produced 10,500,000 francs in 1872 and 8,300,000 francs in 1871. The French Iceland fisheries 6,400,000 francs in 1872, and 5,381,000 francs in 1871. In an article on "Les Pecheries de Terre-Neuve," in the *Revue des Deux Mondes* for 1874 (Nov.), a very different statement is made. The French fisheries of St. Pierre and Miquelon together with the French fisheries on this so-called French shore, are there stated to employ 9,000 sailors, and to bring some 15 to 20 millions francs to French commerce.

FRENCH FISHERY ON THE NEWFOUNDLAND COAST.

1871. Product	8,300,000
Number of vessels engaged	163
1872. Product of Newfoundland Fishery	10,500,000
Number of vessels engaged	187

F. CODFISH EXPORTED FROM ST PIERRE AND MIQUELON⁽²⁾

	Quintals dried Fish.	No. of green Fish.	Number of fish.
1858	233,291	495,741.	
1859	224,339	1,209,070.	" "
1860	206,080	1,280,872.	" "
1861	165,939	1,614,205.	" "
1862	206,545	1,004,380.	" "
1863	152,583	3,231,253.	Kilogramme.
1864	196,997	4,691,063.	"

Number of Craft employed in the Fisheries (1864.)

98 square-rigged vessels.....	Carrying 2,742 men
579 small craft and boats	4,541 "
Total	7,283

STATISTICS OF THE LOFOTEN FISHERIES FOR THE YEAR 1870 TO 1873 INCLUSIVE :—

Year.	Fish.		Yield in Liver.		Yield in Roes.	
	Number.	Price per 120.	Quantity.	Price.	Quantity.	Price.
	Millions.	Sp. dol.	Barrels.	Sp. dol.	Barrels.	Sp. dol.
1870	123	6	30,000	6	20,000	9
1871	19	7	22,000	6 4-5	16,000	7
1872	18	6 1-5	24,000	5 3-5	22,000	6 1-5
1873	22 ¹ / ₄	7	59,000	6	31,000	8

(1) *Revue Maritime et Coloniale*, 1874.

(2) *Newfoundland Journal of the Council*, 1866.

The following table shows the number of men and boats engaged, and produce of the gear used in the fishery for the year 1873:—

With Nets.					With Lines.				With Deep Sea Lines.				Totals.			
Fishermen.	Labourers.	Boats.	Nets combined with Lines.	Fish caught.	Fishermen.	Labourers.	Boats.	Fish caught.	Fishermen.	Boats with Lines.	Fish caught.	Boats without Lines.	Fishermen.	Boats.	Labourers.	Fish caught.
8,971	1,511	1,774	224	10,782,000	6,832	1,027	1,922	10,683,000	1,459	35	785,000	544	17,264	4,275	3,771	22,250,000

DETAILS OF NORWEGIAN FISHERIES.

Value of the Fisheries in detail in 1873.

	Specie Dollars.	£. str.
Cod Fisheries.....	2,741,626	609,249
Cod Roes	362,536	80,564
Liver Oil.....	746,166	165,804
Herring Fishery	1,153,550	256,345
Mackerel "	186,350	41,412
Salmon "	36,000	8,445
Lobster "	136,843	30,410
Total	5,363,065	£1,192,229
Shark Fishery	24,749	
Walrus "	24,654	
Seal "	360,000	90,979
	409,403	
Grand total	\$5,772,468	£1,283,208

Artificial guano is largely manufactured from fish refuse and from whale carcasses. In 1873 there were in Sweden and Norway 2 German, 1 French and 2 Norwegian factories of fish guano. In 1870 from 5,000,000 to 6,000,000 cods' heads were collected for guano manufacture.

The Norwegian coast line extends for 1,500 miles and is fringed by innumerable islands. The fisheries give employment to 50,000 men (1).

BAIT USED IN THE LOFOTEN FISHERY.

Small sprats are commonly used as bait at the Lofoten fishery. The consumption is estimated at about 25 barrels per man, or in all about 20,000 barrels, valued at from £11,111 to £13,333. Three steamers are constantly employed in supplying the fishing station with bait.

The total value of the fish caught at Lofoten in 1875 (23,000,000), including value of liver and roes, amounted to £393,334. The proportion of the wages or earnings of the net fishermen to the line fishermen who consumed the bait was as 11 to 9, so that the value of the catch of the line fishermen, who mustered, in 1875, 9,141, consuming 2½ barrels bait per man, or in all 22,852 barrels of bait, must have been about £177,000, and the ratio of the value of barrels to catch, notwithstanding all the facilities afforded by Government, was about one to thirteenth. In other words, the cost of the bait amounted to about one-thirteenth of the catch in the most favored cod-fishing places known in the world, with every facility offered to fishermen for prosecuting their work, by supplying them with bait on a large scale.

CAPE BRETON ISLAND.

STATE OF THE FISHERIES carried on by the French in the Island of Cape Breton, previous to the British taking possession in 1758.

	Deck vessels.	Shallops.
Egmont Bay, near Cape North.....		30
Meganish Bay and Cove.....		245
Meganish Islands.....		30
Port Dauphin on St. Anne's	100	
Entrance of Great Bras d'Or.....	20	45
Petit Bras d'Or.....		60
Spanish River or Sydney	6	
Indian Bay or Lingan.....		50
Scattarie Island.....		200
Main a Dieu		190
Lorambes.....		80
Louisburg	300	300

(1) Consular Report.

Gabarus Bay.....		50
Fouche		50
St. Esprit Island.....		60
Grande Riviere.....		60
L'Arloise.....		14
St. Peters.....	100	
R-ri de Grat Isio Madame		100
River and Bay of Inhabitants	100	
Different places in the Gut of Canso.....	100	
	726	1,555
726 decked vessels at 8 men each		5,808
1,555 Shallops at 6 men each.....		9,336
Total		15,138
726 decked ves-els at 700 quintals		508,200
1,555 shallops at 300 quintals		466,500
Total.....		974,700 quintals

This was the amount of fish annually exported from Cape Breton.

FISHERY STATISTICS OF CANSO.

In 1720 P. Mascarene relates that but for the depredations of the Indians, 20,000 quintals of codfish would have been exported from Canso in that year; and in 1725 Governor Armstrong writes that the Canso fishery is "one of the greatest in the world." Speaking of Chedabucto in 1749, Cornwallis writes that the harbour is "full of fish of all kinds," and in the same year he states that Chedabucto, in respect of fishing, has the advantage of all the Maritime Colonies. In 1750 Cornwallis noticed the general failure of the fisheries, but (writing from Halifax) he says the produce of the fishery is but 25,000 quintals, instead of 30,000, as he expected.

In the year 1740, according to a report sent to the Lords Commissioners of Trade by Capt. Smith, of H. M. S. "Eltham," the guardship of Cansoau, 48 schooners and 393 chaloups were employed in the cod fisheries of Cape Breton, at the following places:—

	Quintals.
At Louisbourg, 42 schooners, which caught	25,200
" 20 chaloups,	40,000
Niganiche, 54	13,000
Satarie, 6 schooners,	3,600
" 18 chaloups,	4,500
Baleine, 30	6,000
Lorambee, 12	2,100
Fouche, 19	5,700
St. Esprit, 23	6,900
Isle Michaux 5	1,250
Petit de Grat, 18	4,500
L'Indienne, 14	3,500
Total.....	117,050
Number of fishermen.....	2145

CAPE BRETON ISLAND.

"It has been ascertained that from the portion of this Island within the Strait of Canso the following quantities of fish were exported in the year 1850:—

Codfish	25,570 quintals.
Herrings	8,750 barrels.
Spring Mackerel	51,600 "
Fall Mackerel.....	7,670 "

"No returns can be procured from the Northern and Western portions of this Island, the fish caught near which being generally carried direct to market from the fishing grounds by the fishermen themselves, without reference to any Custom House. It has been ascertained, however, on good authority, that the quantity of herrings and mackerel caught and cured at Cheticamp (the Western extremity of Cape Breton), during the season of 1851, was not less than 100,000 barrels." (4)

TABLE SHOWING THE RELATION BETWEEN THE YIELD OF OIL AND THE CATCH OF COD AS INDICATING THE CONDITION OF THE LIVER OF THE FISH AND THE VARIATION IN THE SUPPLY OF FOOD DURING DIFFERENT YEARS, IN NEWFOUNDLAND.

In 1856 it required 300 quintals to produce one ton of Cod Liver Oil.			
1857	280	"	"
1858	"	"	"
1859	257	"	"
1860	296	"	"
1861	361	"	"

(1) From Brown's History of Cape Breton.

(2) Nova Scotia Documents.

(3) A History of the Island of Cape Breton, by Richard Brown, F. G. S., F. R. G. S., London, 1869.

(4) Andrew's Report on Colonial and Lake Trade, Washington, 1854.

1862	it required 312 quintals to produce one ton of Cod Liver Oil.
1863	" 335 " " "
1864	" 451 " " "
1865	" " " " "
1866	" " " " "
1867	" " " " "
1868	" 225 " " "
1869	" 248 " " "
1870	" 256 " " "
1871	" 235 " " "
1872	" 280 " " "
1873	" 320 " " "
1874	" 517 " " "
1875	" 370 " " "

From this table it appears that while in 1859 it required but 257 quintals of fish to make one ton of oil, in 1864 it took 451 quintals, and in 1874 no less than 517 quintals to produce a ton of liver oil. The inference is that in 1864 and 1874 the fish were poorly fed, and in 1868 and 1871 they were richly fed.

Under date Aug. 7, 1778, Sandwich Bay, Labrador, Cartwright says:—"Fish not well fed this year."

IN NORWAY.

Adopting a different method of comparison with respect to the Norwegian Fish, which the returns permit, we have the following curious result:—

The number of fish required to make a Norwegian barrel of liver and a barrel of fish roe, or spawn, was as given below:—

Year.	No. of fish to a barrel of Liver.	No. of fish to a barrel of Roe.
1870.....	766	1150
1871	864	1187
1872	750	818
1873.....	375	714

According as more fish were required to make a barrel of liver, so also was a greater number required to make a barrel of roe. Roe and liver appear to be mutually dependant upon one another. This may be explained by supposing that the size of the fish varied, or that the fish were less richly fed. The true state of the case is, perhaps, explained by the appearance of the fish caught on the Lofoten Banks in 1870, as stated in the text, page 67.

THE EFFECTS OF THE EARTH'S ROTATION ON THE LABRADOR CURRENT.

The rapidity of the diurnal motion of any point on the surface of the earth, from west to east, varies with its latitude. On the sixtieth degree the speed of rotation is about nine miles in a minute; in the latitude of Paris it is a little more than eleven and a half miles during the same period, whereas on the equator the motion of any point from west to east is at the rate of eighteen miles a minute, or equal to that of a cannon ball weighing 26 pounds and projected from a piece of artillery with thirteen pounds of powder. (1) Hence it is that any current, whether of a river or in the ocean, moving from north to south in the northeru hemisphere, must necessarily remain in the rear of the increasingly rapid terrestrial movement which carries it round, and must consequently deviate towards the west. The arctic current moving generally from north to south, continually traverses as it gains a more southern latitude portions of the earth's surface, which are moving with increasing rapidity towards the east, owing to its rotation; the current is, as it were, left behind, being a body possessing a distinct motion of its own, and the result is that it has always an increasing westerly trend, as it progresses towards the equator. The reverse of this is the case with the Gulf Stream, which flows generally from south to north, and is continually attaining parts of the earth's surface, which have a rapidly diminishing motion from west to east, and the tendency to leave it in the rear grows less in proportion, hence its deviation is towards the east or in the direction of the earth's rotation.

In the southern hemisphere exactly the reverse action takes place. This law of deviation is observed by all moving bodies, such as winds, rivers, balls in motion, etc. Rivers in the northern hemisphere flowing from north to south cut away the west bank, whereas rivers flowing from south to north attack the east bank. Rivers flowing from east to west have their currents accelerated, and from west to east retarded, because they flow respectively with or against the motion of the earth.

The Labrador current is thus evidently affected by the rotation of the earth, which causes it to press upon the coasts, and as it rounds capes this pressure is removed, which causes at once strong local currents to the westward, the cause it is feared of many shipwrecks and the loss of life, especially in vicinity of Cape Race, Newfoundland, and in a less degree Cape Sable, N. S.

WRECKS OF FISHING VESSELS ON BRITISH-AMERICAN SHORES FROM 1863 TO 1876.

Nationality.	No. of vessels lost.
Canadian.....	105
American	62
British	1
Newfoundland	1
Total.....	169

Average tonnage of the vessels lost..... 60 tons.

(1.) Consular Report.
(2.) Reclus. "The Earth."