FISH AND FISHERIES

A SELECTION FROM

The Prize Essays

OF THE

INTERNATIONAL FISHERIES EXHIBITION

EDINBURGH, 1882.

EDITED BY

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WITH MAPS AND ILLUSTRATIONS

WILLIAM BLACKWOOD AND SONS
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PREFACE.

THIS volume is an outcome, and may be regarded as a memorial, of the International Fisheries Exhibition held at Edinburgh during April 1882. That interesting display of the methods and materials of the fishing industry, and its results in fish as food, was preceded in England by the National Fisheries Exhibition, at Norwich, in the spring of 1881, and was followed by a Maritime Exhibition, with a Fisheries Department, at Tynemouth, from September 6 to October 14, 1882. These three successful events must be regarded as very auspicious heralds of the Great International Fisheries Exhibition that is to be held in London during the present year 1883. The Norwich Exhibition was preceded, in Germany, by the International Fish and Fishing Exhibition, at Berlin, in 1880. In France there was the International Maritime Exhibition at Paris in 1875, and a kindred Exhibition at Havre in 1869. In the Netherlands there was a Fishery Exhibition, at the Hague, in 1868. And, again in France, the first great Fishery Exhibition was held at Arcachon in 1866.

Great shows of the materials, methods, and implements of agricultural industry, and its results in various staple articles of food, are of earlier date. The Highland and Agricultural Society of Scotland has held Exhibitions annually since 1821. The Royal Agricultural Society of England was incorporated by Royal Charter in 1840. And these two national associations are both best known by their important and magnificent shows. Local cattle-shows also are very common, and exhibitions of poultry—especially under the management of Christmas Clubs—are becoming universal.

The principle of a grand show, on the other hand, in the interest of the manufacturing industries, received imperial and international sanction in the Great Exhibition of 1851—thirty years later than the start made by the Highland and Agricultural Society,—and it has been frequently and splendidly applied since that year, so memorable and significant on account of the London Exhibition.

It is distinctly a modern enterprise, the show on a large scale of the materials, methods, and results of industry, with the view of stimulating industry—an aspect in which Art Exhibitions also may be viewed,—and it is a mode of enterprise very different from the venerable institution of a show whose end is amusement,—its only industry the arranging and working of it, and its commercial value, when it has any, the money that passes as the price of admission. Ancient and modern ideas of the requirements of social order could not easily be put in more vivid contrast. The Highland and Agricultural Society of Scotland, the Royal Society of England, and the Great Exhibition of 1851, have been, in the order of time in which they are given, the three leading agencies in this country in infusing modern life into an ancient institution and new meaning into an old name—in transforming a show into a commercial enterprise with prospective aims at benefit.

The International Fisheries Exhibition at Edinburgh was a show of this kind; and a succinct account of its origin and success would seem to form a fitting Preface to its memorial volume.

The first suggestion of a Fishery Exhibition in Scotland

—so far, at least, as such a suggestion has been embodied in any available document—came from Mr. W. Anderson Smith, Ledaig, Argyllshire, who, in a letter dated 31st January 1881, to Mr. F. N. Menzies, Secretary of the Highland and Agricultural Society, on behalf of the fisheries and other industries of the Highlands, said: "May I suggest, as a prominent mode of drawing attention to your desire to do justice to these industries, that a *Fisheries Exhibition* be held in Glasgow, in connection with your great Exhibition of 1882?" The italics are Mr. Anderson Smith's. A few days later, an article appeared in the *Scotsman*—on February 8, 1881—headed, and advocating, "A Fisheries Exhibition in Edinburgh." In that article the Waverley Market was pointed out as an area very suitable for such a Show.

Mr. Anderson Smith's letter was brought under the notice of the Directors of the Highland and Agricultural Society on March 2, 1881; and at the same meeting there was read a letter from Mr. Archibald Young, advocate—at that time Commissioner of Scotch Salmon Fisheries—suggesting that the proposed Exhibition should be held in Edinburgh. These letters were referred to a special committee on Highland Industries, consisting of Sir M. R. Shaw Stewart, Bart., Sir James R. Gibson Maitland, Bart., Sir James H. Gibson-Craig, Bart., Mr. Irvine of Drum, and Professor Wilson—Sir James H. Gibson-Craig to be convener. The committee requested the Secretary of the Society, Mr. F. N. Menzies, to prepare a statement, showing what the original objects of the Society were, and what the Society did formerly in promoting the fisheries and other industries of the Highlands of Scotland. That statement was prepared and submitted to the Committee, at its meeting on April 6, 1881. It showed that to extend and promote fisheries was one of the original objects of the Society;

that the first advertisement of premiums by the Society was published in March 1785, when various gold medals were offered for essays relative to fisheries and manufactures in the Highlands; that these premiums were continued for several years, and that numerous awards were made for reports on subjects connected with the fisheries. The statement showed also that to the exertions of the Society were due the establishment of the British Fisheries Society, and the Scottish Board of Fisheries.

The Committee, at the same meeting, gave the statement submitted to it full consideration, and, "anxious that the "original objects of the Society should not be lost sight of, had "no hesitation in recommending the Directors to re-establish "a department on Highland industries and fisheries."[1] They recommended also that Mr. F. N. Menzies, the Secretary of the Society, should visit the National Fisheries Exhibition at Norwich, with a view of ascertaining whether any of the classes shown there could be beneficially introduced into the general Shows of the Society.

Mr. Menzies accordingly visited the Fisheries Exhibition at Norwich, as did also Sir James R. Gibson Maitland, and Mr. Archibald Young, both members of Committee—Mr. Young having joined it in the meantime—who were also members of the Council of the Scotch Fisheries Improvement Association. Mr. Menzies reported to a meeting of Directors of the Highland and Agricultural Society, on May 4, 1881, that the Exhibition at Norwich was most interesting, and that much of what they had seen could be advantageously introduced into the Shows of the Society.

In the meantime another energetic agency was at work. At

[1] See *Transactions of the Highland and Agricultural Society of Scotland*, Fourth Series, vol. xiv., Appendix (A), page 15.

a meeting of the Council of the Scotch Fishery Improvement Association, held on February 17, 1881, the Secretary, Mr. J. Barker Duncan, W.S., called attention to the article in the *Scotsman* of the 8th instant, and also to a notice, in *Land and Water*, of the forthcoming Exhibition at Norwich. The Council requested Mr. Young to report on the subject. At the next meeting of Council, March 17, 1881, Mr. Young read a report on the proposed Fisheries Exhibition in Edinburgh, and mentioned the substance of communications on the subject to and from the Highland and Agricultural Society, the City Clerk of Edinburgh, and others. The Council expressed their belief that such an Exhibition in Edinburgh would be a great success.

At a meeting of the Council, held on May 12, 1881, after the Norwich Exhibition was over, Mr. Young made a statement regarding that Exhibition, which Sir James R. Gibson Maitland and he had visited, and moved that steps be taken to promote a similar Exhibition in Edinburgh. Sir James R. Gibson Maitland concurred with the views expressed by Mr. Young, and seconded his proposal. The terms of a memorial to be presented to the Town Council were adjusted. It was agreed that a deputation should wait on the Town Council at its next meeting, and that Sir James R. Gibson Maitland should see Mr. F. N. Menzies, with the view of cooperating with the Highland and Agricultural Society.

The Memorial, as finally adopted, was as follows:—

The success which has attended the National Fisheries Exhibitions in Paris, Berlin, and Norwich has induced many Scotchmen to think that a similar Exhibition held in Edinburgh, in the course of April 1882, would be not only highly advantageous to our fisheries, but would likewise prove a great attraction to the public.

The Scotch herring fishing is the most valuable fishing industry in the United Kingdom. It has increased so much during the present century that the single port of Fraserburgh, one of the chief centres of the herring trade, now takes, in an average year, as many herrings as were captured in the whole of Scotland in 1809. It is still, however, susceptible of further development. Then there are the cod, ling, haddock, and other hook and line fisheries; the crab and lobster fisheries, the salmon fisheries, and the oyster, clam, and bait fisheries; all of which would derive great encouragement from the holding of a National Fisheries Exhibition in Edinburgh, the capital of the country, and the natural centre of the most valuable fisheries in Scotland. Before, however, taking any further steps in the matter, we are anxious to obtain the approval and co-operation of the Lord Provost, Magistrates, and Town Council.

At a meeting of the Town Council, held on May 17, 1881, there was presented a letter from Mr. J. Barker Duncan, W.S., Secretary of the Scotch Fishery Improvement Association, on the subject of the proposed Fisheries Exhibition, and along with it the Memorial. The following deputation was introduced by Bailie Hall to support the Memorial:—Mr. D. Milne Home of Milne Graden; Sir James R. G. Maitland, Bart., Craigend; Major-General A. Macdonald of Dalchosnie; Messrs. E. A. Stuart Gray of Gray and Kinfauns; Archd. Young, advocate, Commissioner of Scotch Salmon Fisheries; Andrew Rutherfurd, advocate; David Lang, LL.B., advocate; Charles Morton, W.S.; John Colquhoun, Royal Terrace; James A. Wenley, Bank of Scotland; Alexander Fraser, Canonmills Lodge; William Handyside, Claremont Crescent; James Grant, S.S.C.; William Menzies, Picardy Place; John Anderson, Denham Green; J. Barker Duncan, W.S.; Fletcher N. Menzies, Secretary to the Highland and Agricultural Society.

Mr. David Milne Home of Milne Graden, as spokesman of the deputation, urged upon the attention of the Town Council that, however prosperous the Scottish fisheries were, such an Exhibition would tend to develop and improve them greatly. The object of the deputation was gained. The Magistrates and Council remitted to the Lord Provost's Committee, with powers, to further the object in view,—Councillor M'Lachlan being added to the Lord Provost's Committee for the purpose of carrying out this special object.

On the same day Mr. F. N. Menzies reported to the Committee of the Highland and Agricultural Society that he had attended the meeting of the Town Council as one of the deputation.

Thus a stage was reached, from which clearer and better defined progress could be made towards an Exhibition,—the Town Council, the Highland and Agricultural Society, and the Scotch Fisheries Improvement Association being all willing to take joint action in the matter. The proposal to hold a Fisheries Exhibition was thus also prominently brought under the notice of the public.

At a meeting of Council of the Scotch Fisheries Improvement Association on May 18, 1881, a letter was read from Sir James R. Gibson Maitland, intimating that he would be happy to subscribe £100 to a Guarantee Fund for the proposed Fisheries Exhibition. This was the first promise of a subscription to that fund. Sir James said also in that letter: "I would "suggest an efficient executive committee, elected by the Town "Council, the Highland and Agricultural Society, and our own "Association; and, in addition, a small committee of our own "Association should be appointed to consider what special "prizes we should offer in the name of the Scotch Fisheries "Improvement Association, and consider how the requisite "sums are to be obtained." Acting according to the suggestion, the Council of this Association appointed Sir James R. Gibson Maitland, Mr. David Milne Home of Milne Graden, Mr. Archibald Young, and Mr. J. Barker Duncan, as a committee to co-operate with the other committees in a joint committee. And at the first annual meeting of the Scotch Fisheries Improvement Association, May 31, 1881,—Mr. David

Milne Home in the Chair,—Sir James R. Gibson Maitland moved—"That whilst cordially approving of the Report sub-"mitted, this meeting heartily and specially concurs in the "steps which have been taken by the Council of the Asso-"ciation for the purpose of holding a Fisheries Exhibition "in April 1882." Mr. Archibald Young seconded this motion, and it was adopted by the meeting.

Next day, June 1, 1881, at a meeting of the committee of the Highland and Agricultural Society, the desirability of appointing a Committee to co-operate with the Lord Provost's Committee and the Committee of the Scotch Fisheries Improvement Association, to arrange for the National Fisheries Exhibition, was under consideration, and the Committee of the Highland and Agricultural Society resolved to recommend their Directors to join the movement. It was at this meeting of the Society's Committee that the suggestion was first made that the proposed Exhibition should be styled International. Acting on this recommendation of their Committee, the Directors subsequently appointed the committee on Highland Industries, whose names have been already given, with the name of General Burroughs of Rousay, C.B., added, to co-operate with the committees of the Town Council and the Scotch Fisheries Improvement Association in a Joint-Committee.

In the meantime, the co-operation in this good work of another association had been solicited, and was obtained. A letter, dated May 27, 1881, from Mr. J. Barker Duncan, W.S., was read at a meeting of the Master, Treasurer, and Assistants of the Edinburgh Merchant Company, on July 11, 1881—Sir James Falshaw, Bart., in the Chair—directing the attention of the Company to the proposed Fisheries Exhibition. The meeting remitted to the Master, Sir James Falshaw, Bart., and the Treasurer, Mr. Josiah Livingston, to confer with any committee which might be appointed by the Magistrates and Town Council, in reference to the proposed Exhibition.

The Joint Executive Committee was thus formed. And at its first meeting, in midsummer 1881—the Lord Provost, Sir Thomas J. Boyd, in the Chair—it was formally constituted with Honorary Secretaries. At that meeting it was resolved that the Exhibition should be held in Edinburgh during April 1882, and that it should be International. The committee instructed the honorary secretaries to put themselves in communication with heads of Foreign Departments, with a view to obtaining exhibits from them. The executive committee, as finally adjusted and published in the official catalogue, was—

THE RIGHT HON. SIR THOMAS JAMIESON BOYD, LORD PROVOST OF EDINBURGH, *Chairman*.
THE MOST HON. THE MARQUIS OF AILSA.
SIR JAMES H. GIBSON CRAIG OF RICCARTON, BART.
ALEX. F. IRVINE OF DRUM.
GENERAL BURROUGHS OF ROUSAY, C.B.
JAS. MAXTONE GRAHAM OF CULTOQUHEY.
BAILIE HALL, EDINBURGH.
TREASURER HARRISON, EDINBURGH.
COUNCILLOR M'LACHLAN, EDINBURGH.
J. BARKER DUNCAN, W.S., EDINBURGH.
JOHN MURRAY, F.R.S.E. ("CHALLENGER" EXPEDITION).
JOHN ANDERSON OF DENHAM GREEN, TRINITY.
JAMES D. PARK (JAMES DOVE & CO., EDINBURGH), ENGINEER TO THE HIGHLAND AND AGRICULTURAL SOCIETY.

The names of the late Sir C. Wyville Thomson and of Bailie Anderson, Edinburgh, appear on an earlier list of the Executive Committee. The Honorary Secretaries, appointed also *ex officio* members of the Executive Committee, were—

SIR JAMES RAMSAY GIBSON MAITLAND OF BARNTON, BART.
WILLIAM SKINNER, TOWN CLERK OF EDINBURGH.
F. N. MENZIES, SECRETARY TO THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.
ARCHIBALD YOUNG, COMMISSIONER OF SCOTCH SALMON FISHERIES.

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At that first meeting, the name of Mr. James A. Wenley, of the Bank of Scotland, was suggested as Honorary Treasurer, an office which that gentleman consented to assume, he becoming thus also an *ex officio* member of committee.

At the next meeting, August 3, 1881, Mr. F. N. Menzies stated that rooms in the Highland Society's Buildings, 3 George IV. Bridge, could be placed at the disposal of the Secretaries and Committee as offices for the meetings and business of the Exhibition, and this was accepted. At the same meeting, Mr. Menzies was instructed to send a list of the noblemen and gentlemen who had, up to that time, consented to become Patrons of the Exhibition, to the Duke of Buccleuch, with a view to his Grace approaching His Royal Highness the Duke of Edinburgh, to request the Prince to become President of the Edinburgh International Fisheries Exhibition. At a subsequent meeting, Mr. Menzies submitted a letter from the Duke of Buccleuch, intimating that the Duke of Edinburgh would have great pleasure in acceding to the request that he should be President of the Exhibition; adding that it was a subject in which His Royal Highness took the greatest interest, and desired to be kept informed of the date at which it was to open, in the hope that he might be able to be present.

The scheme having been fairly launched, the Executive Committee began their labours. In bringing it under the notice of the public, the Committee were successful in securing the patronage of many influential noblemen and gentlemen interested in the subject; and it may not be out of place here to give the List of the Patrons as it appeared in the official Catalogue.

H.R.H. PRINCE ALFRED ERNEST ALBERT DUKE OF EDINBURGH, K.G., K.T., K.P.—*President.*

His Grace the Duke of Buccleuch and Queensberry, K.G.
His Grace the Duke of Richmond and Gordon, K.G.
His Grace the Duke of Argyll, K.T.
His Grace the Duke of Roxburghe.
His Grace the Duke of Portland.
His Grace the Duke of Sutherland, K.G.
The Most Hon. the Marquis of Exeter.
The Most Hon. the Marquis of Lothian, K.T.
The Most Hon. the Marquis of Ailsa.
The Most Hon. the Marquis of Tweeddale.
The Rt. Hon. the Earl of Caithness.
The Rt. Hon. the Earl of Mar and Kellie.
The Rt. Hon. the Earl of Home.
The Rt. Hon. the Earl of Elgin and Kincardine.
The Rt. Hon. the Earl of Leven and Melville.
The Rt. Hon. the Earl of Breadalbane.
The Rt. Hon. the Earl of Glasgow.
The Rt. Hon. the Earl of Rosebery.
The Rt. Hon. the Earl of Hopetoun.
Lord Colin Campbell, M.P.
The Rt. Hon. Viscount Arbuthnott.
The Rt. Hon. Viscount Strathallan.
The Rt. Hon. Lord Elcho, M.P.
The Rt. Hon. Lord Saltoun.
The Rt. Hon. Lord Herries.
The Rt. Hon. Lord Kinnaird.
The Rt. Hon. Lord Polwarth.
The Rt. Hon. Lord Abinger.
The Rt. Hon. Lord Tweedmouth.
Major the Hon. Robert Baillie Hamilton.
The Hon. R. Preston Bruce, M.P.
The Hon. Bouverie Francis Primrose, C.B.
The Rt. Hon. John Inglis, Lord Justice-General.
The Rt. Hon. J. B. Balfour, M.P., Lord Advocate of Scotland.
Sir Wm. Forbes of Craigievar, Bart.
Sir Robert John Abercromby of Birkenbog, Bart.
Sir Robert Menzies of Menzies, Bart.
Sir Michael R. Shaw Stewart of Blackhall, Bart.
Sir Alexander Jardine of Applegarth, Bart.
Sir Robert Anstruther of Balcaskie, Bart.
Sir James Gardiner Baird of Saughton Hall, Bart.
Sir George H. Leith Buchanan of Ross, Bart.
Sir John George T. Sinclair of Ulbster, Bart., M.P.
Sir Molyneux Hyde Nepean of Loders Court, Bart.
Sir G. Graham Montgomery of Stanhope, Bart.
Sir James Ramsay Gibson Maitland of Barnton, Bart.
Sir James H. Gibson Craig of Riccarton, Bart.
Sir George Houstoun Boswall of Blackadder, Bart.
Sir George Macpherson Grant of Ballindalloch, Bart., M.P.
Sir Thomas Gladstone of Fasque, Bart.
Sir Alex. Milne, Bart., G.C.B., Admiral of the Fleet.
Sir James Falshaw, Bart.
Lieut.-Gen. Sir J. E. Alexander of Westerton, C.B.
Sir Alexander Anderson.
Sir Peter Coats of Auchendrane.
General Sir George Balfour, M.P.

Sir Hugh Allan, Montreal.
Sir Donald Currie of Garth, M.P.
Sir George Waldie Griffith, Bart.
The Right Hon. Sir Thomas Jamieson Boyd, Lord Provost of Edinburgh.
The Hon. John Ure, Lord Provost of Glasgow.
The Lord Provost of Perth.
The Lord Provost of Aberdeen.
The Provost of Leith.
The Provost of Dundee.
The Provost of Wick.
The Provost of Montrose.
The Provost of Annan.
The Provost and Magistrates of Dunfermline.
The Provost and Magistrates of Stirling.
W. Cunliffe Brooks, Esq., M.P.
T. R. Buchanan, Esq., M.P.
Stephen Williamson, Esq., M.P.
The Magistrates and Town Council of Leith.
The Edinburgh Chamber of Commerce.
The Edinburgh Fish Trade Association.
The Forth Yacht Club.
The Leith Dock Commissioners.
The British Fisheries Society of London.
The Walton Angling Club, Edin.
The Waverley Angling Club, Edin.
The Lochleven Angling Club.
London Fish Market and National Fisheries Company.
General Burroughs of Rousay, C.B.
General Irvine.
Major-Gen. A. Macdonald of Dalchosnie, Commander-in-Chief in Scotland.
Major-General Henry, C.B.
Colonel Balfour of Balfour.
Colonel Moncrieff, C.B.
Colonel J. Colquhoun.
Major Hamilton of Dalzell.
Admiral Maitland Dougall of Scotscraig.
Professor Archer.
Walter Berry, Esq. of Glenstriven.
A. J. Dennistoun Brown, Esq. of Balloch.
Francis Day, F.L.S. and F.Z.S., Deputy Surgeon-General (retired), late Inspector-General of Fisheries in India.
R. W. Duff, Esq. of Fetteresso, M.P.
Duncan Forbes, Esq. of Culloden.
James Maxtone Graham, Esq. of Cultoquhey.
Albert C. L. G. Gunther, M.A., Ph.D., M.D., F.R.S., Keeper of the Zoological Department in the British Museum.
J. B. Hamilton, Esq. of Leny.
Wm. Holms, Esq., M.P.
David Milne Home, Esq. of Milne Graden.
Robert Hutchison, Esq. of Carlowrie.
The Edinburgh Angling Club.
J. A. Harvie Brown, Esq. of Quarter.
D. J. Macfie, Esq. of Borthwick Hall.
Alex. Forbes Irvine, Esq. of Drum, Sheriff of Argyllshire.
Professor Douglas Maclagan.
J. D. Maclean, Esq., Lagarly Hall.
James Clerk Rattray, Esq., M.D.
James Duncan, Esq. of Benmore.
James F. Pullar, Esq.
John Pender, Esq. M.P.
John Pullar, Esq.
Robert Pullar, Esq.
Andrew H. Turnbull, Esq.
Robert Crossman, Esq.
Alex. Campbell, Esq. of Cammo.
E. A. Stuart Gray, of Gray and Kinfauns, Esq.
Charles Morton, Esq., W.S.
John Wm. Young, Esq., W.S.
John F. Cathcart, Esq.
A. R. Gillespie, Esq.
Geo. J. R. Gordon, Esq. of Ellon.
T. G. Murray, Esq. of Stenton.
John M. M'Candlish, Esq., W.S.
John Blair, Esq., W.S.
Thomas Aitken, Esq.
Wm. Warden & Co., Leith.
Edward Marjoribanks, Esq., M.P.

F. Newman, Esq.
Wm. Gardner, Esq.
Geo. Waterston, Esq.
John Murray, Esq., F.R.S.E.
David Carnegie, Esq. of Stronvar.
R. W. Cochran-Patrick, Esq., M.P.
Geo. Hunter Thoms, Esq., Sheriff of Caithness and Orkney.
Charles Rampini, Esq., Sheriff-Substitute of Shetland, Lerwick.
W. S. Thomson Sinclair, Esq. of Freswick.

Professor Turner.
Thos. Stevenson, Esq., C.E.
J. Leslie, Esq., C.E.
H. G. Cumming, Esq.
Archd. Young, Esq.
} *Commissioners of Scotch Salmon Fisheries.*
Spencer Walpole, Esq.
Professor Huxley,
} *H.M. Inspectors of Fisheries for England and Wales.*
Major Hayes,
T. F. Brady, Esq.,
W. Johnston, Esq.,
} *Inspectors of Irish Fisheries.*
J. Lindsay Bennet, Esq.

AND

The Worshipful the Fishmongers' Company of London.

The raising of a Guarantee Fund was another of the essential preliminary arrangements. It was in May that Sir James R. Gibson Maitland had written pointing to the necessity for securing such a Fund, and intimating his readiness to subscribe to it; and the Executive Committee resolved, in October, to appeal to the patrons, to corporations, and others who might feel interested in the forthcoming Exhibition, for guarantee subscriptions. The subscriptions varied from a hundred guineas to one pound sterling, showing widely prevailing sympathy with the aims of the Committee, and foreshadowing the success of the Exhibition. Fortunately none of the subscribers were called on for any of the money subscribed, but none the less do they deserve the thanks of the Committee and of the public for the assistance they rendered.

The hundred-guinea subscribers were public bodies:—The Town Council of Edinburgh, The Highland and Agricultural Society of Scotland, and the Fishmongers' Company of London. The Town Council of Glasgow subscribed fifty guineas. Lord Tweedmouth put his name down for £60; the Duke of Buccleuch, the Earl of Rosebery, and Mr. David

Milne Home of Milne Graden subscribed each £50. The Duke of Portland subscribed £30, as did also Mr. Robert Crossman of Cheswick, Beal, Northumberland. The Leith Dock Commission subscribed twenty-five guineas. The Marquis of Lothian, the Earl of Breadalbane, the late Sir C. Wyville Thomson, Mr. J. W. Young, W.S., Mr. John F. Cathcart, Mr. R. M. Smith, Mr. John Colquhoun, Mr. Thomas Aitken, and Mr. John Murray, each subscribed £25. This amount also was at first guaranteed by the Edinburgh Merchant Company, and was subsequently changed by them into a payment to the funds of the Exhibition. It was given in their name as a prize for the essay on Harbour Accommodation. The Town Council of Aberdeen also guaranteed £25. The Town Council of Leith subscribed twenty guineas. A guarantee of £20 was given by the Duke of Roxburghe, the Marquis of Tweeddale, the Earl of Home, the Earl of Glasgow, the Earl of Leven and Melville, Lord Saltoun, Lord Abinger, the Hon. R. P. Bruce, the Hon. Bouverie F. Primrose, C.B., General Burroughs, C.B., Mr. Edward Marjoribanks, M.P., Mr. E. A. Stuart Gray of Gray, Mr. James Leslie, C.E., and Mr. Andrew H. Turnbull, Manager of the Scottish Widows' Fund Assurance Society. The names subscribed for sums under £20 formed a lengthy and varied list.

At a meeting of the Executive Committee, December 7, 1881, Mr. Menzies was requested to apply to the Home Office for a substantial recognition of the Edinburgh Exhibition, similar to that which had been extended to the Exhibition at Norwich; and also for the further recognition, that Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries, should co-operate with the Executive Committee under the instructions of the Secretary of State for the Home Department, in the same manner as Mr. Spencer Walpole, Inspector of Fisheries, had co-operated with the committee of the Norwich Exhibition. Government recognised the Exhibition in both these respects. Intimation was received from Lord Rosebery, Under-Secretary of State, Home Department, at a subsequent meeting, of a grant from Government of £150, towards purchasing medals and diplomas of merit, and Mr. Young received the instructions solicited.

Communications had now been opened and correspondence carried on with the heads of foreign fishery departments, with the principal fish-curers and fish-salesmen in the various towns on the coasts of Scotland, with the consuls and vice-consuls at Edinburgh and Leith, the Town Clerks throughout Scotland, and of certain towns in England and Ireland, the London Company of Fishmongers, the Metropolitan Board of Works—in a word, with every public body at home and abroad, and all noblemen, gentlemen, merchants, manufacturers, men of every kind of enterprise that could or would assist the Executive Committee in their endeavour to render the proposed Exhibition a certainty and a success. As the work increased, it became apparent that a stage had now been reached at which the Honorary Secretaries could not any longer be expected to spare the time to carry forward the complicated arrangements which had, from the nature of the undertaking, begun to force themselves on the attention of the Executive Committee. Accordingly, at a meeting, held December 21, 1881, a letter was read from Mr. Wenley, the Honorary Treasurer, intimating that the Bank of Scotland had given him a credit of £1000, on his own security, for the purposes of the Exhibition, and suggesting that the Committee should at once appoint an Acting Secretary who should look after all the details. This suggestion was acted on, and Mr. Henry Cook, W.S., was appointed Acting Secretary on 4th January 1882.

Soon after this the lists of prizes were finally adjusted, and the final selection of subjects, the names of donors, and the amounts of their donations, filled in. A Sub-Committee of Essays and Prizes had been appointed, composed of Mr. John Anderson, Mr. J. Barker Duncan, W.S., Councillor M'Lachlan, Mr. F. N. Menzies, Mr. John Murray, F.R.S.E. ("Challenger" Expedition), Mr. Archibald Young, and Mr. J. Maxtone Graham who had joined the Executive Committee in January 1882. That Sub-Committee had prepared a list of Prizes both for Exhibits and Essays, and it only remained to obtain private donors to take them up. Happily their solicitations were cordially met. Many parties came forward unasked, and others willingly agreed when applied to, and in the Prize List, as ultimately adjusted, the Executive Committee were able to offer money prizes amounting in all to £845 for competition, in addition to the Gold and Silver Medals and the Diplomas which the Government Grant enabled them to confer. The Prize Lists—I. for Exhibits, and II. for Essays—are given in Appendix A. to this Preface.

The list of Jurors to adjudicate on exhibits and essays was a subject of careful and frequent deliberation; and the names of the gentlemen—in the alphabetical order of their surnames—who kindly undertook the arduous and difficult task of adjudicating on the merits of exhibits and essays, will be found in Appendix B.

The exhibits were divided into twelve classes, and these classes, with the subdivisions of those of them that were subdivided, and the names of the jurors appended to each, will be found in Appendix C.

The Loan Collections proved a special attraction at the Exhibition; and chief among them was the splendid assortment of exhibits sent, with great trouble and at his own cost, by Mr.

Oscar Dickson of Gothenburg, under the charge of Dr. A. H. Malm, Director of the Zoological Department of the Gothenburg Natural History Museum, assisted by Herr Lindstrom. By the liberality of Mr. Dickson, and under the able direction of Dr. Malm, the whole exhibits from Sweden, commercial as well as scientific, were displayed as one national collection, and formed the most notable sight of the Exhibition. The Swedish Collection comprised displays of preserved fish, tinned fish, preparations of salmon, fish offal, oil, raw materials for isinglass and gelatine. Specimens of tinned anchovies, with skinned and boned herrings in tins, from a dozen different Swedish exhibitors, showed how extensive that trade has become in the north of Europe. There was a pretty show of brooches and other ornaments from fish scales, made by Evelina Hagberg, Grundsund, Bohus. These were all sold some days before the Exhibition closed. There were publications, statistical tables, paintings, an interesting series of maps, and a chart of the south coast of Sweden, giving the sites of fishing ports and fisheries. Specimens of fishing-tackle also, models of boats, and glass floats for fishing nets—these, manufactured at the glassworks of Messrs. Ornberg and Anderson, Foglavik, Westgötland, and exhibited by them—were among the attractions. Professor A. E. Nordenskiöld, Stockholm, of "Vega" renown, exhibited the following results of his famous voyage:—Evertebrata from the Polar Seas of Asia; parts of skeletons of *Rhytina stelleri*, and the algæ, etc., forming the food of that animal; four screens containing fishing-tackle of the Tochutsks and of the Port Cloimu Esquimaux. There was something very appropriate in the presence of these exhibits, as the "Vega" Expedition was conducted at Mr. Oscar Dickson's sole expense. Mr. J. Randberg of Gothenburg's eggs of birds that prey on fish were interesting.

But Mr. Oscar Dickson's own exhibits had the double interest of their value, and a sense of his generosity in contributing so effectually to the success of the Edinburgh International Fisheries Exhibition. They were a collection of Clupeidæ (herrings) from the Cattegat and other Scandinavian fishing-grounds, and from the northern parts of the Atlantic, at various seasons of the year, and of various ages; a display of the stages of development of several species of fish; and a collection of lower marine and lake animals from Sweden.

There were other attractive loan exhibits, besides those from Sweden. Circumstances connected with one of them deserve, and here receive, specially grateful recognition. They were these: In February 1882, Mr. Fred. C. Clench, 39 Liverpool Street, Bishopsgate, London, E.C., wrote offering to act as Honorary Secretary to a committee in London for the purpose of arranging to send to the Edinburgh Exhibition, on loan, specimens of stuffed fish from the valuable collections of the London Fishing clubs, and of individual members of these clubs. Messrs. R. Ghurney, S. Morgan, R. B. Marston of *The Fishing Gazette*, F. C. Hatfield, J. P. Wheeldon, Captain Alfred, and Mr. L. Bonvoisin most kindly agreed to act with Mr. Clench. By their exertions an extremely interesting and valuable collection was sent to Edinburgh, which added greatly to the attractions of the Exhibition. The Edinburgh Committee were also much indebted to Mr. Morgan, who came in charge of these exhibits, and arranged them. The clubs represented were the Piscatorial Society of London, the Good Intent Angling Society, the Edmonston and Tottenham Angling Society, the Hammersmith United Angling Society, the Reform Angling Society, the Anchor and Hope Angling Society. The individuals who sent from their private collections were Mr. Wilkinson of the Hearts of Oak, Mr. H. Brookwell, Mr. R.

Wright, Mr. W. H. Hare Winton, Mr. W. J. Hodges, Mr. E. Sanders, Mr. Dacosta, Mr. Thomas R. Sachs, Miss Florence Sachs, Mr. John Cooper, Mr. J. Ireland, Mr. James Starkey, Mr. Alfred H. Jervis.

The South Kensington Museum Loan Exhibit, from the collection of the late Mr. Frank Buckland, was a centre of constant crowds at the Exhibition. The exhibits from the South Kensington Museum were under the special charge of Mr. Eden, to whose efficient services the Committee were much indebted. They included an interesting collection of the dredging and other apparatus used on board the "Challenger" in her famous expedition under Sir Wyville Thomson.

In the General Loan Collection there was great variety of interest. Among those of scientific interest, that of Dr. M'Intosh, F.R.S., Physician-Superintendent at Murthly Asylum, and Professor of Natural History in the University of St. Andrews, comprising a collection showing the development, food, parasites, etc., of the Tay salmon, and specimens of crustacea, etc., preserved in spirits, was specially noticeable and valuable, as was also the collection of specimens illustrating the anatomy of fish and the fungus disease, so fatal to Salmonidæ, sent by Professor Turner of Edinburgh University. The Models were industriously inspected at all hours. A collection of models of Norwegian fishing-boats, from Bergen Museum, showing the various types of boats in use on the west coast of Norway, was very instructive. The Royal National Lifeboat Institution, 14 St. John Street, Adelphi, London, sent, along with nine or ten other exhibits, models of the Institution lifeboat on its transporting car, of a safety fishing-boat, and a ship's lifeboat, considered unsubmergible. Mr. Arthur Feddersen of Viborg, Denmark, exhibited the model of a fishing-boat from the west coast of Jutland.

From the Edinburgh Museum of Science and Art, under the direction of Professor T. C. Archer, F.R.S.E., there was sent a model of a section of the breakwater of the Albert Dock, Leith, and some interesting models of Lighthouses, by the kind permission of the Commissioners of Northern Lights. There was a model of Fraserburgh Harbour, supplied by the Harbour Commissioners. There were numerous models besides; models of Chinese fishing-gear, of fishing-boats, yachts—half models of the yachts "Madge," "Nora," "Quiraing," "Scuta," "Sweetheart," sent by G. L. Watson and Company, Glasgow, and a model of Norwegian methods of hatching and transporting fish eggs, sent over by Frederick M. Wallem, manager of the Society Fjelds Fiskeriselskab, Bergen, Norway, and others too many to enumerate.

The Drawings also were numerous and various. To the Edinburgh Museum of Science and Art and its courteous Director, Professor Archer, the Committee were indebted for ten perfect coloured illustrations of the water-fowl and twenty illustrations of the game fishes of the United States of America. Mr. John Clark, Glasgow, supplied four American photographs, illustrative of salmon-fishing: "The Rise," "Hooked," "The Struggle," "Landed." Dr. R. H. Traquair, Edinburgh, exhibited a series of original drawings of fossil fishes found in British carboniferous rocks, most exquisitely executed in pencil, by Mrs. Traquair and himself.

It would be quite impossible to mention all the great variety of objects lent by the hundred and twenty exhibitors, to this Class XII. Mrs. Morison-Duncan of Naughton, Fife, lent an interesting trophy composed of fishing implements—lances, harpoons, etc. Herr H. C. Müller, Thorshavn, Faröe Islands, sent, among other things, specimens of fishermen's dress, a glass with mussel and sponge, in spirit, a written description of the whale-fishing in the Faröe Islands—which appears as the first Essay in this volume—and a model of fishing- and whale-boat, with utensils. M. Raveret-Wattel, Secretary of the Société d'Acclimatation of Paris, sent a very complete careful large ichthyological chart of France. Francis Day, Esq., Deputy Surgeon-General, Kenilworth House, Pittsville, Cheltenham, exhibited in this Class—The Fishes of India, 2 vols. 4to, London 1874-8 (by Order of H.M. Government of India); a Report on the Sea Fish and Fisheries of India and Burma (8vo, Calcutta, 1873); a Report on the Fresh-Water Fish and Fisheries of India and Burma (8vo, Calcutta, 1873); The Fishes of Great Britain and Ireland (Parts 1 to 4, imp. 8vo; Williams & Norgate, London, 1881-2); and The Ichthyology of the Second Yarkand Expedition. He also exhibited in Class I. a very pretty collection of about 100 species of British fish in spirit. Colonel J. S. Stirling, Gargunnock, showed a beautiful little collection of native fish-hooks from the South Sea Islands, made of tortoise-shell and mother-of-pearl. There were books, papers, plates, charts, all bearing on fish, fisheries, and fishermen. The Shipwrecked Fishermen and Mariners' Royal Benevolent Society, Hibernia Chambers, London Bridge, S.E., supplied examples of their objects and working results: Gold and silver medals, books, papers, forms, charts, maps, with descriptive particulars of the benefits of the Society to fishermen. Miss Agnes E. Weston, Sailors' Rest, Devonport, supplied books and papers descriptive of philanthropic work among seafaring men; also on seamen's and fishermen's coffee-houses, homes, etc.

There was endless variety: otoliths, brain ivory, ear-bones of fish, mussel-pearls from the Tay, aquatic birds stuffed, collections of shells, a shell and coral work-box, and a metal flask found in the stomach of a ling fish caught off Brandon

Head, Ireland;—the flask when found containing two glasses of spirits. This exhibit was supplied by Mr. Henry Ffennell, London, of *Land and Water.* Messrs. Lees and Wilson of Leith most kindly volunteered to supply a number of nets for the purpose of draping the sides of the Market, a decoration at once extremely appropriate and which added greatly to the general effect.

Although all cannot be specially mentioned, to one and all of the exhibitors in the Loan Collections, on the Continent, in America, and in the United Kingdom, the promoters of the Edinburgh International Fisheries Exhibition owe and offer their sincere thanks.

To resume the outline of the work of preparing the Exhibition, and the workers at it: The co-operating committee in London has been mentioned; but other assistants had been busy also. Mr. Archibald Young had mentioned at the half-yearly meeting of the Scotch Fisheries Improvement Association, held November 28, 1881, that there were sub-committees in Dundee, Aberdeen, Fraserburgh, Peterhead, Kirkwall, and Lerwick, co-operating with the view of creating a local interest in the projected Exhibition. The railway companies gave facilities, by reduction of carriage rates, for the transit of exhibits, and showed a cordial interest in the success of the Exhibition, and to Mr. James M'Laren, General Superintendent of the North British Railway, who took the lead in these arrangements, the Committee desire specially to record their hearty thanks. All who had to do with the transit of exhibits were most careful and obliging, a most striking example of which may be quoted: 10,000 young fish (fry of the species *Coregonus baeri*) sent from Russia by M. Constantine Muszynski, reached the Exhibition alive. The liberality of the Edinburgh Water Trust, who afforded *gratis* the whole supply of fresh water that was needed for the purposes of the Exhibition, is also gratefully mentioned.

The last stages of preparation had now been reached, and made a heavy demand on the practical knowledge and the energy of Mr. F. N. Menzies, who undertook the chief charge of the arrangements in the Waverley Market, with the assistance of Mr. James D. Park, Engineer of the Highland Society, and the Secretary. By arrangement with the Town Council the promoters of the Exhibition had, as early as December 28, 1881, secured the exclusive use of the Waverley Market for their purposes from April 7, 1882; and, notwithstanding certain preliminary difficulties, which for a while bore a threatening aspect, but which were fortunately overcome, this arrangement was carried out. Among other arrangements made by the Committee, when these difficulties had been overcome, was the hiring of the Aquarium, which has for some years occupied a space at the west end of the market buildings. This gave them the command of water-tanks, etc., for the display of live fish of various kinds, and, thanks to the labours of Sir James R. Gibson Maitland and Mr. John Anderson, formed an interesting feature of the Exhibition.

The market-place, thus fortunately secured for the Exhibition, was admirably adapted for its purposes, but one serious drawback remained. The 7th of April left only four clear days before the day fixed for the opening. This had always been foreseen as adding enormously to the difficulties with which those charged with the arrangement of the exhibits had to contend, though, perhaps, hardly realised fully till it had to be faced. But the energetic application of the exhibitors and their agents, and of hosts of workers, under the direction of Mr. Menzies and the Secretary, aided by Sir Robert Menzies, Bart., who had kindly offered his assistance, transformed the appearance of the vast market-place, as if by magic, and the opening day found the exhibits of over 500 exhibitors all placed and in order. The contract for the fitting up of the stalls was in the hands of Mr. Robert Shillinglaw, Edinburgh, and was carried out in a most satisfactory manner.

The Exhibition was opened, with imposing ceremonial, on Wednesday, April 12, and it continued open till Saturday, April 29, 1882. It was opened by Lord Rosebery, in the absence of H.R.H. the Duke of Edinburgh, who found himself unable, from other engagements, to be present. Just as the time-gun at Edinburgh Castle announced one o'clock, the hour appointed for the opening ceremony, Lord Rosebery, with the Lord Provost of Edinburgh and the Magistrates in their robes of office, preceded by the bearers of the sword and mace, and accompanied by the halberdiers, ascended an octagonal platform, covered with crimson cloth, erected near the centre of the Waverley Market, and announced the opening of the Exhibition, amid great enthusiasm. It was a large and fashionable assembly. On the platform with the Earl of Rosebery, in addition to the Lord Provost and Magistrates, and the Town Clerk, were:—The Earl of Stair, the Earl of Elgin, the Earl of Mar and Kellie, the Earl of Lindsay, and the Earl of Dalhousie; the Lord Advocate (Mr. J. B. Balfour, M.P.), and the Solicitor-General (Mr. A. Asher, M.P.); Lord Belhaven, Lord Elphinstone, Lord Lovat; Lord Elcho, M.P.; Lord Balfour of Burleigh, Lord Watson, Lord Lamington, Lord Polwarth; The Honourable R. Preston Bruce, M.P.; Mr. Charles Dalrymple, M.P.; Mr. R. W. Duff, M.P.; Sir Alexander Gordon, M.P.; Mr. Andrew Grant, M.P.; Mr. Peter Maclagan, M.P.; Colonel Milne Home, M.P.; Mr. William Holms, M.P.; Mr. T. R. Buchanan, M.P.; The Hon. H. Jerningham, M.P.; Mr. J. Dick Peddie, M.P.;

Sir Alexander Grant, Bart.; Sir Graham Montgomery, Bart.; Sir William Maxwell, Bart.; Admiral of the Fleet, Sir Alexander Milne, Bart., G.C.B.; Sir Hew Dalrymple, Bart.; Sir Walter Elliot; Sir George Warrender, Bart.; Sir William Miller, Bart.; Sir Robert Menzies, Bart.; Sir James H. Gibson Craig, Bart.; Sir James R. Gibson Maitland, Bart.; General Burroughs of Rousay, C.B.; Professor Huxley, Mr. Spencer Walpole, Mr. James Maxtone Graham of Cultoquhey, Mr. J. Barker Duncan, W.S., Mr. John Murray of the "Challenger" Expedition, Mr. John Anderson, Mr. James D. Park, Mr. F. N. Menzies, Mr. Archibald Young, Mr. Henry Cook, W.S., Mr. Josiah Livingston, Master of the Merchant Company; Sir William Fettes Douglas, President, and Mr. George Hay, Secretary, of the Royal Scottish Academy; The Hon. Bouverie F. Primrose, C.B., Secretary of the Scottish Fishery Board; Mr. D. Milne Home of Milngraden, Vice-President of the Scottish Fisheries Improvement Association; Professor Archer, Director of the Museum of Science and Art; Provost Pringle, Leith; Mr. Oscar Dickson, Gothenburg; General Forlong, Rear-Admiral Maitland Dougal of Scotscraig, Major-General Alastair MacDonald, commanding the Forces in Scotland, and Captain Crofton, A.D.C.; Colonel Preston, C.B., Assistant Adjutant-General; Major-General Lockhart, Colonel Brown, Colonel Macpherson, Colonel Lambton; Professor Maclagan, Professor Blackie, Dr. Arthur Mitchell, Dr. A. H. Malm, Mr. Campbell of Possil, Mr. Alexander Buchan, Mr. Francis Francis of *The Field*, Mr. H. Ffennell of *Land and Water*, and others.

A feature of the opening ceremony was the presence of a bevy of a dozen fisher-lasses from Newhaven, in full fishwife costume, who had been retained for the purpose of selling Catalogues. After the opening ceremony was over, Lord Rosebery, accompanied by the noblemen and gentlemen who had supported him on the platform, made an inspection of the Exhibition, and afterwards, his Lordship, accompanied by the Lord Provost, and other gentlemen, drove to the Edinburgh Arboretum, where Lord Rosebery planted a tree as a memorial of the Edinburgh International Fisheries Exhibition. It is a mountain ash, and was the first tree planted in a prominent spot of the Arboretum.

The Exhibition was daily visited by immense numbers, and was often crowded to excess. While it was open about 140,000 visitors paid for admission, exclusive of season ticket-holders, who numbered several hundreds. The Committee also sanctioned special cheap rates of admission for the children of the various hospitals and schools of Edinburgh, which were largely taken advantage of. On Saturday, April 29, the closing day, as many as 13,500 persons paid for admission—6600 in the forenoon, and 6900 in the evening. The visitors on that day consisted largely of excursionists from a distance, who availed themselves of the facilities offered by the railway companies. The following statement regarding the visitors to the Exhibition on that day is from the *Scotsman*:—"At the Waverley Station nearly 3000 excursionists arrived, in addition to the large number of passengers by the ordinary trains, by all of which—especially those from Fife—the traffic was unusually heavy. Of the excursionists, about 350 were from Dundee, 400 from Anstruther and district, 200 from Berwick and Tweedmouth, 500 from Hawick and Kelso, 500 from Falkirk and Grangemouth, 200 from Glasgow, and 600 from Newcastle and Sunderland. A special train from St. Andrews brought about 200 fisher-folks; including fishermen and their wives and families, who were conveyed to the city at the expense of Mr. J. Ritchie Welch, Solicitor, St. Andrews, who also provided for their free admission to the Exhibition. On arriving at the Waverley Station, they were met by Mr. Welch and Mr. J. Young Guthrie, S.S.C., who conducted them to the Exhibition, where they seemed to enjoy themselves thoroughly. A special train conveyed them home at half-past six o'clock in the evening. The passenger traffic on the Caledonian system was also unusually heavy, all the early trains, some of which consisted of sixteen and seventeen carriages, being completely filled. From Glasgow and the intermediate stations return tickets were issued at reduced fares. Altogether between 2000 and 3000 passengers in excess of the ordinary traffic arrived at the Caledonian Railway Station. . . . During the afternoon and evening the battalion band of the First Perthshire Rifle Volunteers, together with members of the Marquis of Lothian's band, played selections of music." This last remark recalls a pleasant feature of the Exhibition. There was always a band in attendance. The bands of the Third (Prince of Wales) Dragoon Guards, the Forty-Second Royal Highlanders (Black Watch), the Edinburgh Artillery Militia, the Queen's City of Edinburgh Rifle Volunteer Brigade, the First Mid-Lothian Rifle Volunteers, the First Mid-Lothian Coast Artillery Volunteers, the Edinburgh City Artillery Volunteer Corps, also played at the Exhibition.

An interesting event, in honour of the promoters and visitors to the Exhibition, occurred on the evening of the day after it was opened, Thursday, 13th April—a conversazione in the Museum of Science and Art, given by the Lord Provost, the Magistrates, and the Town Council of Edinburgh. The Lord Provost, Sir Thomas J. Boyd, in proposing it to the Magistrates and Town Council, said: "It was anticipated there would be a large number of distinguished strangers, many of them from foreign countries," visiting the Exhibition, and that "it would be becoming, on the part of the Council, to show hospitality to the promoters and visitors on the occasion of the opening of the Exhibition, having regard to its importance and international character." The anticipation of foreign visitors was fully realised. France, Germany, Spain, Italy, Greece, Denmark, Norway and Sweden, and America were all represented at the Exhibition. The American, Greek, Italian, Swedish, and Norwegian Consuls were present at the conversazione, which was a most brilliant gathering. About 2500 ladies and gentlemen attended. In addition to the distinguished gentlemen from foreign countries whose names occur in this Preface, should be mentioned M. le Chevalier Enrico Hillyer Giglioli, Director of the Museum of Vertebrates, Florence, who attended the Exhibition as delegate from the Italian Government. Professor Giglioli acted as one of the jurors.

Another very interesting event that sprung from the Exhibition was an excursion to the Howietoun fisheries of Sir James R. Gibson Maitland. On Saturday, April 15, a party of about a hundred gentlemen, visitors to the Exhibition and promoters of it, at the invitation of Sir James, paid a visit to Howietoun for the purpose of inspecting his hatching-houses and breeding-ponds for salmon and trout, which have been in successful operation there for several years past. Besides several of the nobility and members of Parliament, it included Mr. Oscar Dickson and Dr. Malm, from Gothenburg, and other Swedish gentlemen; Herr Fritz B. K. Vuhr, representative of Danish fisheries; Mr. Francis Francis, of *The Field;* Dr. Francis Day, Cheltenham; Mr. W. Oldham Chambers, Lowestoft; Mr. Byram Littlewood, Huddersfield; Mr. Archibald Young, advocate, Edinburgh; and Professor Archer, of the Museum of Science and Art. Sir James and Lady Gibson Maitland received the party at Howietoun, and a tour of inspection was made of the rearing-ponds and hatching-houses, and every detail of the apparatus and working was explained. An elegant repast was served to the guests in the upper floor of a new hatching-house, into which the tanks had not yet been fitted, presided over by their host, Sir James Ramsay Gibson Maitland. The weather also proving favourable, it was a bright day in all respects.

Other courteous attentions to the visitors to the Exhibition were that the Library Committee of the Senatus of the University of Edinburgh threw open the University Library to visitors, Mr. Small, the librarian, kindly exhibiting a number of works possessed by the library on topics kindred to the Exhibition. And the Faculty of Advocates conceded a similar privilege in connection with their library, Mr. Clark, the librarian, exposing in the corridor a collection of literature relating to fish, fisheries, angling, etc.

The Exhibition, it need not be added, was in all respects most successful, and there is no doubt that if it had been possible to keep it open for a longer period its financial success would have been even greater than it was. To the end the public interest was unabated, and indeed was increasing, as the daily attendance proved.

The last Sub-Committee appointed by the Executive Committee consisted of four gentlemen,—Sir James R. Gibson Maitland, Mr. F. N. Menzies, Mr. J. A. Harvie Brown, and Mr. Alexander Buchan, with Mr. Cook as Secretary. Its duties were to superintend the publication of a volume of Essays selected from those to which prizes had been awarded.

The Committee is deeply indebted to Francis Day, Esq., Deputy Surgeon-General, of Cheltenham, who, at their request, has gone with the greatest care over the proof-sheets of the volume, with a special reference to zoological questions. His great authority on such questions is a guarantee of accuracy on these points to the readers of the volume. But he did not confine himself to his own well-known speciality. Dr. Day's wide learning and careful accuracy were brought to bear on every, even the minutest, detail of all the Essays, with the result of greatly adding to the value of the book.

In addition to the patient and careful assistance cheerfully rendered by Mr. Menzies and Mr. Cook, the editor has gratefully to acknowledge courteous assistance received from Mr. Archibald Young, Mr. W. Anderson Smith, Ledaig, Mr. Francis Francis, editor of *The Field*, and Mr. J. K. Grant, editor of the *Northern Ensign;* nor would his thanks, or those of the Committee, be complete without recording their warm appreciation of the manner in which Messrs. T. and A. Constable, Printers to Her Majesty and to the University of Edinburgh, have performed their important share of the work, grudging as they did no pains to make the Catalogue and this volume worthy of the Edinburgh International Fisheries Exhibition.

APPENDIX A.

I.

SPECIAL PRIZES FOR EXHIBITS.

		Name of Donor.
1. Specimens of Tinned Fish of all kinds.	£25	The International Fisheries Exhibition.
2. Specimens of Dried, Salted, and Smoked Fish of all kinds.	£60	The International Fisheries Exhibition, £50; and the Glasgow Fish Salesmen, £10.
3. Models or Plans of Fishermen's Dwellings.	£10	J. Lindsay Bennet, Esq.
4. Models and Drawings of Fish Passes and Ladders.	£20	Scotch Fisheries Improvement Association, £10; and the International Fisheries Exhibition, £10.
5. Models of the safest and handiest Sailing Fishing-Boat—hull, spars, sails and rigging.	£20	J. W. Young, Esq., W.S., £10; and David J. Macfie, Esq. of Borthwick Hall, £10.
6. Models and Plans of Piscicultural Establishments.	£10	James Duncan, Esq. of Benmore.
7. Models and Plans of Fish-curing Yards.	£5	The Hon. Bouverie F. Primrose, C.B.
8. Models and Plans of Apparatus for transporting Live Fish long distances in safety.	£10	Members of the Berwick-on-Tweed Town Council.
9. Models and Drawings of a handier and safer rig, for the boats now in use on East Coast of Scotland, than the lug-sail, which requires to be dipped at every tack in beating to windward.	£20	J. W. Young, Esq., W.S., £10; and the International Fisheries Exhibition, £10.
10. Specimens or Models and Plans of Trawl Nets.	£10	W. Cunliffe Brooks, Esq., M.P.
11. Specimens or Models and Plans of Bag, Stake, and Fly Nets.	£10	The Edinburgh Hotel Keepers' Association.
12. Collections of Inland Fishing Tackle.	£20	The International Fisheries Exhibition.
13. Collections of Sea-fishing Tackle, excluding Nets.	£15	The International Fisheries Exhibition, £10; and Stephen Williamson, Esq., M.P., £5.
14. Fish-hatching Apparatus, full size, with Appliances and Implements.	£25	Sir Molyneux Hyde Nepean, Bart., £10; and the International Fisheries Exhibition, £15.

		Name of Donor.
15. Models or Drawings illustrating the best system of rendering streams polluted by sewage and manufacturing refuse innocuous to Fish life.	£25	The Earl of Rosebery.
16. Models and Drawings of Fishing Trawlers—sail or steam.	£20	The London Fish Market and National Fisheries Company.
17. Eel Trap for River not to interfere with other Fisheries.	£5	Peter Hall, Esq., Campbeltown.
18. Apparatus for catching Lobsters and Crabs.	£5	Mrs. and Miss Morison-Duncan of Naughton.
19. Systems of Signalling at Night for Fishing Fleets and Vessels.	£25	The International Fisheries Exhibition.
20. Model of Machine, worked by Hand or Steam Power, for taking in Trawl, Coble or Herring Nets.	£15	Charles Morton, Esq., W.S., £10; and the International Fisheries Exhibition, £5.
21. Improved Salmon Net, Cotton or Hemp, for use with Coble.	£5	T. R. Buchanan, Esq., M.P.
22. Improved Herring Net.	£5	The Hon. Bouverie F. Primrose, C.B.
23. Models of Whale Boats, and of all kinds of Apparatus and Tackle used in the Seal and Whale Fisheries.	£20	The International Fisheries Exhibition.
24. Best style of Fishing Boat suitable for the East Coast of Scotland, and to have a stayed mast.	£10	The International Fisheries Exhibition.
25. Angler's Outfit, suitable for the Rivers and Lochs of Scotland.	£10	The Waverley Angling Club, Edinburgh.
26. Collections of Materials used in dressing Salmon and Trout Flies.	£5, 5s.	James Clerk Rattray, Esq., M.D.
27. Best collection of Flies suitable for Scottish Lochs.	£5	The Lochleven Angling Association.
28. Best Life-saving Jacket to be used by Fishermen.	£10	R. W. Duff, Esq., M.P.
29. Best Exhibit of Waterproof Clothing suitable for Fishermen.	£5	Warden & Co., Leith.
30. Best Exhibit of Fishermen's Clothing other than waterproof.	£5	George Barclay, Esq., Hunter Square, Edinburgh.

II.

SPECIAL PRIZES FOR ESSAYS.

		Name of Donor.
1. On the various methods of Fish Culture practised in the different countries of the world.	£15	The Lord Provost, Magistrates, and Town Council of Edinburgh.
2. On the various methods of Oyster Culture.	£15	The Lord Provost, Magistrates, and Town Council of Edinburgh.
3. On Harbour Accommodation for Fishing Boats on the East and North Coasts of Scotland, pointing out the localities where harbours are most required, and distinguishing between natural coves or bays, which may be converted into good harbours by artificial assistance, and places where the harbours must be entirely artificial.	£25	The Merchant Company of Edinburgh.
4. On Oyster Culture in Scotland, including Orkney and Shetland, specifying the localities and the species or varieties of oysters most suitable, and discussing the effects of the laws at present in force.	£20	George Hunter Thoms, Esq., Sheriff of Caithness, Orkney, and Shetland, £10; and the International Fisheries Exhibition, £10.
5. On the Legislation at present applicable to the Salmon Fisheries in Scotland, and the best means of improving it.	£10	James Duncan, Esq. of Benmore.
6. On the best means of increasing the Supply of Mussels for Bait, indicating the most suitable localities for Musselbeds, and on substitutes for Mussels as bait.	£20	William Gardner, Esq., Glasgow, £10; and the International Fisheries Exhibition, £10.
7. On the Natural History of the Herring, with special reference to its migrations.	£10	George Waterston, Esq., Kirtle Lodge, Trinity.
8. On the various means of Curing and Preserving Fish at Home and Abroad.	£15	Dr. A. H. Malm, Gothenburg, £10; and the International Fisheries Exhibition, £5.

		Name of Donor.
9. For the best description of the means used for Curing and Preserving the various kinds of Fish caught on the Coasts of Scotland, the Hebrides, and the Orkney and Shetland Islands.	£15	The Highland Society of London, £10; and the International Fisheries Exhibition, £5.
10. On the Pollution of Rivers, indicating specially the kinds of pollution injurious to fish life.	£20	The Walton Angling Club, Edinburgh, £10; and the International Fisheries Exhibition, £10.
11. On the Salmon Disease.	£10	James Maxtone Graham, Esq. of Cultoquhey.
12. On the Migration of the Salmonidæ, as affected by meteorological and other influences.	£10	The Edinburgh Angling Club.
13. Should there be a Mesh fixed by law for Herring Nets, and if so, of what size; or should fishermen be at liberty to use any size of mesh they please?	£10	The British Fisheries Society, London.
14. On the best method of Preserving fish alive for Markets.	£15	The International Fisheries Exhibition.
15. On the Artificial Propagation of Sea Fishes suitable for food.	£10	The International Fisheries Exhibition.
16. On the Breeding and Rearing of Fresh-water Fish.	£10	The Earl of Dalhousie.
17. On the Species of Foreign Fish most suitable for introduction into British rivers and waters.	£15	The Highland and Agricultural Society of Scotland.
18. On the Utilisation of Fish Offal.	£10	The Highland and Agricultural Society of Scotland.
19. On the Fish Supply of Great Cities, with special reference to the best methods of catching and packing, and of distribution, and other means calculated to facilitate the delivery of the fish in good condition for market.	£20	The Edinburgh Fish Trade Association, £10; and the International Fisheries Exhibition, £10.
20. On the Herring Brand.	£10	The British Fisheries Society, London.
21. On the Food of Fishes, both in fresh and salt water, accompanied by illustrations and preparations.	£15	John Murray, Esq., F.R.S.E.

		Name of Donor.
22. On the Natural History and Habits of the Fresh-water Trout, with special reference to the institution of an annual close time in Scotland, and the expediency of adopting a rod licence.	£10	The Waverley Angling Club, Edinburgh.
23. On the Migrations and Spawning of Sea-fish suitable for food.	£10	The International Fisheries Exhibition.
24. On Angling Associations, with Code of Rules for their management.	£10	Professor Douglas Maclagan.
25. On the relations existing between the Annual Migrations of Sea Birds and the Migrations of Fishes.	£10	J. A. Harvie Brown, Esq., F.R.S.E.
26. On the best modes of Preserving Ice.	£10	Sir James Ramsay Gibson Maitland, of Barnton, Bart.
27. On Seine Trawling and Beam Trawling in Estuaries and Sea-Lochs in Scotland; pointing out their advantages and disadvantages.	£10	The British Fisheries Society, London.
28. On the History and Statistics of the Herring and Pilchard Fisheries in England.	£10	The Lord Provost, Magistrates, and Town Council of Edinburgh.
29. On the History and Statistics of the Herring Fishing in Norway and Sweden.	£10	The Lord Provost, Magistrates, and Town Council of Edinburgh.
30. Fish in its relation to Dietetics.	£20	The British Fisheries Society, London.
31. The causes of the deterioration of Trout Fishing in many of the Lochs of Scotland, and the best means to be adopted for their improvement.	£10	David Carnegie, Esq. of Stronvar.

All the prizes announced for Essays were not awarded. For Nos. 1, 12, 21, 22, 25, there were no Essays. The prizes for Nos. 10, 14, 30 were withheld for want of merit. All the Essays for which prizes were awarded are not printed, while there will be found in the volume three Essays that are not in the list. These are Essay I., "Whale-Fishing in the Faröe Isles," by H. C. Müller; Essay XVI., "Sur la Pêche de la Truite à Vallorbes," par Albert Matthey, Instituteur, Montreux; and Essay XXIX., "Model of the safest and handiest Sailing Fishing-Boat, as to Hull, Sails, Spars, and Rig."

APPENDIX B.

Jurors.—Alexander Adam, Aberdeen; Dr. Aitken, Chemical Laboratory, Clyde Street, Edinburgh; Thomas Aitken, Edinburgh; Colonel Allan; A. G. Anderson, Edinburgh; John Anderson, Denham Green, Trinity; Professor Archer, Museum of Science and Art, Edinburgh; J. A. Harvie Brown, F.R.S.E., of Quarter, Dunipace, Larbert; Alex. Buchan, Secretary of the Meteorological Society, Edinburgh; Major-General Burroughs, C.B., Rousay, Orkney; Captain Cator, in command of H.M.S. *Lord Warden*, Queensferry; W. Oldham Chambers, Lowestoft; John Clark, Glasgow; Sir James H. Gibson Craig, Bart., Riccarton, Currie; Hy. Gordon Cumming, Pittyvaich, Dufftown; D. Davidson (of Davidson, Pirie, & Co.), Leith; Dr. Fras. Day, Kenilworth House, Pittsville, Cheltenham; Colonel James Duff, Knockleith, Turriff; R. W. Duff, M.P., of Fetteresso, Stonehaven; J. Barker Duncan, W.S., Edinburgh; the Right Hon. Lord Elphinstone; Francis Francis, *The Field*, 346 Strand, London; Professor Giglioli, Museum of Natural History, Florence; David Gillies, net manufacturer, Largo; J. Maxtone Graham, of Cultoquhey, Perthshire; Dr. Günther, British Museum, London; Bailie Hall, Edinburgh; Treasurer Harrison, now Lord Provost, Edinburgh; D. Milne Home, of Milne Graden, Coldstream; Charles L. Jackson, Hill Fold, Bolton; John Jameson, Teviot Bank, Abbotsford Park; John Johnston, Linthill, Eyemouth; W. D. Johnston, Montrose; J. Falconer King, School of Medicine, Minto House, Edinburgh; Lord Lovat, Beaufort Castle, Beauly; Dr. Stevenson Macadam, Analytical Laboratory, Surgeons' Hall, Edinburgh; Captain F. C. Macdonald, *Vigilant*, Granton; Bailie M'Intosh, Burntisland; Councillor M'Lachlan, Edinburgh; Professor Douglas Maclagan, Edinburgh; Sir James R. G. Maitland, Bart., Craigend, Stirling; Dr. A. H. Malm, Gothenburg; F. N. Menzies, Secretary Highland and Agricultural Society; Sir Robert Menzies, Bart., Farleyer, Aberfeldy; John Morison, junior, Vice-Commodore, Forth Yacht Club, Granton; James Muirhead, 79 Queen Street, Edinburgh; John Murray, F.R.S.E., 32 Queen Street, Edinburgh; Joseph Napier, River Forth Salmon Fisheries Office, Stirling; Robert Ovens, The Schoolhouse, Cockenzie; James D. Park, Edinburgh; Hon. Bouverie F. Primrose, C.B.; Robert Pullar, Perth; Professor Pavesi, University of Pavia, Italy; John Rae, Fochabers; James Reid, Port-Glasgow; Hugh Rose, junior, oil-merchant, Edinburgh; John Small, M.A. University of Edinburgh; W. Anderson Smith, Ledaig, Argyllshire; David Stevenson, C.E., Edinburgh; Thomas Stevenson, C.E., Edinburgh; Robert Stewart, of Ingliston, Ratho; Livingston Stone, United States Fish Commissioner, Charlestown, N. H.; Professor P. G. Tait, Edinburgh University; Captain Thomson, Master of Trinity House, Leith; E. J. Thomson, Manchester; Professor Turner, Edinburgh University; Spencer Walpole, H.M. Inspector of Fisheries for England and Wales; James S. Warden, oil-merchant, Edinburgh; Archd. Young, advocate, Inspector of Salmon Fisheries for Scotland; J. W. Young, W.S., Edinburgh; Dr. Zenk, Würzburg, Germany.

APPENDIX C.

Class I.—*Fish, Aquatic Birds, etc.*

1. Specimens of all kinds of Salt-water and Fresh-water Fish, including collections of Stuffed Fish, specimens of all kinds of aquatic birds. Jurors: J. A. Harvie Brown, W. Oldham Chambers, Dr. Francis Day.

2. Models, Drawings, Photographs, and Paintings of Fish and other Marine Animals, Sea and Fresh-water Paintings and Drawings. Jurors: J. A. Harvie Brown, Dr. Francis Day, Archibald Young.

3. Illustrations of the Diseases of Fish. Jurors: Dr. Günther, Sir James R. G. Maitland, Bart., John Murray.

Class II.—*Boats and Implements used in Fishing.*

1. Models of Apparatus and Gear complete, including Steam Machinery, for all kinds of Fishing Boats and Vessels employed in the conveyance of Fish to market. Jurors: Thomas Aitken, Andrew Greig Anderson, John Anderson, R. W. Duff, M.P., Bailie M'Intosh, J. D. Park, James Reid.

2. Apparatus employed in catching Lobsters, Crabs, and Prawns; Single Specimens and Collections of Nets used in Sea or in Fresh Water Fishing. Jurors: Andrew Greig Anderson, W. D. Johnston, Councillor M'Lachlan, Bailie M'Intosh, John Rae.

3. Collection of Fresh-water Fishing Tackle, including Rods, Lines, Reels, Artificial Flies, Baits, Gaffs, Landing Nets, etc.; Collection of Hooks used in Sea and Fresh-water Fishing; Collection of Tackle used in Sea Fishing. Jurors: Andrew Greig Anderson,

Colonel Allen, Col. James Duff, Francis Francis, Lord Lovat, Captain Macdonald, Sir Robert Menzies, Bart., Archibald Young.

4. Models of Whale Boats, Knives, Harpoons, Lances, and Whale and Seal Fishing Appliances of all kinds; Portable Boats, Ropes, Cordage and Canvas. Jurors: Sir James H. Gibson Craig, Bart., Francis Francis, David Gillies, Largo, Captain Macdonald, the Rt. Hon. Lord Elphinstone.

5. Models of Yachts suitable for Fishing, and of Yachts in General. Jurors: Captain Macdonald, John Morison, Jr., Hon. B. F. Primrose, James Reid, Archibald Young, J. W. Young.

CLASS III.—*Pisciculture.*

Apparatus used for Hatching, Rearing and Transporting Live Fish and Ova; Models and Drawings of Fish-Breeding Establishments; Models and Plans illustrative of the various processes of Oyster Culture; Aquaria; Illustrations of the Development and Growth of Fish. Jurors: W. Oldham Chambers, John Clark, C. L. Jackson, Thomas Stevenson, Livingston Stone, E. J. Thompson, Dr. Zenk.

CLASS IV.—*Fish Passes.*

Models and Drawing of Fish Passes, Stairs, and Ladders for enabling Salmon and other Migratory Fish to surmount the Natural and Artificial Barriers that obstruct their ascent to the Spawning Grounds in the rivers of this and of other countries. Jurors: H. Gordon Cumming, Francis Francis, Sir James R. G. Maitland, Bart., F. N. Menzies, Joseph Napier, Thomas Stevenson, S. Walpole, Archibald Young.

CLASS V.—*Preserved Fish.*

Specimens of Dried, Salted, and Smoked Fish of all kinds, and Fish Oils; Various kinds of Salt for curing purposes. Jurors: Alexander Adam, Andrew Greig Anderson, John Anderson, D. Davidson, J. Maxtone Graham, John Jameson, John Johnston, Councillor M'Lachlan, James Muirhead, Hugh Rose, James S. Warden.

CLASS VI.—*Tinned Fish.*

Tinned fish of all kinds. Jurors: Alexander Adam, Andrew Greig Anderson, John Anderson, D. Davidson, J. Maxtone Graham, John Jameson, John Johnston, Councillor M'Lachlan, James Muirhead, Hugh Rose, James S. Warden.

CLASS VII.—*Fish Products, etc.*

Fish Manures; Isinglass, and Hard and Liquid Glues made from Fish; Models of Refrigerating Fish Vans; Methods of Preserving Fish for Domestic Use; Models of Fish-curing Yards. Jurors: Dr. Aitken, John Anderson, D. Davidson, Councillor M'Lachlan, F. N. Menzies, John Johnston, John Murray, Professor Turner.

CLASS VIII.—*Social Condition of Fishermen.*

1. Drawings and Models of Fishing Boat Harbours; Fish Markets and Swimming Schools; Life Boats and Life-Saving Apparatus of all kinds; Fishermen's Food and Clothing; Medicine Chests for Fishermen. Jurors: Andrew Greig Anderson, R. W. Duff, M.P., John Jameson, Professor Douglas Maclagan, Councillor M'Lachlan, Robert Ovens, Thomas Stevenson, David Stevenson, S. Walpole, Archibald Young.

2. Waterproof Garments and Waterproof Articles of all descriptions. Jurors: John Anderson, General Burroughs, John Clark, J. Barker Duncan, Bailie M'Intosh, Robert Ovens.

3. Systems of Signalling Fishing Fleets and Vessels at Night; Plans for preventing Collisions at Sea; Models of Lighthouses, and examples of different kinds of Lights used therein; Compasses, Barometers, Marine Chronometers, Patent Logs, Sounding Machines, Telescopes, etc. Jurors: Alexander Buchan, Captain Cator, of the *Lord Warden*, Professor Giglioli, John Murray, David Stevenson, Thomas Stevenson, Professor Tait, Captain Thomson, the Right Hon. Lord Elphinstone.

CLASS IX.—*History of Fishing.*

Literature and Statistics relating to Fisheries, both Ancient and Modern; Ancient Fishing Implements; Reports and Statistics of the Commissioners of Fisheries in the various Countries where such Commissioners exist. Jurors: Alexander Adam, Dr. F. Day, Dr. Günther, Sir James R. G. Maitland, Bart., John Small, Archibald Young, Dr. Zenk.

CLASS X.—*Pollution of Rivers.*

Systems, Plans, and Appliances for the Prevention or Remedy of the Pollution of Rivers and Waters; Statistics with regard to the effect of Pollution on Fish; Disinfectants. Jurors: J. Falconer King, Dr. Stevenson Macadam, Professor Maclagan, Robert Pullar, Thomas Stevenson, R. Stewart.

CLASS XI. *General.*

Corals, Pearls, Shells, Amber, Jet, Ambergris, Spermaceti, Shagreen; Aquatic Flora and Fauna; Shell Fish of every description; Common objects of the Sea-shore; Rock Works, Grottoes, and other Exhibits approved by the Committee. Jurors: Professor Archer, J. Barker Duncan, Professor Giglioli, J. Maxtone Graham, Dr. Günther, Bailie Hall, Treasurer Harrison, Dr. A. H. Malm, F. N. Menzies, Professor Pavesi, Livingston Stone, Dr. Zenk.

CLASS XII.—*Loan Collections.*

Jurors: Professor Archer, J. Barker Duncan, Professor Giglioli, J. Maxtone Graham, Dr. Günther, Bailie Hall, Treasurer Harrison, Dr. A. H. Malm, F. N. Menzies, Professor Pavesi, Livingston Stone, Dr. Zenk.

JURORS ON ESSAYS.

The Jurors appointed to judge of the Essays were: John Anderson, J. A. Harvie Brown, Alexander Buchan, John Clark, Sir James H. Gibson Craig, Bart., R. W. Duff, M.P., Dr. Günther, D. Milne Home, Dr. Stevenson Macadam, Professor Douglas Maclagan, Sir James R. G. Maitland, Bart., John Murray, Robert Ovens, James D. Park, John Small, Professor Turner.

ESSAYS.

I.

WHALE-FISHING IN THE FAROE ISLES.

BY H. C. MÜLLER.

THIS description, as far as the capture and the appearance of the Grind-whale are concerned, is founded partly on the accounts of the royal income of Faroe, which are deposited in Offices in Copenhagen, and which have been kindly opened to me for investigation; and for the rest upon my own experience.

As a native of the islands I have had, from childhood, opportunities of observing this sport, which is as interesting as any sport can be. Old men hardly find a more interesting topic for conversation than the "Grindefangst." It having been my duty as "Sysselmand," from the year 1839, to frequent and rule the captures in Stromö Syssel (district of Stromö), I have consequently had excellent opportunities of investigating everything concerning the "Grindefangst;" besides that, at a younger age, I often frequented the captures on others of the islands, especially in Vaago. I have thus frequented more than a hundred captures. Although I have not studied natural history at large, I am of opinion that I have such knowledge of the "Grindefangst" that I am, in some way, entitled to make the following remarks, and to assure the public that the information I give is to be relied upon. I hope my remarks will lay a good foundation for better qualified writers or inquirers in the future.

The oldest indication which I have observed about the appearance of the grind-whale in the Faroe Isles is afforded by an account of the collector of the King's taxes, for the year 1584, which runs as follows:—

"Saint John's Day this summer, during an awful cold and snowstorm which happened in the Faroes, were, by the providence of God and wonderful occurrence, found on the shore of the Little Dimonen iiij small whales named Nyingur."

The *Delphinus globiceps*[1] (bottlenose; Danish, Grindehval) has undoubtedly been known and hunted in the North since a time far back in antiquity. According to Luiar Debes, in his *Faroe et Faroæ Reserata* (Copenhagen, 1676), the grind-whale is mentioned in Peder Clausen's *Description of Norway.* Luiar Debes is of opinion that the name is derived from the fact that the grind-whales run alongside each other in large herds, all lattice-work made of wood or iron, according to the explanation of Peder Clausen, being called "Grind" in the Old Norse language. In the Norwegian law-book, however, of Christian v., B. iii. ch. 12, v. 18, vi. 14. 18, and vi. 19. 8, a wicket which is hung in a gate on a fence is named a "Grind." A reasonable origin to the name might therefore, perhaps, be looked for in the circumstance that the whale herds, when driven either outside the land, or between the islands, are surrounded by the boats, and when driven into the whale bay, the mouth of which forms a gate, are locked or shut up, the boats forming the wicket or "Grind."

On the Faroe Islands the name of "Grind" is given to a herd of these whales; a single whale is called "Grindehval," or "Grindefish;" the young ones are named "Leiptur." In olden times a grown-up grind-whale was named "Nuydengur," which I have seen in an account dated 1584; and in "Kongespeilet," (Har. Einarsen's edition, Sorö, 1768, pp. 120, 121), "Huidingur" is said to be very abundant in the Iceland seas, where they were very frequently hunted upon the shore in hundreds, and were a blessing to the people as food.

There are two races or breeds of them. The one has a broader back-fin than the other, and is generally fatter and easier to drive; the other has a narrow, more erect back-fin, and is leaner and more wild and ungovernable.

The appearance of the grind-whale about the Faroe Isles has varied at different periods, both as to the time of the year and as to the numbers in which they appeared.

According to the information I have acquired in investigating the accounts of the royal revenues of Faroe, as far back as possible, it appears that the captures in the period from 1584 to 1641 were principally made in the months of July, August, and September. For the years 1642 to 1708, no information is to be found about the whale-fishing. Probably the accounts of the royal revenues of the islands, for the most part of this period, were given to the Privy Councillors

[1] *Globicephalus melas*, Trail; the Pilot whale: the ca'ing or driving whale of the Shetlands.

Christian and Frederik v. Gabal (father and son), who were granted the revenues of the islands from 1662 to 1706. But plenty of grind must have been caught in this period, as Luiar Debes, although mentioning large numbers before, says that in 1664 there were captured in two places about a thousand.

In the period from 1709 to 1744 the captures were frequent, and occurred almost every year; only two years in this period no grind was captured. The greatest numbers were killed in July, August, and September, but the numbers killed in May and June were not inconsiderable. In April and October about the same numbers were killed, but in the remaining months of the year almost none.

In the period from 1745 to 1795 inclusive (fifty-one years) very few were captured; in all, 3583, or seventy a year at an average. During several succeeding years in this period no regular grind were killed. For example, during the years 1755 to 1775 (twenty-one years), only 16 whales were killed in December. In this period the greatest numbers were captured in the months of July, August, and September—the most in August.

In the next period, from 1796 to 1812 inclusive (seventeen years), grind were killed every year. The greatest numbers in August, September, October, and November; some in December, January, February, March, and April; but in May, June, and July not a single whale was taken. From 1813 to 1859 grind appeared every year, the greatest numbers in the months of June, July, August, and September, but since 1859 the captures have been more frequent in the winter months.

Studiosus Svabo, who travelled in Faroe for scientific purposes in the years 1781 and 1782, says in his reports "that the principal period of the whale-fishing had been from 1717 to 1739, in which period (1717, the best year, included) there are found above two hundred whale-accounts presented to the Lagthing. From 1739 to 1744, eighteen accounts are found. From 1744 the herds were scarcer till 1754, when they almost disappeared for twenty-two years, 1754-1776; although grind were seen and hunted during these years, almost none were killed.

These remarks of Svabo, however, do not conform to the information which the accounts give. Unquestionably the period 1717 to 1739 was the best in the eighteenth century, but according to the two hundred accounts which are found to have been presented to the Lagthing, during this period, 1717 was not the best year, as only 720 were taken that year, while 803 were taken in 1720, 905 in 1721, 1320 in 1723, 1063 in

1724, 1359 in 1725, 835 in 1727, 1423 in 1729, 915 in 1730, 2188 in 1731, 1186 in 1733, and so on.

It is interesting to observe that, as Svabo says, in the twenty-two years 1754 to 1776, when no grind was captured, herds were seen and hunted. In the same way, from 1856 to 1871, when the captures were scarce, very large herds were seen and hunted.

The reason is not known why the grind at this time, just as in the period 1796 to 1812, is rarely captured in the summer months, unlike earlier periods, as the period 1813 to 1859, during which grind were taken only as an exception in the months from September to June. But I suggest that it may be owing to the state of the ice to the north of the Faroe Isles, which may have an influence upon that food for the grind, the cuttle-fish (Loligo), whose place of residence probably depends upon a certain temperature in the ocean.

Where the grind resorts to when it leaves the ocean about Faroe Isles it is difficult to say. I suppose it lives during the cold time of the year in the Atlantic, in such latitudes as have a temperature equal to that of the sea about the Faroe Isles in summer months, or in the Gulf Stream. I have frequently inquired at sailors born in the Faroes where they have observed grind, but I have not been able to acquire any information to be relied upon, as my informants have often mistaken other delphins for grind-whales. One of my countrymen says that he has seen grind on a voyage from Java to Persia, but adds that the whales had white sides, which the grind has not. In the Chinese seas, east of Formosa, he believes he has seen grind, as well as on the great bank of Bahamas, between the Bahama Islands and Cuba. On this bank he has seen vast numbers of small whales, in four or five fathoms of water. The depth of the water shows, however, that these whales cannot have been grind, because the grind would not be quiet in such low water.

I find the information more probable, that a large herd of grind was seen late in July 1859, a short distance from the entrance of the Channel between England and France; that a very large herd, in company with a herd of kvarringur (*grampus*),[1] which played in front, was seen in June 1860, in the middle of the Atlantic, on a voyage from the West Indies to Europe; and that herds have been observed on the banks of Newfoundland. Whether a herd which was seen, in February 1866, off the Cape Verde Islands, close to a vessel going south, were grind, is questionable. The relater says that the whales appeared to him to be rather large for grind-whales, but they had a back-fin broad at the base.

[1] *Orca gladiator*, Lacépède or *Pseudorca crassidens*, Owen; grampus or killer.

About New Year 1872, Captain Ellingsgaard, schooner *Soormen*, on a voyage from the Mediterranean, met with a herd of grind-whales, inside the Straits of Gibraltar, and was fortunate enough to harpoon one of the animals of a little below the average or middle size. Flesh and blubber were, after Faroe fashion, pickled, and became useful afterwards, as they ran short of provisions before their arrival in England. I am convinced that no confusion has taken place in this instance, as Captain Ellingsgaard, a native of Faroe, had been at many whale-hunts before he left his native country to go to sea, and could therefore not make a mistake.

The grind-whale gives birth only to one young one at a time, although I once found a female with twins. It breeds probably once a year, and propagates at all seasons of the year. Accordingly, you will find every season the same number of young ones, and the like number of teeming females. The number of males in a herd is generally a third of the entire number. The female never grows so large as the male. Out of eight takes, consisting of 1624 individuals, which I have examined on purpose, 545 were males and 1079 females. The largest male measured 14 feet 4 inches from the eye to the anus, the entire length being nearly 22 feet; the largest female, 8 feet 10½ inches, entire length 13 feet. The grind is in best condition during winter, leanest at midsummer-time. It is an interesting fact, which has very often happened, that catches on the west side of the islands have been comparatively very much leaner than catches taken on the eastward about the same time.

Some wounded individuals are tormented with parasites, small white cancers, crawling round the wound. Sometimes, though rarely, a sort of cirripedes are found on the outskirts of the fins. In appearance, they are like longnecks which are found on drift-wood, except the colour, as the cirripedes are brown; and they have no shells like the longnecks. I once found a white sample on the gums of a grind-whale. The grind-whale most certainly has a voracious enemy in the *Delphinus orca* (the tiger of the ocean).[1] I have frequently seen very plain marks of the teeth of a whale of prey on the body of the grind-whale, and it is not rare to see individuals whose breast-fins, back-fin, or tail, has been bit off.

The natives of Faroe believe that the dolphin *Lagenorhynchus* of Erchricht, or *Delphinus tursio* (Far. Kvarringur),[2] bites the grind-whale, but this cannot be the case, as their mouth is too narrow and their teeth too small to be able to do any damage to the grind-whale. Its food is the same as that of the grind, viz., the cuttle-fish. It is a fact, however, that when the "kvarringur"

[1] Grampus. [2] Bottle-nosed dolphin.

are amongst a herd of grind, the herd is then always wild and unruly. *Delphinus tursio,* which I have only recognised twice in company with the grind, the first time in 1871, has probably not the same effect upon the grind as the other kvarringur, although it is more vivacious in its movements than the grind, and is frequently seen to jump out of the sea several feet above the surface of the water.

The first time I saw this delphinus was in the catch in Midvaag, 16th July 1871. There were two individuals. The herd was discovered at nine o'clock in the forenoon, and was laid by for one hour off Kirhebo. Soon after the driving had been commenced, the grind put on uncommon speed, so that only the best-manned boats could descry it a long way ahead. It did not slacken its speed before being off Kvivig, a distance of twelve miles, when the boats succeeded in getting ahead of the herd, and driving it into Midvaag, where it was killed at five o'clock in the afternoon. That this very uncommon speed was occasioned by the presence of the two *Delphinus tursio* is not unlikely.

The whale-hunting (Grindefangst) was before 1832 only regulated by usage, which, in some respects, had degenerated to disorder. It was for the first time regulated by the regulations of 1st November 1832. These regulations were altered in 1857 and 1872, principally only with regard to the extent of the districts taking shares in certain whale voes.

The hunting is performed in the following manner. When a herd (grind) is discovered, either from land or by a boat on the sea, a piece of garment is immediately hoisted to the top of the mast in the boat, as a signal for boats that might happen to be in the vicinity, or for the inhabitants on shore. As soon as this signal is discovered, or the grind is seen from the shore, every boat gets off immediately for the place, and express messages are sent round from village to village, partly by persons on foot, partly by signals from the one island to the other, consisting of smoke, produced by setting fire to hay, or the spreading of white blankets on certain places appointed. In this way people are informed where the grind is to be met with.

When a message of grind (Grindebud) is noticed in a village (sometimes long before it is reported where the grind is, as the cry can frequently be heard from the hills long before the messenger is advanced within a mile of the village), it is like an electric spark upon the population. The men rush immediately to their boats, only taking time to take with them their Homlebaand (a piece of the fin of the whale dried for a sling for the oar). The women run to the shore, carrying necessary articles of dress and food for the men. The children cry

"Grindabo" in the mouth of each other, and a stranger might believe that the whole population had become insane, as it is not sorrow or fear for any calamity that is shown, but joy that is shining on every face.

The boats which have arrived at the herd generally commence the driving at once, which is performed by the boats shaping in a half-circle round the herd, and throwing stones of the size of a man's fist into the water. When loose stones are not at hand, a fishing-lead or a stone fastened to a fishing-line, is used for throwing. The grind-whale avoids or shuns these stones, and in this way the herd may be driven in any direction for several miles. It is however necessary to accommodate the driving to the tide and wind, especially the tide, for against a strong tide a grind cannot be driven, though it prefers to swim against the wind.

The splash in the water, and the white air-bubbles occasioned by the stone when going down, the grind shuns to such an extent that when a regular and constant casting or throwing is kept up, a grind, under common circumstances, never will break through the rank of boats. White-painted stones are very useful, as well as anything that may produce some sound below water. A tin plate beaten against a stone or a piece of iron, is, in my experience, a first-rate instrument to use at casting. It is probable that the grind makes use of its hearing as well as its sight in order to escape danger.

When the tide is unfavourable for driving the grind towards the whale voe, where it is intended to capture it, the herd must be "laid by," that is, kept in a bay where there is little or no tide till the favourable tide sets in. A grind may be kept for other reasons, such as an insufficient number of boats, too short daylight, etc. When a grind is "laid by," it "grinder," that is, it lies entirely quiet, stowed together in a little space, like a flock of sheep. The driving of a grind is very like the driving of a flock of sheep.

It is an interesting sight to observe, from an elevated plain on shore, a grind when it "grinder." Now and then some of the whales stand erect in the water, with their heads above the surface, seeming to spy. Others float quietly on the surface. The main body swims round, stowing the herd together, so that some in the middle find it difficult to get below water.

On such occasions the grind can be neared in a boat, so that the motions of the single individuals may be observed closely. A grind may lay itself by during the very driving. During night the grind keeps entirely quiet and "grinder," but with the first dawn of the day it grows restless, and at this time it is a great matter for the boats to be attentive, in order to prevent the grind from escaping suddenly, which has happened more than once.

The grind commonly swims on the surface of the water; sometimes, however, the whole herd disappears at once, but appears again, generally within five minutes. The air-bubbles which rise sometimes inform the boats in what direction the grind is swimming below water.

When the herd "grinder," now and then a whale may give a piping sound. This sound is always heard when the herd is below water, and the boats right above it. One can ascertain whether the grind goes in one direction or another by lying down and putting his ear to the bottom of the boat. Some are of the opinion that this sound is produced by friction when the animals rub against each other, but I have convinced myself that it arises from the blow-hole of the animal.

The "Finding-boat" and the four "Grindeformand" elected for each whale voe have the command at the driving, and every person is obliged, under threat of punishment, to obey their orders.

The implements which a boat, according to the regulations, is obliged to be provided with, are, besides the aforementioned stones, whale lances (Hvalvaaben)—four for the largest boats,—which are 12 inches long and 4 inches broad, upon a wooden shaft 6 feet long, to which a thin line is attached; and strong iron hooks (Söhnakroge)—three for the boats with four lances,—with the necessary strong ropes. The harpoon is prohibited to be used before it is evident, after several unsuccessful attempts, that the grind cannot be driven on shore, and the capture in company is given up, as any person who catches a whale by the harpoon is entitled to keep it for himself, besides the tithe. Generally it is only a single wounded whale out of a flock that is caught by the harpoon.

It is with great reluctance that a grind is given up to harpooning, because experience has shown that although all hope may seem lost, it has nevertheless been possible to make a good catch in the ordinary way. As a proof of this, in the month of August 1843, a grind was found off Nordgothe, and tried to be driven on shore in that whale voe; but the attempt proved unsuccessful, upon which it was driven to the good whale bay Vaag on Bordö, where the attempt, by a mistake, proved to be unsuccessful too. Upon this the grind went south through the Kalrö Fjord to sea. Almost all the boats left it and went home, but one boat continued in the pursuit. About eight miles east of Nolrö, the grind turned again towards the coast and went up into the sound between Stromö and Orterö. But although a great number of boats had rejoined the one which continued the pursuit, it was impossible

Whale-Fishing in the Farore Islands.

The Driving.

to drive it up to the narrow of the sound, where the regular whale voe is, as the grind shunned the land and the shallow waters. It was then resolved that a last trial should take place on Stromnarären, at the one side of the sound, and if this trial should not prove successful, to give the grind up to harpooning. Only five boats commenced the driving, as the men were entirely exhausted by hard rowing and the want of sleep. Never did I see a more beautiful rush on shore (Landgang) than this grind made, and in the course of three-quarters of an hour 250 fine animals were lying on the sands. It is true the affair had cost much trouble, a constant pursuit being kept up for three days, and upwards of forty-eight miles.

A whale voe (Hvalvaag) is a bay with a level sloping bottom of loose sand or mud. The looser the bottom is the better, because it is the sooner stirred up, which prevents the animals from finding their way in the water. There is a great difference in the fitness of the whale voes. The sound between Stromö and Osterö is unquestionably the best of them all. The next are Vaag on Bordö, Vaag on Suderö, and Midvaag; then Thorshavn, Vestmanhavn, Nordgothe, and Kvalbö. The inferior voes are Avannsund, Fundingsfjord, Sand, and Trangirvaag. Vestmanhavn was, before 1843, one of the inferior voes. The sloping bottom is too narrow, and at the side of it there is a "Marbakke," or suddenly sloping bottom, against which the grind strikes when it is attacked.. The harbour is wide, quite a mile long, and it has at the mouth a sand-bar upon which there is three fathoms of water. This bar has a level sloping bottom outside, but inside the bottom suddenly slopes, the result of which is that the grind can be easily driven in over it, and finds difficulty to get out again. For this reason a grind can be kept in at Vestmanhavn for days. Many large herds escaped from Vestmanhavn formerly. In 1841 such a herd had been driven in and kept there for several days. It was several times attacked, but without success. At last bundles of straw were tied to a long rope with stones attached to make them swim a little below the surface of the water. This line was drawn after the grind, and in this manner we succeeded in forcing it to so near the shore that it could be lanced. By the assistance of this simple instrument thirty whales were killed.

By the time the next grind was driven into Vestmanhavn another plan was adopted. The Rev. Mr. Schoun of Nordstromö, who before this had planned a whale-net, and a mode of watching for the discovery of grind, caused a net to be made in a hurry out of old fishing-lines. The meshes were 6 feet square; and with this fragile implement thirty-six whales were killed. When Governor Plöyen and Sheriff Lunddahl, who took great interest in the whale-fishing, and never neglected to be present, saw this astonishing result, they adopted the pastor's plan of a net for Vestmanhavn, and caused one to be made. This net, which was manufactured by the intelligent blacksmith Peder Fr. Jacobsen of Narset, according to the pastor's sketch, consisted of nine yarn ropes, 200 fathoms long, 8 fathoms high, with meshes of 6 inches square, lead-sinkers on the bottom rope, and buoyant at the top, with fifty oak barrels for floats, and was ready for use in the spring 1843. It was fitted up for trawling after the grind, so that it was forced in upon the level bottom and prevented from striking against the "Marbakke." The expense amounted to about £100. A store was built for keeping it in.

It was used for the first time on Whitsunday morning, the 4th June 1843. The draught was successful above all expectation, as 234 animals were killed with only one attack, not a single whale escaping or getting outside the net. This successful result was followed the same year by two catches less successful, as the herds broke through the net; but we succeeded nevertheless, after hard work, the net being very heavy, to replace it outside the flocks, and catch both these grinds in the course of two days. The deficiency of the net arose partly from want of sufficient sinking weight to prevent the grind from lifting it from the bottom and swimming out underneath; partly also from the fact that when the bottom line was made heavier, and the grind was not able to lift it, it went over it, although all the boats that could be spared from the spearing were fastened to the floating rope. The boats were obliged to allow a passage over, or to sink themselves, which happened a few times, although no damage was sustained by the crews.

This deficiency was not easy to mend, as more weight made it impossible to move the net, and better floating could not be applied. We were consequently forced to be pleased with the net as it was. Later grinds were partly as successful as the first one, but in 1858 one grind was lost, because the net could not be put out again after the grind had broke through it, as bad weather came on. As the net by this time required general repair, it was resolved to have a new one made, smaller, of 100 fathoms length, which was easier to handle, and to use the old one to bar the grind upon a smaller portion of the harbour, by which means much time would be saved when the grind broke through the smaller net, as it had not a fourth part of the harbour to move in. This plan is best suited to the purpose, and not a single fish has escaped since it was adopted. As soon as the grind is barred by the large net the smaller one is set from the bottom along the north shore of the harbour.

When the grind is to be attacked—which may most appropriately be performed in rising water, as the current from the river Foraa has detained many a catch, driving as it does the blood too soon into the net—it is driven in between the west end of the net and the shore, the end of the net is hauled on shore, and the grind is then locked at the same time as the attack is made. When this is done in good order a grind will be caught in Vestmanhavn as easily as in the best whale voe.

From 1843 to January 1878, thirty-five years, there were caught with this implement 6030 whales, representing in value £20,100, while, on the contrary, from 1584 to 1843, 260 years, only 2169 were caught, notwithstanding that large herds were more frequent in Vestmanhavn than in the thirty-five years in question—herds which after many days' trouble and enormous exertions, loss of tools, etc., were lost.

For keeping the net in repair the Government ordered one-eighth of the draught in Vestmanhavn, after the usual tenth, to be deducted. The net having now saved the little capital considered sufficient for its necessities the deduction is not made at present.

When the grind has arrived at the mouth of the whale voe the boats are arranged for the attack, generally in three rows, with a proper distance between each row, in order that if the grind should break through the first row the second may take its place and turn it, and so on.

The attack, called "holding a grind to," is conducted thus: One boat in the foremost row pulls up to the herd before it is aware of the shallowness of the water, about five or six fathoms, according to the number of the herd, and the man in the prow wounds one individual with his lance. The wounded whale rushes into the herd, and the herd, frightened, suddenly strikes ahead, sometimes right upon the shore, leaving several individuals lying on the dry shore. The first row of boats pursues and distributes thrusts with the lances, right and left, by which means the water is soon mixed with blood, as the animals are very plethoric, which has the effect that, although the grind makes a turn before it is landfast, it turns into the blood again; and it has happened that a large portion of a grind has broken through the rows and got outside the whale voe, but nevertheless has allowed itself to be driven again into the blood.

The second and third rows keep outside on the clear water, till it is evident that the grind "maler;" that is, the animals are bewildered and seek the blood; upon which all the boats pull into the slaughter, and with the heavy lances work an awful butchering. It is of great importance to give the first thrust or stroke at the proper instant, and with necessary attention. It must be applied while the herd, unconscious of danger, is quietly swimming in the direction of the sandy beach. The animal requires to be wounded in the hind part of the body, as it, in this case, rushes right ahead. A stroke in the fore part of the body, or before the back-fin, causes the wounded whale to throw itself on the wounded side, and turn into an oblique direction; the herd follows it, and in its wake easily takes the same direction, breaking through the row of boats.

Some of the crew jump into the water, partly from the boats, partly from land, with their whaling-knives and iron hooks fastened to ropes, and by them the animals are hauled on shore, and at the same time are killed by a cut with a knife on the neck, in which the Faroese are extraordinarily expert. The animals are generally killed from the boats too, in the same way, and then towed on shore. The driving and the attack is an interesting and stirring sight, but the slaughter is a mere sickening butchery. There is an awful noise, crash, cry, and apparent confusion, when as many as a hundred boats and several hundreds of whales crowd and press together within a limited area, and toss each other about in a violent life-and-death struggle. Here men may be seen wading to the neck in the bloody water; there a whale towing a boat with railway speed, so that one would think the boat would smash any other boat coming in its way. Then a man loses his balance in the boat and plunges into the bloody sea; next a whale in the agonies of death lashes the water with its tail and fills a boat. One man is hurt with a knife; another receives a mighty blow with the tail, when he has been imprudent enough to get within its reach, not keeping at the head of the whale.

When a grind makes a good landing, the killing is performed in an incredibly short time. And even when the landing is not good, the killing does not generally last long. On the 8th of August 1873, 657 whales were killed at Thonhavn, in less than four hours from the commencement of the attack, although not a single whale made the landing.

The butchering being over, the whales are hauled upon the beach as speedily as possible, in order to have them numbered and valued, which is done by measure, and according to the judgment of the two sworn appraisers. Number and value is cut upon each whale. The valuing is done, after an old computation, in "gylden" and "skind." A whale of a medium fatness, which measures 10 feet from the eye to the anus, shall, according to the regulations, be valued one "gylden" (20 skind). Scarcely any whale is larger than to be valued at one gylden.

A whale will render one Danish barrel of oil on an average

Whale-Fishing in the Faroe Islands.

The Slaughter.

(thirty gallons English), which, according to the present prices, is 45s. The meat I shall put at half the value of the blubber, which renders the oil. A whale of a medium size is, according to this estimation, worth £3, 7s. 6d.

The division is next made, and must be accomplished without the least delay, in order that every one may get his share in kind, as it is of the greatest consequence that the meat, which is a wholesome and nutritious food, be delivered uncorrupted. Formerly, that part of the meat which could not be used fresh was hung up for drying, but in that way a great part of it was destroyed. Now the most of it is pickled. The entrails, except the heart and kidneys, are left on the beach, and it is the business of the Sysselmand to see the refuse carried away before seventy-two hours after the division is made. This refuse, which contains plenty of manure, ought to be made use of in a better way than being carried out to sea to serve birds and fishes of prey as food. The stomach of the animal and the gullet are tanned, blown, and used as buoys on fishing-lines and nets.

The division is performed by the Sysselmand, according to the regulations. First, the tenth is calculated; and it is divided between the Crown—whose part is sold to the Sysselmand at a very low rate,—the Church, and the minister of the district. Next the largest and best animal is selected by the crew of the boat that first reached the herd, and the head of this whale belongs to the person who discovered the grind. Then "Madhval" is made, that is, a proper compensation according to the estimation of the Sysselmand, to the inhabitants of the village or villages, near to the whale voe, for lodgings and provisions given to the "Ragstesmand." Again, "Skadehval" is reckoned, that is, indemnification for damage of boats and implements, and personal injuries sustained in consequence of the grind. There is an allowance made for keeping watch and for valuing; a small proportion for the poor-box and the school-fund is fixed; nor are the Sysselmand and the four "Grindeformand" forgotten in the division. The rest is divided into four parts,—the landowner, on whose estate the whales are killed and hauled up receives one, and the "Ragstesmand" the other three parts. By Ragstesmand is understood, not only the men that have been at the butchering, but the entire population of the district which is regulated as belonging to the whale voe, with a view to which a census is taken once every year. The whales which are fished up from the bottom of the whale-bay, or float up there, after the commencement of the dividing, and in the two first days after the slaughter (at an average 10 per cent. of the whole number), are sold by public auction, after deducting the tenth and salvage, in behalf of the economical fund of Faroe, out of which are paid the expenses of bridges, roads, landing-places, etc., in the islands. Boats not belonging to the district, arriving after the valuing is finished, are entitled to a share of these whales. Whales that are found after the expiry of the two days are the property of the finder, with deduction of the tenth. During the division the men enjoy themselves dancing.

Each village, and every person entitled to a share, receives a ticket, on which the number and value of the whales to which they are entitled is marked, and with these tickets every person sets out for the shore; they seek out their whales, without causing any disorder or confusion, cut them up, and load their boats with the share of their village.

During the cutting up, in which task all the men are employed—some cutting off the blubber and meat, others carrying it to the boats,—the Sysselmand is selling by auction the whales belonging to the public funds. The cutting up is performed in a very short time.

In the course of a couple of hours the most part of the capture is loaded in the boats, which pull homewards, sometimes laden to "Gribsbord," *i.e.* when one puts the thumb on the gunwale, and stretches the other fingers on the outside at the middle of the boat, and the tips of the fingers touch the water, which means that the distance from the gunwale to the water is only 7 inches. The bones of the animals are put on the top of the cargo, that, in case of rough sea and bad weather on the voyage, they may be thrown overboard to lighten the boat.

No boat leaves the place without striking up a song of praise to the Lord as a thanksgiving for the gift. It is a solemn sight to behold the boats as they, often in the quiet midnight hour of the clear nights, glide over the glassy level of the sea; and it is a solemn sound to hear the notes of praise sounding along the calm ocean.

Figures to the left denote number of catches. … but have been fished up or floated afterwards.)

Year.	Kvannesund.	Vedvig.	Bordovig.	Vaag on Bordö.	Fundingsfjord	Fuglefjord.	Gothevig.	Lamhauge.	Skaalefjord.	Vordskaale.	Sundet, between Osterö and Stromö (the Sound).	Thorsvig.	Kollefjord.	Hoivig.	Thorshavn.	Sandegjerde.	Nolsö.
1584* to 1640	.	.	.	13 1162	.	.	.	.	1 80	1 32	12 1537	.	.	.	.	.	.
1641† to 1708	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1709* to 1744	3 135	.	13	46 7351	6 572	2 120	5 552	.	4 110	7 244	58 9770	12	2	1	2 65	19	58
1745* to 1795	.	.	.	7 782	1 262	.	.	.	.	2 8	5 1033	.	.	.	.	.	.
1796 to 1812	3 131	138	29	2210	5 206	4 269	69	23	54	.	5 486	.	2 75	.	.	.	.
1813 to 1859	534	490	.	9703	515	16	1365	.	72	260	9482	.	300	.	3214	.	26
1860	.	.	.	.	.	.	.	.	.	.	163	.	.	.	.	.	.
1861	.	.	.	.	.	.	.	.	.	.	147	.	.	.	.	.	.
1862	.	.	.	.	2 529	.	178	.	.	.	.	.	.	.	2 85	.	.
1863	.	.	.	.	186	.	.	.	.	.	.	.	.	.	.	.	.
1864	.	.	.	1 185	86	.	.	.	.	.	.	.	.	.	.	.	.
1865	.	.	.	2 584	.	.	.	.	.	.	221	.	.	.	.	.	.
1866	.	.	.	3 449	.	.	.	.	.	.	213	.	.	.	.	.	.
1867	.	.	.	.	.	.	.	.	.	.	171	.	.	.	.	.	.
1868	.	.	.	.	.	.	417	.	.	.	.	.	1	.	.	.	.
1869	.	.	1	.	.	.	.	.	.	.	203	.	.	.	.	.	.
1870	.	.	.	.	.	.	.	.	.	.	247	.	.	.	1 460	.	.
1871	.	.	.	.	.	.	91	.	.	.	2 385	.	.	.	125	.	.
1872	.	.	.	1 856	.	.	.	.	.	.	1 516	.	.	.	.	.	.
1873	.	.	.	2 331	.	.	.	.	.	.	.	.	.	.	2 654	.	.
1874	.	.	.	.	.	.	.	.	.	.	153	.	.	.	.	.	.
1875	.	.	.	26	.	.	.	.	.	.	.	.	.	.	38	.	.
1876	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1877	.	.	.	.	.	.	.	.	.	.	185	.	.	.	.	.	.
	800	628	43	23,672	2306	405	2672	23	266	544	24,912	12	378	1	4641	19	84

Year.	Vestmanhavn.	Saxen.	Midvaag.	Sandevaag.	Bö and Sorvug.	Sand.	Skaalvig.	Husevig.	Kvalbo.	Kvalbo Eccle.	Kvalvig.	Trangisvaag.	Ordevig.	Vaag on Suderö.	Lobra.	Fumsin.	Little Dimon.	Totality Yearly.
1584* to 1640	.	.	7 1018	.	.	.	.	.	4 290	.	.	.	.	1 40	.	.	4	4113
1641† to 1708	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1709* to 1744	10 675	.	25 4002	3	.	.	.	.	26 1682	.	.	6 224	10	16 2428	.	.	.	28,048
1745* to 1795	.	.	5 1181	.	.	.	1	.	2 316	.	.	.	.	.	.	.	.	3583
1796 to 1812	5 702	155	8 2052	.	.	2 183	62	.	10 1152	.	2 411	19	1	8 913	.	.	.	9340
1813 to 1859	3815	.	11,567	1	129	619	114	12	2974	114	184	1099	280	4911	315	369	.	52,480
1860	2 299	.	152	.	.	.	.	.	.	.	.	.	.	26	.	.	.	640
1861	77	.	73	.	.	2 44	.	.	.	.	.	.	.	.	.	.	.	841
1862	2 242	.	95	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1129
1863	.	.	5 523	.	.	.	.	.	.	.	.	.	.	.	.	.	.	709
1864	.	.	346	.	.	.	.	.	.	.	.	.	.	.	.	7	.	574
1865	3 210	.	93	.	.	.	.	.	146	.	.	.	.	.	.	.	.	1254
1866	880	.	.	.	.	.	.	.	2 583	.	88	.	.	89	.	.	.	1752
1867	.	.	177	.	2	.	.	.	.	.	.	.	.	40	.	.	.	390
1868	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	420
1869	130	.	2 377	.	.	.	.	.	.	.	.	.	.	.	.	.	.	711
1870	.	.	136	1	.	.	.	.	.	.	.	.	.	.	.	.	.	844
1871	.	.	168	.	.	.	.	.	.	.	.	.	.	.	.	.	.	769
1872	2 480	.	82	.	.	.	.	.	.	.	.	.	.	2 873	.	.	.	2307
1873	101	.	321	.	.	.	.	.	.	.	.	.	.	257	.	.	.	1667
1874	124	.	.	.	.	.	.	.	.	.	.	299	.	.	.	.	.	576
1875	1 506	.	.	.	.	.	.	.	.	.	.	.	.	199	.	.	.	769
1876	1 333	.	2 266	.	.	.	.	.	182	.	.	.	.	.	.	.	.	781
1877	1 125	.	67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	377
	8199	155	22,696	5	131	848	177	12	7275	114	683	1641	291	9276	315	376	4	113574

* 1585 to 1599, 1601, 1603 to 1612, 1622, 1625, 1627, 1631 to 1634, 1636, 1639 to 1640, 1740, 1742, 1745, 1750, 1751, 1753, 1755 to 1769, 1771 to 1776, 1777 to 1780, 1783 to 1786, 1788 to 1791, 1795—no catches.

† No statistics.

SPECIFICATION OF THE WHALE HUNTS IN THE FAROE ISLANDS, ARRANGED ACCORDING TO THE MONTHS OF THE YEAR.

(To the total Number may be added 10 per cent. for "Drivhvale," that is, Whales that have sunk during the slaughter, but have been fished up or floated afterwards.)

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totality Yearly.
1584* to 1640	3	.	.	243	230	124	756	1061	1414	130	.	152	4113
1641† to 1708	.	.	.	.	.	.	.	.	.	.	.	.	.
1709* to 1744	250	.	505	635	1018	2098	7473	9668	4895	726	247	536	28,048
1745* to 1795	.	288	72	236	1	316	381	1379	484	.	148	278	3583
1796 to 1812	106	657	206	408	.	65	55	2197	969	1484	2484	709	9340
1813 to 1859	223	205	348	873	798	7152	16,491	16,499	6666	1607	897	721	52,480
1860	.	.	.	.	.	.	.	217	26	.	397	.	640
1861	.	.	.	.	.	10	111	73	147	.	.	.	341
1862	.	139	.	.	.	.	482	508	.	.	.	.	1129
1863	.	.	.	.	.	.	318	186	.	.	205	.	709
1864	36	.	.	.	.	.	.	.	346	192	.	.	574
1865	.	182	.	146	.	92	95	468	.	270	.	1	1254
1866	.	.	.	.	213	57	660	89	433	300	.	.	1752
1867	.	.	.	.	.	2	.	40	171	.	177	.	390
1868	.	.	.	.	.	.	.	.	.	419	1	.	420
1869	.	.	.	1	.	.	208	409	.	.	93	.	711
1870	248	.	.	.	.	.	.	.	460	.	.	136	844
1871	.	.	.	.	.	.	259	.	510	.	.	.	769
1872	.	.	.	.	.	105	.	553	82	516	1051	.	2307
1873	.	.	.	.	.	142	35	1389	.	.	101	.	1667
1874	.	.	.	.	.	.	153	299	.	124	.	.	576
1875	.	.	.	.	.	.	.	506	237	26	.	.	769
1876	.	.	.	.	182	.	.	.	.	410	189	.	787
1877	.	.	.	.	.	.	252	.	125	.	.	.	377
	866	1471	1131	2542	2437	10,168	27,724	35,541	16,965	6206	5995	2583	118,574

* [illegible] 1631 to 1634, 1636, 1639, 1640, 1740, 1742, 1745, 1750, 1751, 1753, 1755 to 1769, 1771 to 1775, 1777 to 1780, 1783 to

Whale-Fishing in the Faroe Islands.

Before the Numbering and Valuing.

II.

VARIOUS METHODS OF OYSTER CULTURE.

BY W. ANDERSON SMITH.

THE attempt to cultivate any creature without a thorough knowledge of its mode of reproduction seems very absurd; and yet the culture of the simply-constituted oyster has exemplified this absurdity. The widest difference of opinion has obtained, and still obtains, on the point; and so late as in the spring of 1880 a meeting of oyster-culturists was held in France, at Orléans, if I remember aright, to discuss the question, at which the culturists of Brittany differed *in toto* from those of the Marennes and Arcachon on the subject of the bi-sexual or hermaphrodite character of the mollusc—the culturists of Marennes and Arcachon holding the hermaphrodite theory, as propounded by M. Coste. The Romans,[1] who were the earliest oyster-culturists of whom we have any reliable knowledge, worked upon the conviction that the oyster had different sexes, and have left a description of how the different breeds were improved by crossing. But since the revival of oyster-culture in France, and elsewhere in Europe, the hermaphrodite theory has been held most tenaciously. In witness whereof see Jeffreys:[2] "It was at one time supposed that the oyster and fresh-water mussel were exceptions to this rule (of Hermaphroditism), and that some individuals were male and others female; but the researches of Daraine, Moquin-Tandon, and other able physiologists, have disproved this idea." Yet from the practical experience of culturists, on the one hand, and the researches of microscopists on the other, there seems good reason to believe that the oyster is, nevertheless, bi-sexual, as was formerly held by such distinguished names as MM. Quatrefages and Blanchard.[3] One of our most experienced oyster-merchants holds that, whatever classes of oysters are laid down in the English beds among an excess of natives, they, in a very moderate time,

1 Varro, Book iii. (See Jeffreys.)
2 Jeffrey's *British Conchology.* Van Voorst, 1863.
3 Hermaphrodite. MM. Quatrefages et Blanchard ont soutenu l'opinion contraire, et plusieurs mémoires déposés à l'Académie des Sciences traitent de procédés de fécondation artificielle et d'ensemencement des bancs d'huitres. *Guide pratique de l'Ostréiculteur.* Par M. Felix Fraiche, Paris.

by interbreeding, become of a uniform character—the descendants being all practically native oysters.

The oyster-culturists of Finisterre, in the season of 1881, allied themselves together, in order to withstand the introduction of the inferior so-called Portuguese oyster, the scalloped-edged, coarse-shelled species recently introduced into Southern France. Their reason was that it would soon not only monopolise the oyster-grounds, but, by crossing, destroy the character of their own oysters. The French Commissioner of Oyster Fisheries for the Marennes has found what he believes to be a distinct cross between the Portuguese and the French oyster, in corroboration of the theory of male and female oysters.

Mr. Littlewood, of Huddersfield, in a paper written for the Norwich Fisheries Exhibition, has directed especial attention to the question, and shows microscopically the marked difference between the ova of the female and the semen of the male. The success of this gentleman in breeding oysters in confined tanks in his cellar gives weight to his important and interesting evidence; but corroboration of his observations is required.

There still remains very great ignorance on the subject, that must be cleared up ere we can properly understand the continued failure of spat in our seas; and before proceeding to explain the present position of oyster-culture, it may be well to invite attention to the following questions:—

If the oyster is hermaphrodite, and throws live young, whence comes the failure of spat, when we know the mollusc to have "sickened"?

If hermaphrodite, and the spat is thrown as eyed ova, how long does it take to hatch?

Do the ova require semen to vivify them, and do they float on the surface until vivified?

Does cold or rough weather kill them readily, and so prevent their vivification?

Are the eggs hatched as well as fecundated in the female, and the young thrown alive and active into the water, where they can at once choose instinctively or intelligently suitable positions and conditions of life?

Do they retain their active existence for three weeks or a month, as has been stated by various authorities, and during that time display a certain amount of control over their movements?

Do they return to the mother and seek security in the shell after exclusion, as has been stated by Mr. Frank Buckland?

These and other questions remain to be answered before we can have any certainty in the breeding of oysters in the North.

It may be well also to state convictions on oyster cultivation which seem well founded at present:—

1. That we should go back to the early belief in the bi-sexual character of the oyster.

2. That the ova are fecundated in the mother oyster, by the inhalation of the spermatozoa of the male with the water currents.

3. That the young as thrown are active, and capable of choosing a suitable resting-place on which to degenerate into a lower life, incapable of activity, and devoid of higher-class organs of vision and progression.

4. There seems no reason to believe the young to be especially delicate. Mr. Eyton maintains[1] that they are exceedingly tenacious of life, the cilia moving until they were dried up upon the glass, while some that he placed in a little salt and water were alive the next day.

It will be gathered from the preceding that the great question of oyster-breeding lies in the gathering of the harvest, which is thrown in myriads, varying, according to different observers and calculators, from two hundred thousand to two million ova each mother oyster.

The two great systems of oyster-culture at present pursued may be called the English and the French. The first is the system that has been conducted in this country for centuries on a great scale, and if not with unvarying success, at least with very general good fortune. The other has been originated within a generation by M. Coste, with amazing results, compared with the money and time expended.

Other methods of oyster-culture are the Italian system, as conducted from Roman times on Lake Fusaro; the American system, as carried on in the Virginian and other waters; and, lastly, the new system that promises to be inaugurated, if the success of Mr. Littlewood of Huddersfield justifies his belief in the possibility of controlling the spat, and obtaining its deposition within manipulative bounds.

The English system may be divided into two:—

1. The dredging of brood, or small oysters, on the open grounds, and laying them down on the fattening beds of Essex and the Thames estuary.
2. The culture of large beds in deeper waters, as carried on by the Whitstable and Colchester Corporations of Fishermen, the Faversham Company, Herne Bay Company, and other owners of private beds, in waters below the ordinary foreshores.

The first system is conducted all over the southern coasts of England to a greater or less degree, but most successfully in

[1] See *Report of the British Association*, 1856.

the estuary of the Thames, where the oysters acquire, and have been noted as acquiring from time immemorial, a plumpness of fish, together with a delicacy of shell that seems nowhere else obtainable, and has made the English natives as famous as they are now rare and costly. At the same time, a fine rock oyster from the Scottish coast has a firmness, richness, and smack of the sea that is greatly preferred by many to even the best Thames natives.

The cause of the superiority of these natives from the Thames beds depends partly on the care with which they are attended to, and partly on the richness of feeding, combined with the freshness of the water preventing the too great deposit of lime, in the shape of shell, and supplying instead nourishment for the enriching of the edible portion. These feeding-beds are not intended in any degree as breeding-places, nor is there any attempt made to secure any spat that may fall. The oysters seem to be nourished greatly upon diatomaciæ and minute spores of confervæ, the latter giving that prevailing delicate green tint so much in request among connoisseurs.

In these beds the owners annually deposit a number of bushels of the common periwinkle, so as to prevent the undue growth of sea-weed, whose spores are yet most useful in the fattening and greening process. Tranquillity has no doubt a good deal to do with the fattening process, and the growth of confervæ and infusoria on which it depends.

By the purchase of brood from the open dredging-grounds, these fattening-beds have supplied millions of oysters of the most delicate character to the London and other markets, the said brood coming, for the most part, from the open banks further down the Thames, to which the spat is regularly carried from surrounding beds. But of late years these have proved less and less equal to the demand, and brood has been sought for with the utmost eagerness throughout the country.

The beds on the west coast of Ireland supplied large quantities for a time, and a modicum was brought from the Scottish coasts; but the diminution of the native supply has been steady, and the Northern French breeding-grounds, in which the spat rarely fails, have recently been largely drawn upon for this purpose. Arcachon is debarred to a certain extent by law from aiding in this stocking of our feeding-ponds, until the oysters are 2″ in diameter, when they are too pronounced in character and the calcareous growth too strong for them ever to acquire the delicacy of shell and largeness of fish of the proper native, deposited at six months old on the feeding-beds, and kept there until five or six years of age. It is to be feared these superior shell-fish have largely disappeared from the market, to be replaced by the more readily manufactured French, Dutch, or American, after six or twelve months' cramming.

The second is the English system proper, and is of the greatest national importance, considering its at least partially self-supporting character, and that it is pursued by the great Oyster Companies already mentioned. We will take the famous supplies of Whitstable natives as an example, working two square miles of ground opposite Whitstable in the Thames estuary.

This Company is virtually a guild or corporation of fishermen, who work the ground for their mutual advantage. The oyster-beds are covered with about a fathom of water at low tide, and the members of the Company expend a large proportion of their labour in dredging over the ground in the close-time that they observe. This dredging is done in order to keep the ground clear of mud and sea-weed, to kill mussels and star-fish, to arrange the oysters as to size, placing the larger ready near shore for the opening of the season, and other necessary labours connected with the business. Only during that portion of the close-time in which the young oysters are observed to be settling on the ground is the dredging stopped, in order to prevent any injury to the young; although some authorities maintain that the benefits to be derived from keeping the ground clear of enemies more than counterbalances any injury caused the young by the passing of the heavy iron over the ground.

It is certain, however, that for many years these great Companies have not been able to supply themselves with brood from their own oysters; nor indeed have they managed to procure brood from our own coasts, except to a partial extent, and at a vast increase in price; and this is generally attributed to the fact that there has been a total or partial failure of spat over the whole British coast for very many years past. Whether this has been owing to severe weather, or to the set of the currents taking the spat out to deep water or distant stations, has never been clearly ascertained; but when we remember that the spat never fails at Arcachon, and, so far as our experience goes, a proportion of our oysters "sicken" every year, the failure of spat must be between the gestation of the oyster and the attachment of the spat.

The French System.—M. Coste, in the year 1857, introduced oyster-culture into France from Italy, and, by directing great attention and care thereto, succeeded in creating the present French system, with its marvellous development, extending as it does from Arcachon, near Bordeaux, to the vast breeding-grounds of Finisterre on the Brittany coast, covering over thirty thousand acres, employing more than forty thousand people, and with an annual return of a million sterling already. The Ile de Ré and Marennes districts have practically failed as breeding-grounds, and are now the great feeding-grounds of the oysters bred at Arcachon and the Morbihan districts.

I shall endeavour to epitomise French oyster-culture from personal experience of its present condition.

The brushwood, stones, and other similar collectors employed to collect the oyster spat at one time, are practically little used to-day; and, with the exception of plank collectors, coated with a mixture of lime and sand, the only *cultch*, or collectors of spat, used at present are tiles. These are coated either with a mixture of lime and sand, or with cement in a thin coating. The tiles are thus coated, because otherwise the delicate young oyster cannot be safely removed from the tile; while the wood is coated because it is too easily removed and swept off by currents.

In commencing an oyster park on the French system, the first thing is to prepare the ground. The best ground they consider to be hard ground, thinly covered with fine sand, composed of disintegrated shells, where much mud will not gather so as to endanger the oysters. To create this special character of ground, which is rarely found naturally, is the aim of the cultivator in preparing his park.

It is difficult to reconcile the statements made officially, " that grounds of deep mud are the only absolutely useless ones for oyster-breeding," with the fact that the parks of the Morbihan are on deep mud of the most slimy character! But the ordinary park is cleared of mud by natural methods,—that is to say, it is made by gradually making a bed of rough, broken stones, against which the tide breaks, creating currents that carry off the mud, and this bed is pushed further and further seaward until the action of the water has denuded it of the injurious mud—most injurious, that is, to the young oyster. If the ground is sandy soil with some cohesion, it is thickly sprinkled with shells, which help to give it greater steadiness and solidity. Where sea-weed is plentiful, it must be cleared off completely, as it is not only unsuitable in itself, but gives refuge to the enemies of the oyster in multitudes; all mussels must also be removed, being most deadly. For it must be recollected that mussels, star-fish, borers (whilks), annelids, and crabs, are serious enemies; while many other classes of much lower life, such as sea-anemones, etc., are inimical to the oyster as spat.

The beds thus made and stocked with breeding oysters are supplied with tile-collectors, being simple curved tiles arranged in various methods, to suit the ground and its exposure to seas, or the taste of the owner. When piled in rows one above another, lengthwise and crosswise alternately, they leave a good space, owing to their convexity, on which the spat may fix. Where the mud is very thick on open ground, the tiles are placed upon little wooden platforms affixed to long stakes, that are thrust into the mud until the wooden floor rests on the top of the mud, and prevents its sinking.

These piles of tiles are only placed in position when the spat is expected, as if too early placed they become coated with mud and the young of barnacles and other creatures, to the exclusion of the oyster, while care must also be taken that they are not too late in position. In the bay of Arcachon the end of May is about the time usually chosen, while in the Morbihan, where the temperature is lower, the season is somewhat later.

At Arcachon, where the temperature is high and spat unfailing, it is largely collected in artificial ponds enclosed from the sea, and furnished with collectors of all kinds from brushwood to tiles; but the use of tiles has become so universal that the industry connected with this manufacture is one of the most important in the neighbourhood. Into these ponds, subdivided as they are, the sea only flows through one regulated entrance, and ere it retires has to run the gauntlet of so many sluices and obstacles that the chance of any spat being removed along with it is reduced to a minimum.

In the open bay the tiles are mostly laid along the edges of the watercourses that cross it when the tide is out; but the piles of tiles, covered with nothing but barnacles, proved conclusively that the oyster had not always its own way even in this magnificent oyster preserve. In these ponds the bottoms are made convex, so as to throw the mud that may enter towards the sides, where it can be removed, leaving the rest of the ground clear.

The bay of La Rochelle, including Ile de Ré and Ile d'Oléron, has not been successful in oyster-breeding, the spat apparently either rarely maturing or being carried out to sea. Here, however, the oysters of Arcachon are brought, to increase rapidly in shell and improve in flavour; and the neighbouring *claires* of Marennes make the famous green oysters, which are among the most noted in France. But it may be well to note here that the further north the oyster the better it is, so that the Arcachon bay oyster, although the most prolific, is the least delicate oyster on the coast. Nor can the green oyster of the Marennes compare in excellence with the green oyster of Ostend, fattened on *Naviculæ* that swarm in their famous pits.

In the Morbihan the oysters are bred extensively on artificial cultch of tiles and wood covered with cement, and although so much further north than Ile d'Oléron, yet the spatting has been continuously successful, and in a more open and natural manner than one would have anticipated.

The tiles when covered with spat are left until they attain a size a little beyond a quarter of an inch in diameter, when they are scraped off clean with a knife that passes under the cement. The young oysters thus detached in thousands are assorted, counted so as to ascertain how many per measure on an average, and then exported or "caged." These cages are formed of wooden frames covered top and bottom with iron wire-netting. They are then dipped into a large box of liquid tar so as to be well coated, and when dry they are fit to contain the tender youngster, and keep him safe from the onslaught of his numerous enemies until he has attained greater maturity. These cages (*caissons*) are three yards long by one wide, and four to six inches deep, and the wire-netting is of a quarter-inch mesh.

The fattening *claires* of France are very much on the same principle as those of this country, the object being to make a quiet pond of no great depth, into which the sea only rises at spring-tides, and where confervæ and infusoriæ flourish under the "heat and tranquillity." The pits of the north of France are deeper, in order to secure safety from frost and cold; but in neither the *claires* nor the pits can oyster-culture proper be said to be carried on, seeing no breeding is attempted, and the general rule is a true one,—that a fattening oyster does not breed, nor a breeding oyster fatten.

Of late the system has been widening its character, and we find that while Arcachon breeds the oyster and keeps it for two years, it then sends it by millions to the sands of Ile d'Oléron, to increase in size of shell more rapidly in the open sea-water, after which it is removed still further north to Cancale or Ostend, to acquire the more delicate flavour of the colder seas and fatten in the pits.

The main principles involved in French oyster-culture are—

1. The supply of a clean hard cultch at the proper season for the spat to attach itself to,—just before spatting, so that it may not be previously occupied by other embryos.
2. The arrangement for the ready removal of the spat, when the shell has attained as much development as the multitudes around it will allow—coating with cements.
3. The careful prevention of the accumulation of mud on the parks or on the cultch.
4. The clearing and guarding the ground from animal and vegetable enemies.
5. The guarding the young in cages (*caissons*) until they have a shell strong enough to resist the ordinary attack of their adversaries.

6. The assortment of the oysters as they grow according to size, so as to secure uniformity, and also prevent a number of large oysters in a cage absorbing most of the nourishment, to the injury of its small neighbours.
7. Constant manipulation and clean ground, with proper room to grow, preserves that cleanness of shell and regularity of contour so much desired.

As the French beds were largely recruited by M. Coste in 1860, and afterwards by oysters from the English beds, there cannot be any marked difference in original character, and the inferiority rightly attributed to them compared with the English must arise from the climate. It seems somewhat anomalous that the waters that are most favourable to the multiplication of the oyster should be least favourable to its delicacy. But it is an admitted fact that French oysters improve as they pass north, and English oysters are superior to the best French.

The Italian System is really the remains of the old Roman and the origin of the modern French system; but although the success of the Italians on Lake Fusaro was the cause of M. Coste directing his attention to its development in France, yet it has not displayed much life as an Italian industry—being mostly confined to this famous lake not far from Naples; the oysters to stock it and keep up the supply of breeders being drawn from the Gulf of Taranto. In this lake, three miles in circumference and one to two yards in depth, communicating with the sea by a narrow channel, little conical artificial rocks are made by laying down heaps of rough stones, and again surrounding these with wattled enclosures. The oysters are laid upon the stones well clear of the mud, and before the water can reach the sea from the saline lake it has to run the gauntlet of many wattled barriers on which the spat is certain to attach itself.

But the Mediterranean has not proved a very suitable sea for the conduct of oyster-culture, owing to the want of any tide; and although the French have successfully laid down deep-water beds at Toulon and Algiers, the proper "culture" of the oyster has not been a success in that sea. The tides are advantageous in bringing life to the foreshore oysters, and in keeping up that continuous movement that prevents the deposition of mud, the deadly enemy of the oyster embryo, as it is of the salmon ova.

The American System.—A great deal has been said as to the oyster-culture of America, and hundreds of acres of plantations are no doubt to be found on the various seaboard States; but it must be recollected that although the American Government, with that care for the fishing industries which characterises it, has directed considerable attention to the breeding of oysters, yet the trade of the country is conducted on a much ruder as well as much larger scale than the French.

The American plantations for the most part are parks marked out on the foreshores, on which quantities of oysters are laid down, the spat being allowed to settle on whatever suitable substance it may find on the ground in a natural manner. The greatest American oyster-ground is the Bay of Chesapeake. The Baltimore beds alone cover three thousand acres, and produce twenty-five million bushels of oysters annually. The whole enormous extent of water of the bay is covered with oyster-beds, whence the oysters are dredged and taken to the beds on the river, while many people find a livelihood by gathering oysters along the waterside with a pair of tongs, and selling them to the owners of parks.

One peculiarity of these Chesapeake oysters is, that after having been parked for a time in the fresh water they are capable of enduring carriage to an extent that our own are wholly incapable of. I have laid them down after they had been two months out of water, with only a very occasional drink during that time!

The American trade is much hampered from the restrictions of the different States, each with separate laws, and acting towards each other as foreigners; so that the French system of removal into more suitable waters for growth, and thence to fattening-grounds, is limited in operation to the individual States. Their usual close-time is from 1st April to 1st October.

The Chinese seem to have early practised the art of laying down bamboo rods at the proper season on the oyster-beds. But they do not seem to have advanced any further in this direction, merely leaving the rods with their young brood to remain until a proportion are matured, when they are pulled up and taken to market with their strange fruit hanging upon them of all shapes.

It thus appears that at present oyster-culture may be divided into five systems:—

First.—The English system of fattening the brood gathered from the natural banks.

Second.—The French system of fattening the same natural spat in *claires* or artificial ponds only filled by the tide at high-water of springs.

Third.—The rude American system of gathering the oysters and laying them down on the foreshores for the spat to attach naturally to the unlaboured parks.

Fourth.—The broad English system of laying down beds in deeper waters, and working them systematically to keep them clear of enemies and prepare the ground for spat.

Fifth.—The careful French system, in which the oysters are kept under control from the first deposition of the spat to the maturity of the fish.

To which we may add—

The system of Mr. Littlewood, which may yet prove to be a most important addition to our knowledge, by enabling us to catch all the spat from breeding oysters in tanks, where they can be kept until transferred to feeding-grounds on the French system. This has not yet been conducted on a sufficient scale to enable us to certify as to its assured success; but if it can be properly conducted on a large scale it would be the first step towards the security of oyster-culture as a trade in this country, where as yet, whether owing to turbulent seas or backward weather, the spat naturally fails us five years out of six, and sometimes much oftener.

III.

OYSTER CULTIVATION IN SCOTLAND.

BY W. ANDERSON SMITH.

IT seems somewhat out of place to write an essay on Oyster Culture in Scotland, where we have gone on steadily dredging our beds and clearing our shores until an oyster-fishery of any kind can scarcely be said to exist.

Naturalists have done much to foster this state of matters, and have done nothing whatever to show our countrymen a way out of the difficulty.

No doubt, as they constantly assure us, an oyster throws a vast quantity of young; but as to its reaching a tangible development, the twenty-three years without spat on the open English beds is a sufficient answer in the negative in the case of exposed coasts. The further statement, so frequently reiterated, that a bed cannot be over-dredged, as a sufficiency of oysters will always remain to re-stock it in a few years' time, has been again and again proved illusory. Indeed, the exceptional fertility of the oyster means, without doubt, that, in the ordinary struggle for existence, it has to grapple with exceptional destruction in its early stages; and when to that is added the further onslaught of man in its mature condition, only man's utmost care and attention will counterbalance the injury inflicted.

This is a fact that cannot be too strongly represented. When offshore beds are so denuded of oysters that the dredge will come up empty over and over again, and two or three oysters are considered a satisfactory haul, then the theoretical world may write as it likes about the prolific character of an oyster, but neither a close-time nor years of rest will re-stock the beds. The few oysters left are too scattered to afford protection either to each other or the brood, should such ever be produced from spat; and the natural enemies, except under very favourable circumstances, keep the scattered stock very much in the condition in which it was left, if they do not still further reduce it; just as the wind will do to a forest once it is broken in upon by the gale. Then as soon as an offshore bed becomes so low as not to pay to dredge, the natural enemies formerly kept at bay by the dredge have free play, and the chances are in their favour, not in favour of the oyster or its young.

In this way the finest Scottish oyster-beds have been almost annihilated, and the oysters of Loch Ryan have now followed Pandores out of the market.

But Scotland on certain of her coasts is supplied with a fine class of oysters, not so easily destroyed, yet at the same time not so capable of being commercially important as those just referred to. I allude to the rock oysters so commonly present along the rocky coasts of the West of Scotland, from the Firth of Clyde to the Hebrides, and even at the Orkney and Shetland Islands. On great stretches of our exposed East Coast an oyster-shell is never to be seen; but this can scarcely be said of the rocky shores of the West, which grow this particularly fine-flavoured and full-bodied oyster up every loch and inlet. The dearth of natives in the South drove the agents of the fish-merchants all over the coast, and wherever these rock oysters congregated in exceptional numbers the adjoining inhabitants were employed in gathering them at spring-tides, until such quarters were practically cleared. Now this result is not quite so serious in the case of the rock oyster as in those of beds in deeper water, for the position of these oysters prevents their being cleared away so entirely, and the aggregate number at any time, notwithstanding many glowing accounts of the "olden time," was never really important compared with offshore beds. Indeed, a boat-load from a few miles of foreshore would denude it at any time. But in this case, as in the other, years of entire holiday will not enable such a stretch of coast to re-stock itself as it was before, the former stock being really the accumulated surplus of the struggle over a lengthened period. This delightful rock oyster ought certainly to be encouraged, as it would, in very many cases at least, supply the local demand; but we cannot believe it can ever be relied upon, of its own accord, to add any important quantity to the national supply. At least it will require considerable cultivation before it will lend itself readily to ordinary foreshore "culture," properly so called.

The reasons for this opinion are these:—1st, The rock oyster will not sufficiently accommodate itself to the necessary change of conditions; 2d, It demands a great quantity of nourishment per oyster; 3d, It is very sensitive to atmospheric conditions; 4th, It demands very salt water to breed in, and will not apparently thrive in too fresh water.

If a sufficiency of spat could be obtained at an early stage, and this brought up on the French system, in all probability they could be cultivated into a more useful character for foreshore beds. I have not yet succeeded in obtaining such spat, and have no doubt that to insure anything like certainty the said spat will have to be secured from mother oysters, that have sickened in their natural habitat in salt water, whence in the proper season they should be transferred to covered ponds kept at a moderate temperature. Without this we can have no certainty, but will require to trust to mild and calm weather at the proper season, and merely supply clean cultch, and safety from the commoner enemies, such as crabs and star-fish.

The only native oyster of Scotland that demands special attention is that of the offshore beds, such as the Firth of Forth, Loch Ryan, and Luce Bay; which may be quite well the offspring of rock oysters carried seaward, and deposited where they have grown up under freer conditions. I do not believe that rock oysters from the foreshores can be deposited full-grown in such beds with advantage, as they have matured under a totally different set of conditions, and are not well suited for withstanding mud or other deep-water adversaries: but yet a good supply of rock oysters on the adjacent shores may be a most likely mode of peopling the sea-bottom alongside, if it is of at all a suitable character. So that the clearing the foreshores of its scattered oyster harvest may be really preventing the accumulation of the deep-water beds we are so anxious to retain.

It will be seen from the foregoing that we cannot accept the hope that a few years of freedom from attack can be relied upon for re-stocking exhausted beds; that we are not to look to the rock oyster, however delightful and useful locally, to prove an important foreshore harvest; nor have we any native Scottish oyster specially adapted for this purpose. We will now consider the whole question from another point of view, to see if there is any other oyster better fitted for our purpose.

Our native oysters are specially protected with very strong shells, and supplied with exceptionally strong muscles to keep these closed—the rest of the animal being strong in proportion. This firmness and distinctness of body is a great desideratum to those accustomed to our own oysters, and an especial recommendation; but it means much food, while the strong shell means very salt water, and the whole creature, as we have it, clearly demands plenty of room. They cannot, therefore, without distinct modification, be expected to flourish abundantly in a limited space.

On the other hand, American oysters, suited for lengthened transportation, have been mostly matured in very fresh water, and therefore are, in regard to the contents of their shells, everything the reverse of our own. The whole creature is, to a large extent, gelatinous, and consequently wholly incapable of encountering the enemies so abundant in our seas. I have laid down two separate classes of Americans in Scottish waters, and so long as they were kept inshore, on comparatively muddy ground, they continued to thrive, and have done so for at least two years. Many thousands were thus transferred to deeper and more exposed water, in the hope that they might have become invigorated, and with the full knowledge that oysters proceeding from brackish to salt water breed more freely. These soon proved themselves incapable of withstanding the ordinary enemies of our seas; and I do not believe that a single one of those laid down outside survive, although their comrades inshore have continued in their ordinary condition.[1]

I regret to state that, although I have fairly tried Americans, and have had them living in two different lochs for two years, I cannot look upon them as a success, nor as promising to provide a suitable stock for our waters. This may arise to a certain extent from the difficulty of procuring spat, owing to the want of systematic and careful culture in America, so that only brood oysters of a certain maturity, dredged from the natural beds, are obtainable.

If next we turn to England for aid, we find that no spat has fallen there for many years, except in special localities where it is too valuable and too much valued to be readily parted with. Indeed, English natives are being sadly encroached upon by Dutch, Portuguese, and French, so that the small, clean, cup-shaped, fine-shelled result of centuries of care, threatens to become extinct like the Dodo. Yet this is the oyster we desire to see carefully introduced into Scotland, in any experiments that may be made in foreshore cultivation. Because:—1st, it is best suited for artificial conditions; 2d, it is the hardiest and least affected by cold or heat; 3d, it is the best qualified to endure lengthened carriage and want of water; 4th, it accommodates itself most readily to brackish water; 5th, it wastes least energy in the growth of shell; 6th, and consequently, it fattens most quickly. Besides these advantages, the English native is the most favoured in the market, cheapest to carry, from its light weight per hundred, and most likely to return a satisfactory account.

Therefore, all who propose to start foreshore cultivation should obtain, if possible, a small stock of English natives, rather than a large stock of any other oyster.

In default of this native oyster, I would recommend the French oyster, as really the offspring of the English, and with many of its good qualities. Whether these will eventually be found to breed in Scotland no one can pretend to say; but under suitable conditions I have found them to grow well and

[1] These also have latterly proved unequal to the contest with our climate.

promise well. The oyster of Arcachon is not to be recommended, as, besides being somewhat coarser, it comes from too warm shores: and, owing to the law in France, it cannot be exported until it is of a size quite useless for cultural purposes. On the other hand, the oyster of Brittany is bred in salter seas, is finer in the shell, and shapelier, and would come from a climate more analogous to our own. It adds to this, freedom of export whenever it can be handled, and so may be brought over when scarcely more than a quarter of an inch in size. If then "caged" in cases of galvanised iron wire-netting, in favourable situations, they grow with scarcely less rapidity than at home in the Morbihan, taking the journey and change of water into account.

When the failure of attempts at oyster-cultivation in Scotland is spoken of, it would seem to be implied that really reliable efforts in that direction have been made. I am not aware of any. The laying down of a small bed or a large bed of oysters in a situation supposed to be suitable, and leaving them to the tender mercies of their enemies, is merely oyster-culture in name. And yet some such efforts have been comparatively successful—the beds in a few years increasing distinctly in importance, and showing sufficient evidence that if the ground had been properly attended to, and the requisite labour expended upon it, the result would have been more satisfactory. But deep-water beds demand this attention to insure success, and dredging over the ground keeps the oysters clean, drives away enemies, and leaves proper spatting ground when the season arrives. The error has commonly been to save this expenditure and trust to Nature, who accordingly takes her own deliberate way of gaining ground, or her own rapid way of losing it, if the conditions are not every way favourable.

Deeper waters should be stocked with what are commonly called "channels"—large vigorous oysters from the deep waters—or by good Arklow oysters from the Irish coast. The ground chosen should be hard and clean, or be dredged clean previous to laying down, and the dredge should be kept steadily going over the ground, more especially during the spring and early summer, so as to prevent the growth of weed, and drive away the "borers" and star-fish. This should be done for some years, until the bed obtains a good hold of the ground, and the brood oysters show sufficiently vigorous. After this the original oysters should be gradually dredged up, and the brood left to continue the bed. Those embarking in the business in Scotland hitherto have anticipated important returns from small expenditure, and have been grievously disappointed in consequence. A distinct outlay must be calculated upon until the bed gets a hold, and its enemies must be kept at bay meantime.

In many of the western lochs of Scotland there are stretches of marly ground, on which a small light class of oyster, such as those of Finisterre, would certainly thrive. Our own oysters are too thick and heavy, and soon sink so deep in such ground that they become choked. Here a few thousand small French oysters, laid down carefully in the winter, at a fathom or less under low-water, would soon accommodate themselves, and be kept warm in the mud. Over these, at the proper season, and when the oysters showed they were "in milk," collectors on the French system should be laid, while floating bundles of brushwood, tied together with ropes of cocoa-nut fibre, would aid in catching the floating spat. If not successful, however, the first season of laying down, they should be at once removed, so as to be kept clean for the next season; for if covered with slime and sediment, any cultch is useless.

I am aware there is strong authority against me, but I yet hold that the Western lochs of Scotland, being of generally mild temperature and strongly salt, and in the generality of cases with native oysters of their own, are well suited for oyster culture, and have participated in all the important spatting years. Indeed, I have known important falls of spat in the Hebrides within a comparatively few years, and English boats were in the habit of frequenting Skye lochs to dredge for spat—and most successfully,—until prevented some few years ago. In reality the absence of oysters entirely is more to be remarked upon in any loch in the West of Scotland than their presence; and this holds good from Luce Bay in Wigton, by Lochindaal in Islay, Loch Scridain in Mull, Loch Sunart in Morven, all the way north to Lochs Seaforth and Roag in Lewis, from both of which oysters of the greatest delicacy are obtainable. To choose between the various lochs for oyster-culture, I should feel inclined to call special attention to these Hebridean sea-lochs, where the temperature on sea and shore is as mild as in any part of the kingdom; and a carefully conducted experiment in the deeper water has as good a chance of succeeding there as anywhere else. Opposite Skye we have Lochs Duich, Carron, and Torridon, all well protected, and facing the prevailing wind, and therefore suited for attempts at forming deep offshore beds, from which the rocky shores would be regularly stocked, to the great advantage of the neighbouring crofters, who might be employed, as in the South, in gathering these oysters for the owners or lessees of the beds, to be laid down on marly ground to fatten for the market.

I have consistently prevented the shores over which I have control from being denuded of rock oysters, looking upon these as the best stock any ground can have; but I cannot quite hold that they are a different variety from the offshore oyster, and am confident that the spat from deeper water floats on to the shores, and, *per contra*, the spat from the rock oysters gets carried to sea by currents, and sinks in the deeper beds. Therefore where a stock of rock oysters already exists, a piece of ground should be cleared in several fathoms, and a bed of vigorous oysters, such as those of Arklow, laid down. The two will mutually aid each other, and the stock on shore should be regularly thinned of the larger oysters, but not cleared.

I am not aware that any consistently intelligent effort has been made to create beds of oysters in Orkney and Shetland, where, for the most part, the seas are too turbulent to promise great success. They possess the rock oyster around their broken coast in a smaller degree than further south, but still equally fine and succulent; and various attempts have been made to form beds, that have generally ended in silting up. I would certainly not recommend any attempt at scientific culture in these islands, except in a still more careful, or very much ruder, fashion than the French.

Either artificial ponds about a foot deep, and covered over with a rude thatched roof about six feet over the water, should be formed, and kept aerated and at a uniform temperature, in which the breeding oysters may be put at a proper season. In this rows of rude mats made of cocoa-nut fibre, so as to be readily taken asunder, might be arranged to catch the spat, to be afterwards treated on the French system, and brought up in cases. Or, the ruder and more natural mode already detailed, of keeping a small stock of breeding oysters on the rocks ashore, and laying down a bed of large strong oysters offshore on clean hard ground. Attention was called many years ago to the value of Stennis Loch as an admirable oyster-ground for culture on the French system, and it is surprising that no progress has been made in testing its suitability. That it would prove a good breeding-ground I can hardly believe, but it looks a likely ground for the introduction of French spat, and fattening them for market in multitudes. French oysters purchased at the quarter of an inch size, and conveyed thither in a welled smack, or even by swift steamer, could be laid down in cases in this well-secured loch, where there are four square miles of ground but slightly affected by the tides, and safe from the turbulent sea outside. Here the oysters would grow delicate in shell and succulent of body, but they would scarcely be likely to breed, unless a set of breeding oysters from the deeper waters were taken in, a short time before throwing their spat, and the entrance entirely closed at full tide. In fact it might be made a second Lake Fusaro,[1] laid

[1] See page 19.

down with pyramids, and these surrounded with wattling; so soon as it proved itself kindly to the strangers. But great caution would require to be exercised ere risking an important venture so near the limits of the oyster's natural range.

Where great stretches of foreshore occur, as in the Firths of Moray, Cromarty, and Dornoch, simpler attempts might be made on the part of the fisher-folk to obtain a spat, from beds carefully tended and treated on the French plan. But before the fishing population can be expected to make any movement in this direction, they must be supplied with incentives to success far other than can at present be offered them.

Our present laws respecting oyster-culture have succeeded in encouraging everything they intended to suppress, and suppressing every natural effort they were originally proposed to encourage.

A large portion of the most likely ground in Ireland has been allotted to grantees, whose main object was to prevent the public gathering oysters on the foreshores *ex adverso* their properties; and the greater number, even according to the admission of inspectors, ought to have their grants cancelled, seeing they have in no way added to the public supply, or made any strenuous attempt to do so.

Similarly, in Scotland, the few grants made have not been worked, having been mainly applied for by proprietors with the view of preventing trespass, and supplying their own private tables. Those who have honestly thought of attempting oyster-culture have been met at the threshold with the demand for a sum of money, and an expenditure in preliminary investigations and arrangements, that would have gone far to produce tangible results in culture. This naturally stops all further advance on the part of people of moderate means, and yet practical habits and experience; and so the little experiment is not made, and we are the poorer in consequence. To have to go through a costly application to the Board of Trade is surely a cumbrous mode of commencing what ought to be a very simple matter of business, in which a poor crofter or fisherman could commence with the same facilities and opportunities as the richest landholder. In the one case, the crofter would in all earnestness seek success; in the other, the object would mainly be, as it has hitherto been, to close the ground for others.

It is scarcely necessary to discuss at length the errors of a system that has everywhere shown failure, and in no case shown success; while we have merely to cross the Channel to find the reverse system as successful as ours has been otherwise. A simple system of inspection and allotment of suitable areas at a rental per acre, such allotments to be held at the pleasure of the Government so long as they are untilled, and, although held by annual tenants, to be inalienable so long as they are honestly and satisfactorily worked, would cause a revolution in marine cultivation. The Board of Trade can only at present deal with what is unquestionably within its rights, but where valuable sea-bottom is in private hands to the national loss, a simple tribunal ought to be within reach of the public, in which the national interests could be protected.

As the law stands, we have a cumbrous and expensive machine that has not added a single oyster-bed to Scotland; while what is required is a simpler and more local machine, readily moveable by fishermen, crofters, and small capitalists, who would give their personal labour and attention to the work of increasing the oyster-harvest of the country.

IV.

THE NATURAL HISTORY OF THE HERRING;

WITH SPECIAL REFERENCE TO ITS MIGRATIONS, ITS FOOD, AND RELATIONSHIP TO THE WHITEBAIT AND SPRAT.

No. I.

BY GEORGE SIM.

CONSIDERING the present divided state of opinion in regard to the life and habits of the Herring, it is impossible to write a history of that species without taking notice of other fishes, because of their intimate, or supposed intimate, connection with the subject under consideration. I therefore propose to take under review the whitebait and sprat, in the following remarks, the latter being still held by many to be none other than young herrings; while, at the same time, the whitebait is generally considered a distinct species.

The herring is justly considered as one of the principal, if not the principal source of our national wealth, and has been fished for regularly, and more or less carefully and successfully, for several centuries—sometimes under legal restrictions, at other times free. That being so, it seems strange indeed that the habits of the fish should still be matter of controversy. Hamilton, in his notice of the Herring, as given in *Jardine's Naturalist's Library*, says: "But, although so familiarly known as an article of food, we are very far from being well acquainted with the natural history of the fish; neither its migrations, kind of food, nor the causes which produce different degrees of excellence in different localities, have been investigated otherwise than in a comparatively superficial and unsatisfactory manner,"—and this applies, in some measure, to the subject at the present time. It is therefore to be understood, that whatever degree of success and confidence can be attached to the following remarks, they are the result of several years' personal study of the subject by the writer, and he leaves it for others to say whether he is justified in coming to the conclusions arrived at.

At the commencement of my labours I consulted the works of the various writers on the subject within my reach, but soon found that the whole matter would have to be gone through independently, because, before a just conclusion on the subject could be come to, it was necessary to examine the fish themselves in all stages of their growth, and study their habits, as far as that was possible, in their native haunts. I shall begin my observations in this paper by considering the relationship of the herring and sprat.

The idea that the sprat, *Clupea sprattus*, was the young of the herring, *Clupea harengus*, was held by Willoughby,[1] who was supported by Fleming,[2] and other writers who followed him; and amongst the first of those who controverted this view was Bloch,[3] and Rutty, in his *Natural History of Dublin*. From this time downwards, opinion seems to have been divided on the subject; latterly, however, it would appear as if the idea of the sprat being the young of herring had been given up as untenable; for most authors on ichthyology, whose works appeared through the early portion of the present century, set the sprat down as a distinct species. Of late, however, the question has been again opened, and some strong opinions have been expressed to prove their being one and the same, and several furious paper wars have been fought over it.

Amongst such writers may be mentioned James G. Bertram, who, in his *Harvest of the Sea* (1865), page 239, says, "It is generally known that the sprat (*Clupea sprattus*) is a most abundant fish, so plentiful as to have been used at times for manure. The fact of its great abundance has induced a belief that it is not a distinct species of fish, but is, in reality, the young of the herring. It is true that many distinguishing marks are pointed out as belonging only to the sprat—such as its serrated belly, the relative position of the fins, etc. But there remains, on the other side, the very striking fact of the sprat being rarely found with either milt or roe. . . . After the nonsense which was at one time written about the parr, and considering the anomalies of salmon growth, it would be unsafe to dogmatise on the sprat question. As to the serrated belly, we might look upon it as we do the tucks of a child's frock—viz., as a provision for growth. . . . The slaughter of sprats which is annually carried on in our seas is, I suspect, as decided a killing of the goose for the sake of the golden eggs, as the grilse-slaughter which is annually carried on in our salmon rivers." As to this writer's statement that the serrations on

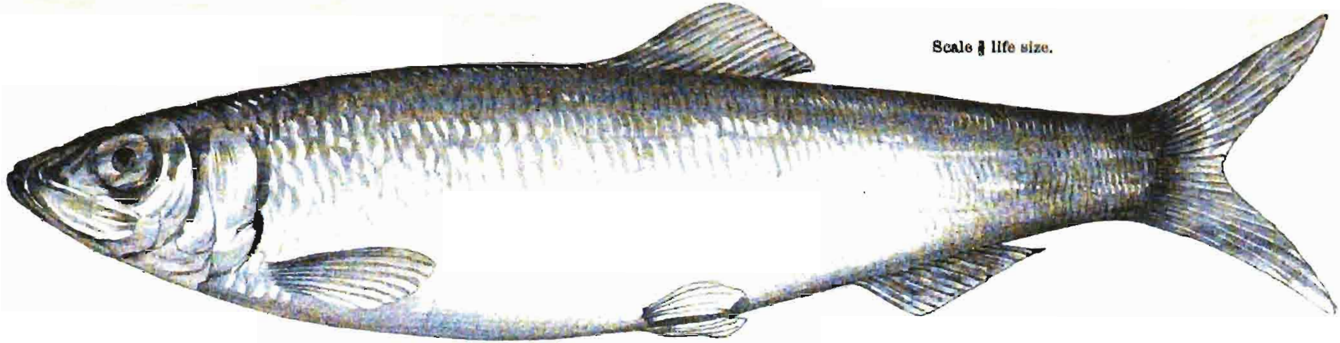
[1] *Ichth.*, p. 122.

[2] Fleming's *British Animals*, p. 183 (Edinburgh, printed for Bell and Bradfute, and James Duncan, London, 1828); Fleming's *Philosophy of Zoology*, p. 385 (Hurst, London).

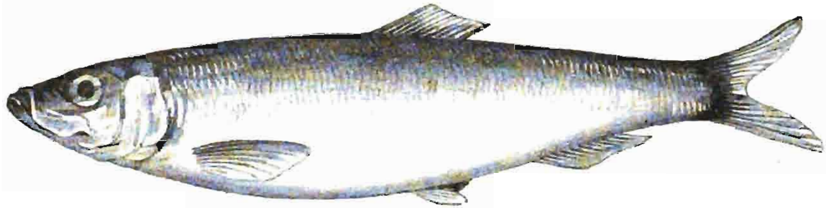
[3] See Fraser's *Review of the Domestic Fisheries of Great Britain and Ireland*, 1818. Longmans, London.

NATURAL HISTORY OF THE HERRING. PLATE I.

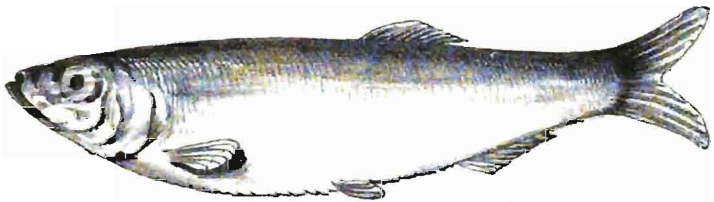
Scale [illegible] life size.



Adult Herring.



Young Herring.



Adult Sprat, showing relative position and size of fins to that of Herring.

T. & A. Constable, Printers to Her Majesty, Edinr.

the belly of the sprat may be regarded in the same light as the "tucks in a child's frock, viz., a provision for growth," and that milt and roe have seldom been found in that species, as also other writers, such as Parnell, in the *Magazine of Zoology and Botany* for 1837, who says that the "serrations on the belly are to be found in all young herrings, and as they advance in size these serrations get worn off, or disappear, through the belly of the fish expanding in breadth, and when the fish comes to have milt and roe, these serrations get quite obliterated"—all these statements can, I think, be clearly shown to be quite fallacious, and do in no way agree with the facts of the case. First, because I am satisfied, from the examination of a large number of both species, at all stages of growth, that the herring has *no serrations* on the belly at *any stage of its existence*, while, on the other hand, the larger the sprat becomes the more distinct do these serrations appear. Second, as has been pointed out by other writers, the fins of the two species are differently placed; and this of course holds good at every stage of their existence. In the herring, the dorsal fin is about a third of its own length in front of the ventral fins, while, in the sprat, the same organ is usually about a fourth of its length *behind* the ventrals;—this will be seen by referring to Plate I. The horizontal line passing along the length of the fish, and the perpendicular one immediately in front of the ventral fins, which is at right angles to the horizontal, show the position of the dorsal fin in both species. Third, the head of the herring is longer than that of the sprat, measuring individuals of the same length of body. Fourth, the colour of the two fish is different. Fifth, sprats are thicker, what we might call broader-shouldered, than herrings of the same length. Sixth, a most important point is that the anatomy of the two fish is different, in so far as the herring has from fifty-five to fifty-eight vertebræ, never less than fifty-five, while the sprat has but forty-seven to forty-eight. This difference has been pointed out by previous writers. An additional point in their being distinct species is, in the herring having well-developed articular processes on a number of the vertebræ. These processes, as will be seen by reference to the figure, Plate II., arise from the base of the transverse processes of each vertebra, pointing towards the head of the fish, and are of a long needle-like form, whilst, in the sprat, the same organs are merely represented by short obtuse knobs. I am not aware of this difference in the two fish ever having been noticed before, and, as will be seen, it is evidence of considerable value in proof of the two fish being distinct; evidence also that the observation of some previous writers has been rather loose.

In addition to what has been already advanced, it may be stated that many sprats caught about the month of December will be found with milt and roe far advanced towards maturity, some of which I possess, while herrings of the same size, and considerably larger, have nothing such; that is, in sprats of 5½ inches long, which is about their average length, the milt and roe are almost fully developed, while herrings of from 6 to 7 inches long have these organs in the lowest possible stage. And, lastly, the intestinal entozoa which infest the two species are totally different; but this point will be more fully explained in the course of my remarks upon the herring's food.[1]

On this point the object I had in view was to identify specifically every creature found to form part of the herring's food, and this, from many years' labours amongst our marine fauna, I have been able to accomplish in almost every case. Hitherto (in so far as I have been able to ascertain) workers on this subject have given the result of their investigations, covering merely a few days of several seasons, and always about the same period of the year—a mode of procedure quite inadequate to bring out a true result,—and their remarks are given in such general terms that those anxious to know something of the subject search their writings in vain. By one we are told the herrings live on shrimps; by another, crustaceans; and by another, prawns; while a fourth says they eat crustaceous animals and sand-eels. Frank Buckland, in his "History of the Herring," as given in the Fishery Report for 1877, devotes two pages of that work to the herring's food. But he gives merely a repetition of the evidence given by various witnesses who came before the Fishery Commissioners of that year, and what he makes of it is, that herrings feed on "crab-spawn, sea-lice, the small infusoria, sand-eels, small crabs, *Oniscus marinus*, and the herring's own spawn." He finishes his remarks thus: "In November 1877 I received from Captain M'Donald of the *Vigilant* cruiser some curious little animals which probably form the food of the herring. Their eyes are large and legs numerous, they have a little tuft at the end of the tail; their name is Thysanopoda." Again, J. W. de Caux, in his history of the *Herring and the Herring Fishery* (1881), says, at page 40, herrings "suck or draw from the water for their own nourishment those medusan organisms which, though invisible to the naked eye, swarm around them." It would have been satisfactory had this writer stated whether he had seen medusæ in the herring's stomach; I doubt it.

Now, although some of the above statements may be correct

[1] For a clear and minute description of the internal structure of the two fish, those interested may refer to Professor Huxley's paper upon the herring, in *Nature* for April 28, 1881.

so far as they go, yet the light thrown upon the subject by them is not much brighter at the end than the beginning.

Well, as already stated, the object of my labour has been to know really what animals do constitute the herring's food; and before the true state of the case could be reached, the work had to be carried on throughout the whole year, as the fish could be obtained; and this has been done for the years 1878, 1879, and 1880. For the first year I kept no note of the number of fish examined, but am safe to say the number was fully over that of either of the two following seasons. In 1879, 233 fish passed through my hands, and in 1880, 133, caught at various places along the east coast, from Inverness on to and including the Firth of Forth—the contents of the stomach of each fish being examined microscopically, and in them were found their own young, their own spawn and scales, and young sprats. Of Stalk-eyed Crustacea, very small individuals of the genus *Galathea*, *Mysis spiritus*, *Thysanoessa borealis*, and *Thysanoessa Aberdonensis*, *Thysanopoda couchii*, and *Acanthocaris Livingstoniana*, as also several larval forms of *Brachyurus decapoda*, some of them in great abundance. Of Sessile-eyed Crustacea there were *Hyperia galba*, *Lestrigonus spinidorsalis*, and one species of the genus *Æga*. Of Entomostraca, *Cythere acuta*, *Cythere minna*, *Temora longicornis*, and another species of Temora not identified specifically, and *Evadne Nordmanni*. Young univalve mollusca; *Sagitta bipunctata* (?); also a small fly and small beetle; and an opaque fleshy substance which, I think, is the skin of cuttle-fish, which, perhaps, may have been taken from the dead bodies of these creatures, some of the pieces being nearly an inch square, and in it are usually rolled the legs and other hard parts of the crustacea on which the fish have fed. Of the creatures in the foregoing list, *Hyperia galba*, *Sagitta bipunctata*, the Entromostraca, *Mysis spiritus*, and young herrings and sprats, form by far the greatest portion of the herring's food, and these appear to be taken at particular seasons of the year, as, for example, young herrings and sprats I find in greatest abundance from December till May. From May to October, on opening the stomachs, a mass of what looks somewhat like wet vermilion is usually to be found, and this, on examination, proves to be *Temora longicornis*, with sometimes a few specimens of *Sagitta bipunctata* amongst them. From the beginning of December till February, *Hyperia galba* along with *Sagitta bipunctata*, form the principal part of diet. Of course I do not mean that this is an invariable law; it is merely given as what has been observed during the time I have been engaged on the subject. The other creatures mentioned seem to be a sort of chance food, taken as it turns up. One thing which has struck me as strange in this subject is, that *Amathilla* *sabini* and *Atylus Swammerdamii*, two species of sessile-eyed crustacea which literally swarm along our coasts,—neither of the two have I ever seen in the herring's stomach, and yet I have found both species adhering to the body of herrings when brought to land. How should this be? The difference in general appearance (apart from the eyes) between *Atylus Swammerdamii* and *Hyperia galba* is not so great as to lead us to think that herrings could perceive a difference, yet the former is passed by while the latter is devoured in millions. Can taste or smell have anything to do in the matter?

Some writers say that shrimps form no inconsiderable part of the herring's food, but, although these creatures abound along our coasts, never, except in one instance, have I found a specimen of the genus Crangon (which includes all the shrimps properly so called) in the herring's stomach, and I am therefore inclined to think that the creatures meant were not shrimps, but something like them. Popularly, the term "shrimp" is applied to all the smaller stalk-eyed crustacea, of whatever genus they may be, which term leads but to confusion; hence it is that the Fishery Commissioners of 1877 received such evidence as they did, some of which were mere groundless notions; with absurdity so plainly stamped in its face, the wonder is how the Commission could have thought it worth reporting. One witness said he had taken "eighty-four shrimps" out of one herring's stomach—evidently a mistake: the stomach of a herring could not contain that number of true shrimps; probably what was found were either *Thysanopoda* or *Mysis*.

Another point in this subject worthy of notice is, that authors say *Hyperia galba* is "oceanic in" its "habits, and found to exist only in the gill cavities of the medusæ," which is an error. They are free and independent creatures, and are to be found on our coasts, and are eaten in countless numbers by the herring when there are no medusæ to be seen. I am therefore inclined to think the fact of their being sometimes found in the medusæ is more a matter of accident than otherwise. The numbers of the *Hyperiidæ* which are at times cast on our beach is really extraordinary. As an instance in point, on 23d November 1879 there were cast up at high-water mark (Aberdeen Bay) millions on millions of *Lestrigonus exulans* and *Hyperia galba;* a band a yard broad and about 400 yards long was formed of them. Although they are often cast up, this was by far the largest number I have seen at one time. They were one wriggling, seething mass, each fighting with its neighbour, and in their death-struggles tearing off each other's limbs, and, after an hour's torture, became a mass of inanimate matter.

In the course of my examinations of the stomachs of herrings, there was an object kept continually casting up, which I could not make out, and its appearance was so frequent that it became to me an object of aversion, all the more so that no light could be obtained as to what it was. This continued for many months, and at last it was passed aside as the "great unknown." Hitherto my mode of operation had been to open the fish as they were obtained, putting the contents of their stomachs into spirit, to be examined at some convenient time. However, having got some herrings one day, and having an hour to spare, I thought of examining their stomachs at once, and without their contents being put in spirit. So, on putting some of the matter on a glass slide, and placing it under the microscope, there appeared, wriggling in the mass, several creatures altogether different from any I had seen before; looking more closely, there appeared as if something was running along the centre of their body. This caused me to remove them from the mass they were then in, and to place them by themselves in clean water, then, when under a half-inch objective, a sight presented itself most strange and beautifully new. Here was a small creature, not more than an eighth of an inch long, and not so thick as a hair of my head, the body of which was composed of a number of rings, the posterior edge of each ring standing its own thickness above the one which followed it, giving the sides of the creature, when viewed from above, the appearance of being obtusely toothed. The alimentary canal was distinctly defined, and lay in a double convoluted line along the body; the mouth and anal orifice were near each other; the heart, if such it could be called, was situated about a fourth of the creature's length from the posterior extremity; and its expansion and contraction, as the blood flowed through it, was quite visible. And the movements of the blood, if I am right in calling it so, was so strange: it would start from the heart and move at a slow rate up to near the mouth, stop for a little, and return the way it came, moving up again, and stopping as before; it would then part in halves, each portion passing down opposite ways, to meet in the heart. Then it would take a rapid course two or three times round the whole system, and then for a while stop altogether, shortly to begin a similar erratic movement. In the centre of the body were a number of small, round, red-coloured bodies, which probably were eggs. The whole appearance and movements of the creatures were so strange and so unexpected, that, instead of an hour, the whole day was spent in watching their various movements. Commencing to note down what had been seen, which occupied some time, I forgot to supply the creatures with water, which had to be done every few minutes, and on looking at them when the notes were completed, I found they were dead; and their dead bodies were exactly the same in form as the "great unknown" which had so long puzzled me.[1] But lest there might be some mistake on my part as to their being the same, I took others and put them in spirit as formerly treated, yet the result was the same. The mystery, therefore, was so far solved. The "great unknown" was a worm. Was it a parasite peculiar to the herring? This could only be answered by the examination of many other fish; and if this proved to be the case, would it not be another proof that herrings and sprats were different species?—that is, if the parasite was not common to both. This was a point which had to be settled, and no opportunity has since been lost to do so. Since then, every herring's stomach has been looked to in a fresh state, and in all the same entozoon has been found. Sprats have also been treated in the same way, and the result is, that they possess a parasite quite different from that of the herring, and it is not confined in either case to full-grown fish; young and old of both species have their own peculiar entozoa, and never in one instance have I found either to possess that of the opposite species. This, coupled with the evidence already advanced, is surely amply sufficient to dispel the doubts of the most incredulous as to whether the two fish are distinct species or not. Everything considered, I have no doubt whatever of the two fish being distinct, if any fish are; but I am afraid that many who venture an opinion of the two being the same have given the subject but very scant consideration.

Opinion still differs widely as to the "movements of the herring." An idea is held by many fishermen, and also by some writers, with reference to this species, notably by Mitchell, in his *History of the Herring*, where, at page 28, he says, "It is also of importance to state, that the effects of winds seem to be very considerable on the visits of the herring, particularly in winter. We have found it almost invariably to be the case in that season that the herring comes nearer our shores, and in greater abundance, when the wind blows for any length of time towards the coasts. For instance: if the wind in winter blows for some time from the west, the herrings are generally more abundant on the west coast than on the east coast, and *vice versa.*" Now, this is quite true in a certain sense, but not in that supposed by the author just quoted, as also by fishermen. If such men are asked how they can account for the wind having such an effect upon the herring, the answer generally given is, "Oh, it just blaws them that way." Now, my opinion is, that the wind does not "blaw" them that way, as it is evident herrings are quite able, under ordinary circum-

[1] See Fig. 2, Plate II.

FIG. 1.

Skeleton of Herring, showing articular process.

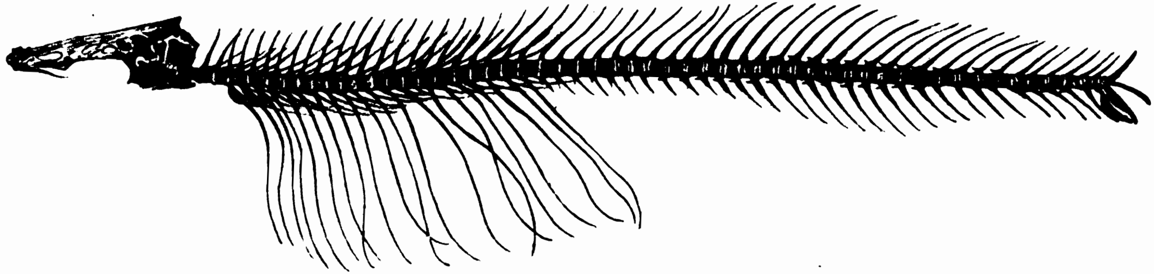
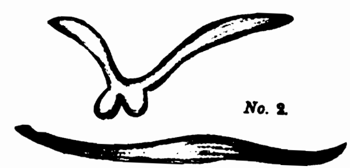


FIG. 2 *No.* 3,

Entozoon from stomach of Herring. (Figured after death.)

FIG. 2 *No.* 1.



Entozoa from stomach of Sprat. (*No.* 1 only once seen, *No.* 2 abundant.)

Fish and Fisheries, p. 44.

T.&A.Constable, Printers to Her Majesty.

stances, to swim in whatever course they choose, irrespective of the direction the wind may blow. True, herrings are influenced by the wind, but not because of its effect upon themselves, *but upon their food;* for where the wind blows it, of course the herrings must follow; which food, as has been shown, consists for the most part of the smaller crustacea, the whereabouts of which depends to a great extent on how the winds blow.

Herring Spawning.

Some say there is but one spawning season, others say there are two seasons. With the latter I quite agree, and am satisfied that there *are* two spawning seasons, viz., an autumn and a spring one; for it will be found on examination that herrings caught in December and January are almost all full fish; and the time of spawning I can, without hesitation, put down as the end of February and beginning of March—that is, on the north-east coast,—because mostly all herrings caught after that date are "shotten" or spent fish.

Does herring spawn vivify at the surface of the sea? De Caux says:[1] "Fishermen have observed the sea to be of a somewhat milky appearance, and, on drawing buckets full of the water on board, they have seen not only that it contained herring spawn, but that it was literally alive with herring fry which had only just then burst into existence." And from this he concludes that the spawn must have been hatched at the surface of the sea. But there is not sufficient evidence in what he states to warrant such a conclusion, because he says nothing to show whether the spawn seen was full or empty shells, nor what appearance the fry had; whether they were still possessed of, or were free of, the yelk-bag. And until such points are cleared up I cannot accept such evidence as conclusive. Huxley,[2] Professor Allman, and Dr. MacBain give their testimony in quite the opposite direction, viz., that the spawn sinks to the bottom at once, and gets firmly attached to sea-weed, etc., and what observation I have been able to make confirms me in the opinion that the latter mode is the right one.

How long does the spawn require to vivify? Huxley says, "There is much reason to believe that the eggs are hatched in, at most, from two to three weeks after deposition, and that in six or seven weeks more (that is, at most, ten weeks from the time of laying the eggs) the young have attained 3 inches in

[1] *The Herring and the Herring Fishery*, 1881, p. 42. Hamilton, Adams, and Co., London.

[2] See *Report of the Royal Commission on the Operation of the Acts relating to Trawling for Herring on the Coast of Scotland*, 1863, p. 28.

length." As to the time vivification takes place, I believe Professor Huxley is correct; but, as he himself says, it depends considerably on the temperature. But I cannot agree with him when he says the young attain a length of 3 inches in "ten weeks," and the reason for my refusal to accept this is that herrings on our coast, *i.e.* Aberdeen and Kincardine shires, deposit their spawn in the latter end of August and beginning of September; and about the month of January following I find many young herrings cast on our beach varying from 1¾ to 2½ inches long; these I believe to be from the August spawning, so that this gives them about four months from the time of deposition before they attain the length of 2½ inches. Again, I find herring fry in the rock pools, in great numbers, in the months of June and July—also about 1½ to 2½ inches long, and these again, I conclude, must be from the March spawning. Of course I find, about the month of January, young herrings cast on our beach of from 3 to 4 inches long, but these, I think, are from the previous spring deposit. It is therefore obvious to me that young herrings cannot attain a length of 3 inches in the short time named by Professor Huxley.

How long time is required by a herring to come to maturity? Professor Huxley[1] says, "It does not appear, however, that there is any good evidence against the supposition that the herring reaches its spawning condition in one year." And again, "But full herrings may be met with little more than 7 inches long." De Caux[2] says, "We may, I think, reasonably infer that herrings arrive at maturity in a comparatively short period—I believe well within twelve months." Mr. Yarrell says (*British Fishes*, vol. ii. p. 115), "From repeated examinations, I am induced to believe these young fish do not mature any roe during their first year." And Mitchell, in his *History of the Herring*, p. 30, says, "It is likely that they attain to full size and maturity in about eighteen months." Couch, in his *Fishes of the British Islands*, vol. iv. p. 100, gives no opinion of his own, but repeats that of Mitchell. My own opinion is, that young herrings of from 6 to 7 inches long are twelve months old, and that they are approaching the expiry of their second year before they shed their first spawn.

But there is this drawback to our ever being likely to come to a definite conclusion as to the time required by the herring to come to maturity—that, although there are two great spawning seasons, there is no doubt, I think, they are spawning more or less all the year round, as witness the young fry which are to be seen in greater or less abundance through-

[1] *Nature*, April 28, 1881, p. 610.
[2] *The Herring and the Herring Fishery*, 1881, p. 50.

out the year. With regard to Professor Huxley's full herrings of 7 inches long, all I can say is, we do not find such on the north-east coast of Scotland.

What is a Matie?

Professor Huxley says this "is a corruption of the Dutch word for maiden." Again he says, "Fishermen distinguish four states of the herring: fry or sile, when not larger than sprats; maties, when larger than this, with undeveloped roe or milt; full fish, with largely developed roe or milt; and spent or shotten fish, which have recently spawned." With this definition I am quite agreed. A matie I take to be a herring which is not full grown, and the name would apply to it until it had, for the first time, brought its roe or milt to maturity. And if this is so, how are we to reconcile it with another statement of Huxley's? He puts it thus: "If the spent fish escapes its myriad enemies, it doubtless begins to feed again" (that is, after having spawned), "and once more passes into the matie state in preparation for the next breeding season. But the nature of this process of recuperation has yet to be investigated." In another part of his article he says, "In dealing with questions of biology *a priori* reasoning is somewhat risky, and if any one tells me 'it stands to reason' that such and such things must happen, I generally find reason to doubt the safety of his standing." To this he has an undoubted right, and I do not think he is the man who will refuse to concede a like liberty to others, should they see cause. I therefore take the liberty of doubting the "safety of his standing" in this matter of the "matie." A herring cannot pass a second time into that state, or have again the appearance of a matie, any more than any other animal, after giving birth to its young, can return to its former condition. Again the same writer says, "It is only as the breeding-time draws near that the herrings (not yet advanced beyond the matie state) gather towards the surface, and approach the land in great shoals for the purpose of spawning in relatively or absolutely shallow water."[1] The safety of his standing I again find reason to doubt, and the thousands of barrels of "herring sile" which are exposed in our markets through the winter is sufficient ground for my doing so; indeed, his statement must go for nothing, for herrings of all "states" and sizes come near land at other times than when the "breeding-time draws near."

[1] The above quotations are from Professor Huxley's article on "The Herring," in *Nature* for April 28, 1881.

Do "Full" Herrings take food?

An idea has got abroad that full herrings do not feed, while those with milt and roe small eat voraciously. De Caux says, at page 40, "Another important fact bearing upon the subject is, that before and during spawning herrings do not seem to feed at all." And Huxley says, "At any rate there is usually no food in the stomach of a herring which approaches maturity." Again, referring to Mitchell's *History of the Herring*, at page 48, we find the following:—"On July 24 we examined the stomachs of several herrings caught off Dunbar. Those which had the milt and roe small had their stomachs filled with young sand-eels, about 2 inches long; while, on the contrary, those in which the milt and roe were full-grown had none." I wish, therefore, to point out that it is no general law that "full" herrings are to be found with no food in their stomachs; for I have examined these fish with milt and roe full-grown, and have found their stomachs crammed full of two species of crustacea, viz., *Hyperia galba* and *Mysis spiritus*, while many others with milt and roe in a very backward condition with nothing in their stomachs at all.

Another point connected with these fish which has often presented itself to me is the great disparity there is in the herrings which are caught during the winter months along the east coast from Stonehaven to Macduff, as compared with those taken in the Moray Firth and the Firths of Tay and Forth. In these latter places the fish appear sooner than on the Kincardineshire and Aberdeenshire coasts, and are of all sizes from 2 to 7 or 8 inches long, with scarce a full-grown fish to be seen amongst them. On the coast of Kincardine and Aberdeen, however, the fishermen commence to take herrings about the beginning of January, if the weather be favourable, all of which are of large size and full of milt and roe, generally from 10 to 12¼ inches long, and the heaviest I have seen weighing 8¼ ounces. They are coarse fish, and are seldom used other than as bait; some few are smoked, but they are not considered good for that purpose. There is no regular winter fishing with us, however.

Mr. Buckland in his "History of the Herring," as given in the Fishery Report of 1877, says, "The largest herrings I have yet had submitted to me were from Shetland; the weight was 9¼ ounces. The roe and milt were slightly developed; they were very fat. The length was no less than 9¼ inches." I mention this to show the great difference between the Shetland fish and those caught in the neighbourhood of Aberdeen. Mr. Buckland's fish were 9¼ inches long, and weighed 9¼ ounces, and had neither milt nor roe; mine were 12¼ inches long, were full of roe and milt, and only weighed 8¼ ounces. Let us put it thus: although my fish were 3 inches longer than Mr. Buckland's, and were full of roe and milt, while his had neither, yet his fish weighed 1 ounce more than mine.

Since the above was written, and during the year 1880, I weighed and measured all the herrings which passed through my hands, and found that the largest, a female, taken on August 4th, was 12¼ inches long, and weighed 9¾ ounces. The fish was a "full" one.

But the average size and weight of herrings throughout the summer and autumn months in this neighbourhood are from 9 to 11¾ inches long, varying in weight from 3½ to 8¼ ounces, according to the state of roe and milt.

What is Whitebait?

To this I need give no further answer than that I agree in every particular with the admirable article under the above title which appeared in *Land and Water*, April 12, 1879, written by Dr. Francis Day of Cheltenham, wherein he proves conclusively that whitebait are the young of herrings and sprats.

Migrations of the Herring.

It is now perfectly well known that this species is a permanent resident in our seas. It is surprising that a man of such close observing powers as Pennant[1] should not have seen the mistake he makes in the graphic account of the herring's march from the Arctic seas, while he at the same time tells us that it was regularly fished for through the winter amongst the Hebrides. This being the case, he allows it no time to perform its wonderful journey. It is, to say the least of it, amusing to see with what pertinacity some people will cling to such stories, even when they have long been proved to be incorrect. In 1833 we find Fraser, in his *History of the Salmon and Herring*, giving an even more ludicrous account of the latter than that told by Pennant, and again the writer of the article "Ichthyology" in the *Encyclopædia Britannica* for 1857 gives a more minute and glowing account of the herring's march from its icy retreat towards our coasts. So particular is he that we are told "the shoals are generally preceded, sometimes for days, by one or two males"—the advance-guard, we may suppose. But, as already said, the movements of the herring are now better understood, although not yet perfectly clear.

[1] *British Zoology*, by Thomas Pennant, vol. iii. p. 336 (4 vols. London, 1776).

There is no creature with which I am acquainted, which the movements of the herring so much resemble, as that of the common rook, *Corvus frugilegus.* In its season it congregates in great numbers at particular places for the purpose of perpetuating its kind; that done, it rambles over the country, to be seen sometimes in large parties, at other times single, sometimes in the interior of the country, at others upon the coast, its movements being regulated principally by the food supply—where that is abundant there will the largest number be,—but always to be met with in some part of the country. So exactly with the herring: it is always to be found in some part of the sea around our island. A proof of this is seen in the fact that herrings are often found in the stomachs of cod caught from fifty to seventy miles from land, while, as is well known, herrings are frequently caught in abundance at no great distance from land. Indeed, they used to be so numerous along the East Coast, and came so close inshore, as to be taken in baskets by people standing upon the rocks. They are therefore not true migrants, but merely wanderers around our coasts.

It is not to be supposed that I consider the subject of the herring's food a settled question—far from it; there is little doubt that other creatures are eaten by that species than those I have named; it is therefore desirable that some one at each of our great fishing centres should be induced to take up the subject, continuing his observations for a series of years, and at all seasons as the fish can be had. It should be the object of such inquirers to identify everything they find in the stomachs, failing which to submit it to those who could. But let us have no general statements such as have been given hitherto. Until some such course as this is adopted the history of the fish will be incomplete, and this important industry so far circumscribed. Until we know the whole life-story of the fish, the benefits which would accrue from such a knowledge cannot be derived to their full extent.

V.

THE NATURAL HISTORY OF THE HERRING;

WITH SPECIAL REFERENCE TO ITS MIGRATIONS.

No. II.

By William Watt.

The point of supreme and commanding interest in the natural history of the Herring, the most important of fishes, is its migratory habits, for involved in these are the vicissitudes to which the Fishery enterprise is subject. The oft-debated question whether there is or is not a falling-off in the supply of herrings in the sea need not concern us. For our present purpose it is sufficiently disposed of by the fact that no conclusive proof on the affirmative side has yet been forthcoming. In particular localities there are the greatest fluctuations in the produce of the fishery, but the supply of herrings in the home and foreign markets is increasing, and not diminishing.

The whole subject of migration is still, to a large extent, shrouded in mystery; the migratory instinct has still to be explained. We know that the swallow and other familiar birds come and go every year; that their coming can be predicted almost to a day, and that the time of their going can also be approximately foretold. But of the faculty by which their movements are directed we know nothing for certain. There is no analogy to it in human experience. The prompting causes are also insufficiently ascertained. Food may be supposed to be one of them; but in this climate the seasons are far from uniform, and the food supply is correspondingly variable, whereas the times of the birds vary but little. Again, the instinct of reproduction apparently operates in bringing them here; but how are their movements directed? what is the faculty or power that enables them, after a sojourn of more than half the year at thousands of miles' distance, to find their way back to the old country and the old nest? It is a strange and most interesting phenomenon, the full meaning of which the human mind has not yet been able to grasp. We know only the fact of the migration, with some of the circumstances attending it; and we can form some estimate of the utilities it serves. Beyond this all is mystery.

Yet the movements of the birds are under direct human observation. The actual migratory flight may not be witnessed by everybody, but the birds are seen preparing for their long journey, and they are also occasionally seen on the passage. And if the mystery is unsolved in the case of the birds, we need hardly expect to lay hold of the key to the corresponding mystery in the case of the inhabitants of the deep. The salmon has through untold ages ascended our rivers from the sea, and the young salmon has made its way seaward from its birthplace in the upper waters of inland streams. Much more is seen and known of the salmon than of fishes that never leave the sea. In modern times this lordly fish has been cared for by anglers, by "salmon lairds" and lessees with the interests of their pockets at stake, and by stipendiary watchers and a nondescript tribe of illegitimate practitioners of the piscatorial craft. But though constantly cared for and vigilantly watched over by all these keen-eyed persons, and by professed naturalists to boot, the salmon long eluded the call to divulge the story of his career, and it is only within the range of living memory that the materials for anything like a complete salmon biography have been accumulated, while to this day there are sundry little matters still to be cleared up. No other migratory fish affords anything like the same opportunities to the observer. Only in his sea-wanderings is he so completely out of sight that an occasional glimpse of him cannot be had. From his first appearance as a tiny, shapeless, living thing at the hatchery till he is ultimately brought to land a full-grown adult, the salmon is an object of unremitting attention. And yet he has managed remarkably well to keep his secrets to himself.

The plebeian and multitudinous herring, there is reason to believe, pursues a career not altogether dissimilar to that of the salmon. In some general characteristics, at all events, there is an apparent similarity. The herring periodically approaches the land—visits creeks, bays, and estuaries, for the purpose of shedding spawn. Sometimes, indeed, it chooses a spawning-ground where the water is only slightly brackish, and not more than two or three feet deep;[1] while its cousin, the shad, approximates still more closely to the spawning habits of the salmon, by ascending the fresh waters of the Severn and some other English and many American rivers for a like purpose. Much of our knowledge of the natural history of the salmon has been obtained or verified by the expedient of marking numbers of the fish at some stage of their juvenile career, and returning them to their fluviatile habitat, there to pursue their

[1] Huxley, Norwich Lecture; Kupffer, German West Baltic Reports.

journey towards the ocean and adolescence. When a considerable number of salmon are thus marked, the chances are that some of them will be caught again, from time to time, by the angler's hook or the fisherman's net; and a comparison of dates and whereabouts will afford a certain quantum of definite information. But this method of inquiry is not usefully available in the case of the herring, for even if many individuals in the stage corresponding to that of the salmon smolt or parr were caught alive, decorated with a piece of metal, and turned loose again, the probabilities of their recapture by human instrumentality would not be great; and more likely than not such problematical recapture would take place near the coast, in a place differing in no essential respect from the scene of the original emergence from and return to the deep. Nor, in truth, could a very great deal be learnt in this way. Cases are conceivable of opportune captures and recaptures, by which some light would be thrown on questions relating to the growth, age, and condition of the fish; but there can be little hope of thus learning a single essential fact with regard to its migration, or its experience during the intervening wanderings. Keep the fish prisoner in an aquarium, or caged within some nook of the sea, and—preservation of its life being taken for granted—we should get at certain facts, perhaps, but should be as much in the dark as ever concerning the nature of the migratory impulse, and the method by which the migrations are directed to particular marine areas. We should, in short, learn very little by such means of the habits of the fish in a state of nature, or of the food conditions or meteorological conditions by which its movements are affected.

A useful discussion of the migrations of the herring is attended by very great difficulty. Not only does the fish itself pursue its career beyond the range of direct human observation, but it feeds on numerous species of smaller creatures of which far less is known. A complete natural history of the herring involves a complete acquaintance with the species on which it feeds and the conditions under which these species flourish and multiply. For generations the subject has attracted much laborious and painstaking research. The older naturalists made a certain degree of progress with it, and the results of their labours are set forth in the lucid description contained in Valenciennes' edition of Cuvier's uncompleted work. Since the days of Cuvier and his able editor numerous researches have taken place under Government authority. In 1843, Von Wright, Chief of the Civil Department at Stockholm, prepared an elaborate official report on "The Herring and the Causes of its Scarcity on the Swedish Coasts." Five years later the Dutch Meteorological Society published the results of observations undertaken on board forty-five herring busses in the North Sea, at the instance of the Government of the Netherlands, the object being a practical one having regard to the conditions of a successful fishery. In 1855 the migrations of the herring formed the subject of a learned but resultless discussion in the French Academy. In 1857 the British Board of Trade issued a list of questions which were to be answered through "a series of observations to solve the natural history of the herring." The observations did not lead to any such important result, or, indeed, to much result of any kind; and though a great many more fruitful observations have been made since then, the natural history of the herring is still by no means complete. Within the last twenty years there have been numerous Commissions and Committees of Inquiry—*e.g.* the Trawling Commission of 1862, the Royal Sea Fisheries Commission of 1863, the Select Committee on the Sea Coast (Ireland) Fisheries Bill of 1867, and the Commission on the Herring Fisheries of Scotland, which reported in 1878. Some useful work, bearing more or less on the herring, though relating chiefly to other fisheries, has also been done by the permanent United States Fish Commission, established in 1871; and a substantial advance has been made in connection with recent German inquiries, prosecuted at the instance of the Government, in the Baltic and North Sea.

The "Icy Sea" Theory and its Refutation.

The theory, as is well known, was once confidently held—theories are always confidently held when knowledge is scarce—that the herring came down in their shoals from the Arctic Ocean, visited the British coasts in summer and autumn, and apparently—though on this point the theory seems not to have been so clear—returned northward again to enjoy the rigours of winter in their icy home. This notable theory attributed an extraordinary travelling power to the little fish, but some names of repute were associated with it, and it certainly had the support of the circumstance that the great summer fishery begins earliest at the Shetland and Orkney Islands, and gradually passes down the east coasts of Scotland and England, till it becomes the autumn "home voyage" of Yarmouth and Lowestoft. Pennant (1776) and other writers of last century—some of them before Pennant's time—gave forth this doctrine of migration from beyond the Arctic Circle with an air of certitude befitting a definitely-ascertained scientific truth. Their doctrine had the fortune to be generally accepted, and for generations it was a little-disputed article of faith. In the Report already referred to, published by the Dutch Meteorological

Society in 1848, it was stated, with the utmost precision, that the herrings leave the east side of Shetland and proceed by two different routes to the south; that in July they remain principally between the 56th and 57th degrees of north latitude, proceeding in August towards the Scottish coast between the 55th and 56th degrees—the Scottish coast apparently being supposed to include Northumberland; and that they retrace their course in September, were most abundant in October between 58° and 60°, and by November were not to be found south of 59°. Notwithstanding these specific averments, and a great deal of other dogmatism to boot, the theory was first questioned, then discredited, and at last discarded as utterly groundless. One of its most effective assailants was Yarrell,[1] who came to the conclusion, and gave good reasons for doing so, that the herring inhabits the comparatively deep water surrounding the British Islands at all seasons of the year, only coming nearer the land "for the purpose of depositing its spawn within the immediate influence of the two principal agents of vivification—increase of temperature and oxygen." Various considerations opposed to the "Arctic theory" are advanced by Mitchell in his important work on the Herring,[2] including these points:—(1.) That no shoals of herrings have ever been seen proceeding southward in high latitudes; (2.) that no shoals have ever been ascertained to exist in the Greenland seas; (3.) that the whales that feed principally on the herring are those that frequent our own coasts and those of Norway; and (4.) that it has been established that fishes of a similar size found in fresh water could not make, from spring till autumn, the long journey attributed to the herring.

The gathering of the Shoals, and the Spawning.

It is now a well-ascertained fact that herrings are to be found on the British coasts at all periods of the year. A herring-fishery may indeed be said to be continuously in progress on some part of these coasts. In Scotland there are the winter, spring, and summer fisheries, and in England there is the autumn fishery in the North Sea, gradually passing down the Channel as winter advances. Even when there is no active fishery, herrings can be caught in a desultory way; and their arch-enemy, the cod, whether taken from his favourite "banks" or from the adjacent seas, may always be expected to reveal to his dissector a herring or two in process of being digested. The great shoals, it is true, appear only at certain seasons; but there

[1] *The History of British Fishes*, by William Yarrell, vol. ii. pp. 183-6. Second Edition; London, 1841.

[2] *The Herring, its Natural History and National Importance.* By J. Mitchell. Edinburgh: Edmonston and Douglas, 1864. See p. 88, etc.

is no proof—and no reason to suppose—that the fish ever retire to any great distance from our shores. Between two and three months before the spawning period, the "matties," as they are called—herrings in which the milt and roe are advancing in development—begin to crowd together, "as the sands of the sea, without number." At no period of its existence is the herring strictly a deep-water fish, any more than the North Sea, its principal habitat, is a deep-water sea. The maximum depth of the North Sea, except at one great gorge near the Norwegian shore, is under six hundred feet; and a zone of similar depth fringes the British Islands to the west. In these shallow seas, which have little in common with the great pelagic abysses, the herring lives, and thrives, and multiplies, and maintains its not unsuccessful warfare with innumerable enemies. It usually dwells at moderate depths, according to the North Sea standard of depth. When the herrings are caught in the fishermen's nets, they are near the surface; but it is only temporarily that they are to be found there in great numbers. The cod, which is caught with long lines at or near the bottom, is always able to find a supply of herrings within reach. In other words, the herrings must pass much of their time within or near the favourite haunts of the cod. The shoals, as we know them, are formed at the surface of the water, when the fish are in the "mattie" stage, and remain together till after the shedding of the spawn, when they rapidly disappear. They may therefore be justly regarded as a manifestation of the reproductive instinct. At all periods of its existence, even in its very earliest days, the herring is gregarious in its habits ; but the huge and compact collections to be met with, first as "matties," and then as full spawning fish, do not remain permanently concentrated together in such extreme fashion. After the accomplishment of the great function of their nature, they begin to segregate. The "spents" of the end of the fishing season are not found in the dense masses of the earlier shoals, but in flocks more or less spread out. The food problem has now become serious. The shoals were content to fast, but the emaciated "spents," or "shotten" herring, are so ravenous with hunger that they do not spare even the spawn and young of their own kind. Their excessive sociability now vanishes, and, instead of crowding together, they begin to look after their prey with great keenness, and to spread themselves over a wide area of sea—most probably without regard to locality or special order in their movements. Some remain near the shore, but the great mass appear to wander indefinitely through the sea. Food is now the dominating idea and sole aim of the herring—to find food for itself, and to avoid becoming the food of some larger fish.

The Food Element.

From its earliest days to the time when the spawn approaches maturity, the herring is a hearty, not to say voracious, feeder. For the few first days after the completion of the hatching process, it subsists on the contents of the vitelline sac which it brings with it from the parent egg; but it very soon begins with characteristic energy to fight the battle of life on its own account. Attempts have frequently been made to rear the young herring to adult age in an aquarium, but hitherto without success. Most valuable observations on its growth up to a certain point have, however, been placed on record by Dr. H. A. Meyer, an eminent German observer, by whom a highly important series of researchės have been carried out at the Baltic sea-port of Kiel and elsewhere, both in the Baltic and the North Sea. Dr. Meyer was able to keep the young fry alive for five months. When only a few days old, they began to prey industriously on the microscopic forms of life existing in the water. In a month they were feeding on minute crustacea. When the sea-water had direct access, and they were as near as might be in a state of nature as to food, the fry grew rapidly, and at the end of the third month had attained a length of from 1·60 inch to 1·78 inch, or say an inch and three-quarters. In an aquarium, under more defective food conditions, they were stunted in growth, only measuring from an inch to an inch and a half; but on obtaining access to the more abundant food, the stunted fry took a start in growth, and by the end of the fifth month had made up all the lost ground, and were undistinguishable from those whose lot had from the first been cast in the comparatively more pleasant place. Beyond five months they could not be kept alive, at which time they measured $2\frac{1}{3}$ to $2\frac{1}{2}$ inches long. This is probably a good deal less than the size to which they would have attained in the same period had they not been in confinement. The appetite of the young and growing herring seems never to fail. The time it requires in order to reach mature spawning condition is now estimated at from a year to eighteen months. There seems to be no reason to doubt that in a favourable environment, with plenty of food, the shorter period is sufficient. As the fish grows up it puts on fat until it is saturated in every pore, and moves about as a living oleaginous mass. It eats voraciously, and assimilates with rapidity. The herrings caught yearly by man in the North Sea are computed in thousands of millions; and when due allowance is made for the far greater depredations of the active company of whales, dolphins, porpoises, dog-fish, cod, gannets, cormorants, gulls, and their thousand other enemies, some faint notion may be formed of the quantity of food required to maintain the stock unimpaired. As many as seven dozen little shrimps have been taken from the crop of a single herring, and if a similar allowance—regard being had to the size of the prey—were made for the whole race of herrings in the North Sea, and to be repeated every day, we should begin to marvel how even the resources of Nature could bear such a strain!

The principal food of the herring appears to consist of small crustaceans. Some species of this family are produced in remarkable profusion. Thousands of gallons of shrimps and prawns are caught daily on the English coasts during the season. The *Thysanopoda* flourish in British waters from Cornwall to Shetland, and large patches of the sea are occasionally to be seen blood-red with those diminutive shrimp-like creatures. On the Norwegian coasts they are still more abundant. Herr Robert Collett, an eminent Norwegian naturalist, mentions, in connection with a research into the habits of the blue whale, carried out in 1874, that this great animal comes down from the north in April and May, and towards the end of the latter month enters the larger fiords to feed upon the enormous quantities of *Thysanopoda inermis* then found there. Both Herr Collett and another distinguished labourer in the domain of marine biology, Professor G. O. Sars, of the University of Christiania, examined various specimens of the whale without finding one that contained any other food; but of this species as much as two or three barrels, or even more, would be taken from a single stomach. The *Astacus* or "roé-aat" serves with the *Thysanopoda* as a staple food of the Norwegian herring. An entire shoal is sometimes found gorged to repletion with the roé-aat, and the fish, should they enter a narrow fiord in this state, are sometimes kept prisoners for a day or two, by the interposition of a barrier of nets between them and the sea, in order that they may digest their food and be in a better condition for a satisfactory cure. Still more important, however, in the food economy of the herring, is the order of *Copepoda*, including, besides the well-known *Cyclops*, several of the species which contribute to the "phosphorescence of the sea." The different species of *Cetochilus*, minute as they are, display a fecundity which is truly prodigious—myriads in number, and a great many generations in descent, proceeding from the eggs of a single specimen in the course of a year. The colour of the sea is often changed by these and kindred species over miles of its area. They constitute the "pasture of the whales" of the South Atlantic, and the "cow-water" of the Cornish pilchard fishery, and are extremely abundant on parts of the Scottish coasts during the summer months. Herrings are generally found to contain the remains of these and others of the smaller crustacea. Nothing, however, in the way of food comes amiss to the clupeid; it readily snatches even at a clear unbaited hook. If it feeds chiefly on crustacea, the reason is that it finds crustacea most abundant on its path. There are indeed some indications of a preference for other kinds of food on its part. The "mattie" herring is a great gourmand, and appears at a certain stage to have a distinct liking for such delicacies as the sand-eel and the various small fry to be found in the firths or lochs or near the shore. But the same net often brings up "matties" filled to repletion with sand-eels, more or less mixed with other food, and fish with the spawn fully developed that are nearly in a fasting condition. The fattening properties of the sand-eel as food for other fishes were noted by Mr. Buckland, who remarked that salmon were always fatter in the estuaries where sand-eels abound than in those where they did not exist.

The question has frequently been asked, Why, if it is the spawning instinct that brings the herring towards the shore, should the "mattie" shoals also approach the land? Two answers may be given, at least by way of suggestion. The salmon spawns in the upper stretches of rivers which it has occupied a long time in ascending from the sea, but it is not therefore unreasonable to conclude that the spawning impulse made it start on the journey. So it may be with the mattie herring. It makes its way towards the shore several weeks before the spawn is to be shed, but the journey and the spawning seem to be parts of one great function. The quest of food, and especially of more suitable food, would come in as an auxiliary explanation. It is impossible to give proof either for or against these suggestions that can be regarded as absolutely conclusive, but at least they seem to harmonise with the known facts, and to be not inconsistent with the probabilities of the case.

From these considerations, then, it may be concluded that food is one of the main agencies influencing the movements of the herring; though the assembling of the great shoals seems primarily due to the reproductive impulse. Two kinds of movement may be distinguished—the general progress shorewards, and minor deflections in the course. These minor deflections may make all the difference in the world in the point ultimately reached. In order that these subordinate movements may be properly understood we require a much more minute knowledge of the physical and biological conditions of the sea than at present exists. A distinct advance has been made in recent years through the researches of the German North Sea Commission, under the direction of Dr. Meyer. The general character of the North Sea fauna has been pretty well ascertained, but of the laws that govern its distribution next to nothing is known. The temperature of the sea, the direction of marine currents, and, as regards species that flourish at the surface of the water, variations of winds, and in the amount of unclouded sunshine, may be supposed to come into play. In the case of the herring itself, it is now definitely known that temperature has much to do with the length of time required for the development of the incubating ova. The German Commission found in the Baltic that the period of incubation, in a temperature of 53° Fah., is about a week—within a day more or less; but that in a temperature of 38° the period is extended to six weeks. These are apparently about the extreme limits of variation, as the raising of the temperature above 53° was found not to be accompanied by any material acceleration of the process. Between these limits there is much latitude, but it may be gathered that the summer brood are hatched out much quicker than that which makes its appearance in winter. Thus we can definitely fix upon one important effect of temperature in relation to the herring. Various attempts have been made to connect the movements of the fish and their position in the water with thermal conditions—as yet with doubtful success. The shoals visit our coasts in summer and in winter, and though they are in no way averse to a summer heat of 53° Fah., or a little more, they are content to retire after spawning to the lower temperature of the depths. But, indirectly, temperature may have considerable influence on the movements of the shoals through its effect on the surface fauna. This subject, however, has still to be systematically investigated. The distribution of the minuter species presents some problems that can be successfully attacked only by laborious and patient research, the means for which can scarcely be said to exist in this country. Private enterprise is not adequate to the task. Innumerable observations are necessary—observations including in their scope the whole field of the natural conditions affecting marine life. Until we know all about the smaller organisms that are the food of the herring, and the food of its food, we shall never be able to give an adequate or authentic explanation of all that concerns the fluctuations of the fishery. Not a little has been done to encourage scientific research into the causes that influence these fluctuations by the Governments of Norway, Holland, Germany, and the United States. In this country various deep-sea exploring expeditions have been sent forth either by the Government or with its co-operation and assistance; and the last and greatest of these—the *Challenger* expedition—will probably long remain pre-eminent and unique in the magnitude of its results.

But it is well worth consideration whether something might not still be done in the way of exploring more systematically and exhaustively so important a source of our national wealth as the North Sea.[1]

The Fluctuations of the Fishery.

Meanwhile one or two further considerations may be provisionally advanced with regard to the fluctuations of the fishery. A great point upon which ingenuity has been exercised is the desertion of the lochs and fiords. For this a great many fanciful reasons have been assigned, from the disturbance of the waters by steamboats to the ringing of church-bells and the wickedness of the people. The inshore fishings as a whole are very uncertain. In some seasons, it may be for a succession of years, the fish are abundant and easily caught. Then comes a season in which they fail to make their appearance; and, reliance having been placed on the fishery, great disappointment and distress overtake the poorer fishing population of the neighbourhood. The herrings failed to come to the fishermen, and the fishermen failed to go to the herrings, and accordingly there was no catch. The Norwegian method of catching herrings by enclosing them in a creek by extending a seine-net across the entrance—a method also practised in the Cornish pilchard fisheries—has its obvious advantages, provided only that the herrings can be got to enter the creek; and enormous quantities of fish have sometimes been caught in this way. The misfortune is that all the shoals sometimes miss the particular creek or fiord where their presence is most anxiously desired. This easy-going mode has the drawback of being highly precarious; with drift-fishing in the open sea, the free use of the telegraph, and readiness to follow the movements of

[1] The *Scotsman* of August 29, 1882, says :—"We do not with certainty know the causes that bring herrings to our shores, and we are yet but imperfectly acquainted with the signs of their presence and their habits after they have appeared off the coast. Without entering into details of the results of scientific inquiries, it may be said that many of those best fitted to judge have come to the conclusion that the chief inducement leading the shoals of fish into British waters is the search for food; no doubt, they also spawn in the shallower water on the coast, but the primary object is said by experts to be food. Further than this, it is established beyond doubt that sea temperature and the electric condition of the atmosphere reacting upon the water, both tell very materially on the shoals of fish when once they have shown themselves in any locality. Thus practical experience has shown that bright sun is not favourable to the fisherman, for the herrings at once seek greater depths, whether because the light annoys them, or for the reason that it causes the smaller creatures forming their food to sink lower, we know not. Again, the boats have learned that after thunder the chances of any catch are but small, though their nets may have been well filled on the same ground shortly before or during the electrical disturbance. To establish a connection between the fortunes of the fishing and these more or less occult electric or barometric changes necessarily involves many careful observations spread over a series of years; but if once the key to the solution of the problem were found, there is every reason to suppose the fishing community must largely benefit."

the fish, far greater certainty of a prosperous fishing is obtained. In the Norwegian fisheries the telegraph is now much used, and there is less disposition than of old to wait until the fish are kind enough to enter the trap. The records of the Scotch loch and firth fisheries tell of perpetual fluctuations of the same kind. The Firth of Forth has been often the scene of a highly productive industry, but at times the fishing has been almost a blank. For centuries the town of Dunbar has been a fishing place of no little importance. It is the "fishery town famous for the herring fishing" reported on by Tucker to Cromwell's Commissioners in 1656, and of which Ray the naturalist, writing five years later, says that "yearly about this time," namely, the month of August, "there is a great confluence of people to the herring fishing; they told us sometimes to the number of twenty thousand persons." Ray had his natural doubts whether so small a town could contain so great a multitude. Statistics were not very exact in those days, especially popular statistics such as an itinerant naturalist would pick up by the wayside. But we may take it that Dunbar was a very important place. It has had many ups and downs since then. Within recent times it was the great centre of the fresh fish trade with England; but the compendious summing-up of its history before the last Commission of Inquiry was that along the whole coast from Dunbar to Berwick the herrings had "completely gone." Similar irregularity has been exemplified in the Moray Firth, and the fluctuations on the West Coast have led to the entire abandonment of old fishing-grounds in favour of the open waters. The record might be extended by reference to the Bristol Channel and other parts of the English coast.

It has been observed, on the East Coast of Scotland, that the inshore fishing—say within the three-mile limit—is subject to very great fluctuations, and that at distances of thirty, fifty, or seventy miles from the land, there is far greater surety of encountering the shoals. When successful, however, the inshore fishing is by far the heaviest; and nets are far more liable to be broken or lost through overloading near the land than at a distance out. The obvious explanation is that the vanguard of the shoal finds itself confronted by the land, and pulls up, while the main body are still pushing forward, and thus a concentration of the forces takes place. Instances are on record of great quantities of the fish being cast ashore in this country, and more particularly in Norway, by the receding tide.

It is absurd to look for any greater uniformity in the movements of the herrings than is observed in the seasons, or in any department of animate nature. The general character of their movements is, no doubt, the same from year to year, but they do not follow any law of mathematical exactitude. We must look for diversity as well as uniformity. I am disposed to attach importance to the element of *fortuity* in the whereabouts of a herring-shoal. Meteorological conditions, currents, food conditions, may all have their influence, but the evidence is insufficient to warrant definite conclusions as to the efficacy of such influences. The wanderings of a flock of sheep, for instance, cannot be reduced to such a law of uniformity as would enable us to foretell the concentration of the flock in any particular part of an open expanse of pasture at a given time. Neither should we look for such uniformity in the case of the herring.

The notion that there is a certain "periodicity" in the movements of the herring, and that the fluctuations of the fishery follow a definite cyclical order, has sometimes been broached. I can find no substantial evidence in support of this suggestion. There is no regularity of sequence observable, for instance, in the well-authenticated statistics collected for three-quarters of a century by the Scotch Fishery Board. A progressive increase in the average quantity caught is exhibited; but this increase is attributable to increase of netting, and the prosecution of the industry on a continuously advancing scale. The fluctuations from year to year do not follow any recognisable order. It must be allowed however that, as regards the abundance or scarcity of fish on the coasts, the evidence is far from complete. Districts where the fishing is poor for two or three years in succession are apt to be neglected altogether, or left to be fished by inferior craft and unenterprising men. At some of the Moray Firth stations the first-class boats, well equipped with nets, have been "well fished" in recent years; but most of the best boats have been fishing from the great centres of the trade in Aberdeenshire.

Again, the success of the fishing depends quite as much on the weather as on the fish. When the weather is unfavourable the number of working-days during the season is reduced; and now that the boats are going so far out, calms as well as storms are prejudicial to success. Boats are detained at sea, and the number of "shots" is thereby lessened. The question of periodicity may be best examined in connection with the weather, which affects both the fishery operations and the marine conditions.

Then as to the earlier beginning of the fishing in the northern part of the North Sea, to which reference has already been made, it is a question whether the appearances are not to a certain extent illusory, and whether we are not looking for recondite explanations when a very simple one would suffice.

There is a great amelioration of climate due to the flow of warm water north-eastward from the equatorial regions, past the Hebrides, Orkneys, and Shetland Isles, and onwards towards Lofoden, the northern shoulder of the Scandinavian Peninsula, and the Spitzbergen Sea. It is just possible that this flow of warm water may have some bearing on the earlier appearance of the fish in the north; but I venture to suggest another explanation of the phenomenon, based not on meteorological or biological conditions, but on physical geography. The North Sea is narrowest at the northern limit. From the Shetlands to the outlying islands of the Norwegian coast, near Bergen, is less than 200 English miles. From the coasts of Caithness and Aberdeenshire to Norway is about 300 miles; and from the north-east of England to either Norway or Denmark about 400 miles. Assuming the herring to be spread over a wide expanse of sea, the greater distance to be traversed before the full concentration into great shoals can take place would appear sufficiently to account for the difference of time in the appearance of these shoals. It is observed, moreover, that the fauna of the temperate northward flow of water of the West Coast of Scotland differs materially from that of the cold indraught along the East Coast.[1] The herring is found in greatest abundance on the eastern side, but the shoals arrive in the Hebridean waters some time before they are readily to be met with in the North Sea.

Conclusion.

The North Sea is the most productive fishing-ground in the world, and yet how imperfectly has its natural history been explored! We know, of course, most of the species by which it is inhabited, but the distribution and life-history of most of them has still to be investigated. Until further progress shall have been made in this direction, with regard to the interdependent species that are its principal food or its most formidable enemies, it will be impossible to add very much to the ascertained facts about the herring. Sooner or later, we may hope, a properly organised Fishery Department will be called into existence in this country; and if the Department had a competent scientific branch, with reasonable resources at command, we might expect soon to know a great deal more, not only about the herring, but about the other sea fishes that contribute so largely to the national wealth.

[1] Wyville Thomson, *Depths of the Sea*, p. 42.

VI.

HARBOUR ACCOMMODATION

FOR FISHING-BOATS ON THE EAST AND NORTH COASTS OF SCOTLAND, POINTING OUT THE LOCALITIES WHERE HARBOURS ARE MOST REQUIRED, AND DISTINGUISHING BETWEEN NATURAL COVES OR BAYS WHICH MAY BE CONVERTED INTO GOOD HARBOURS BY ARTIFICIAL ASSISTANCE, AND PLACES WHERE THE HARBOURS MUST BE ENTIRELY ARTIFICIAL.

By Archibald Young, Advocate.[1]

Increase of the Scotch Herring Fishery during the present century.

The statistics contained in the Reports of the Board of British White Herring Fishery, which commenced in 1809, and have been regularly continued down to the present time, exhibit one of the most gratifying examples anywhere to be found of rapid progress and continuous success. The harvest of the teeming North Sea is yearly reaped by more labourers and gathered into larger and more powerful boats. During the ten years which followed the institution of the Board, ending in 1816, the average number of barrels of herring annually cured was 132,837; during the ten years ending 1826, it was 336,624; during the ten years ending 1836, it was 392,860; during the ten years ending 1846, it was 578,669; during the ten years ending 1856, it was 640,952; during the ten years ending 1866, it was 646,772; while during the ten years ending 1876 it had risen to 806,563 barrels. And it seems still increasing. For we learn from the Report of the Board for 1880 that the total number of herring captured in Scotland in 1880 was by far the greatest ever known; the gross yield of the fishing being 1,473,600 barrels,[2] of which 272,495 barrels were from the West Coast, and no less than 1,201,105 barrels from the East Coast. In that year, the number of

[1] Inspector of Salmon Fisheries for Scotland, and formerly Commissioner of Scotch Salmon Fisheries, and Commissioner to inquire into the Herring Fishery on the Coasts of Scotland with the view of ascertaining whether any legislative regulations would tend to promote the welfare of the fishermen engaged in the said fishery, and increase the supply of herrings for the benefit of the public.

[2] At 25s. a barrel, this gives the value of one branch of the Scotch Fisheries to be no less than £1,842,000.

fishing-boats in Scotland was 14,751, of fishermen and boys, 47,131; while the estimated value of the boats, nets, and lines used in the herring and cod and ling fisheries was £1,288,508, being an increase over the preceding year of 294 boats and of 629 fishermen, and an increase of £47,319 in the estimated value of boats, nets, and lines. The great increase in the average annual yield of the herring fishery since 1866, is coincident with the extension and improvement of the fishing-boat harbours at Aberdeen, Peterhead, and Fraserburgh, and the construction, by the late Mr. Gordon of Cluny, of the excellent harbour at Buckie on the Moray Firth. The value of the herring yearly brought into the chief fishing stations on the Aberdeenshire coast is at least equal to the land rental of the county; and the value of the herring cured last year in the whole of Scotland exceeded by half a million the rental of the nine northern counties.[1] The ocean is more productive and inexhaustible than the land.

Remarkable development of Fraserburgh.

If we look to Fraserburgh, now the chief herring fishing port in Scotland, and possessing the most spacious and complete fishing-boat harbour, we shall find a marvellous instance of the prosperity arising from the successful prosecution of the herring industry. In 1868 the number of boats engaged in fishing was 389, and the total value of the herrings exported was £105,606. In 1880 the number of boats had nearly doubled, and the total value of the herring exported was £312,725. The total number of boats now owned within the district is 703; number of fishermen employed, 2053; value of boats, £45,804; value of nets, £52,548; value of lines, £5450;—total value of boats, nets, and lines, £103,802. In 1850 the harbour revenue was £1559, 17s. 1d.; in 1880 it was £10,185, 0s. 11d. In 1851 the population of the town and parish was 4447; in 1881 it was 7541. In 1862 the total rental of the fish-curing yards in Fraserburgh was £393, 15s.—say £400 at 20 years' purchase, or £8000. In 1880-81 the total rental of the fish-curing yards, as entered in the valuation roll, was £2842, 13s., besides ground-rent charged otherwise in the roll—say £3000 at 20 years' purchase, or £60,000. These are instances of wonderful prosperity and development. But the herring fishing is often prosecuted, at less favoured stations on the East Coast, at great risk, and a terrible loss of life and property too often occurs. The North Sea, though a fruitful nursery of fish, is stormy and treacher-

[1] See a very interesting pamphlet by R. W. Duff, Esq., M.P., on *The Further Development of our Sea Fisheries.* Aberdeen: D. Wyllie and Son. 1881.

ous, and almost yearly claims its victims. The chief fishing stations are on the salient and exposed points of the coast. On the whole eastern shores of Scotland there is no good natural harbour between the Firth of Forth and the Cromarty Firth, a distance of at least 160 miles. At Aberdeen, Peterhead, Fraserburgh, and Buckie, there are now good fishing-boat harbours, where art has done much to supply the natural deficiencies of sheltered anchorages. Much, however, still remains to be done at various points on these exposed and stormy shores, where many excellent fishing-grounds are either entirely deserted, or only partially fished, for want of a good harbour in their vicinity to which they may run in time of danger. The greatly increased size of the fishing-boats, some of which measure from 40 to 50 feet keel, and draw from 5 to 7 feet water, necessitates an increase in the size and depth of the harbours. The crew of a fishing-boat will hang by their nets to the last moment when they know that they are near a harbour to which they can run at any time of the tide. But the case is far otherwise when they know that the neighbouring harbour has a shallow entrance accessible only for an hour or two during each tide.

Loss of Fishing from Want of Deep-water Harbours.

In such cases it is impossible that the fishing can be prosecuted to the best advantage. Mr. Boyd, agent for the Trustees of Peterhead Harbour, stated, in a paper read before the Herring Fishery Commissioners in 1877, "That during the last ten days of the herring-fishing season of 1876 the yield of the fishery at Peterhead would have been increased by at least £60,000, if adequate and safe harbour-accommodation had been available." And Captain David Grey, the most experienced and successful of the Peterhead whaling captains, and who is also intimately acquainted with Peterhead harbour and the herring-fishery in the vicinity, said that "in doubtful weather the boats do not go to sea at all. During the present season some of the boats have not been ten times to sea. Last season there was a great body of herrings off the town, which was ascertained from the fact that the few boats that did go to sea had heavy takes. He estimated that the fishermen lost herrings worth over £50,000 from being unable to go to sea. This year is almost a complete failure from the same cause. This very morning the harbour was blocked up, the boats were bound to run for the south harbour, and they were coming in one on the top of the other. It is a vital question to the herring trade to increase the harbour accommodation." James Couper, Fishery officer, Fraserburgh, gave evidence to the same effect, estimating the loss to the Fraserburgh fishermen, arising from insufficient harbour accommodation, at 64,000 crans of herring, or £80,000 at 25s. a cran. If such was the case in 1877, even at such harbours as Peterhead and Fraserburgh (which have since, however, been much enlarged and improved), how much greater is the risk and proportionate loss at such exposed stations as Banff, Lybster, Helmsdale, Wick, Sarclet, and others on the Moray Firth; at Eyemouth and Burnmouth on the Berwickshire coast; and at the fishing villages on the Fife coast to the eastward of Buckhaven! For the preservation of life and property, and for the full development of the herring, cod, ling, and other fisheries on the East Coast, the chief essential is the improvement and increase of harbour accommodation. Experience has clearly proved that the best harbour will have the best fishing, and will attract boats from other stations where the harbour accommodation is inferior.

Requisites of a Fishing-boat Harbour.

The requisites for a fishing-boat harbour are thus stated by the Commissioners employed on the last inquiry into the Scotch Herring Fishery: "The requisites of a perfect fishing-boat harbour are an entrance which will allow the boats to have free access and egress at all times of the tide; perfect shelter within the entrance, sufficient space for all the boats that frequent the place to lie together without crowding or jostling; enough depth of water in every part of the harbour to enable them to be afloat at all times of the tide; and proper facilities for taking in their nets and gear and landing their fish." How many harbours on the East Coast possess these requisites? Only Aberdeen, Peterhead, Fraserburgh, and Buckie; while, on the North Coast, there is no good harbour between Thurso on the east and Loch Erribol on the west, though there are one or two places where a harbour might be constructed at a moderate outlay. Yet fishermen are well aware of the value and importance of good harbour accommodation, and are willing to pay for it, in the shape of dues, sometimes to the extent of £3 annually for each first-class boat; so that, if capital were forthcoming, and were judiciously expended in improving imperfect harbours, or constructing new ones in the vicinity of good fishing-grounds, there would be a fair prospect of the interest being regularly paid. There have been not a few failures, indeed, in fishing-boat harbours, for example at Anstruther and Wick. At the former, at least £40,000 have been expended. But the harbour, though spacious enough, is quite insufficient in depth for the requirements of the first-class boats; and, at the latter, the place was originally ill-selected, and after an expenditure of £140,000, the breakwater intended to shelter the bay is to a considerable extent destroyed, and its ruins encumber and choke up the harbour it was intended to protect. But, on the other hand, the judicious and well-directed operations of the Harbour Commissioners and Trustees, at Aberdeen, Fraserburgh, and Peterhead, have been eminently successful, and the recently constructed harbour at Buckie, which will shortly be united by a branch to the main line of railway at Keith, possesses all the requisites of a good fishing-boat harbour, as set forth by the Commissioners in their Report of 1878.

The Sorrows of the Sea.

The loss of life and property that has occurred, owing to the want of good harbours on the East Coast, is appalling. The disasters from this and other causes connected with the fisherman's adventurous life at sea, in the fishing village of Cellardyke, on the coast of Fife, have been chronicled in an interesting little volume, entitled *Fisher Life.* From this we learn that, in one tragical period of seven years, Cellardyke, out of its scanty population of some 300 inhabitants, lost thirty fishermen engulfed by the waves; and a Mrs. Reid is mentioned, who died at Cellardyke in February 1873, and who had lost, by various catastrophes at sea, two husbands, two sons, two sons-in-law, two brothers, and three brothers-in-law. The 19th November 1875 will be a day long remembered in the fishing villages of Fife. Five boats, with all on board, went down on the English coast on their homeward voyage, —the east coast of England, be it noted, being even more conspicuous than the east coast of Scotland for the absence of good fishing-boat harbours. Fifteen Cellardyke men were drowned, and twenty-one of St. Monance, leaving eighteen widows and seventy-one children. One woman, a Mrs. Paterson of St. Monance, by this single disaster, lost her husband, her son, two brothers, a brother-in-law, and a cousin. Some of the worst losses occurred at the harbour mouth, within stone-throw of safety, and before the eyes of relatives and friends. These arose from want of proper access and sufficient depth of water:—for example, at the old harbour at Cellardyke in September 1793, when a boat was lost and six fishermen were drowned; and again at the same place, in February 1800, when a precisely similar catastrophe occurred. Strangely enough, on both of these occasions there were seven men on board each boat, and on each occasion six were drowned and one was saved.

In August 1848, a furious storm burst upon the east coast of Scotland, which inflicted terrible loss in boats and men on the fishing fleet. At Peterhead fifty-one boats and thirty-one lives were lost in running for the harbour. The boats got wedged together close to its entrance, and lay exposed to the full fury of the gale. At Wick, in the same storm, twenty-five men perished in taking the harbour, besides twelve others whose boats were swamped at sea. Altogether, the number of fishermen drowned on the East Coast during this great storm was 100, and the value of the boats and nets lost amounted to £7000. The tempest burst on the boats just as the fishing was being busily prosecuted. Most of them ran for shelter to the nearest harbour. Many perished at its mouth, with home faces within sight and home voices within hearing. The whole damage was done in three or four hours. Wick Bay is exposed to a terrible sea from the south-east, and has been a fatal place for fishermen. On one occasion, fifty boats, lying at anchor in the bay, were overtaken by a sudden storm, and foundered; and, since 1845, more than 150 fishermen have perished, and about 400 fishing-boats have been wrecked in the neighbourhood. The year 1881 proved a most disastrous one for our fishermen. In the Shetland seas, in a single gale during the month of July, 58 fishermen perished, leaving 33 widows and 88 children. The autumn of the same year brought a still more grievous calamity on the fishing villages of Berwickshire and its vicinity. On the 14th of October a sudden and violent gale swept over the Berwickshire coast, and overtook and overwhelmed the fishing fleet. The flower of the population in the fishing villages perished at sea, and their families were left desolate. Eyemouth lost 129 fishermen; Cove, 11; Burnmouth, 24; Coldingham Shore, 3; Musselburgh, 7; Newhaven, 17;—making a total loss of 191 fishermen, who left 107 widows and 351 children. With what terrible significance do the following well-known lines, written by Lady Nairne, apply to that fatal year!—

> "When ye were sleepin' on your pillows,
> Dreamt ye ought o' our puir fellows
> Darkling as they faced the billows
> A' to fill the woven willows?
>
> Wha 'll buy my caller herring?
> They 're no brought here without brave daring;
> Buy my caller herring,
> Haul'd thro' wind and rain.
>
> Wha 'll buy my caller herring?
> Oh ye may ca' them vulgar farin',
> Wives and mothers maist despairing,
> Ca' them lives o' men."

Oil on the troubled Waters.

A number of experiments have lately been made with a view of testing the efficacy of oil in smoothing heavy seas and preventing them from breaking; and so rendering the entrance to harbours and the crossing of bars in gales of wind less dangerous, and enabling vessels when hove-to to ride out a storm in greater safety. Mr. John Shields of Perth has been especially conspicuous for the perseverance and success which he has displayed in devising means for applying oil to calm the angry sea. The idea, he states, was first suggested to him about six years ago by observing the effect of some oil accidentally spilt on one of the ponds connected with his works. A high wind was blowing on the pond at the time, and the water was rough. But the oil spread in all directions, notwithstanding the wind, which appeared to skim over it, and left a smooth glassy surface on the water. After this, Mr. Shields commenced experiments on a small scale, and continued them for about two years; the result being that he was thoroughly convinced that oil might be made practically useful in saving life at sea. The great problem was to get the oil when it was wanted, and where it was wanted.

The first experiments on a larger scale were made at Peterhead, where only twelve quart bottles of oil were taken; but they proved very effective in calming the waves. In subsequent trials, gutta-percha pipes were laid down under water, and conical valves put on at their seaward extremities, while a force-pump on shore was employed to drive the oil through the pipes. The day following the completion of these arrangements was a very stormy one, and a schooner making for the harbour mouth was signalled not to attempt to enter. The force-pump was then put in action, and the oil driven out upon the troubled waters. The result was rapid and satisfactory. In less than an hour afterwards the tug, with the schooner, steamed safely into the harbour; the surface of the waves being by that time as smooth as glass, though the undulations still continued. A great difficulty at Peterhead was found to be to preserve the gutta-percha or leaden pipes which were laid along the bottom of the sea from being damaged by boulders rolled about by the force of the waves. The pipes were broken or bent so as to be rendered incapable of discharging the oil. It has been proposed to cover them with bags of concrete, as the most effectual way to protect them. So recently as the 16th October last, oil was tried successfully at Aberdeen during a gale. It was found to smooth the surface of the seas, and to render the harbour entrance less dangerous. On this occasion 70 gallons of oil were used.

I may mention a few of the recorded instances in which oil has been instrumental in saving life at sea. Thirty years ago some fishermen, in the employment of Mr. John Anderson of Edinburgh, were caught in a gale of wind thirty miles to the eastward of the May, after having hauled their lines. They dared not run before the storm, but had to face it. To save themselves, they cut up a quantity of the skate, cod, and other fish they had caught, chopped their livers, and threw them into the sea all round the boat. They were hove-to for ten hours. Immediately around them, where the oil had acted, the waves were rising in a glassy swell, while outside this charmed circle they were breaking furiously. The *New York Herald* states that the whaling ship *Abram Newland* was caught in a typhoon in the Japanese seas, and compelled to lie-to, moored as it were to a great whale; and the oil from the greasy monster so smoothed the sea to windward that the vessel rode out the storm in safety. In December 1881 a Captain Adams encountered a terrific gale and heavy sea. Whilst laid-to he kept bags of oil over the side, also swabs dipped in oil to try and smooth the breaking seas. The effect was satisfactory, and the use of the oil was continued for twenty hours. The captain of the *Gem*, belonging to Sackville, New Brunswick, found a pricked bag of oil efficacious in saving his ship during a storm; and Captain Betts of the *King Cenric*, which arrived at Bombay from Liverpool, with a cargo of coal, imputed the preservation of his ship during a heavy gale, which lasted for five days, to the use of oil. During the height of the storm, Mr. Bowyer, the first officer, obtained the captain's consent to try the effect of oil. He then got out two canvas clothes-bags, and poured into each two gallons of fine oil. These bags he pierced slightly, and hung one over each quarter, letting them tow astern. The effect was magical. The waves no longer broke against the ship, but many yards away, beyond where the oil had spread itself over the surface of the water. The bags lasted two days after the worst fury of the gale had expended itself.

The cheapest kind of oil to use is said to be dark fish-liver oil, which can be had from 1s. 9d. to 2s. per gallon. It has been suggested that every fishing-boat should carry one or two gallons of this oil for use in case of emergency. It is stated that a few drops of oil will smooth four feet of water. The oil does not decrease the height of the seas. It merely smooths their surface, changing the dangerous breaking wave into the comparatively innocuous glassy swell.

Absolute necessity of providing good Harbour Accommodation.

It would be easy to multiply, in melancholy monotony, the sad story of death and disaster on the East Coast for want of sufficient harbour accommodation. But enough has surely been said to show that the providing of such accommodation is a matter of national importance, without which one of the greatest fishing industries in the world can never attain the development which it is capable of receiving. With good fishing-boat harbours at Eyemouth, on the Berwickshire coast, and at Elie and Anstruther on the Fifeshire coast; a harbour of refuge in Peterhead Bay; improved harbours at Banff, Helmsdale, and Lybster; a fishing-boat harbour at Wick—not in the bay, but in the channel of the river, which should be excavated for about 4 feet; and fishing-boat harbours in Melvich Bay and in the Kyle of Tongue in Sutherland; there would speedily follow a vast development, not only of the herring-fishery, but also of the cod, ling, haddock, and other hook-and-line fisheries.

Importance of Scotch Fishing Fleet and Mercantile Marine.

The sailing and steam vessels owned in Scotland, and the Scotch fishing fleet, are manned by upwards of 100,000 men and boys. The stormy Pentland Firth is often strewn with wreckage from Dunnet's Head to Duncansby Head; and along the iron-bound shores of the counties of Kincardine and Aberdeen the cliffs rise like a wall above the North Sea waves. Yet on all that perilous coast there is not a single harbour of refuge. But while the shipping and fishing interests of Scotland have been thus neglected, it appears from a Parliamentary Return, issued not many years ago, that during the present century there has been expended, as voted by Parliament, for harbours in England and Wales, and in the Channel Islands, upwards of seven millions sterling, and for harbours in Ireland nearly two millions, whereas the sums voted for Scotland amount to only £435,000, or, including the remission of £178,000 to Leith, to £613,000. Mr. J. M. Mitchell, in his excellent and exhaustive work on *The Herring, its Natural History and National Importance*, writes as follows:—"When the importance of encouraging the fishermen in this important occupation is considered, surprise may be expressed that the British Government has done so little towards providing suitable harbours for the fishermen, to enable them to proceed out and in and be in safety at all times. We may contrast the neglect of harbour accommodation for our fishermen and mercantile marine on the Scottish coast, with the millions of pounds spent on Kingston and Holyhead harbours." Mr. Joseph Mitchell, for twenty-two years engineer to the Board of White Herring Fisheries, takes quite as strong a view of the question, in his evidence given before the Herring Fishery Inquiry Commissioners in 1877. He then stated that the result of his experience was that the two great requisites for the development of the fisheries were—improved and increased harbour accommodation, and the adoption of steam fishing-boats. Government should build extensive harbours suited to the requirements of the fishery without asking the locality to bear a proportion of the cost where the local resources are inadequate. The harbour question involves the question of humanity. There are 45,000 men and boys employed in the herring-fishery, and that fishery affords a nursery for the supply of men to the naval service. On all these grounds it is necessary and expedient to provide adequate harbour accommodation. Government should afford much more assistance than they have hitherto done to the encouragement of the fisheries on the east coast of Scotland.

Fishing-boat Harbours.

I shall now proceed to describe briefly some of the existing fishing-boat harbours. I have personally visited nearly the whole of them; and to some of them, such as Aberdeen, Peterhead, Wick, Banff, and Helmsdale, I have paid several visits.

North Sunderland.—Beginning in the extreme south, we come to North Sunderland, which, though an English fishing station, is under the supervision of the Board of White Herring Fisheries. Near it there is an important herring-fishery in the neighbourhood of the Farne Islands. This is a great fishing-ground for the Scotch boats, in which most of the herrings landed at Eyemouth and Berwick are caught. In 1877, there were 200 boats from Eyemouth and other stations on the Berwickshire coast fishing off North Sunderland. The fishing-ground is capital, and subject to less than the usual fluctuations which characterise the herring-fishery. But it is not half developed, owing to the want of adequate harbour accommodation; there being no sufficient shelter between North Sunderland and Berwick-on-Tweed, twenty-three miles to the north, and between it and the mouth of the Tyne on the south, a distance of forty miles. North Sunderland is the chief seat of the kippered herring trade. But in 1877 the harbour could accommodate only seventy-six boats. In that year the Fishery officer gave the following evidence with regard to the harbour:—"The present catch of herrings is from 15,000 to 18,000 crans, worth from £20,000 to £25,000, but by an expenditure of £10,000 on the harbour, accommodation would be provided for from 300 to 400 boats, whose catch would be from 60,000 to 80,000 crans. In other words, an outlay of £10,000 in improving and extending the harbour would increase the annual catch of herrings from 15,000 to 18,000 crans, worth from £20,000 to £25,000, to 60,000 or 80,000 crans, worth from £80,000 to £100,000, and this wealth of food and money would be available and perpetuated by the outlay on the harbour. The sea off this coast is open to labour; the herrings are there; and there are plenty of boats and crews ready and eager to work this rich field of industry, if only they had a safe and commodious harbour to shelter them in case of storms. If a harbour, with sufficient depth of water and harbour space, were constructed at North Sunderland, which would admit of the white-fishing being prosecuted in large decked boats, as at Eyemouth, a valuable cod and haddock fishery would be created there. At Eyemouth forty-one decked boats are employed in the haddock-fishery. Last week (from November 5 to November 10) these boats were four times at sea, and the estimated catch for the week was 16,530 stones, or upwards of 100 tons of haddocks. The estimated annual value of the haddock-fishery to Eyemouth is £30,000. Their best fishing-ground is south-east of Berwick-on-Tweed, and is more easily reached from North Sunderland than from Eyemouth. It is certain that the harbour, if improved and enlarged, would be fully taken advantage of by the fishermen, as nothing prevents them from proceeding there at present, except the dread of the autumn gales, and the want of a good harbour to run for, if overtaken by them." The trustees of the Crewe estate, with the consent of the Charity Commissioners, were prepared to undertake the improvement of the North Sunderland harbour on receiving an opinion favourable to the undertaking from Messrs. Buckland, Walpole, and Young, which is given in the second supplementary Report to their principal Report of 1878.

Eyemouth.—A little more than thirty miles north of North Sunderland we come to the important fishing station of Eyemouth, which imperatively demands harbour extension and improvement. There are no larger or finer lug-sail boats on the East Coast than those built at Eyemouth, nor a hardier or more enterprising race of fishermen. In the recent disaster, already alluded to, they had their full share of the sorrows of the sea, and many a hearth was left desolate. But public aid has been freely given to the widows and orphans, and time, the consoler, will gradually bring healing. And if that sudden and striking calamity shall have the effect of directing the attention of Government, and of the proprietors in the neighbourhood, to the absolute necessity that exists for having a harbour at Eyemouth deep enough for the largest class of boats at all times of the tide, good will have come out of evil. In 1877, Mr. P. Wilson, Fishery officer at Eyemouth, gave the following evidence with regard to the harbour: "The harbour at Eyemouth is inconveniently small, especially for the large decked boats. The boats are all aground at low-water. They can enter the harbour at about half-tide. It would be important to improve the harbour accommodation."

Dunbar.—In the Report of the White Herring Fishery Board for 1881 it is stated that the repairs of Dunbar Harbour have been completed, and that the work was carried on with energy and executed well. But, notwithstanding this, Dunbar cannot yet be accepted as possessing the requisites of a perfect fishing-boat harbour for the first-class boats of the present day, which form two-thirds of the whole tonnage of the herring fleet.

Anstruther.—At Anstruther, on the Fife coast, very large sums, from £40,000 to £60,000, have been spent on the harbour, which covers an area of 7 acres, and has spacious and handsome quays. But it is deficient in depth of water. It can neither be entered nor departed from at all times of the tide, and the boats within it are not afloat except for a portion of each tide. It is therefore quite inadequate for the requirements of the large boats of the present day. In their Report of 1880, the Fishery Board give a favourable account of Anstruther harbour. "Anstruther harbour," they say, "constructed by the Board for the benefit of the fishermen, becomes every year of increasing use to them. Upon the 11th June 1880, 73 boats arrived in the harbour with large takes of white fish caught in the North Sea; spacious as the east pier of this harbour is, it was several times covered over by these fish when they were landed on it and laid out for auction, and the value of the fish put upon the pier on this one day was reckoned at £1200. During the winter herring-fishing as many as 190 boats entered the harbour in one day; and in the month of March during a heavy gale from the south-east, lasting three days, with a tremendous sea, the boats found in it safe and commodious shelter."

Roome Bay.—Between Anstruther and Fife Ness is the fishing village of Crail, close to which is Roome Bay, which, though small, is deep and well-sheltered, and seems capable of being converted into a good harbour. It is thus spoken of in the 3d volume of Leighton's *History of Fife from the Earliest Period to* 1840:—"There are two havens in Crail, the old and the new harbours. The old, situated at the west end of the town, is small, and not very safe, and can only be entered by the smaller class of vessels at high-water; but the other, one-quarter of a mile to the eastward, called Roome Bay, might, at no great expense, be converted into an excellent harbour capable of containing 200 sail, which might here lie in from 20 to 22 feet water at ordinary tides, and 29 feet in spring-tides. It is sheltered from all winds but the south, and may be entered by vessels drawing 10 feet water from any point at an hour and a quarter's flood. Its improvement ought to be at the public expense, as it would be of the greatest benefit to the trade on the Firth, and to the whole east coast of Scotland."[1]

[1] Since writing the above I have been favoured, through the kindness of Mr. D. B. Mackay of Crail, with a report and plan for a harbour at Roome. The report is dated Dundee, 30th April 1846, and is addressed to the Magistrates and Town Council of Crail. It is drawn up by that eminent engineer, Mr. James Leslie, now of 72A George Street, Edinburgh. The following extracts from the report will be found interesting:—"Agreeably to the instructions given me by the magistrates, I last July examined the harbour of Crail and the adjacent coast, and more particularly the cove or natural harbour of Roome, lying immediately to the east of the town, which had been pointed out as forming a very eligible site for a low-water or asylum harbour. I have since then had an accurate survey made of the coast from Kilwinning, about one mile east, to another point about one mile west of Roome Harbour, and have had soundings taken and the sets of the tide carefully observed. These are all laid down on the accompanying plan, on which I have drawn, in red lines, a design for an asylum harbour, made out after having consulted and heard the suggestions of nautical men, and others well acquainted with the coast.

"The proposed site has very considerable natural advantages, from its being much sheltered by high land and rocks both on the east and west, and having clear ground and good anchorage immediately off the entrance, and for a considerable extent in either direction outside. It is at a part of the Firth where the shelter of a harbour is very much wanted, to save vessels from having to run up in easterly gales to the lee of Inchkeith, or to Burntisland Roads, or even above Queensferry; and where it would be of great use also in westerly gales, which, although they do not raise so heavy a swell in the Firth of Forth as those off the German Ocean do, are nevertheless more frequent, and often more violent; so that it is no uncommon thing for vessels to be blown out of the Firth by a heavy south-wester, for want of some secure place of refuge which they might run to.

"There are two plans laid down, of which the larger has a depth, at its mouth, of 18 feet of low-water of spring-tides. It encloses an area of 16 acres, covered at low-water, and having a depth at that state of tide varying from 5 to 18 feet, and 23 acres between low-water and high-water, thus giving a total area, at high-water, of 39 acres.

"Lest this plan should be thought on too extensive a scale, there is also a plan of a smaller harbour, shown by red dotted lines, with its mouth placed where there is a depth of 16 feet at low-water of spring-tides. It encloses an area of 8 acres below low-water, and varying in depth from 5 to 16 feet, and of 15½ acres between high-water and low-water, thus making the total area enclosed within the piers 23½ acres.

"The advantages of the smaller plan are, on the whole, nearly the same as those of the larger one, excepting that the deep-water space is much reduced. The mouth would be rather more sheltered by being more embayed; but for the same reason there would be less facility for vessels leaving the harbour with a wind right in, as in that case it would be more difficult to lie such a course as would clear the projecting points of rocks situated on the east and west of the harbour.

"The harbour, according to the larger design, would be fit to afford shelter and floating accommodation at low-water to 100 vessels averaging 100 tons each, if the piers were built upright inside, so as to allow vessels being berthed alongside of them: and, according to the smaller design, it would accommodate half that

Peterhead.—Peterhead is the second of the Scotch herring-fishery ports, ranking next to Fraserburgh. It is also an important centre of the whale and seal fisheries. The north and south harbours now afford great facilities for the prosecution of the fishery on that part of the coast of which Peterhead is the centre. The north harbour has an area of 9½, the south of 5½ acres. There is also a new harbour at Port Henry, with an area of about 5 acres. In 1877, when the Commissioners engaged on the Herring Fishery Inquiry visited Peterhead, the harbour required deepening. But the Harbour Trustees had then decided to excavate and deepen its area so as to give a clear depth of 6 feet of water at low-water of ordinary spring-tides, and likewise to deepen the entrance and to remove certain rocks that obstructed it. To meet the expense of these operations they were engaged in a negotiation for a loan of £30,000 from the Public Works Loan Commissioners. The total number of herrings cured at Peterhead in 1880 was 271,850 barrels. There were 647 boats employed in the fisheries, with an aggregate tonnage of 6874 tons, manned by 2656 fishermen. Altogether, reckoning fishermen, fish-curers, coopers, and others, the fisheries at Peterhead furnished employment to 6723 persons during the year 1880. Of the boats, 311 belonged to the first-class, over 30 feet keel, and had an aggregate tonnage of 5287 tons, or more than three-fourths of the whole tonnage of the boats fishing from the port. And it cannot be too often repeated, or too emphatically dwelt upon, that it is this preponderance of the first-class boats over the boats belonging to the second and third classes, and the increased and increasing size of these first-class boats themselves, that render deeper and more spacious harbours a matter of national importance, and indeed of absolute necessity, if full advantage is to be taken of the unexhausted and inexhaustible harvest of the sea. In the vast majority of cases the boats have outgrown the harbours. It is time to restore the equilibrium that should exist between them. Peterhead is situated on a promontory jutting far out into the North Sea, farther out than any other point of land in Scotland, and is placed nearly half-way between the Firth of Forth and the

number of a similar tonnage; and as there would be no objection to the smaller class of vessels taking the ground, a great many small craft might be accommodated, in addition to the number mentioned, upon the beach above low-water.

"Supposing the two heads and the inner face of the piers to be built under low-water by caissons or bell-work, and the back slopes founded on rubble stones thrown down promiscuously under water, and brought up from that level, of good pitching, with a high substantial protecting parapet, the larger plan would cost, according to my estimate, £142,500, and the smaller plan £107,600.

"Supposing the inner face also to be founded on stones, tumbled into the water, and formed above low-water with a pitched slope, and the outer face to have no parapet, the cost of the larger plan would be £108,850, and of the smaller plan £81,900."

Cromarty Firth. It possesses great natural advantages for a harbour, which were recognised so far back as 1705, when an Act of the Privy Council of Scotland authorised a voluntary contribution within all the parish churches of the three Lothians and north of the Forth for building and repairing the harbour. The fishing-boat harbour has now been much enlarged and improved, with great advantage to the fisheries; and there is now little wanting to make it perfect and complete. But the formation of a good harbour for fishing-boats is not sufficient in the case of Peterhead. Its immense superiority for a harbour of refuge over every other sea-port on the east coast of Scotland has been again and again pointed out and demonstrated by Government Commissioners, by officers of the Navy and of the Mercantile Marine, by Civil Engineers, and by other persons of skill and experience. The Commission of 1858-9 pointed out that as harbours of refuge were not likely to be taken up as a commercial speculation, Government should come forward and offer inducements to Harbour Trustees and Commissioners to combine harbours of refuge with mercantile harbours. The suggestion was carried out in the Act of 1861, known as "The Harbour and Passing Tolls Act," which inaugurated the system of lending money at moderate rates of interest for the improvement of existing harbours, and through its operation much good has since been effected. Peterhead was one of the places specially recommended by the Commission of 1858 for a harbour of refuge. The following extracts from a paper read by Mr. Boyd, agent for the Harbour Trustees of Peterhead, before the Herring Fishery Commissioners in 1877, will show of how much national importance and advantage to Scotland would be the construction of a harbour of refuge in Peterhead Bay:—"The north-eastern portion of the coast of Scotland, from the Firth of Forth on the south to the Firth of Cromarty on the north, comprehending a sea-board of 160 miles, is throughout the greater portion of its extent precipitous and rocky, and of a bold and dangerous character. It is exposed to frequent easterly gales of great violence, but, although much frequented by shipping, and although it comprehends within its limits the most important stations for the prosecution of the fisheries in Scotland, it affords no place of safety to which vessels and boats can at all times run for refuge, when overtaken by storms. For nearly 200 years the most competent nautical authorities have regarded the position of Peterhead, which is situated nearly midway between these Firths, and on the most easterly promontory of the mainland of Scotland, as possessing peculiar and exceptional natural advantages as a site for a harbour calculated to afford shelter and refuge on this dangerous coast, and these advantages have, on various occasions, received national recognition. That portion of the fishing-ground which lies about thirty miles in a south-easterly direction from Peterhead, is admittedly the best and most productive on the east coast of Scotland, and the fishery is prosecuted in its vicinity, not only by boats sailing from Peterhead, but by those engaged at all the other ports and creeks on the sea-coast of Aberdeenshire, extending for a distance of fifty miles, and including the important fishing stations of Aberdeen and Fraserburgh. The number of boats fishing at the Aberdeenshire stations, of which Peterhead is the centre, amounted, in 1876, to 2098; they were manned by 12,600 men and boys, the value of property involved in their safety amounted to £630,000, and they afforded employment to 10,500 persons on shore. Notwithstanding the inadequacy of the accommodation at present available at the harbours of Peterhead, they frequently supply means of shelter in stormy weather to portions of this great fleet,—an important advantage, which would be greatly increased if their capabilities for refuge purposes were to be extended." The Select Committee appointed by Parliament in 1857 to inquire into the policy of making further grants of public money for the improvement and extension of harbours of refuge, collected and placed on record convincing evidence in favour of Peterhead as the best site on the east coast of Scotland; and the Royal Commissioners appointed to complete the inquiry reported on its eligibility in the following terms:—"Its advanced position at the most prominent headland on the east coast of Scotland constitutes it a turning-point to the greater part of the traffic frequenting the Moray and Pentland Firths; it is much resorted to by wind-bound vessels, and is a favourite port of call for orders as well as an excellent land-fall and point of departure for the passing trade; it is the principal port of the Scotch whalers, and is a considerable station for the herring-fishery; it presents the most fitting point for the collection of convoys, and for a naval station for the protection of the trade on that part of the coast of Scotland. It was stated to us that a breakwater, to convert the south bay of Peterhead into a moderate-sized harbour of refuge, could be constructed for about £300,000, owing to the configuration of the bay and the abundance of granite lying close at hand. . . . Under these favourable circumstances, combined with the consideration of the natural facilities which we have detailed, we recommend the enclosure of the south bay at a cost not exceeding £300,000; and considering the proportion which the shipping trading to the port will bear to those of the passing trade which will resort to it for refuge purposes, we are of opinion that the amounts of national and local benefit conferred will be fairly represented in the proportion of one-third and two-thirds respectively. We therefore submit that a grant of £100,000 be made in aid of the proposed harbour, to be met by a sum of £200,000 raised in the locality, and to be applied to the same purpose." The Report of the Commission, with regard to Peterhead as being the best place on the whole East Coast for the construction of a harbour of refuge, was generally approved of by those best qualified to judge. But the Harbour Trustees found it impossible to raise the large sum required to be raised locally; so that, although the amount of life and property now exposed to the hazards of the sea on that stern and stormy coast is far greater now than at the date of the Commissioners' Report, no steps have been taken to carry out their recommendations.[1]

Fraserburgh.—Proceeding northwards from Peterhead, we next come to Fraserburgh, the chief of the Scotch herring-fishing stations, whose rapid and marvellous growth and development have already been described—a growth and develop-

[1] The prospects of a harbour of refuge at Peterhead have improved considerably since this Essay was written. The authorities at Peterhead have issued a statement in which they say—"The number of boats fishing on the coast from Montrose on the south to Burghead, of which Peterhead is the centre, amounted in 1881 to 2894, manned by about 18,087 men and boys. The value of property involved in their safety amounted to £850,000, and they afforded employment to upwards of 15,000 persons on shore. It is estimated that the loss annually in the yield of Peterhead alone amounts to upwards of £60,000, arising from the want of adequate and safe harbour accommodation. From the official wreck charts it appears that during the four years ending with the year 1874-75 there were sixty-five wrecks between Kinnaird's Head and the river Ythan, a distance of about 33 miles; and during 1881 thirteen vessels were wrecked on the same limited extent of coast. Peterhead is the nearest point in Great Britain to the Baltic, and is connected by submarine telegraph with Norway. A harbour of refuge would consequently be of manifest national importance, not only in the interests of trade and commerce, but as affording a safe and convenient anchorage for the largest ships in the navy." At a meeting of the Leith Chamber of Commerce on October 3, 1882, the chairman, Mr. W. G. Pattison, after reading the statement from which this is extracted, said the Chamber had been asked to give an opinion as to the best place for a harbour of refuge. It seemed that at the present moment there were a large number of convicts at Chatham doing nothing. Scotland, it appeared, had as yet had no share in labour of this kind, and there seemed no reason why they should not now get some benefit from labour which they had all to pay for. It was consequently proposed that they should petition to have this labour brought to Scotland for the purpose of making a harbour of refuge. A grant, he believed, was promised of about £200,000, if something like one-third more were contributed locally. Stonehaven, Eyemouth, and Peterhead had been mentioned as suitable places for a harbour of refuge. After some discussion, it was unanimously agreed to petition in favour of Peterhead being fixed upon as the most suitable place for the proposed harbour. It was stated in the *Scotsman* next day that a communication had been received in Peterhead intimating that the Prisons Board in Edinburgh had unanimously resolved to recommend convict labour at Peterhead. The following paragraph in the same paper, on November 1 following, gives a later phase of the question of a harbour of refuge at Peterhead:—"With reference to rumours regarding the construction of harbours of refuge on the East Coast, we understand that, in so far as Scotland is concerned, it has been resolved by the Government to construct an extensive breakwater at Peterhead, which will make a safe harbour easy of access at all times. It is also understood that the works, which will require a considerable number of years for their completion, will be largely executed by Scotch convict labour."

ment mainly owing to the judicious outlay on the harbour, which is now in all respects an admirable one—spacious, deep, and safe. The enlightened liberality of Lord Saltoun, the superior, who has always taken a warm interest in the prosperity of the town and the success of the fishing, and the well-directed exertions of the Harbour Commissioners, have met with a rich and well-deserved reward.

Buckie.—At Buckie, on the Moray Firth, there is now, thanks to the munificence of the late Mr. Gordon of Cluny, a first-rate fishing-boat harbour, which can be entered and departed from at all times of the tide by boats belonging to the first class, and inside which they are perfectly sheltered, and are always afloat. This harbour is constructed of concrete, and has an area of 8 acres. It cost upwards of £50,000. It consists of two basins, an outer and an inner one, and has accommodation for 450 first-class boats. In the entrance there is a depth of 10 feet, in the outer basin a depth of 6 feet, and in the inner basin a depth of 10 feet at low-water of ordinary spring-tides. The total length of quay-walls for discharging purposes is 2900 lineal feet, of which 1400 are in the outer harbour, and 1500 in the inner. The Great North of Scotland Railway Company are at present promoting a scheme to connect this important harbour with their railway by constructing a line along the coast, commencing at Portsoy, and going by Cullen, Buckie, and Garmouth to join the Great North of Scotland line from Elgin to Lossiemouth. There is also another scheme, promoted by the Highland Railway Company, for a line from Buckie to Keith, a distance of about nine miles.[1] At Buckie a great and rapid increase in the number of boats and men has followed upon the construction of a safe harbour. The Buckie district is an important one, including, besides Buckie, Port Gordon, Portessie, Findochty, Portknockie, and Cullen. In 1880, 854 boats, of which 657 were first-class, manned by 3815 men and boys, were employed in the herring and cod and ling fisheries, having an estimated value, for boats, nets, and lines, of £147,104. Buckie is the only good harbour on the south shore of the Moray Firth. The rest are small and shallow, and require to be enlarged and deepened.[2] On the north

[1] Buckie is now (1883) connected with the railway, which will add greatly to its value and importance as a first-class fishing port.

[2] In their Report for 1880 the Commissioners of the Fishery Board state that they will undertake improvements at the harbour of Rosehearty, in Aberdeenshire, for which they have entered into arrangements with the local Harbour Board, and that they are also in treaty with the fishermen of Findochty, in the Buckie district, for the erection of a breakwater. In their Report for 1881, they say, as regards harbour works, those at Rosehearty were begun in July, and are approaching completion. At Findochty the working plans and specifications have been prepared, and tenders invited for the work.

shore of the Firth the case is worse, as there is not a single good harbour, though there is at least one place where a harbour, with ample depth of water at all times of the tide, might be constructed for a moderate outlay.

Helmsdale.—Near the eastern boundary of the county of Sutherland is the village of Helmsdale, at the mouth of the well-known salmon river of the same name. There are rich fishing-grounds in the neighbouring sea, and the capture of herring in a single year has reached the large amount of 34,271 crans. As a proof of the richness of these fishing-grounds, I may mention that I heard the late Captain Macdonald of the *Vigilant* Fishery schooner, state that, while cruising off Helmsdale, he once fell in with a shoal of herrings in 18 fathoms water, extending for 4 miles in length along the coast, and 2 miles broad,—a solid mass of herrings. There were far more herrings in that shoal alone than are taken in the year throughout Scotland. These productive fishings are, however, subject to great fluctuations, and in 1880 the take was only 17,070 barrels, while in 1872 it fell as low as 4348. The harbour accommodation is defective. The boats cannot take the harbour much before half flood. Then there is a bar at the mouth of the river, which renders access difficult and dangerous, particularly when there is a heavy sea on the bar, and a flood in the river. The existing harbour has accommodation for about 170 or 180 boats. Hugh M'Angus, fisherman, Helmsdale, gave the following evidence with regard to the harbour before the Herring Fishery Commissioners in 1877:—"Improved harbour accommodation is much required; has twenty times experienced the want of it himself. When there is a heavy sea on the bar and a heavy spate in the river it is very bad. A new entrance should be made to the east of the present harbour, and the boats would not then have to cross the bar. The bottom of the sea here is partly rock and partly sand. The new pier which he proposes would be built on rock. The fishermen would be willing to pay increased dues for the sake of improved harbour accommodation. They would be willing to subscribe annually one cran of herrings, worth about 25s. This would produce a revenue of about £500 a year." Another fisherman, Angus Macaulay, said:—"Does not consider the so-called harbour a harbour. It is capable of great improvement. Thinks the harbour should be made to the eastward. A proper harbour would afford great safety to property and lines. There would be a great increase of fishing if there were a harbour. Would be willing to have his dues raised to 30s. for the sake of a harbour. Has seen accidents here, and three lives lost in his time for want of a harbour." Possibly both the Duke of Sutherland and the Sutherland and Caithness Railway Company, who have a station at Helmsdale, might find it worth their while to improve the fishing-boat harbour.

Forse Cove.—About eighteen miles from Helmsdale, and two from the important fishing village of Lybster, is Forse Cove, which is capable of being converted into one of the best fishing-boat harbours on the coast of Caithness. The construction of a breakwater here would give accommodation and shelter to from 700 to 800 boats. It would enclose a large cove or creek, and within it there would be a depth of 20 feet, so that the largest boats would be waterborne at all times. It would thus also form a harbour of refuge on a small scale.

Lybster.—Two miles north-east of Forse Cove is the fishing village of Lybster, belonging to the Duke of Portland, where the average annual take of herrings, for the seven years ending 1841, was 32,871 barrels; for the seven years ending 1848, 30,670 barrels; and for the seven years ending 1855, 36,901 barrels. In the seven years ending 1876, however, it had fallen to 21,675 barrels; and in 1880 the total number cured was 17,449 barrels. I visited Lybster when the late Duke of Portland was alive, and at that time the harbour was in a melancholy state of dilapidation and decay, the breakwater protecting it being shattered, and half-cut through by the winter storms of 1877, and seeming scarcely able to resist the force of a heavy and continuous gale. Very strong evidence was given before the Herring Fishery Commissioners in 1877 of the absolute necessity of repairing the harbour in order to prevent the ruin of Lybster, whose inhabitants look to the sea for money to enable them to live and to pay their rents. Mr. Thomson, the Fishery officer, said: "There are 178 boats in the district, 128 of which are at Lybster. They are all first-class boats, but they are not all decked. The best boats go away to the better harbours. The harbour here is not adequate for the boats. If there are four or five coasting vessels there is not room for the boats. The harbour was originally built by Mr. Sinclair, the then proprietor. The Government granted £6000 specially towards its construction. The improvement of Lybster harbour would do more to develop the fisheries than anything else. It would be possible to make a very good harbour here for £5000 or £6000." Most of the fishermen examined expressed their willingness to pay high dues on their boats provided the harbour was improved. John Sutherland said he "would be willing to pay the dues if the harbour were kept up. There will be no fishing here unless the harbour is improved. The ground here is so highly rented that they look for the rent of it from the sea, and if the harbour is not improved the place will be ruined." When damage occurs from violent storms, in the case of comparatively small fishing-boat harbours, such as Lybster, it is of the utmost importance to have that damage thoroughly and promptly repaired.

Wick.—Wick, once the queen of Scotch herring-fishery ports, has now fallen from her high estate, owing to the decay of her harbour, and ranks below Fraserburgh and Peterhead, whose harbours are far superior, and whose fishermen are equally industrious and enterprising. The late Captain Macdonald, H.M.S. *Vigilant* Fishery cruiser, than whom no man was better acquainted with the Scotch herring-fishery and everything connected with it, gave the following evidence at Wick in 1877 with regard to the harbour: "Bad weather and the want of harbour accommodation at Wick account for the failure in 1876 and 1877. The weather has been exceptionally severe, and the boats are larger than formerly. The fishermen won't go out, because they must return to the harbour at a certain state of the tide, or not at all, and they run great risks in doing so. Wick harbour is the property of the British Fisheries Society. They have spent a very large sum of money in endeavouring to improve the harbour. The plan has utterly failed. More than half of the breakwater which has been constructed has been washed down, and the bay filled up by the débris. It seems hopeless now to improve the present harbour, but a good harbour might be made by excavating the bed of the river and building piers and other works. There are no local funds to accomplish this. But Government might undertake the work for this important industry. Having harbours of easy access, where the boats could float at all times, would do more than anything else to develop the fisheries. Scotch fishermen furnished four-fifths of the Naval Coast Volunteers when they were originally established in 1857. Is in favour of Government advancing money on easy terms to the local authorities, and of supplementing those loans with grants."[1] Mr. Joseph Mitchell, C.E., who was engineer to the Fishery Board for twenty-two years, during which time he constructed sixteen harbours, was of the same opinion with Captain Macdonald as to the proper place for a fishing-boat harbour at Wick being the

[1] The state of Wick harbour was considered by Parliament at the close of the session which adjourned in August 1882. A grant was made. Mr. J. K. Grant, editor of the *Northern Ensign*, writing to the editor of this volume, October 31, 1882, says, "The case with respect to Wick harbour stands thus:—Of the sum of £150,000 spent on the now ruined breakwater, £62,000 was advanced by the Public Works Loan Board. When the harbour was transferred two years ago to a Local Trust, £58,000 of this loan remained due. As the result of persevering efforts, this £58,000 has been made a *postponed charge* till the cost—£100,000—of the proposed new harbour works has been defrayed. The Treasury has promised £30,000 of the new loan, and is expected to give £40,000 more at a subsequent date, the balance of £30,000 to be raised from revenue. In the long interval which must elapse, the old loan of £58,000 will be practically null, neither interest nor instalments of principal being payable."

channel of the river, which should be excavated and deepened for about 4 feet. Mr. James Louttit, ex-provost and councillor of Wick, was likewise of the same opinion. He stated that the harbour "is silting up with rubbish from the destroyed breakwater. The material which should have kept out the sea is filling up the bay. This condition of things partly accounts for the failure at Wick. The fishermen are afraid to go to sea because there is no safe landing-place in heavy weather. The harbour cannot be taken until half-tide. Unless the harbour is improved, Wick will cease to be the herring capital of Scotland. It is not possible to improve the harbour in Wick Bay. It would be possible to convert the river into a harbour. The general feeling among all the local people is that the river should be improved."[1]

Want of Fishing-boat Harbours on the North Coast of Scotland.

There is a great want of fishing-boat harbours on the north as well as on the east coast of Scotland. There is no want of herring. Captain Macdonald, whose evidence we have already referred to, stated that there are some parts of the coast from Cape Wrath to the Pentland Firth where the herrings are not fished. Whenever he passes that way he verifies the fact of the presence of herrings by shooting the gannets that are feeding on them. Forty years ago there were excellent fishings between Cape Wrath and the Pentland Firth. It is clear, however, that the creeks and coves which might shelter the small boats of forty years ago are totally inade-

[1] Since the above was written, the aspect of matters at Wick has brightened. A plan of an improved and extended harbour has been prepared by Mr. James Barron, C.E., and has been adopted by the Harbour Trustees. The salient features of that plan are the extension of the South Pier as a breakwater with a quay, and the covering in of the north shore by a breakwater, both constructed of concrete work, leaving an entrance of 250 feet wide to the harbours within. The special works within the shelter of these breakwaters are—1. The deepening and refacing with concrete walls the existing harbours, the outer harbour to a depth of 8 feet, the inner harbour to 6 feet at low-water of spring-tides. 2. The broadening out of the North Pier to an extent of 100 feet, including the removal of the present parapet and lighthouse, and the shortening to a small extent the pier-head. 3. The formation of a new harbour in deep water outside the North Pier. 4. A boat basin with quays inland of the new harbour, with the construction above that of an embankment of about 2½ acres, in the line of the river, to afford new curing ground. 5. A new traffic bridge on the site of the present foot-bridge, to connect the north and south sides of the extended harbour. 6. The formation of a harbour on the north shore at the land end of the north breakwater, and the formation thence of a quay-way straight to the bridge and town of Wick. 7. The dredging of the whole river channels and basins outside the existing harbours. The breakwater is to be constructed in the strongest and most substantial manner. No single block under low-water is to weigh less than 200 tons, and the greater part of the structure is to consist of masses from 800 to 1200 tons each. The estimated cost of the works is £110,000. But as the river channel is not to be executed at present, the actual cost may probably not exceed £100,000. The casting of the first block of concrete was finished on Friday evening the 18th August last. It is 40 feet thick, the width of the quay, and the side facing the harbour entrance is 32 feet in length. The estimated weight is 1300 tons.

quate to the requirements of the large-decked boats of the present day. Yet, between Scrabster Roads near Thurso and Loch Erribol, within twelve miles of Cape Wrath, a distance of nearly fifty miles, there is no good fishing-boat harbour. At Port Skerra, not far from Melvich Bay, and eighteen miles west of Thurso, there used to be a considerable herring-fishing, and the herring were of very good quality. It has now, however, declined, the number of boats being only about half what it once was. The harbour is very limited in extent; but the water is deep. The entrance is narrow and dangerous from the proximity of rocks on either hand. A much better harbour might be constructed on the west side of Melvich Bay. All the fishermen in the neighbourhood are agreed that this would be the best place for a harbour to which they could run for shelter in stormy weather. It would be a great boon to the fishermen of Port Skerra and Melvich if they had a small harbour in Melvich Bay, especially now that railway communication has been brought within fifteen miles of them by the enterprise and liberality of the Duke of Sutherland. About eighteen miles to the westward of Melvich, the channel between Roan Island and the mainland would, at first sight, seem to afford a suitable place for a fishing-boat harbour. But owing to the strong currents, and the holding-ground being only sand, it is unfitted for such a purpose. On the south-eastern side of the island there is a sheltered sandy cove that might suit small boats that can easily be beached. On the mainland side there is an opening between the rocks facing north, through which a heavy sea rolls when the wind comes from that quarter, rendering the riding unsafe. This opening is about 100 yards wide, and the water at low tide is 10 feet deep. The tide rises 15 feet. If this opening were filled up, and another opening made through the rocks to the eastward, a safe harbour might be formed here. But no results that could reasonably be expected would warrant the expenditure that these operations would entail.

Some years ago, a fishing-boat harbour was formed at Scullamie, on the east side of the Kyle of Tongue, which has proved a failure owing to the rocky and dangerous nature of the entrance. But there is a position, between Tongue House and Scullamie, where a natural reef of rocks affords great facilities for the construction of a safe fishing-boat harbour on a moderate scale, and at a moderate cost. There is a large reef of rocks on the seaward side, a smaller reef at some distance from it, and between the two a sheltered sandy bay. The construction of a small breakwater and two short piers would convert this into a safe harbour for a moderate number of fishing-boats. The expense need not be great, as the stones from the adjacent harbour of Scullamie, that has proved such a failure, might be utilised for the construction of a harbour on this more suitable site. At Tolmine, on the opposite side of the Kyle of Tongue, there is an island—about 100 yards from the mainland—which, if joined to it by a pier, would form a safe and sheltered haven for fishing-boats.[1]

Conclusions arrived at.

I have thus endeavoured briefly to describe the distress and disaster, as well as the stagnation, or imperfect development of our great fishing industries, in certain localities, that have arisen from the want of adequate harbour accommodation on the east and north coasts of Scotland. I have likewise attempted to describe a number of fishing-boat harbours, good and bad. And I venture to think that the following conclusions come clearly out as the results of the evidence I have cited, and the examples I have brought forward:—

1st, That the harbour accommodation on the east coast of Scotland is inadequate to the increased and increasing size of the boats, and the expansion of the fishing industry.

[1] *Floating Harbours of Refuge.*—A proposal to have floating harbours of refuge was published about a year ago in Edinburgh by Dr. John M'Cosh, of the Madras Civil Service. Dr. M'Cosh stated that, more than twenty-five years ago, he wrote, from personal observation, a paper on the Surf at Madras, and suggested a mode of subduing its violence, so as to make it passable in safety by the boats of ships anchored in the roads. He describes and illustrates his system in the following terms:—"Every observant person walking along the shore of a reedy lake, where a stiff breeze is blowing, must see that the wavelets are reduced to smoothness before they get a dozen yards into the reeds. Even the wild-fowl are conscious of this theory, and build their nests on the water amongst the reeds, or upon the reeds themselves, without apprehension of danger to their eggs; and the ducklings, when they are out, warily keep amongst the water-lilies, while their more robust parents venture out into the open, breasting the waves. If it should happen that an open piece of water in the centre of the lake is enclosed with nothing more substantial than a circle of water-lilies, it will be seen to be absolutely quiescent, whilst all beyond this charmed circle is tempestuous. *In fact, such is a perfect model in miniature of the breakwater proposed!* . . . We have therefore only to imitate Nature's engineering to be able to afford adequate protection to our fishing-boats in stormy weather; and this I propose to do by a net-work of coir-ropes about 1 inch in diameter, the meshes about 9 inches square, a buoyant construction that would float on the surface of the water. To give greater buoyancy, a series of rings of indiarubber tubing, say 1 inch in diameter, should be made fast with log-line to each marginal mesh, externally and internally, and the avenues to the centre should also have such extra support. The whole mesh-work, consisting of four quadrants, could be removed like a net for repair, and transported to any other locality." "Apart from the application of floating substances to control the force of the waves and give shelter to boats, they might be applied with great effect in the protection of stable structures of masonry. The recent gales have shown how the most solid walls are liable to be broken; and had the piers at Hastings, Folkestone, Dover, Oban, etc., had a floating outwork of this description, they would undoubtedly have been preserved intact. In fact, no lighthouse exposed to the sea should be without such a protection; and the Calf Rock Lighthouse at Castleton on the coast of Ireland, lately washed away, might, if so protected, have been standing still. As to the expense of such a harbour, it would not be easy beforehand to give an estimate; but as the principal article, coir, is not very expensive, and as the net-work could be made by the boatmen themselves, it could not be extravagant."

2d, That, taking the various localities near the inexhaustible fish-supply of the North Sea, that locality which provides the best harbour will be almost certain to have the best fishing.

3d, That in the great fishing centres, such as Aberdeen, Fraserburgh, and Peterhead, there is no great difficulty in raising money for harbour improvements on the security of the harbour-dues; and that the real practical difficulty meets us when we come to think of how to raise money for harbour improvement in the case of smaller places near good fishing-grounds, such as Eyemouth, Banff, Cullen, Lybster, Helmsdale, etc.

4th, That we imperatively need, and are entitled to demand from Government, considering the vast sums spent on harbours of refuge in England and Ireland, one harbour of refuge at least on the east coast of Scotland, for the protection, not only of the fishing-fleet, but also of the mercantile marine; and that the proper place for that harbour of refuge is the south bay of Peterhead, midway between the Firth of Forth and the Cromarty Firth.

I propose to close this essay by offering a few remarks on the latter part of the third of these conclusions, namely, the practical difficulty of raising money for harbour extension and improvement, where the local sources are inadequate. At present, in such a case—apart from a free grant from Government, which will be afterwards considered—four courses seem open in Scotland:—(1.) An application to the Fishery Board for a grant in aid out of the fund of £3000 per annum which it administers; (2.) An application to the Public Works Loan Commissioners; (3.) The formation of a company who will take up the matter as a speculation; (4.) The raising of the money required under the guarantee of trustees, or of a railway company, or of an influential private person. There cannot be the slightest doubt that the average annual take of herring on the east coast of Scotland might be almost indefinitely increased by the construction of new fishing-boat harbours, or the improvement of those which already exist. Experience has shown that even the affording of imperfect and limited harbour accommodation has, in many cases, had a most beneficial effect, and has sometimes, in a few years, raised a mere hamlet by the shores of a creek into a thriving fishing-village. But the annual grant of £3000, of which the Fishery Board are the administrators, will now go but a little way in the formation of harbours suited to the first-class boats that form two-thirds of the tonnage of the fishing fleet. Such a grant, even when supplemented by local subscriptions, will not do much for the construction of harbours where the largest boats can lie afloat at all times, and can enter and depart in every state of the tide. Even the surplus brand-fees, which the Herring Brand Committee of last year recommended to be applied, for the future, in aid of harbour accommodation, would not be sufficient. But they would give material aid, and certainly could not be expended in a better cause. What we now require is not a number of small piers or harbours, but a certain number of larger ones, at well-chosen points along the East Coast, which the largest boats of the present day can take in all states of the tide and weather. The terrible calamities of the year 1881 have taught us, or at least ought to teach us, a lesson as to the inutility and danger of harbours which cannot be taken in heavy weather at all times of the tide; and surely there is nothing grasping or unjustifiable in the suggestion that a small share of the money contained in the national purse should be applied to encourage and develop a great national industry, and to increase the supply of cheap and wholesome food, where the local resources are inadequate. It is no doubt true that the tendency of modern legislation has been to leave such matters to local resources and local rates, and not to unclose the strings of the national purse, except in the case of naval arsenals, packet-stations, or harbours of refuge. But this tendency may be carried too far; and if the Government had before them a list of places,—drawn up after careful inquiry by experienced and impartial men,—where a liberal and judicious employment of Government money in constructing or improving fishing-boat harbours would certainly encourage and develop the fisheries, there seems no sufficient reason why Government money should not be forthcoming.

Several suggestions were made by the Herring Fishery Commissioners in their Report of 1878, with the view of obviating the difficulty of raising money for harbours in those places where the local resources are inadequate. Among other things, they suggest the repeal of the 14th section of the General Piers and Harbours Act, 1861 (24 and 25 Vict. c. 45), which is intended to facilitate the construction of piers and harbours. "By the 14th section of that Act," they say, "the promoters are not to do any act which shall prejudice or affect any right acquired by any person or persons, by Royal charter, by prescription, or by any local or personal or private Acts, for the purpose of executing any works such as are contemplated by this Act 'without the consent in every case of such person or persons, and such consent shall be expressed in writing.' Now it has been stated to us that this last provision, in some cases, renders it impossible properly to carry out the purposes for which the Act was passed, which are thus stated in the preamble:—'Whereas it is expedient to encourage and facilitate the formation, management, and maintenance of piers and harbours in Great Britain and Ireland; and whereas in certain cases where it is now necessary to apply to Parliament for special local Acts, the expense of obtaining such special Acts serves to prevent many necessary works being undertaken.' It would therefore probably be better, so far as Scotland is concerned, to substitute for such consent in writing an inquiry on the spot by the Sheriff of the county, the result of which should be reported to the Board of Trade for their consideration and decision. This might be effected by repealing section 14 of the General Piers and Harbours Act, 1861, which at present really tends to defeat the purposes for which the Act, of which it forms part, was framed; since it enables a single dissentient to frustrate the objects of the Act, and necessitates an application for a special local Act, if the work is to be proceeded with." The Commissioners also state their opinion "that the best results have ensued in the past from the loans which Government has advanced, through the Public Works Loan Commissioners, for works of this description. The continuance, and, if possible, the extension of this system, is very desirable." So far, however, from this system having been continued and extended by subsequent legislation, it has been limited and crippled since 1878, so as to render it comparatively useless. Surely the fishing community are entitled, at the very least, to demand that Government shall give them the money for harbour improvement on the old terms. In comparatively small fishing villages, near fruitful fishing-grounds, such as Banff, Cullen, Lybster, Helmsdale, etc., nothing can be done unless money can be had at a moderate rate of interest to supplement and assist local effort; unless, indeed, the great proprietors in the neighbourhood of such places were to follow the munificent example set them by the late Mr. Gordon of Cluny, and were to make or improve the harbours themselves, getting a power to levy dues in return for the shelter afforded.

In a series of papers which recently appeared in *Engineering* on the management and encouragement of harbours, a suggestion is made, similar to that of the Herring Fishery Commissioners, with regard to the propriety of continuing and extending the system of loans from the Public Works Loan Commissioners at the old rates of interest; and in the concluding article of the series the formation of a Central Harbour Board is advocated. "If Parliament," says the writer, "really desires to promote the growth of all sea-ports, which have contributed so enormously to the prosperity of the country, let it simplify legislation on the subject. Give us a Board somewhat on the lines of the Local Government Board, and let it only in exceptional cases be necessary to apply for a special Act. Give it the powers at present exercised by the Harbour Department of the Board of Trade, the Scotch Fishery Board, and the Loan Commissioners, so far as regards harbour loans. Put all the public harbours in the United Kingdom under its control and supervision; let it examine and audit all accounts, revise and consider alterations in dues and rates, authorise new works, and, in approved cases, grant loans. Instruct this body to carry out the Act of 1861, as regards loans, in the spirit intended by its framers, or, if there is doubt on this point, issue new instructions dealing liberally with harbours as regards the nature of the works and the security."

If the Board of British White Herring Fishery is really to be reorganised and reconstructed on a new and sounder basis, and with more extensive powers as regards the Fisheries; if the management of the Fisheries is to be disjoined from that of the Fine Arts, there being assuredly no natural or necessary connection between the two; why should not the improved and reconstructed Fishery Board, with increased powers and means, discharge, with reference to fishing-boat harbours in Scotland, some of the duties which the writer in the article we have just quoted proposes to intrust to a Central Harbour Board?[1]

I hope and believe that this pressing and important subject of increased harbour accommodation for the vast fishing-boat fleet, with its living freight of more than 30,000 men and boys engaged in the fisheries along the stormy East Coast, will have attention very strongly directed to it at the forthcoming International Fisheries Exhibition in Edinburgh, which will illustrate and bring prominently forward the immense value of our Scotch fisheries, and their capability of far greater development under more favourable circumstances.[2]

[1] The new Fishery Board, which has absorbed the functions of the Board of White Herring Fisheries and of the Commissioners of Scotch Salmon Fisheries, has now been constituted under "The Fishery Board (Scotland) Act, 1882." It consists of several unpaid Commissioners, including the Sheriffs of Aberdeen, Argyll, and Caithness; and there are besides three paid officials,—a Chairman, an Inspector of Salmon Fisheries, and a Secretary.

[2] There were four models of fishing-boat harbours shown at the International Fisheries Exhibition in Edinburgh:—"A model of Aberdeen harbour, per W. Smith, harbour engineer, Aberdeen;" "a model of Buckie harbour, sent by Lady Gordon Cathcart;" "a model of proposed new harbour at Eyemouth, shown by Messrs. Thomas Meik and Sons;" and "a model of Fraserburgh harbours, exhibited by the Fraserburgh Harbour Commissioners." There was no model of Peterhead harbour. The International Fisheries Exhibition, which is to be held in London this year, will probably attract a much larger collection of models of harbours; and a prize of £100 is offered for an essay "On improved fishery harbour accommodation for Great Britain and Ireland, indicating the localities most in need of such harbours, the general principle on which they should be constructed, and the policy the State should adopt in aiding and encouraging harbour accommodation for fishing purposes."

VII.

CURING AND PRESERVING FISH AT HOME AND ABROAD.

By W. Anderson Smith.

The preservation of fish on a large scale is still of the crudest character, for when we consider that a fish fresh from the water is one of the most delicate, most nourishing, and most digestible of comestibles, and that very often a fish as preserved for the general market is everything the reverse, the great scope for advancement in this direction is apparent. In order to improve, it is in the first place necessary to make ourselves acquainted with what has been already done. Before considering the cruder and cheaper modes in which this important produce is prepared for the market, we may advantageously examine the rarer or more costly methods of preserving fish. Some of them may be worth utilising more widely.

In Portugal a method is adopted which seems simple and satisfactory. After removing the viscera sugar is sprinkled over the interior, and the fish is kept in a horizontal position so that the sugar may penetrate as much as possible. It is said that fish prepared in this way can be kept completely fresh for a long time, the flavour being as perfect as if recently caught.

Mungo Park describes the fish in Senegambia as being preserved by first drying in the sun, and afterwards rubbing with shea[1] butter, so as to prevent them contracting fresh moisture. The Bongo of Central Africa employ two methods to preserve the flesh of their fish. They cannot get purified salt, but they substitute what they obtain from ashes. The fish is cut lengthwise throughout, and simply exposed to be dried in the sun, and afterwards it is hung up to be fumigated in the clouds of smoke that fills their huts. A second way is to cut the fish up and dry it, and then to pound it all up in mortars until it is reduced to a jelly, which is rolled into balls

[1] Shea butter is a vegetable butter, made, if I recollect aright, from the shea tree.

about the size of the fist. These with their *high flavour* form a favourite ingredient in soups and sauces, which are entirely wanting in aromatic condiments.

A similar process is followed in the north of Africa. The small fish are prepared for sale by pounding them entire, as they come from the stream, in a wooden mortar, and drying them in the sun in large lumps like sugar-loaves. The smell is certainly not very agreeable, says a traveller, but in the Moorish countries north of the Senegal, where fish is scarcely known, this preparation is esteemed a luxury. The natives dissolve a piece of the black loaf in boiling water, and mix it with their Kouskous or farinaceous pudding. This process is very ancient and very universal in the East.

In South Africa a small species of fish about the size of a minnow is dried in the sun by the natives, and has a pungent aromatic odour.

In the interior of Mexico fish is often obtained from great distances enclosed in coarse paste pies, half baked to preserve them.

The Indians also take a small delicate fish in the canals and ditches near the lakes. These are enclosed in the leaves or capsules which surround the head of the Indian corn or maize, and then roasted. In this state they are sold cheap in Mexico.

The processes at present in use for preserving fish may be thus classified:—

1. *Drying*—in which the fish is either dried in the sun or artificially, either whole or pounded, either comparatively fresh like stock-fish, or strong-tasted like skate or dog-fish.
2. *Salting, etc.*—either dry or in pickle, either alone or in company with other processes, such as drying or smoking; sugar and other materials are occasionally employed.
3. *Smoking*—either partially for a limited period, or more thoroughly along with salting and drying.
4. *Exclusion from Air.*—This may take the form of expelling air from vessels to be afterwards sealed, or sealing vessels and destroying the elements of putrefaction. It is also attempted by rubbing over with oil, glycerine, and other substances, natural and chemical; or by withdrawing the air and moisture *in vacuo*, and refilling with a preserving agent; or by driving out the air by pounding and firmly potting, along with pepper and spices and other preserves, and further covering it from the air.
5. *Vinegar or other Acid.*—By coagulating the albumen and keeping out the air.

6. *Ice and Cold—Natural and Artificial.*—By keeping the fish at a temperature below that at which decay or fermentation commences. This artificial cold may be produced either by chemical freezing-mixtures, such as "salt and snow," etc., or by sulphuric acid, ammonia, or ether machines, and lastly by compressed air; but into this wide subject of refrigeration we cannot now enter, although it promises to be the most useful of recent modes of adding to the food power of the country.

Some fish from their character demand simpler treatment than others, as in the case of the dog-fish, *Acanthias*, which is so full of oil that it is simply cut open and dried, even in the moist climate of the Scottish Hebrides. The white flesh is somewhat strong-tasted, but is largely used by the poorer classes, and is wholesome food. This, and other species of the genus *Squalus*, is prepared in great quantities for certain markets in the interior of the country, and the fish are sold by the dealers under the name of "Darwen salmon," after having had their rough skins removed to prevent their identification.

Skate fish again, from the peculiarity of their skins, which continue to exude mucus for some days after the death of the fish, will not take salt, and consequently are merely dried by being hung up in the air. This mode of preparing what is known as "sour skate" is in universal use in the Highlands and Islands, and the result is one of the most favourite articles of diet with the inhabitants. Strongly smelling of ammonia, and pungent as it is, it yet soon commends itself to the stranger, no doubt from the commonly monotonous diet of the locality.

We must bear this in mind in judging of the most commercially useful mode of curing, as simple-feeding nations such as the Chinese do not want their fish well cured, but sufficiently pungent to give a flavour to their other viands. In Shetland they especially love *blaun*, an article which may be seen preparing inside their cottages. Huge stacks of cod or ling are laid in a pile, giving forth a most penetrating odour from the partial fermentation and decomposition that brings it to the proper condition. The islanders of North Ronaldshay, in Orkney, eat their fish similarly impregnated with ammonia by smoking with dried dung cakes. The Shetlander also prepares the young of the coal-fish (*Gadus carbonarius*) by gutting them, washing them in sea-water, and drying for eight or ten days; and indeed this *penchant* for semi-cured fish is wide-spread. Perhaps the rudest form of preparation at present is that of simply gutting the fish and drying them in the air, as employed in Norway in the case of stock-fish. Stock-fish, so called from *stocken*, sticks or poles, on which the fish are dried, are largely prepared in the Lofoden Isles, and must at one time have been their only mode of preparation. Yet of late years it must have rapidly given place to salting, as in 1879 even the large catch of that year, twenty-four millions, was salted to the extent of 85 per cent., and only 15 per cent. dried as stock-fish. Fish thus dried lose all their flavour and much of their nutritive value, while they require to be kept free of moisture, otherwise they readily decay. The English introduced cod-drying, or making these klep-fish, at the beginning of last century into Norway, and the great proportion of those dried are sent to Spain, where they are sold as *Baccalao*. Cod captured after the 12th of April are considered unfit for klep-fish, and are dried artificially, which makes them as dry as a deal board, in which condition they are well known in Italy. As the average capture of cod throughout Norway, over and above what is used fresh, is forty-six millions annually, there must be a much larger proportion dried in other districts than in the Lofodens.

After simple drying, the most common mode of preparation is that of salting, and although at first sight this may appear a very simple process, yet the difference between a skilfully cured herring and one of the ordinary class is very wide indeed. In no class of fish preparation is there more room for improvement in Scotland than in this, as we too frequently look more to quantity than quality, and despatch thousands of barrels to home and foreign markets which an expenditure of a little more care and skill would have raised enormously in economic value. Benkelaer of Biervliet, in the fourteenth century—he died in 1397—is said to have taught the Dutch to cure herrings in small kegs, in place of in irregular heaps, as they did before his day; and certainly to the Dutch we must still look as the most careful and skilful curers. It is no uncommon saying that fish in the early part of the season will not cure, and herring cured in the Lewis or Wick before the middle of July are commonly, if not uneatable, so poor in a month or two that they are spoiled for good markets. This does not come wholly from their unsuitability for curing, but also from demanding more care in the curing. Half a century ago, Lord Teignmouth called attention to this in noticing a curing establishment in Loch Erribol, near Cape Wrath, where the Dutch process was employed, "as the inferior process used at Wick and other parts of Scotland would be inapplicable to fish in the early season." He proceeds: "Every particle of unnecessary matter is removed; and the fish are so closely packed as to exclude air; and, as the cleansing is so complete as to remove all matter that would generate noxious effluvia, very little salt is necessary. The fish are, when packed, laid on their backs, not on their sides, and the barrels are of oak wood; those used at Wick are chiefly of birch, produced from the coppices of the western coast. The bounty attracts adventurers unacquainted with the process of curing, adopting the process of packing the fish in the open air, and endeavouring to correct the ill effects produced by sun and rain by large quantities of salt;"[1] but no result has followed this complaint, so far as we have observed.

It is natural enough that, in out-of-the way stations, where the season is short, and the cost of suitable arrangements would be serious, the rudest system should be followed; but in important centres, where the season is often long continued, as at Wick, a much more careful and skilful system ought to be pursued, for the credit of the trade. At present the fish may be, and often must be, a long time of reaching port, when they are carried to the large troughs of the curers and tumbled in. Thence they are removed to the gutters, who, with a short knife and one dexterous movement, relieve the fish of viscera and gills. They are then taken and "roused" with salt in a large tub, and afterwards placed regularly and rapidly, with great precision, in the barrels, a handful of salt being thrown over each layer. The barrels should meantime have been well seasoned with water; and for some days, as the fish settle down, the barrel is filled up until it remains steadily full.

The fish now depend for quality on their original condition and assorted sizes, upon the rapid transfer from the water to the tubs, on the care of the gutters, the rejection of all broken or injured fish, and the proper seasoning of the barrels, as well as upon their being immediately covered upon completion. Compare this with the exactitude demanded from the Dutch operators, for the first class of herrings, whether on board vessel or on shore.

The pickle that was placed in the packing-tub was carefully passed through a sieve to clean it from scales and other impurities, and into these two or three barrels of clean pickle only so many herrings at a time were thrown as might be lifted with the hands, so that they might get proper justice and not be hurriedly heaped. So soon as seven barrels were put into the tubs the pickle was again sieved, so as to prevent an accumulation of impurities. The herring, when removed from the pickle, were placed upon draining-trays to allow the pickle to run off. In the meantime the barrels were filled up with pickle to season them, and, before filling, the plugs were knocked out, so that this pickle should be thoroughly removed. The herring were then packed back down as close as possible, and every crevice filled up. Four barrels of salt were used to twelve

[1] *Sketches of the Coast and Islands of Scotland and the Isle of Man.* By Lord Teignmouth. 2 vols. London: J. W. Parker. 1836.

barrels of herring. In heading-on the barrels the herring were formerly pressed down with the feet, so as to be absolutely tight, exclude air, and prevent shifting and breaking the fish.

It may be mentioned that a marked distinction was made, as ought always to be the case, between those fish taken before and after the 26th July, and again those taken after the 24th August; and it was distinctly ordained that the packers throw out all broken herrings, such as are sick in milt or roe, belly sick, those too long ungutted, matties, those scrimped of salt, white-roed herrings, or others inferior and unsuitable. Those working in the open air were obliged to cease work immediately it commenced to rain. Great care was taken always as to the salt. Common salt always leaves a bitterness on all fish salted, after a time, but Cheshire rock-salt is considered equal to bay. The Dutch formerly used that from Spain or Portugal, and it was considered that their salt would cure the fat summer herrings when the British salt could not. It was always carefully refined.

The use of a knife in removing gills and viscera, so as to free the fish of blood more fully, is said to account for the whiter appearance of the best Dutch-cured fish, the blackness caused by the coagulation of blood being absent.

Cod, ling, tusk or torsk, and the common coal-fish, are split up and the back-bone extracted before pickling, the head also being removed. They are commonly dried on the gravel beach, if such is procurable, or otherwise on wooden staging. In this country, where the summers are so frequently wet, it would be a great saving of labour, and a means of improving the quality of the cure, if the drying-grounds were covered over from the rain by means of a simple canvas awning, that could be drawn aside when the sun promised to be of any aid in drying the fish; for the more rapidly the fish is dried the less flavour is removed, and the more the nutritive properties of the fish are retained. Those fish that are salted in pickle in thoroughly tight barrels, such as herring, are far more nutritious than dried stock-fish, or salted and dried ling-fish, from which a large quantity of the nutriment is driven, while what is left is in a condition that demands the greatest efforts of the stomach to extract the food-value from the fibrous mass. So that the additional cost of cutting up the larger *Gadidæ* and pickling in tubs would be amply repaid in increased value.

The first step beyond salting, in the case of the common fishes, is smoking, and the best of all our British fishes are no doubt those thus treated. Smoke-drying is advantageous, not only from the heat of the smoke, but from the pyroligneous acid and kreosote disengaged in innocent quantities, the kreosote coagulating the albumen of the fish.

Yarmouth bloaters have long been famous, and are said to derive their name from the fish swelling during the curing process. Being close to the fishing-grounds, the Yarmouth boats can return rapidly to the curing-houses, and yet they take out a considerable quantity of salt with them, and rouse the fish as they are thrown into the hold or well of the boat, from which well arrangements are made for the blood and water to run. In the curing-houses the fish lie two days in salt, after which they are well washed in fresh water, and dried with the smoke of oak wood. Those exported to the Mediterranean are cured more highly, being kept from four to six weeks before packing in barrels, and one barrel of salt goes to three barrels of herring.

The finest bloaters really demand more careful treatment. The best fish being chosen, they are thoroughly washed in baskets that are agitated in tubs of salt and water, and each fish is pickled separately, to insure thorough impregnation. The best solution, it seems, is 29 lbs. of common salt to 71 lbs. of water, in which the herring will float. By keeping them wholly immersed by battens of wood held down with bags of salt, the latter is gradually dissolved, and retains the solution at its proper density, both at surface and at bottom. The vats are arranged with holes and taps, to run off the pickle when the fish are sufficiently salted. This is when they become stiff or rigid on handling. The fish are now strung by the heads on wooden rods, and hung in a current of air until removed to the chimney, where they are smoked with two parts oak, two parts beech, and two parts "fern or grass turfs," for from twelve to eighteen hours, according to the size of the fish and the steadiness with which the smoke has been kept up. These bloaters only keep four to five days, and are best kept for use hanging in currents of air.

Findon haddocks or speldings are similarly prepared after being split open and the gills and garbage removed. They are salted in brine, hung for a day or two, and dried over an ember fire of oak and beech chips, after which they are smoked according to the time they are meant to keep. Throughout the north of Scotland these fish—which were originally prepared by the fisher folk simply hanging the fish in their chimneys—are preserved for a few days' keeping by smoking in little batches in headless casks, with wood shavings, or even occasionally peat, the fish being hung on wooden skewers laid across the cask. No finer mode of curing for a short keep is practised. The following method of smoking sprats ought to be much more generally practised in outlying parts of Scotland. Wash the best fish in salt and water, and thread them on wire skewers, so that each fish hangs separately in the small pickling vat.

After two hours in pickle they may be removed, and kept in a current of air till next day, when they may be smoked like bloaters until they are of the colour of gold. Longer pickling and longer smoking will enable them to be kept longer than four or five days, but the former preparation will keep that time, and be delightful.

Hard woods and peats do well together for smoking, although peat by itself is not so good. Yet the peculiar flavour imparted to haddock by these smokes is now-a-days imitated in cities, where the unsold fresh haddock are subjected to impregnations with carbolic acid, with preservative results. This imitation is as far removed from the delicacy of the original Findon as the unsold towns' fish is inferior to that fresh from the North Sea.

When on the subject of sprats, we may note the field there is here for improved modes of curing, as the enormous trade in sardines (*Clupea sprattus*, L.) from the west coast of France testifies. Three million tins of so-called sardines are annually imported into this country, out of an estimated annual produce of fifty million tins. These fish for the most part are not the sardine of the Mediterranean, but really indistinguishable in quality, as they are in appearance, from the sprats which are caught in such multitudes around our coasts, and sold at the very cheapest rates when not used as manure. Recently the smaller class of pilchards have been preserved as Cornish sardines at Mevagissey; and a sardine from the west of France, a small pilchard from Cornwall, or a sprat from the north of Scotland, are practically equally good, if equally carefully and skilfully prepared. The process of preserving the tinned sardines is said to be a trade secret,[1] and no doubt, from the superior excellence of certain well-known brands, so far excelling their neighbours, the best houses must have the skill that comes from long and close attention to a well-ordered business. But in this the great secret is the employment of the finest olive oil, the rejection of all inferior fish, and careful preparation. A bay leaf is found at the bottom of the best tins, to impart an agreeable flavour. In some factories the fish are rapidly washed in salt and water, and thrown upon perforated trays to dry, then lightly grilled on a huge gridiron over a red charcoal fire, and closely packed, seventeen to twenty-two in a 16 oz. tin. About Dovarenez (Finisterre), where upwards of eight hundred boats fish, the catch is mostly salted or kippered, as the muddy character of the coast gives a taste to the fish, which becomes still more pronounced when they have been a time in oil. As second-rate houses sometimes put up these salted fish in tins, this accounts for the very inferior character

[1] The entire process, fully illustrated by excellent wood-engravings, appeared in the *Graphic*, of July 17th, 1880.

of some of those imported. These fish are also of a larger class, and seven to twelve fill a tin of 16 oz.

The thick skin of the best French fish enables them to stand the cooking and handling without injury to their appearance; while in tins of inferior quality the broken character of the fish would of itself denote a marked difference in value. The use of cotton-seed and other oils as adulterants also greatly deteriorate all but the best brands. Some fish are rapidly fried in oil before being transferred to the tins.

Sprats should be carefully selected, the gills and guts extracted, quickly washed in baskets in salt and water, and rapidly dried. Then rub them with a mixture of saltpetre and table-salt, in the proportion of one to four, in fine powder, adding spices as desired. Cook them in white earthenware dishes standing in boiling water, the fish being closely packed together. Now remove the covers, and allow them to cool; pour off any fat or oil that may have run off, then fill up with fine olive oil or clarified butter, and cover securely. Done in this way they are superior to sardines, and if prepared in jelly cans, covered over with parchment paper, and the heads dipped in melted paraffin, they might be readily sold in quantity to compete with the best French. The oil that fills the tins or cans should never be heated; and butter will not keep so long, but those cans treated with it would require to enter the market at once. I understand a very important trade in tinned sardines, made from English sprats, is already carried on at Lowestoft.

Red herrings are prepared by curing still more than bloaters. They are pickled in a saturated solution of common salt, to which half an ounce of saltpetre is added for every pound of salt. When the fish are rigid the pickle is removed, and they are dried for a day or two on spits, and then smoked until they are of the proper colour, preferably with oak wood.

From North America we receive a very pleasant and popular herring, prepared by pickling for a short time in a saturated solution; it is dried afterwards on spits for a week, and smoked for a month with pine branches. They will keep a long time, and the turpentine flavour has not been found disagreeable.

Sugar has the same peculiarity as salt in removing the moisture from fish, and thus preventing putrefaction. If a salmon of six pounds weight is prepared by splitting up the back, and rubbing it thoroughly with a tablespoonful of brown sugar, with a teaspoonful of saltpetre added, left for a few days, and afterwards dried in the air, turning frequently, it is known as kippered salmon.

Herrings are kippered by pickling in the usual manner, wiping dry, splitting open at the back until one inch from the tail, so as to leave the bone bare, clearing off offal and gills, and brushing clean with salt and water. They are then hung by the shoulders for a night in a current of air, and afterwards smoked until light brown or chestnut. They are always packed face to face, with oiled paper between each pair, to keep them from contact. They do not keep very long.

In all large curing establishments drying is now facilitated by artificial currents of air from fans or Roots' blowers.

Smoke from juniper, rosemary, etc., impart an aromatic flavour to fish; and salmon are occasionally smoked with cedar-wood for wealthy purchasers.

There are many other modes of preparing fish in an especial manner, in which sugar and spices play more important parts, but these are more the province of the dealer than the general merchant, to whom rough and ready methods are necessary. But it may be pertinent here to insist upon the value of coarse sugar as a preservative, and to suggest the West Indies and other sugar districts as equally well supplied with valuable fish, that might be readily prepared for our markets by its means, or even simply packed in casks, and these filled up with molasses.

Anchovies are prepared by drawing off the head and removing the viscera. They are neither washed nor wiped, but put into small casks of five to twenty pounds weight, in layers, alternately with a mixture of two pounds of bay salt to two ounces sal prunella (saltpetre deprived of its water of crystallisation by heat). They should be thoroughly pressed down and air excluded. These fish are of remarkably fine flavour, plump and firm, with silvery lustre and compact form, about the size of a medium sprat. Anchovy sauce is made by bruising the fish, and simmering with melted butter over a slow fire, a little vinegar and flour being frequently added. The fish entirely dissolves in the process.

Fish are occasionally potted with advantage, and this is especially the case with shrimps and fish-roe. The following mode of potting smelts may be noted as indicating the principle on which the process is based, viz., that of cooking well and carefully, spicing properly, and then by pressure, and otherwise, excluding the air from the meat. The smelts are cut open, cleaned, and washed in salt and water, the tails and fins cut off, and the fish rubbed inside with a mixture of table-salt and spices. Next day they are laid in pots, and covered with clarified butter, baked in a slow oven until properly done, the butter drained off, and the fish left for other twelve hours, at the end of which time the butter is re-melted, sieved, and replaced upon the fish, so that the pots are quite filled, and afterwards properly covered. Vinegar acts as a preservative, like other acids, by coagulating the albumen, and is frequently employed.

The preservative power of cold has of late years attracted great attention, although it is only comparatively recently that ice was used in the transit of salmon to market from outlying ports, a discovery that has added greatly to the importance of our salmon-fisheries. Frozen food has scarcely received sufficient attention in this country, owing to the prevailing ignorance of how to thaw it. If suddenly thawed, putrefaction soon sets in, and although cooked at once, it is hard and deficient in flavour. The only satisfactory way is to thaw it by immersion in cold water. We must go to Russia or Canada to properly understand the value or utility of cold as a preservative. In Russia, during the winter seasons, the shops are filled with frozen fish, upon which the saw and the axe require to be used, in order to cut them up to supply the customers. In Canada the sportsman tosses his fish on the ice, through which he has lured it, and leaves it until it is quite hard frozen, when it will keep any length of time. One of our most enterprising Scottish fish merchants, Mr. John Anderson, had salmon frozen in barrels many years ago, and in this condition brought to our market from the Arctic regions; but the result was not such as to encourage repetition. In 1870, five cases, in which I had had a large quantity of haddock and other fish frozen into a solid mass, were sent to the late Frank Buckland in London, and inspected by a number of experts, who reported most favourably on the process, which proved a very effectual one, as a solid mass of fish and ice thus prepared was displayed for a week in the summer-time, in a fishmonger's shop in Glasgow, without any deterioration.

These processes, although far superior to that of packing in ice, quite loose, as at present pursued with salmon—from which the finest flavour and juices are removed in the dripping water,—are yet in themselves both expensive and unsatisfactory, and have been superseded in practice on a large scale by refrigeration without freezing. This is managed by keeping the receiving vans or vessels at a temperature sufficient to preserve without solidifying. I would suggest double-cased boxes as a great improvement in the transit of salmon, as tending to prevent thawing of the ice, the water running into the false bottom. The fish might also, when possible, be placed in the ice-house for a little, so as to reduce the temperature before packing, in place of doing so afterwards, and thawing so much ice in the boxes.

Preserving in tins is a process now-a-days conducted on a very great scale in various parts of the world, notably for salmon on the Pacific coast, lobsters in the Canadian territory, and oysters and clams in the Eastern States of America. The ordinary tinning process is a very simple one. It consists of placing the fish in tins—preferably washed in bran and water to remove grease—and soldering the lid on, leaving a small hole in the centre. The tins are then placed in a bath of chloride of calcium and water, which covers two-thirds of them. This mixture requires a much higher temperature than water ere it boils, and by means of heat, applied either directly or through steam-pipes, may be raised to 270°, driving off the air and water from the tins. The fish being cooked, and the air and water expelled, a drop of solder closes the tin, and the process would be complete, but from the necessity that exists for slowly reducing the heat; as, if the tins were suddenly removed from the bath, they would collapse. Having left them for a time to come off the boil, they are taken out and placed in cold water, when the small portion of steam remaining condenses, and the outward pressure bulges in the top and bottom of the tins. So long as this concavity exists in tins they may be pronounced good, but so soon as they bulge outward, the chances are that the fish has putrefied, and the gases generated are exerting a dangerous pressure on the tin.

In this process, even when done in simple boiling water, at a lower temperature, much of the delicacy of the fish is expelled in the vapour; and the loss of weight is considerable, requiring one and a quarter pound of fish to fill a one-pound tin, while the fish in every instance is overdone.

An improvement on the common process is that known as Phibb's Patent, in which the tins are at once soldered down the exact quantity of fish having been placed in them. These tins are then subjected to steaming in a closed boiler, under pressure, so that the external pressure of the steam overcomes the internal pressure of the vapour generated, and the fish may be cooked sufficiently, but not overdone. In cooling the tins, boiling water is rapidly run through the boilers, and in a very few minutes they may be withdrawn and stored. No loss of delicacy is sustained, no loss of weight in the fish tinned, and there is no necessity whatever for the contents being overcooked. In the case of salmon rich in oil, as the Pacific fish is to an exceptional extent, the tinning process is so far quite reasonably successful—the oil seemingly counteracting the taste of the tin. All other fish, however, are most unsatisfactory when tinned, as the corroding action of the salt water, contained naturally in the mollusca and crustacea, attacks the metal, and destroys the delicacy of the fish,—even if the oyster or clam would bear the cooking necessary to preserve them in tins, without destroying their finest qualities. We have yet to discover a mode of transmitting these more delicate viands superior to, or cheaper than, that of refrigerated chambers.

To properly appreciate the relative values of the various systems in use, it must be kept in mind that the object is to prevent decay or fermentation; and this should be done with the least loss of nourishment and the least injury to its readiness of digestion. For if a fish be prepared with most of its nutriment in it, and yet be so hard or stringy as to be indigestible, the result is practically the same as if the nourishment had been expelled. This decay or fermentation may be produced either from the minute organisms in the atmosphere coming in contact with suitable conditions for growth in the fish, or from such organisms already in the contained air of the fish; so that it is not enough to coat the fish with oil or other safeguard, without first destroying such possible organisms already in the body. As the albuminous portion of the fish is the most readily attacked—after the gills and viscera—whatever tends to coagulate and harden the albumen helps to keep the spermatozoa of fermentation at bay.

VIII.

CURING AND PRESERVING FISH IN SCOTLAND AND ITS ISLANDS.

BY JOHN ROSS, JR.[1]

THE means used for curing and preserving the various kinds of fish caught on the Scotch coasts will be best described by explaining the various processes employed in different localities upon each class of fish, under the heading of the particular class considered.

In point of annual value landed, the first place must be given to the haddock and its kindred fish the whiting, and smaller-sized codlings which are generally cured along with these.

In former times, that is to say, down to within about thirty years ago, before railway communication was so wide-spread, and while sea-carriage was almost the only available mode of transport within the means of Scotch curers, it was customary to cure these fishes very highly, both as regards salting and smoking. The *modi operandi* of those days, as far as the preparation of the fish for these latter processes was concerned, were very much the same as those still in vogue; and more primitive means cannot be conceived. Indeed, on some of the Egyptian mural paintings displayed in the British Museum, we have the identical processes depicted which are now practised by fish-curers all round our coasts. That such should be the case is quite unworthy, not only of the age, but of the known energy of our race. Thanks, however, to the stimulus afforded by such exhibitions as the present, this stigma is now, it is to be hoped, in a fair way to be removed.

The haddock cure now most common on our coasts is first met on beginning a survey of them at their south-eastern boundary, and is known as the Eyemouth Cure.

It is the direct outcome of the improved transport services of the country, and the enormously increased growth of our Scotch cities which has kept pace with these improvements.

This style of cure is practised on the coasts of the counties

[1] Muchalls, near Stonehaven.

of Berwick, the Lothians, Fife, and part of Forfar, part of Kincardine and Aberdeen, part of Banff, Moray, and Inverness; and since the opening of the Duke of Sutherland's railway through Cromarty, Ross, Sutherland, and Caithness, it has occasionally been practised on the coasts of these counties. Any haddocks cured on the Argyllshire coast nearest Glasgow are done in this way, as also those of the Firth of Clyde, and the Ayr, Wigton, Kirkcudbright, and Dumfries coasts; although, from the ready transport and market facilities for fresh fish, the quantity cured on these latter coasts is necessarily small compared with that in the former divisions.

In all the places where this mode of cure prevails the practice is identical. The fish are delivered by the fishermen at the curers' yards and carried into the fish-house. This is usually a room of varying dimensions and degrees of internal finish, according to the taste and extent of trade of the owner, and external circumstances. It is usually furnished with back and front doors, and cannot be too well lighted, either naturally by window light, or artificially. Its fixed fittings consist of an ordinary washing boiler for heating water fitted with tube, and benches for cutting the fish on, and a good length of elastic tube attached to the water-pipe. Of moveable furnishings, there are usually a proportionate number of tubs in which the fish are washed and pickled, with stands; a gutting-trough, and a number of dripping-troughs, termed "dreepers," also with stands. The usual complement of gut cogues or pails and water lifts, with a dozen or so of opening and gutting knives, and a like number of rubbers or scrubbers made of heather or bass, and four or five high-tempered splitting-knives, complete the fish-house furnishings.

The fish are placed promiscuously in the gutting-trough, from which they are lifted one by one by women, who, holding them by the head in the left hand, belly upwards, slit the latter carefully with a knife from the gullet to about an inch or so before the vent, thus laying open the abdomen and exposing the viscera and guts. The knives used at this operation are narrow-bladed, tapering to the point, with thick razor-like backs to prevent cutting the roes in their season. In opening the fish for this cure, care is taken to pass the knife down the right-hand side of the ventral fin. In all well-ordered fish-yards, where the labour supply is not unduly restricted, division of labour is universally practised, in some cases to a very great degree, and with corresponding advantage to those practising it. Hence, on the fish being opened, they are passed on to the women acting as gutters. These first remove the liver, and put it aside to be subsequently used in the making of fish-oil. Then during its season the roe is next removed for fresh sale, or to be tinned. With one movement of the hand the whole remaining viscera and guts are removed from the belly, and the head, with the guts and viscera still attached to it, is deftly separated from the body thus: passing the forefinger and thumb of the left hand round the neck, and seizing the head in the right hand, the vertebræ are dislocated at the base of the skull by a straight backward jerk over the left thumb, finishing by a sharp pull, whereby the muscles and skin of the shoulder are detached from the base of the skull. The action of heading the fish is one of considerable nicety, and needs some practice and great care in its manipulation, for, simple as it seems, on the proper performance thereof depends the whole success of the curing of the fish. Should, for instance, the operator through carelessness or want of knowledge wrench off the head by a twisting motion, the pectoral bone—shoulder girdle or humeral arch—is thereby torn from its place, and the ligaments and sinews of the pectoral fin are ruptured. These, with their muscular attachments, are technically known as the "lug" of the fish; and on their retention *in situ* depends the hanging of the fish in the smoke kiln, the spit on which they are hung being passed through the "lug" under the pectoral bone. The whole weight of the fish thus depends upon them for support, as in the case of animal carcases hung by the hock sinews. The need for care in this part of the process is greater in the case of such modes of cure as the *Real Finnan Cure*, in which the fish are spitted by one lug only, and the chances of dropping in the kiln through ruptured lugs are correspondingly increased.

On the fish being successfully "headed" it is passed to the "sounder," whose care it is to remove the sound or air-float of the fish. This is attached to the back-bone, and extends the whole length of the abdomen. It is removed by inserting the point of a knife, or sharpened piece of wood, at the anal end of it, and twisting or dragging it off the bone in one piece; or in the case of soft over-days' fish, bit by bit, as best may be. The effect of the delay in getting the over-days' fish gutted is to soften the gelatinous material of the sound to such a degree that it has not toughness enough to permit it being torn off unless ruptured. This of course increases the cost of cure by causing loss of time in its removal. The sound removed, the fish are then thrown into fresh cold water, and thence removed after a few minutes' soak by the "picker," who, with a small sharply-pointed knife, strips off any small adhering portions of sound, and slacks the blood coagulated on the bone. This clotted blood is covered by a membranous film, the entire removal of which would cause loss of time if left to the "washer," whose primitive procedure comes next to be described.

After picking, the fish are thrown into another tub of fresh water, the temperature of which, in winter, has been slightly raised by the careful addition of a little heated water from the copper. This is done in most fish-yards to facilitate the work by keeping the hands of the workers in better temper than if they worked in cold water. The addition of the warmed water does not, however, in any way improve the condition of the fish; but, on the contrary, even when added with the utmost care, softens them, that they do not split smooth, and increases the chances of dropping in kiln. It further in no way improves the flavour of the fish, as it tends to unfix the curd and its glutinous accompaniments, on which the flavour most depends. The washer then sets to work with a small hand-scrubber, or scrubber made of heather or bass, and taking up the fish one by one, scours off the remaining blood from the back-bone and lugs of the fish, and with a final strip through her fingers to remove the "glut" or slime, present on the skin of all newly-caught haddocks, she throws the fish either on to the splitting-table or into a basket for ultimate removal thereto.

The splitting of the fish is sometimes performed by women, but more usually by the coopers attached to the establishment. It is done with knives of hard temper, soft-tempered knives losing their edge on the fish-bone with one or two passes. They have a blade of about 5 to 6 inches in length, by 1⅛ to 1¼ inch in breadth throughout the whole length, and rounded at the point. They are carefully sharpened daily to a very keen edge, and a wire edge avoided.

In splitting, the fish is placed on its side, with the tail toward the operator, and the opened belly towards his right hand. Holding the fish firmly yet lightly by the upper lug, the knife is passed down the upper side of the back-bone, close to the junction of the ribs with it, and severing the former at a rather obtuse angle till the extreme end of the abdomen is reached, when the angle at which the knife is held is changed to one more acute to the plane of the table. Continuing with one sweep till the tail is reached, the knife is passed right out thereat, leaving the ventral and anal fins all on the bone side of the fish when split. Then turning the fish partly round, with the tail towards the right, the splitter strikes off the small part of bone and fish, covering the clot of blood always found at the extreme end of the abdomen, leaving it exposed ready for the next operation, which is termed "seynding."

The fish being carried to another tub of clean cold water, this clot of blood is scrubbed off the bone by women, with scrubbers identical with those described before, and the fish being then ready for pickling they are thrown into baskets till they accumulate sufficiently to be what is termed "a pickling," or, in other words, till there is enough to fill a pickle-tub when floating in the pickle.

The pickle is made in the ordinary well-known way, by dissolving in clean cold water common salt in sufficient quantity to float a haddock. The fish are then plunged into it, there to soak and absorb the dissolved salt for periods varying from fifteen to thirty minutes, according as they are likely to be sold quickly, or held back for better times and higher prices. At the expiry of the allotted time they are removed from the pickle as quickly as possible by scoops, similar to potato-lifters, and placed on "dreepers," or drainers, on which they are sorted out with some degree of evenness and regularity, and so allowed to remain for varying periods, according to the necessity for pushing them forward to catch clear markets, or holding them back waiting for a glutted one to overpass.

From the "dreepers" the fish are lifted one by one, and being folded as it were backwards, are spitted upon either iron or wooden spits, of length varying from 3 feet 3 inches to 4 feet 3 inches, according to the breadth of the kiln voids (to be afterward described), in which they are placed. The spitting consists in passing the spit through both "lugs," under the pectoral bone and fin sinews, and thereafter stretching the fish their full breadth on the spit. Each spit will thus hang from three to six fish, according to size. The spitted fish are then conveyed to the kiln which comes next to be described.

The kiln walls may be of any of the usual house-building materials. It is commonly built from two to four void size in breadth, the depth being according to external position and circumstances—the voids, as before explained, being the spaces or divisions into which the kiln is internally divided for the purpose of hanging the fish-filled spits. The height may vary to almost any extent, according to the owner's necessities. Kilns are usually roofed with tiles, but of late years slates are being used. If of tiles they are pointed, but not invariably so. Unpointed tile-roofed kilns in confined situations are very liable to down-draught, and consequent irregularity in the smoking of the fish placed within them. Those having free space round them are believed to be improved in their action by being left unpointed. The side-walls of the kiln are pierced about mid-height by one or more air-ducts, measuring about 18 in. by 30 in., closed by either sliding or swivel wooden panels, worked by cord-and-pulley attachments inside. The number of such openings will of course depend on the size and height of the kiln. As regards breadth, there is usually an opening for every two voids—most three void kilns having two openings per side, and should the height exceed 15 feet, a second set of openings is usually made just at the easing. These air-ducts are used to regulate the temperature of the kiln, for should a kiln inadvertently become overheated, the result would be that the fish would soften and drop, but by opening and regulation of the air-ducts this is avoided. The kiln-door is halved transversely, the purpose of that also being to regulate the temperature and draught. The upper half may be opened independently of the lower one, thus introducing a current of cool air into the kiln without unduly blowing the fires and dusting the fish. The internal fittings are of the simplest description. Stout wooden joists, 7 in. by 3 in., are placed exactly at the void breadths in line of the door, on beam sockets let into the wall from 6 to 7 feet from the floor. Depending from the rafters, and attached to the joists, are stout 3-inch square rails, say 4 feet apart. Fixed transversely on both sides of these are 2 by 1 inch rails, which form the direct support of the spits, and are attached to the upright rails at 14-inch intervals, and this completes the kiln. The fish being now spitted and spread are passed up spit by spit to the kiln-fillers, who stand with a foot on each side of the void, and, commencing at one side of the kiln, place the spits one after another on the transverse rails, beginning at the lowest and mounting up till the roof is reached, then placing them down again till the lowest is reached, and so on till the void is filled, or the fish all hung. The fish are handed up to the higher tiers by passers, who stand on the lower rails and hand them up to the filler.

The kiln filled, the fires are thus arranged. "Trains" of cooperage chips are placed on the floor, which is usually brick, at right angles to the voids, and the trains may number one, two, or three, according to the size of the kiln, or whether it be full or partially so. Added to these chip trains, and resting upon them, are billets of hard wood, which in their turn catch fire from the lighted chips. At the back of the billets have been placed heaps of hard-wood sawdust, which is used subsequently to smother up the billets should they throw too fierce a heat. The kilns are then left, the door and air-ducts being regulated according to outside atmospherical conditions, and, in the case of the cure under description, the fish are allowed to hang till the superabundant moisture ceases to drop from them, and sometimes hardly that, the time required being from half an hour to two hours, when they are taken down, having a scarcely perceptible tinge of colour and taste of smoke; and being then stripped off the spits are packed in barrels for market. Haddocks, etc., cured in this way will keep good in winter four or five days, and summer two or three days. The relative weights of cured to fresh fish in this style are about as 11 is to 20, or, if very moist packed, 19.

Although we find, as mentioned, this cure practised at intervals round the whole Scotch coasts, yet it is the first we find on the east side coming northwards. Proceeding in the same direction, the next style in point of geographical position is that practised in the small strip of Forfarshire coast immediately adjacent to Arbroath, and known as the Auchmithie Cure, the Lucken or Close Fish Cure, and as Pinwiddies. So far as the gutting, heading, and cleaning of the fish is concerned, the practice for this cure is the same as for Eyemouths. There the similarity ceases, for the close fish, as their name implies, are not split. On being scrubbed at the bone they are simply tied in pairs by the tails with stout twine, and either laid in dry salt or pickled for an hour. Then, if salted, they are washed out of it, or, if pickled, lifted out and strung across the spits (from twelve to twenty couple per spit) they are smoked on, and set outside on frames to drouth—the object of drouthing being to dry up the superabundant moisture and so toughen the skin, and render them less liable to drop in the smoking. The kiln used in smoking this cure being radically different from that last described, must be specially noted.

It is an air-tight chamber, so far as lateral openings are concerned, and may be constructed either wholly above or wholly below ground, or partly both, according to the convenience or circumstances of the owner. Although no openings are allowed in the walls, it is entirely open at the top, and is frequently made by the fisher people in a primitive way by cutting a hogshead in two and sinking the halves in the earth, the cavity thus formed being the kiln. A more scientific arrangement is built of brick, floor and all, with a sliding but air-tight iron door at one end, the breadth to be within 4 inches of the extreme length of the spits employed, usually 3 ft. 6 in. At a height of about 18 inches, or rather better, the transverse row of bricks needful every third or fourth row in bricklaying is put in of half-bricks only on both internal sides of the chamber. This leaves a groove from end to end of the side-walls. The depth, as in other kilns, may be to suit circumstances, and again, the height will be according to the extent of trade done. This groove in the side-walls may be repeated *ad libitum* at intervals of 12 to 13 inches till the top of the chamber be reached, when a ledge is left for the upper row of spits by adopting the same plan of building half a brick crosswise instead of a whole one. This, with a light cloth to cover the open top when the kiln is charged, completes it.

The fish having been exposed to more or less drouth, according to atmospherical conditions, are now ready for removal from the drouthing-frames to the kiln. Immediately before doing so a good fire of small billets of hard wood, and that kind of peat known as "stickly" peat, is kindled on the brick floor of the chamber in a pretty large heap, the door being meanwhile left open. This fire is allowed to burn pretty well down, partly to secure that half-consumed fiery remainder of wood and peat fires known as "iezle," and partly to heat up the chamber the better to cure the fish. The iezles are then spread through the chamber floor, and in this state give out a fair heat but little smoke. The fish are transferred from the drouthing-frames to the chamber, fresh fuel, in the shape of cooperage chips, and billets, and peats, are added to the iezles, hard-wood sawdust being then thickly strewn over all, and the iron door is shut. After a short interval, which varies according to the amount of drouth on the fish, from ten to twenty-five or thirty minutes, the light cloth is drawn over the top, and the whole left to smother in the closed-in chamber for from forty to fifty minutes from the commencement, according to the size and condition of the fish in the matter of drouth. At the end of this time, the condition of the fish having been ascertained in the interval by test-drawings, the cloth is thrown off, and the fish, still on the spits, are withdrawn from the chamber to the frames to cool. By this process the fish are out-and-out cooked, and quite edible as they come from the chamber, and indeed are largely eaten without further preparation. The external colour is from a dingy brown to almost black, but the smoke flavour having to filter through the skin in this cure, leaves the flesh of a deliciously sweet taste, and quite white in colour. They will keep in winter till they mould, and in summer good for a week. The relative weight of smoked to fresh fish is as 11 is to 26. The fish cured in this way are nearly all cured by the wives of the fishermen, and it is not usual for them to employ other than the primitive half-hogshead as described. The brick chamber was introduced by curers having the fishermen bargained with in the usual way to fish for them.

Continuing northward, the next special form of cure we find is the Real Finnan, or Aberdeen Finnan, or Aberdeen Cure. It is only practised on the small strip of coast lying between Stonehaven and Aberdeen, about twelve miles in extent. There are now a few Real Finnans made in Aberdeen itself, but the practice there is of very recent introduction, and confined to three or four individuals. Like the Eyemouths, the Finnans are indebted for their development to the increased transit facilities. The great bulk made are the handiwork of the fishermen's women folk, each curing their own share of the catch, and within the past twelve to sixteen years the cure in their hands has very much deteriorated. This has come about solely through carelessness in the handling, and the use of objectionable materials in the making, such as hard stickly peats, as used for close fish, instead of soft grey peats, and an indiscriminate use of sawdust. As already explained, the hard peat gives much heat but little smoke, thereby partly cooking the fish in the smoking and burning them, thereby causing the colour to come patchy, and making the fish soft and difficult to handle. In the matter of sawdust, again, the whole aim seems to be the getting colour quickly on the fish; and to do so with little trouble to themselves the women select the most resinous sawdust they can, thus certainly gaining time, but at the expense of flavour, which is of infinitely greater importance. The flavour imparted by this class of material is bitter and disagreeable, causing great uneasiness to eaters at all bilious, and, in short, bringing the cure into disrepute.

For Finnans, the fish are opened down the left side of the ventral fin, and the gutting, heading, and cleaning was till lately the same as for Eyemouths, and, indeed, still continues to be the same in the case of all those fish cured by the fishermen. Several modifications and improvements have been lately introduced in the Aberdeen cure, not the least notable being cleaning by a machine invented by the writer of this paper.[1] To all appearance the improvements will not end here, a self-acting washer and splitter being aimed at, and will be introduced undoubtedly ere long. The advantages of any system of machine-cleaning are—time gained, less handling of the fish necessary, and relief to the workers. The fish cleaned, they are passed to the splitter, who uses a knife similar to that already described. The operation differs from Eyemouth style, first that the ventral and anal fins are all cut to the "flag" side of the fish, and the knife not passed out at the tail but stopped at the lower end of the anal fin. The splitter then half-turns the fish round, as in Eyemouth style, and makes a long curved cut, down the bone next the dorsal fin. This has the double effect of allowing the salt to penetrate the fish better, and likewise, coupled with the short cut at the tail, has a tendency to broaden out the fish and give them a thick fishy look different from Eyemouths. This cut along the bone is termed the "gaefeather." The fish cut, they are hand-salted lightly, and allowed to lie in salt overnight; then, after being washed out of salt, they are, one by one, laid out on frames or dykeheads to drouth previous to smoking. The drouthing dries up extra moisture and gives the fish what is termed a "set," that is, it

[1] This machine consists mainly of an adaptation of rotary brushes working on the surface of a troughful of water. To these the attendants lightly hold the opened fish, from which all blood, etc., is instantly cleansed,—the working power, compared with the old system, being fully as two to one, and that with unskilled labour.

fixes them in a broad open style which they would not have otherwise. After lying drouthing for a time varied according to atmospherical conditions, they are spitted under the pectoral bone and fin, by one "lug" only, and that on the "flag" side, on wooden spits only, and taken to smoke.

It is needful to describe the smoke-house and its furnishings specially, as they are quite different from any yet noticed. It consists of a house—a room, it might be called,—placed as free as can be managed from other buildings, for the sake of the improved draught thus gained. It must have a door in both side-walls, placed at points as far as practicable from the gable to be used in smoking as hereinafter detailed, also at least one window as near the middle of the house as practicable. The roof, slated or with pointed tiles. The internal measurement will altogether depend on the extent of the owner's trade, and the extent is quite immaterial to the working. The floor, except that part to be used as a fire-hearth, may be of any material, but for the fire hearth-brick is much to be preferred for reasons to follow. The fire-hearth must be raised not less than 9 inches from the floor-level, and should extend the whole gable breadth. In depth it ought to be 6 feet at least, measured from the gable to the edge of the step, as it were; the hearth should slope from that edge backward to the gable at about one in ten. Fixed to the gable wall by "dooks" are vertical supports of 2½ in. × ¾ in., sufficient in number to carry light horizontal rails fixed at 13-inch centres, commencing 21 inches from the hearth and extending upwards to not fewer than five rails. This arrangement of rails is termed the "back reest." The smoke-house ought to be joisted, beam filled, and plastered like any ordinary house. The joist next the gable over the hearth should be omitted, and attached to and erected upon the next joist should be a hanging chimney-brace leading the smoke to the roof at the gable, and thence by a wooden "lum" to the open air. The lum should measure 2½ inches square for every lineal foot of hearth, and should be furnished with a cowl, as in mill-kilns for the exclusion of wet. Well-appointed lums are also furnished with a draught-fan, driven in any of the many ways devised for small machines, by which on quiet days the draught is very much improved. About 18 inches within the hanging brace, and attached to a strong beam resting upon the side-walls, are the "hangs," between which and the "back reest" the spitted fish are suspended. These hangs are made of good 9-ply sma'-line, and are put on the beam double, and knotted together at intervals, occurring always between the rails of the "back reest," and hung about 8 inches apart on the "balk," as the beam is termed, whence they depend. Knotted, or spliced in at each knot on the "hang," but running free, are "lugs" of the same material as the "hang," and long enough to reach to the exact level of each rail of the "back reest." The whole system of "hangs" and "lugs" hang at 3 ft. 1 in. from the "back reest," and as the spits used are 3 ft. 3 in., their ends protrude an inch through the lug, and give a good hold of the spit, the other free inch being rested on the rail of the "back reest." The object of this system of lugs is to obviate the risk of pulling all the spits depending on one "hang" down on removing any one of them from the hang and reest. It will be obvious that, were the spits to be inserted at the knots on the hang, instead of in the "lugs," the hang could only be slipped off any desired spit by pulling it bodily toward the operator, thus endangering the other four spits in that "hang" by pulling the further ends of them off the "back reest." The "lug" obviates this simply by giving a certain amount of slide space to each spit individually, and enabling them to be in a measure independently hung.

This precaution of the "lugs" would, of course, be quite unnecessary were the spits of fish never to be moved from one end of the smoking operation to the other, but when it is explained that even in a good working day the position of each spit will have to be shifted not under four times, and when the draught is bad certainly not under a dozen times each, in order to correct colouring of each and every fish, then the need for this arrangement will at once be admitted. This, with a couple of large cloths for hanging from the roof for the regulation of the draught by the doors, completes the "Finnan" smoke-house. A stock of grey soft peat having been provided in summer, and a sufficient stock of white-wood sawdust obtained, we may commence to smoke the fish. The fish spitted and carried from the drouthing-frame by pedal-driven carrying cloth, they are spread on the spits, that is, separated at regular intervals on the spit. The size of these intervals depends on two things, viz., the size of the fish and the amount of drouth they have got. If big fish, they need to be further apart, but if well drouthed less space will do. Each spit will hold from twelve to twenty-two fish, according to circumstances and size. The fish should be "sized" on the spits as well as possible, that is, not to mix the different sizes on one spit. The reason for this is that the larger fish all hang at first next the fire, then the medium, and highest of all the smalls. While the spitting and spreading are in progress, for both go on at once, the smoke-woman builds up at one end of the hearth, and kindles a heap of peat of a size regulated by the size of hearth or by the number of fish to be smoked. She selects for this kindling-fire the harder peats from amongst the grey ones for the sake of the iezle left when the heap is well burnt down. When all the fish for the time being are put into the "reest," as it is termed, she, with a tongs and shovel, lifts the peat iezles and places them in a row just under the near end of the spits, and then, breaking soft peats into quarter-pieces, she proceeds to induce their kindling by the careful sprinkling on of very dry white-wood sawdust. By and by the whole ignites, and then the skill of the trained operator shows itself. In a reest, say 16 feet across, there would be 140 spits, holding close on a ton of selected fish. To attend properly on this needs the constant attention of two women, for while one sees that the fire is properly tempered, the other takes care that the fish colour equally. With fish 18 inches from the fire it is only reasonable to think that the closest attention is needed to prevent them from being burned, and so drop in the fire, having but the one "lug" of each to hang by. The smoke is draughted rather back towards the gable wall by the manipulation of the draught-cloths mentioned, and rises freely up throughout the whole reest, gradually slightly colouring the back fish of the lower gang of spits in about an hour from the start. On this occurring, the spits are reversed in the reest, and what was the facing fish on the spits is now the backmost, and it is in its turn coloured a little. Should the draught be working well this one turn will suffice to colour slightly each fish on the lower gang or tier of spits; and on this being done they are all shifted up to the upper tier and the next higher tier let down next the fire, spit by spit. The colouring goes on as before, and each successive gang is brought to the fire, except perhaps the third one originally. This gang generally takes a pretty clear colour in good working days, without being let to the fire altogether, but all need reversing, however good the draught be. Should it, however, unfortunately be a quiet day, or too windy, then the work is increased in a most extraordinary degree. The draught either carries the smoke so that only the three or four fish (if, say, sixteen are on a spit) next the back take colour, or it colours only three or four just in the centre of the spit. In either case it is manifest that mere reversal of the spit won't help matters very much. The only remaining thing to do is to remove every fish and alter their position on the spit so as to give each a chance of the capricious smoke. This to be done to, say 100 scores of fish, two or three, and often more, times in the course of one smoking, involves an amount of labour which may be imagined, but nearly baffles description. Many plans have been tried to obviate this labour, but have never succeeded; it being found that so far as smoking the fish is concerned, if the pristine flavour is wished, the primitive method must be strictly adhered to. While all this work has been progressing, the fire has needed constant care and attention. Now it needs peat added; and again, and more frequently, sawdust; indeed the sprinkling of this latter is constant from start to finish. So near are the fish to the heat, and such is the amount of peat required to give the requisite flavour, that unless an unceasing care be exercised, the fish get burned and their value reduced, or they are irregularly coloured, with a like result. The "smoking" of a quantity of fish, such as mentioned above, occupies from six to nine hours, according to draught and amount of drouth upon them; for, should they be fairly well drouthed, less time is needed, as they are firm enough prior to smoking, and it doesn't need the fire to dry up the superfluous moisture. As the smoking proceeds the erstwhile narrow line of fire is gradually and carefully broadened out under the spits backward towards the gable wall; and, towards the latter half of the time, the advantage of having the hearth brick-laid is seen. The bricks get heated up and reflect the heat strongly, far more so than any other material, and this hastens the operation very materially. At the same time, in careless or ignorant hands, it becomes a source of danger, as the heat increases in a very quick ratio on brick, and the fish must be withdrawn upwards in the latter part of the smoking to obviate the danger. When finished smoking, perfect fish should show an even, glossy surface, as if varnished: they should have an even colour throughout, except towards the bone edge, where the tint deepens a little, but should not do so to the extent of darkness, nor should it through firing be altogether colourless and broiled. The flavour of well-prepared Finnans is exquisite, and quite different from that of wood-smoked fish.

On being all correctly coloured and firmed, the fish, as they are ready, are put in racks or frames, spits and all, to cool. On cooling they are removed from the spits, and being matched in bunches of three fish each, are tied together by having a dried rush passed through the spit-holes and knotted.

During the smoking of them, so constant has been the movement amongst the fire, keeping the peats from being covered amongst the ashes, and spreading the fire back and replenishing it, etc., that a considerable amount of dust, or "coom," has been draughted up and settled upon the fish, rendering them rather unsightly. To remove this is the workers' care after tying the fish. A tub or trough of slightly warmed and salted water is set. The bunches are taken one by one, and the fish carefully turned over singly, and washed back and front, with a small rag, till they are clean. They are, in laying them down, carefully assorted into packing-baskets, in three or more sizes, ready to be packed for market. They will keep sweet and good fourteen days in winter, and four in summer. The relative weights of well-cured to fresh fish in this style is as 11 is to 22.

The style of cure just described is at once the most intricate and costly of any through which any form of fish is put. It needs more skill in the manipulation and in the ordering of the accessories than any, and costs more after the fish are smoked than styles such as Eyemouths cost from first to last.

In the same district identified with the Finnan Cure, there was formerly practised, and very occasionally still is, a form of cure known as Bervies. They fell into disuse as transit improved, and with it, as noted, the making of Finnans increased. The whole process is the same as for Finnans, except that the smoking is entirely carried on with stickly peat, and what are known as yellow sods, which are simply a very recent formation of peat,—indeed, so recent, as to be hardly fit to be called peat, and which mainly consists of the entire plants of white bog-mosses, mostly *Sphagnum cymbifolium*, in a partly decayed state, and found in some peat-mosses overlying the true peat. Its preparation in summer is similar to that of peat, and now that Bervies are obsolete, it is neglected. This yellow sod inclines to flame when kindled, and in this characteristic lay its value in Bervie-making. Towards the end of the smoking, and when, as Finnans, the fish would be rather overdone, these sods were added to the fire, and by careful fanning induced to blaze up amongst the fish. They were let down once more, gang by gang, to the blaze, and by it cooked similarly to the close-fish described. Thereafter they were cooled and bunched in threes, by being tied with dried rushes, not knotted, however, through the spit-holes, but passed through a hole specially made in the "flag" side of the fish, and, being carried entirely round the "bone" side, then tied. Bervies were or are not washed after smoking, as Finnans are, but simply dusted with a duster and packed for market. The colour of Bervies is a dirty blackish brown, and the flavour something between a Finnan and a dried spelding. The relative weight of cured to fresh fish is the highest yet described, and is as 11 is to 26. The Bervie will keep good for a very long time at any season.

In geographical sequence the Spelding Cure comes next, it being practised extensively on the east Aberdeenshire coast, beginning at Newburgh, twelve miles north of Aberdeen, and at various places betwixt that and Fraserburgh, as yet beyond the reach of railway service,—the "Collieston" spelding having a more than local fame. It is also the staple cure for those haddocks and kindred fish caught in the more inaccessible parts of the northern and western Scottish mainland, the Orkney and Shetland Islands, and the Hebrides.

The gutting and cleaning are precisely the same as described for other cures of haddocks, etc., but the fish are not headed. The head is split with the body of the fish, and left on. They are about an hour, or rather better, in strong brine, and being thereafter well washed in sea-water, are laid out in small bings on sloping boards to dreep. After a short lapse they are spread out on pebbles to dry. Care must be taken that the pebbles are not too strongly sun-heated, else the fish will be scalded and much deteriorated thereby. After one day's good drouth, during which they have at least been turned over once, they are, before sundown, gathered in small bings, and pressed down with stones and other weights. They are left there the next two days to insure a nice flat "set," and if the fourth day be nice and drouthy, they are again spread and turned frequently, care being taken always to have them binged before sundown. After the first week, the fish are allowed to remain in bing a few days at a time to sweat out the salt, and make them take a nice greenish-red colour, which is the sign of well-cured speldings. It is the constant care of the curers that the fish shall not be exposed to passing showers; temporary waterproof covers being used to cover over the outspread fish, and so save gathering them in for every flying shower.

Although largely marketed *au naturel,* it is usual to make at least a portion of the cure into smoked speldings, as the smoked style is preferred in some places.

The fish are fit for smoking when about hand-clean, and the kilns used are ordinary Eyemouth kilns. Iron spits of $\frac{3}{8}$ths of an inch in thickness are placed across the voids about two inches apart, and the speldings are built on them to about the depth of three fish in open order, to allow the smoke to permeate the whole. The reason of the fish being laid on each other to some little depth is, that they thereby are prevented in a great measure from curling up when heated. The fires used, and mode of management of them, are identical with the Eyemouth style. They remain in kiln till of a nice light-brown colour, and are then stowed in dry lofts, covered up from the air till marketed. They have then a nice smoky flavour and sweetish taste, mingled with that of salt. They will keep good for a very long time if kept free from damp. The relative weights of cured fish to fresh is as 11 is to 30.

We now come to the style of cure of Haddocks, etc., identified more particularly with the north-east coast of Scotland, though now practised elsewhere, and known as the Moray Firth or Buckie Cure. It is practised when markets suit, or the season of the year requires it, by nearly all regularly engaged in the making of Eyemouths, and, besides the shores of the Moray Firth, it is in use at all places in the north of Scotland at which steamers call regularly, and at some places in Orkney and Shetland and the Hebrides favoured with similar service.

The method in use at all places where this cure is practised is essentially the same as that for Eyemouths, with the sole exception that, instead of being packed with a very slight colour and flavour of smoke, the fish are left in kiln not under twelve hours, and come out well dried and of a beautiful light-golden yellow colour, not unlike Aberdeens. By so doing the fish can be kept sweet for periods far exceeding Eyemouths, and it consequently is a style better adapted for long keeping, waiting markets, or summer-caught fish even with quick transit. As it is never the case that a whole kilnful of fish are ready at once, the kiln has to be "stripped," as it is termed, or relieved of those fish first ready. This is a service of some degree of disagreeableness to those engaged in it, inasmuch as the fires are smouldering while the workers are aloft passing down those fish ready for stripping. Of late, however, nearly air-tight covers of sheet-iron have been devised to cover the fires temporarily during stripping, and so keep down the heat and smoke while this is going on.

As the fish are smoked they are at once cooled and packed, and allowed to remain so till wanted for market, and will thus keep good for three weeks or a month in ordinary winter weather, or a week in mild weather. They taste like Eyemouths, but of course rather more of smoke than they. The relative weights of cured fish to fresh is as 11 to 22.

An explanation will now be given of the cure of the fish next to the haddocks, etc., in point of annual value landed, viz.:—

The Herring.

At the whole of the fishing-stations on the Scotch coasts the methods of cure of this fish are identical. It will not therefore be needful to divide our subject geographically, but simply to describe the processes employed.

In point of value cured pickled herrings take the first place. In the landing the herrings are measured by the fishermen to the curers, according to contract and as by law directed, by the cran, but it is very seldom indeed that the actual measure known by this name is used. The curer instead provides quarter-baskets for the measurement of the fish. A quarter-basket to measure four such per cran ought to be 18 inches inside diameter across the mouth, and 21 inches oblique internal measure from lip to bottom. The baskets supplied by curers are mostly in excess of this. The fish landed, they are conveyed to, and thrown promiscuously into a sort of tank known as a "Farlin," being well sprinkled the while with either Lisbon or Liverpool rough salt to secure an adhesion of the scales. Round the farlin stand the gutters, who are women employed by the curer to gut the fish, and are superintended by the coopers belonging to the yard. The gutters are divided into crews of three each, which crews are numbered, and their number marked on every barrel they pack for identification in case of bad work being challenged by the Fishery Board officer on his inspecting the fish previous to branding them. The gutters' crews are arranged so that there shall be two gutters to one packer. The two gutters select the herrings one by one from the heap in the farlin, and while gutting them divide them into the following classes, viz.:—Fulls, *i.e.* fully developed fish, with roe or milt full-sized; matties, *i.e.* immature fish, with only partially developed roe or milt; spents, *i.e.* spawned fish; torn bellies, *i.e.* damaged fish.

To properly gut the fish it is held in the hollow of the left hand with its belly uppermost, and the head and shoulders projecting about an inch before the forefinger and thumb; the gutting-knife is held in the right hand, with the forefinger and thumb grasping the blade to within an inch or so of the point. The knife is then plunged into the throat of the fish at the side next the right hand, and thrust down so as to touch the back-bone, and so forced through to the other side, with the point a little projecting therefrom. The forefinger is then turned over the head of the fish and placed under the point of the knife, and the flat part of the thumb laid on the pectoral or breast fins or "gip" of the fish, and pressed on the broad part of the knife. The entrails are then to be gently started, the gut and gip seized between the knuckles of the fore and middle fingers, and a sudden pull given, by which means the crown gut will be left hanging from the body of the fish, while the gills, fins, heart, liver, etc., will fall into the hollow of the hand. Gutters have to be careful to make the pull upwards and not down, so as to leave the orifice as small as possible, and to prevent the breast of the fish from being torn. That mode of gutting, by which the crown gut is left attached, is peculiarly well adapted for the Continental market, where it is believed that the crown gut has a powerful influence in improving the flavour of the fish, and where the look of the herring is held to be greatly injured if it has been by chance removed.

The packing of the fish proceeds at the same time as the gutting. The moment the fish are gutted they are conveyed by the gutters in small baskets to the packer, and emptied into the rousing-tubs sitting by her. She has a tub for each class of the fish, and proceeds to pack each in turn as they happen to come to hand. The fish are well roused or sprinkled with Lisbon or Liverpool salt, or perhaps a mixture of both, in the tubs, and, taking a barrel, the packer first puts a good liberal sprinkling of salt in its bottom, and proceeds to lay the fish on their back closely together in the bottom of the barrel. The next tier of fish is laid across this first one, with a sprinkling of salt between, and so on till the barrel is filled. The cooper then marks the barrel with the crew's number and the date of cure, and, placing a loose cover on the top of the herrings, leaves it there till next day, or perhaps two or three days, by which time the fish have "pined" or shrunk a tier or two. The barrels are then refilled with fish of the same day's cure and description of fish, and headed up and the hoops tightened. They are then laid on their sides, if possible under cover, and left for fifteen days, at the end of which time they are being packed by having the pickle-vent opened when the barrel is upended and the pickle run off the upper half of the barrel. The head is again removed, salt scattered in between the fish and the side of the barrel where needful, from space occurring, the fish packed closely up and gently pressed down until the barrel is properly filled. Any leaks are then finally closed by flagging the joints, the head replaced, the barrel laid once again on its side, and the pickle replaced as far as required, the barrel blown and bunged tight, and the curing marks scratched on it. The fish are then ready for branding, should their owner wish it. An industrious crew of three gutters will pack thirty barrels a day of ten hours, even though their day should only begin at 3 P.M. and continue through the night with artificial light.

The capacity of the cran is 37½ imperial gallons, that of the barrel being 26⅔ gallons. Barrels may now be made of fir-wood, but formerly the material was confined to hard woods or larch; and the Board of Fishery requires each barrel to have on top four hoops, three on the quarter, and from nine to eleven on the bottom end. Well-cured herrings are not red at the bone on being opened, and have a nice silvery look externally, while badly cured fish become yellowish. They will keep an indefinite length of time.

A great quantity of the herrings caught on Scotch coasts are not gutted, but pickled as they are for the home and foreign smoked trade. In fact all herrings not cured within twenty-four hours of capture are required by the Board of Fishery to be withheld from the official brand for the export trade, and so must be sold as smoked herrings.

The pickling is conducted as first described, and the fish set aside. When wished they are removed from the barrels and spitted through the gills and mouth upon iron or wooden spits similar to those used in haddock-curing. They are then placed in troughs of fresh water, the ends of the spits resting on the edges of the trough and the herrings hanging down in the water. They are allowed to soak there from twelve to twenty-four hours, according to the season of the year, and as to whether they are wanted for bloaters or reds. They are removed thence and spread on the spits, averaging eighteen fish per spit, and placed in kilns exactly the same as described for Eyemouth-cured haddocks.

If bloaters are wished, they get about twelve hours of a slow billet fire with sawdust, as for haddock cure, and on being taken down are usually packed into small boxes containing eight to twelve dozen fish, according to the class of herring.

These bloaters, when properly cured, are of a silvery yellow colour. They taste slightly of wood-smoke, and will keep a month in ordinary weather, quite fresh, after being boxed.

Should reds, however, be wished, the smoking is continued for from ten to twenty days, and they are then of a nice reddish-brown colour, and smell and taste strongly of wood smoke. They are packed in open-jointed barrels or small boxes like the bloaters, and will keep good a year.

Of late years a very extensive trade has sprung up in kippered herrings, the best mode of curing which is as follows:—The herring, on being landed, are conveyed immediately to the kipper-yards. These are covered-in spaces varying in extent with the owner's trade, and consisting of fish-house, kilns, packing-house, and extensive accommodation for storage of pads (*i.e.* carrying-baskets) and boxes and fuel. As the cutters are usually English women brought from the Northumberland coast, lodgings for them are generally provided at the yard by the owner. As the fish-house is furnished with cutting-benches round three sides of it, the herrings are thrown on to them, and the splitters, furnished with well-sharpened small knives, proceed to split. This is done very deftly by the woman holding the fish under her left hand, with its back towards her right: she pushes the knife into the back of the fish, under the bone at the neck, and sliding the knife down the bone, cuts right out at the tail; then turning her knife, she with one cut slits open the head, and, laying the fish out open, proceeds to clear away the viscera, gills, and guts with one movement of her hand into the gut-barrel which projects from under the bench.

The herring split, it is cast into a pad sitting beside her on the bench, which, when full, is removed by others and emptied into the washing-basket—a round basket capable of washing an $\frac{1}{8}$th of a cran; and it is lifted by the washer, usually a man, who floats the basket in the wash-tub, a large tun of about 400 gallons capacity. It is made thus large that one filling may wash the day's cut of fish without unduly dirtying the water in it. The washer plunges about the basket in the water till the fish are swilled clear of most of the blood. Then, having his hands covered with a pair of woollen mittens, he gives the fish a good dabble in the basket ere he withdraws it from the tun. The fish are then emptied on the salting-bench, where they are hand-salted, or they may be taken and emptied in the pickle-trough, if pickling is the rule of the yard. Should they, however, be salted, fine "butter" salt is used, and the fish are laid carefully but quickly in flattish bings on the bench. Care is taken in finishing the bing to water its edges with fresh water from a rose watering-pan, else those edges, having got extra salt, and all the drippings from the body of the bing, would thus be too salt. They lie in salt fifteen minutes, and are then washed out of it with the rose pan and spitted. If pickled, they lie in pickle ten to twenty minutes and then are scooped on the dreepers. These latter are similar to haddock-dreepers, but have balk holders at either end for supporting the balks, whereon the fish are hung in smoke. These latter are usually 4 feet long, or 4 feet 3 inches, and $1\frac{3}{4}$ by 2 in thickness, and are mounted with tenter-hooks on either side, whereon the fish are fixed. The hooks are put into the balk in pairs, each pair $1\frac{1}{2}$ inch from the other, and each balk having eight or nine pairs on either side of it. The tenter-hooks are $\frac{1}{8}$th inch iron rod, galvanised, and bent with a pointed quarter-inch knee at right angles at one end. The other end is straight, and pointed also. It is driven into the balk with the knee upwards, forming a hook by which the fish are hung.

The fish spitted, they are put into the kiln, which is the same as for Eyemouth cure of haddock, and filled similarly.

The fire-trains are wholly composed of oak turnings and oak smothered in oak sawdust; and the fish take from eight to ten hours to smoke if the kilns be working well. They need to be stripped as in Moray Firth haddock-smoking, and the fires in doing so are seldom dulled, so hardy are the English smokers employed by the better makers of this much-appreciated cure of the herring. Being quite smoked, the fish are racked on frames to cool, and are then packed. The better-sized fish are selected and packed in pads, forty couple per pad: the fish in each couple being laid face to face, and the lid of the pad tied down, and sent to London market. Smaller-sized fish are boxed in bloater boxes, either to be sent to be tinned at the preserved provision works (to be presently described) or sold in secondary markets. The fish, when well cured, are of a darkish-brown colour, and have a peculiarly sweet nutty flavour when smoked with the materials here described. Kippers being mostly made in Scotland in summer, do not keep beyond a few days in their full flavour.

The making of Bloatered Herrings from roused fish is not much practised on Scotch coasts. When it is, the fish are well sprinkled with salt, and laid in rows in troughs or tubs for six hours; then washed out of salt, spitted as for pickle bloaters, and smoked a similar time. The flavour is delicious, and exceeds even the kipper in richness.

Roused herrings for present use is a form of partial cure much practised. The fish are simply sprinkled with salt in the farlin or tub, and packed in "carrier barrels," getting a further sprinkling of salt in the packing.

The next class of sea-fishes in point of value landed annually is what are termed Gratline Fish, and include the Cod, Ling, Tusk, and Hake. Of course there are other and very valuable fish caught on gratlines, but as they are not usually subjected to any form of cure at the hands of fish-curers, it is not needful that they should be noticed here.

In curing these fishes much greater attention is now paid to what may be called the preliminaries than was formerly the case. Immediately the fish is unhooked it is bled and gutted. A few crews carry boxes wherein to stow the fish, but the greater part lay them carefully in the boat in bulk, and cover them from the sun. On landing the fish they are immediately headed, sounded, and cleaned in fresh water with scrubbing-brushes. They are then passed to the splitter, who, in addition to splitting them, takes out the bone to within 20 or 22 joints of the tail, and cuts a slit along the remaining joints, to let out what blood may be there. The fish are then dropped in clean water, sea-water being preferred, and all remaining impurities carefully removed. They are then salted in large troughs, being spread in layers, and salt sprinkled, in the proportion of about 45 or 50 lbs. Liverpool salt per cwt. of fish. The foolish practice of over-salting is now exploded on most Scotch stations, curers finding that by saving their fish from salt-burn they best conserve their own interests. They generally lie three days in salt; but very fresh fish will not take more salt than is sufficient to cure them. They are then well washed, and laid in bings to dreep, and may lie thus for a day ere being laid out. The flake system of drying has many admirers and advantages, but where pebble beaches are handy they are invariably used. Care must be taken to have the fish spread early in the day, ere the sun heat the stones to any extent, else the fish will undoubtedly be scalded and blistered. Too hasty drying at first must likewise be avoided, else the fish will become brittle and ill-looking. They are laid out at first on their backs, and towards evening are turned over, and before sundown gathered into small heaps, back uppermost. As the drying proceeds they must be frequently turned, and when hand-clean, gathered in always in double layers, the face of each towards the other. They then should be pressed when in the heaps, at night, with heavy weights, to the great improvement of their appearance. When about half dry the fish should then be only laid out with their backs uppermost, which draws the salt from the flesh side, and improves the colour. After about a fortnight's drying, they should be laid in a pack or large bing, to sweat, and should remain so for ten days or so, carefully covered up with cloths or mats. They then are dried a week, as before, and sweated a second time for about half the length of the first sweat. Two or three days of further drying will finish them. This course of operations may, of course, be greatly retarded by damp or unsuitable weather, but the plan of action sketched above must be adhered to as rigidly as possible, more particularly the turning and sweating. If well done, they will keep for a very long time; but to keep them properly needs care. When storing care must be taken to do so when they are nice and cool, and at the end of a rousing day of drouth, if at all possible. The keeping will be helped by putting a little clean fresh oat straw between each layer in the store, and covering the whole carefully up. The colour of well-cured fish is a reddish green, and the relative weights of cured to fresh fish is as 11 is to 28.

In Orkney and Shetland and the Hebrides, remote from speedy transit, where haddock-fishing is not practised to the same extent in winter as on other parts of our coasts, cod and ling form the staple of the fisheries. During that season, of course, immediate drying is out of the question. The fish therefore get a little additional salt on being washed out of the salt-trough, and are laid in bings, and carefully covered with mats or canvas, to insure cleanliness, and prevent them from getting discoloured. They remain so till the drying season comes round, and to those unaccustomed to it, it is anything but a pleasant shelter when, in a passing shower, one has to go to the lee-side of one of these bings of wet fish.

In curing these fish for pickle or wet cure, the early processes are the same as for dried fish. When they are removed from salt, in which forty-eight hours is enough, they are carefully scraped on the backs, to remove the slime, and well washed. They are then repacked in tight pickle-barrels, with fresh salt, the skin side being next the bottom of the barrel in the first layer. Each layer gets its proper quantity of salt, which, from first to last, will amount to about from 80 to 100 pounds weight per barrel, according as the fish are for the home or export trade. On the barrel being filled, the uppermost fish is put with its back upwards, and salt sprinkled over all. The barrels are allowed to stand overnight under cover, and next day are flagged, headed, and, being laid on their sides, are filled up with clean pickle by the pickle-vent. The number and kind of fish is then marked on the barrel, and the date of repacking, and they are then, if properly cured, branded by the Fishery officer in the same way as herrings.

The last class of fish cured on our coasts is the Salmon, and the more common form of cure of it is known as Kippered Salmon, and is prepared in this way:—

The newly-caught fish is laid on its side, with the dorsal fin towards the operator's right hand, and is carefully split down the under side of the dorsal fin, commencing at the neck right out at the tail. The head is not removed, but split also, and the bone and guts then removed. The fish is cleaned with as little contact with fresh water as possible. It is then carefully rubbed over with "butter" salt, and put aside for two hours; but some allow a little longer. It is the while occasionally rubbed and squeezed with the open hand, to facilitate the absorption of the salt, but great care is taken not to separate the flakes, nor otherwise to mar the look of it. The following mixture, per fish, is meanwhile made and rubbed into it:—Saltpetre, a good big pinch, red rum a wineglassful, soft sugar 2 oz. Dissolve the saltpetre and sugar in the rum, and slowly and gradually pour the mixture over the fish, rubbing and soaking it into it. After lying overnight, if the following day be suitable, it is laid out to dry on flakes, with the back undermost. A kind of frame of willows is made, and the fish stretched and kept on it, to insure a nice shape. If the drouth is at all strong, care is taken that the fish get it gradually, by occasionally covering them up and frequent turning. With good weather, the fish are laid in small bings or heaps to sweat, about the third day after laying out. They lie there a day and two nights, and are then laid out again. They are not usually sweated specially after that, as the nightly ingathering in bings is sufficient in most cases. With good weather, salmon will need a month to five weeks to thoroughly dry, and are then stored, by being hung in cool lofts or other storage. By this form of cure they will retain their rich natural colour, and have much of the original delicious flavour of the fresh fish; and will keep a very long time. The relative weights of fresh to cured fish is about the same as for other thoroughly dried fish.

Salmon are also smoked for market. For this style of cure they are split, cleaned, and salted as for kippering, but the rum mixture is not used. They lie overnight in the salt, and are then washed out, and being stretched on the willow frames, are hung on tenter-balks, and placed in an ordinary haddock or herring kiln, and wood-smoked till of the desired tinge of colour. They will keep a fortnight in summer quite good, and have much of the natural flavour coupled with that of smoke. The colour is likewise well retained, but, of course, deepened in tint. The relative weights of fresh to cured is much the same as for other smoked fish.

A single word to conclude with on the preservation of fish caught on the Scotch coasts at the hands of the preserved provision manufacturer, by close tinning and other treatment.

Although all of the fish caught on our coasts are so preserved, it is neither usual nor needful to be at this expense with such cured fish as thoroughly dried haddocks, cod, etc. Other forms of cure being less thorough in their preservative power, the fish so treated are subjected to the tinning process, and with extremely slight modifications, and these exceptions, the methods are identical for all fresh and cured fish.

The fish are cut, if too large for the tins, and being placed therein, a little water is added to most, and to all a small bit of butter or fine marrow fat. The tin is then closed by soldering on the lid, and being placed in a sling of hoop-iron, are plunged in the bath. This is a metal vessel containing boiling water. Various salts are, by some modes, added to the water, to heighten the boiling-point, but in most cases it is simple boiling water that is used. The tins are boiled in this two hours, and being withdrawn, are probed, to let the air escape. This done, they are soldered again, and replaced in the bath, and boiled an hour and a half, when the operation is finished.

IX.

SALMON LEGISLATION IN SCOTLAND

AT PRESENT APPLICABLE TO THE SALMON FISHERIES IN SCOTLAND, AND THE BEST MEANS OF IMPROVING IT.

By J. M. Leith, B.L.

Whether we look at salmon-fishing from a commercial point of view, or as the means of supplying to the public a valuable and delicious article of food, we cannot but be impressed with the necessity and duty of so regulating the capture and treatment of the fish as to preserve for the future, in at least undiminished quantity, the gift which Nature has so bountifully placed in our hands. The State has, from a very early period, recognised the stewardship imposed upon it by circumstances, and accordingly we find that the legislation inaugurated by so ancient monarchs as William the Lion and Robert the Bruce, has increased and multiplied during successive reigns until it has attained voluminous and decidedly unwieldy proportions.

The early Statutes, though most of them are still in force, are as a general rule practically inoperative, and it is therefore unnecessary to discuss them. The spirit of these Statutes, and the determination which they evince, especially with regard to unfair and severe modes of fishing, are, however, worthy of all praise.

Home Drummond's Act (1828).

Between 1705 and 1828—a period of 123 years—there was no Act passed relating to Scotch salmon-fishings. In the latter year an Act (9 Geo. IV. c. 39, still partially in force), generally known as Home Drummond's Act, was passed, containing several provisions for the preservation of salmon, chief of which was a postponement of the commencement of the annual close-time, and an extension of the whole period to 139 days. Previous to this, the close-time, though commencing earlier, had only extended to about 107 days, and was regulated by an Act of James I., 1424, c. 35. This Act of 1828 has been very generally condemned, as being most injurious to the fisheries, because it added to the netting-season at the end of the then existing open period, when netting was most destructive, and took from it at the beginning, when it was of little importance, and also, because it gave no extension of time to the upper proprietors for rod-fishing, after the nets were off, and so gave them absolutely no interest or encouragement to protect the fish while breeding in their waters. Three years before, a report by a Select Committee had been presented to Parliament, containing recommendations in every way superior to those in this Act, but for some reason or other it was not attended to. In the interval between 1828 and 1862 a great number of proposals were made, and bills brought in with a view of placing the laws of Scotland on a more satisfactory footing on the subject of salmon-fishing. Not till 1862, however, did the Legislature, or the promoters, succeed in passing an Act, and then only on giving up, perhaps, the most important reform of all.

Bill of 1861.

In the preceding year (1861) two important and comprehensive Salmon Bills came before Parliament, one for England, and the other for Scotland, both proceeding on the same lines, as recommended by special Commissioners and a Committee of the House of Lords respectively, and both directed, *inter alia*, against the use of "fixed engines." The Scotch Bill was thrown out, chiefly owing to the opposition of interested parties.

If the matter had been left to be fought out on the question of fixed engines, we should probably, even yet, have had no progress to report, but the Lord Advocate (Moncreiff) wisely determined to forego this point, for the time, in order to secure the enactment of other important and pressing improvements, and accordingly, in next session (1862), he brought in and passed a Bill for this purpose, taking care to provide that nothing in the Act should be held to legalise any mode of fishing which had before been illegal.

The Act of 1862.

This Act of 1862 forms the foundation of the present state of the law on salmon-fishing, and a short *résumé* of its provisions, to point out its main defects, will be in place.

Summary of Provisions.—The Act (1.) constitutes each river, with its tributaries, lakes, and estuary, and adjoining sea-coast, into a district; (2.) Appoints Commissioners to fix boundaries between estuaries and sea, and between upper and lower proprietors on rivers, limits of districts, and of annual close-time, and to make general regulations regarding cruives and obstructions, meshes of nets, and due observance of weekly close-time; (3.) Fixes annual close-time of 168 days for every district, and weekly close-time of 36 hours, with qualifications as to rod and line,—the annual close-time being applicable to every mode of fishing in river, lake, estuary, and sea, except rod and line, during extension to be fixed by Commissioners; (4.) Imposes penalties, with forfeitures of articles used, for fishing during close-time, or with illegal mesh of net; for obstructing or impeding passage of fish; for selling fresh fish taken during annual close-time; for taking or possessing foul or unseasonable salmon at any time; for fishing with lights; for setting nets or traps to catch fish leaping at a fall; for using or selling salmon-roe for purpose of fishing; and for polluting waters; (5.) Enjoins Commissioners to make bye-laws on matters committed to them, which (after certain steps) should have all the force of law; (6.) Provides as to election, constitution, and powers of District Boards; (7.) Declares illegal fishing by three or more persons at night to be a criminal offence, punishable by fine or imprisonment; (8.) Provides for prosecutions, and recovery and application of penalties and expenses; (9.) Extends the English Act of 1861, as to fixed engines, to the Solway after 1st January 1865,—a provision which, however, has not been carried out. The Act does not apply to the Tweed, with the exception of three sections, relating to illegal modes of fishing (saving clause), possession of salmon-roe, and poaching by three or more persons at night.

In pursuance of this Act, the Commissioners, after due and in some cases protracted inspections and inquiries, marked out 105 districts, to be supervised by the District Boards provided for in the Act, and made bye-laws regulating the various matters above mentioned (except obstructions).

Failure of District Boards.

There can be no doubt that the general effect of the Act of 1862 has been beneficial to salmon-fishing, but it has utterly failed in one of its chief purposes,—the establishment of an effective local supervision and control of the fisheries. The Act itself is partly to blame for this, and partly the proprietors of fisheries, who, for the most part, have shown a most discouraging apathy in taking up the duties required of them. Although 105 districts were constituted, so few proprietors came forward that only thirty-six boards were elected, and this small number has since been reduced to twenty-two,[1] or about

[1] There are, however, fifteen rivers in Sutherland, belonging to the Duke of Sutherland, who has by virtue of the Act all the powers of a District Board, and his factors act as clerks.

one-fifth of the number constituted, by the lapse of several Boards who had neglected to observe the triennial election prescribed by the Act. Some of the probable causes for this state of things are not difficult to ascertain. In the first place, the membership of the Board was not put on a satisfactory basis. An equal number of upper and lower proprietors, not exceeding three of each, was to be elected, but, contrary to the usual practice in similar associations of persons for any purpose, the chairman was not to be elected by the other members, but was appointed by the Act in addition to the elected members. The largest proprietor in the district was to be *ex facto* the Chairman of the Board, with both a deliberative and casting vote. The unwisdom of this policy is manifest. Looking to the long-standing antagonism and jealousy between upper and lower proprietors, it might have been anticipated that the former would resent the establishment of, and would at least not cordially carry out, a system which placed all the power in the hands of the lower proprietors,—for, of course, the largest proprietor is always a lower proprietor,—and gave the upper proprietors less hope than ever of seeing their grievances redressed. This jealousy, and other local influences, have had full sway, and, as the sequel has shown, have effectually blocked the way of all real improvement in many cases, owing to the absence of the impartial mediation and control of permanent inspectors. Then, in order to provide funds for the necessary expenses of watching and prosecutions, and of administration generally, the Boards must impose assessments on themselves and the other proprietors, if any, in the district, according to the rental in the valuation roll.

Another mistake was made in constituting every river in Scotland into a district, which should have a Board of its own, quite regardless either of geographical considerations or of the value of the fishings. In many remote districts of the country, where possibly the proprietors are few and far between (making united action virtually impracticable), it is quite impossible, without great expense, to prevent illegal fishing, or indeed to regulate the fishings at all. In such cases, where the proprietors could never hope that the benefit to be derived would even counterbalance the expense and trouble to which they would be put, there was no inducement to form a Board. And what would have been the use of forming Boards for rivers where there was not, and had not been for years, a salmon to look after? It is quite plain that the Commissioners should have had power to arrange or combine districts according to their own judgment. Again, the powers given to Boards were far too much restricted, rendering them in a great measure powerless to prevent many abuses, as those which have been constituted have found out—the result being that they often remain entirely inactive, and the law-breakers are encouraged accordingly to persevere in their evil doings.

We find a contrast to this unfortunate state of affairs if we cross the Border. In England there is an efficient Board of Conservators in every district, although the system was of later introduction by three years than in Scotland. True, there are only forty-four districts in England, and except in a few cases in Wales (where the "Rebeccaites" have now and again distinguished themselves), they are all within easy reach. But there are other reasons for the marked difference of efficiency in the two countries, and in the forefront of these must undoubtedly be placed the fact of the existence of permanent Government inspectors[1] at an adequate salary, who exercise a continual control over the whole fisheries, and support and advise the local conservators in the execution of their duties, and to whom the latter make annual reports—they themselves in turn being under the necessity of rendering an annual report to the Home Secretary.

The constitution of these Boards of Conservators is regulated on a satisfactory basis, and they, as a rule, work together in harmony. The tacksmen of fisheries are represented in proportion to the rent they pay. The Boards have powers which make them more than a mere name, including power to make bye-laws for the better protection, preservation, and improvement of the salmon-fisheries within the district. Again, they are not obliged themselves to subscribe the necessary funds for carrying out the law, but obtain them from a system of licences, graduated according to the mode of fishing.

Abolition of Fixed Engines in Estuaries.

Perhaps the most important result of the Act of 1862 (except perhaps the alteration of the close-time) which has actually been attained, is the abolition of stake and bag nets, or other fixed engines (except cruives), in the estuaries of rivers. The old Scotch Statutes prohibited all fixed engines in waters where the sea ebbs and flows, and this rule had been confirmed by decision, and also by legislation, in the case of the Tweed and one or two other rivers. In the absence, however, of any

[1] Since this was written, and under the Act to establish a Fishery Board for Scotland, passed in August 1882, which came into operation on October 16th the same year, Mr. Archibald Young, advocate, formerly Commissioner of Scotch Salmon Fisheries, has been appointed by the Secretary of State Inspector of Salmon Fisheries in Scotland. The Act says:—"The inspector shall, under the directions of the Fishery Board, inspect all the salmon fisheries of Scotland, and inquire into the operation of the Salmon Fishery Acts, and report thereon from time to time to the Board, and shall attend the meetings of the Board when summoned by the Chairman.'

authoritative definition of the limits between estuary and sea, estuaries had become more and more encroached upon by fixed-net fishers, with the result of more or less seriously deteriorating the fishings in the rivers. The fixing of the limits of estuaries by the Commissioners removed all possibility of excuse for these interlopers, but the Act is deficient in not providing penalties for using fixed engines within these limits or on rivers. Consequently the offence, which is by no means unknown, cannot be prosecuted by District Boards, but must be left to private prosecution by a proprietor.

Extension of Close-time.

The extension of the annual close-time from 139 to 168 days, and of the weekly close-time from 24 to 36 hours, was undoubtedly a great improvement, and has tended much to the good of the fishings. The effect would no doubt have been more marked had the provisions been carried out in their entirety, but there is good reason to believe that the law is evaded in many instances, more particularly in the case of stake and bag nets, and perhaps also cruives, which are not, as a rule, very easily supervised. The extension of time allowed for rod-fishing does something to enlist the interests of the upper proprietors in the protection of the fish while in their territories during the breeding season.

There are several minor defects in the Act which might have been avoided, if the immediately preceding English Act and the Tweed Acts had been properly kept in view, which contain many useful provisions left out of the Scotch general Act. For example, the 1862 Act provides for no increase of penalties for repeated offences, except with regard to pollutions; foul or unseasonable fish could not be seized and forfeited, and a cumulative penalty of £2 for each fish could not be inflicted, unless fish could be proved to have been taken as well as "in possession;" the use of a leister was not prohibited in the day-time; articles used and fish taken by night-poachers could not be seized and forfeited. These omissions, however, were all supplied by the subsequent Act of 1868, but there are still a few others to set right.

Omission of "Poaching."

The great evil of poaching was not taken up by the 1862 Act at all, except with regard to night-poaching by three or more persons, and it is still regulated by the 1828 Act and the general Poaching Act, 7 and 8 Vict. cap. 95. It would have been well to have followed the example of the Tweed Acts in this also, as it is much more convenient to have all the provisions relating to the subject in as few Acts as possible. The still greater evil of pollution was taken up, but all the legislation on this point, whether in Salmon or other Acts, has hitherto proved practically abortive, though it is not for the want of the enactment of penalties, sometimes severe. So far as salmon are concerned, the powers given to District Boards are totally insufficient to enable them to cope with the matter; they have not even the common-law powers which individual riparian proprietors have to prevent pollution by upper heritors.

Summary of Act of 1868.

With the exception of two short Acts continuing the powers of the Commissioners, and making certain regulations regarding District Boards, and the Salmon Exportation Act (United Kingdom), no Act relating to Scotch salmon-fishings was passed till 1868. In that year an Act was passed of some length, but of comparatively little importance. It contains a good many provisions regarding District Boards, though it gives them no real increase of power. A considerable portion of the 1862 Act is re-enacted, with numerous small improvements in the way of diction or arrangement, so as to give a wider application, and the omissions already alluded to are corrected. The powers of officials under the Act are somewhat amplified with regard to offences, and removal of all nets and implements is ordered, on the expiry of the open season for fishing. This last regulation was very necessary, as it had been found that fishing often went on, particularly with stake and bag nets, for some time after the commencement of the close-time, the difficulty of detection enabling it to be done with comparative impunity. Even yet, transgression of the law is not unknown. In connection with this, an inconsistency deserves to be noticed. Under § 15 of the Act of 1868 a breach of either annual or weekly close-time is punished by a fine of £5, with supplementary penalty of £2 for each fish taken, and optional forfeiture of nets, etc., while, under § 24, it is also provided that failure in due observance of weekly close-time shall involve on each occasion, in addition to forfeiture of nets, a penalty of £10 for each net in use, and also £2 for each salmon caught. There is nothing to show why the penalty under both sections should not be exacted for breach of the weekly close-time, but, in any event, the penalty exigible is greater than for breach of the annual close-time. Of course if the nets, etc., used in fishing are not removed within thirty-six hours after the commencement of the annual close-time, in compliance with the twenty-third section of the Act, a penalty of £10 for each day during which any article shall remain unremoved, together with forfeiture of nets, etc., is incurred; but even in this case the penalty is less, because there is no supplementary penalty of £2 for each fish caught. This anomaly should be done away with.

Commissioners' Report of 1871.

The Government appointed, in 1870, a Commission, consisting of Mr. Buckland and Mr. Archibald Young, to inquire into and report upon the effect of the Acts of 1862 and 1868. These Commissioners issued their Report in 1871, and it still remains the most recent official document on the subject of Scotch salmon-fishings. The Report is a most valuable document. The Appendix contains a mass of evidence upon all the questions put before the Commissioners by the Home Secretary.

Suggestions for Improvement of Law.

In suggesting improvements on the present state of the law with regard to salmon-fishing, to be embodied in a new Act, it will be impossible to avoid traversing, in great part, the ground which has been already gone over by various authoritative writers, notably by Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries, whose long and extensive experience attaches weight and importance to his numerous writings. The patent character, however, of most of the reforms about to be suggested, as well as of the defects in the law already alluded to, will absolve the writer of this paper from any charge of appropriation.

Consolidation Act.[1]

The first thing to be done in framing a new Act, though it has nothing to do with the preservation of salmon, is to repeal

[1] The following are the recommendations with regard to a Salmon Fisheries Consolidation Act contained in the Report of 1871 by Messrs. Buckland and Young:—"It seems worthy of careful consideration, in contemplation of another Scotch Salmon Fishery Act, whether it would not be better, instead of making it an amendment of the general Acts of 1862 and 1868, to make it a totally new and independent measure, repealing the mass of legislation that at present applies to the subject, and embodying as clearly and shortly as possible the provisions that are considered most essential for the protection and development of the fisheries. At present there are many Scotch Statutes wholly or partially in force, as well as more recent Acts; while on the Solway there are—besides certain ancient Scotch Acts—the Solway Act, the Annan Act, the English Acts of 1861 and 1865, and the Scotch Acts of 1862 and 1868. Acts have been added to Acts, and amend-

all prior Statutes, and consolidate in one Act all the previous legislation which it is desirable to retain, with the amendments and additions to be made. The omission to adopt this course was a serious defect in the Act of 1862, and the result has been that there are now a considerable number of old Statutes wholly or partially in force, most of the provisions of which have been superseded, though not repealed (except perhaps by implication) by that Act. Such a state of affairs can only be productive of confusion and uncertainty as to what is legal and what is not, and in fact is an indirect incentive to breaking the law. The framers of the English Act, passed only in the preceding year, took care to sweep away all its predecessors.

Appointment of Inspectors.[1]

The greatest and most necessary reform of all is the appointment of permanent Government inspectors to supervise the fisheries throughout the kingdom, to advise with District Boards and counteract local influences; to act where there are no District Boards; to make arrangements for the collection of statistics, and the rendering of annual reports by the Local Boards; to make annual inspections of all the districts, and present reports to Government; and generally to make and enforce bye-laws and regulations for the fishings, as occasion arises, with appeal to the Secretary of State, or to the Fishery Board for Scotland, if that should be thought necessary. There have been in England since 1861, and in Ireland since 1863, Government inspectors with all the powers above mentioned, though, as has often been pointed out, the Scotch salmon fisheries nearly approach the value of those of Ireland, and are three times as valuable, according to the latest returns, as those of England. And so in England the value of the fisheries has increased from £18,000 in 1863 (two years after the appointment of inspectors), and £30,000 in 1865, to £100,000 in 1880, while in Scotland, though there may have been some increase, it has by no means been in the same ratio. Scotland should have inspectors with all the powers presently enjoyed by the English and Irish inspectors, and indeed these powers might advantageously be extended in

ments piled on amendments, until, in the multiplicity and confusion of salmon legislation, it is difficult to know what is legal and what illegal, and what to do and what to avoid. It is time that such a state of things were remedied. There may, indeed, be much doubt and difference of opinion as to the proper remedies to apply, but some progress towards a cure would surely be made by sweeping away the complicated legislation that at present embarrasses the subject, and embodying in a single new Act all the points essential to the development of the Scotch Salmon Fisheries."

[1] See note, page 134.

some directions, as with regard to fixing of the length of the annual and weekly close-times, the compulsory removal of obstructions, etc. In England the annual close-time, though nominally only 154 days, may be extended or varied by the Home Secretary, and in Ireland the inspectors are only limited to a *minimum* of 168 days. An appeal to the Secretary of State should not be necessary except on very important points (which might be specified or indicated), for, as a general rule, the Secretary of State, even with advice, is not so well able to judge as those whose opinion he is asked to review, and the necessity of waiting for his confirmation is often productive of very great delay in carrying out important changes. If the discretion of the inspectors could not be trusted where no important private interests were at stake, recourse might be had to the Sheriff of the county concerned, instead of to the Home Office.

"*Fixed Engines.*"

We now come to "fixed engines," which, together with pollutions, share the unenviable distinction of being the most destructive agency affecting the salmon-fishings of the whole kingdom. It was very early discovered that the use of fixed nets and engines in rivers exercised an injurious effect upon the development of the fisheries, and in fact that it promised, if unrestricted, to exterminate salmon altogether. Therefore, as we see by the old Statutes before referred to, fixed engines were sternly and forcibly prohibited both in rivers and estuaries, and this prohibition has been confirmed by modern judicial decision, and also by Statute, except with regard to a certain limited number of cruives and yairs, which exist by virtue of special grant from the Crown, and cannot be abolished without compensation. About sixty years ago, however, it was discovered that nets fixed on the sea-shore were quite as productive as they had been in the rivers, and accordingly in a comparatively short period the whole coast bristled with them, altogether irrespective of right to fish for salmon. They have somewhat decreased since then, because in many cases it was found unprofitable to work them, but they still exist in large numbers, and, judging from the weight of evidence and authority which is accessible on the point, they are prejudicial to the increase and preservation of salmon, and, if they cannot be altogether abolished, they should be placed under much more stringent regulations. It is urged on their behalf (1.) that they are established by prescription, and cannot therefore be abolished without compensation; (2.) that to abolish them would seriously affect the food supply of the country from this source; (3.) that though they may diminish the number of fish which reach the rivers, they cause no decline in the total number of fish caught annually, and further, that the fish which they catch are in better condition than those in the rivers; and (4.) that no other method of fishing with profit is available in the sea. The first of these pleas is a very plausible one, and no doubt will be very difficult to get over. Prescription, however, cannot run against Statute; and though fixed nets on the shore are not specifically mentioned in the old Statutes, we ought to hold them included, because the spirit of the whole legislation is so clearly and forcibly directed against that mode of fishing as being unfair and destructive, that we cannot doubt that the prohibitions would have been extended to the sea, had fixed nets been in existence there at the time. Remedial Statutes must receive a liberal interpretation. These old Acts prohibit all fixed engines in the "run of the fish." The natural history and habits of the salmon were not then well known, and the legislators were totally ignorant of the fact that the sea-shore was as much the "run of the fish" as the river. In no charter granted is any such mode of fishing authorised or contemplated, and the proprietors of fixed nets have simply erected them without any right to do so, and on chance of no one interfering. It was in the rivers that salmon-fishing was originally recognised as property, long before even a coast charter was granted (in 1603), and no person had at any subsequent time a right to encroach on this private property. That is exactly what the fixed-net fishers on the coast have done however, with the result that what was once a valuable possession has in many cases become useless, and no compensation has ever been paid to those deprived of a considerable portion of their income, in securing which often a large amount of capital had been sunk. It is difficult to see what better claims to compensation those persons would have for the abolition of a practice which was really illegal at first, and which has only acquired a semblance of right because, owing to the uncertainty of the law and the want of proper opposition, it has been allowed to exist beyond the prescriptive period. The appropriation of the waters of rivers and streams by manufacturers without any title, and totally oblivious of the rights of others, is a case on all-fours with that under discussion. Their doing so destroyed in many cases the fishings enjoyed by riparian proprietors, and deteriorated in all cases the value of the land through which the streams passed; but for want of proper challenge, and a notion that it would not do to interfere with industry, the illegal encroachments were allowed to go on till they obtained a hold which it is difficult now to shake off. The dispossessed proprietors got no compensation here either. No doubt many of the present proprietors of coast fisheries have paid large sums for their fishings in the belief that they were legal, and it might be hard to punish them for the fault of their predecessors. These cases might, perhaps, receive extra consideration, but they do not affect the public question of the legality or illegality of the fixed nets, and if that question were decided against the legality, there can be no doubt that there would be no right to compensation. On the contrary, there would arise claims of damages on the part of those who had suffered from the usurpation.

There is a strong preponderance of evidence and presumption that these nets were unlawfully erected at first against the spirit, if not the letter, of the Statutes, and that therefore prescription should not be held to legalise them. Besides, prescription properly only applies to private rights, and has never been, and is not now, admitted where it is "hurtful to the commoun weill."

The argument that the abolition of fixed nets would seriously reduce the food supply of the country, supported as it is by the high authority of the Commissioners of 1870, is, of course, entitled to greater consideration.[1] But it is fair to state

[1] In their Report, published in 1871, the Commissioners write as follows with regard to this *quæstio vexata* of fixed nets:—"With regard to the present position of fixed nets generally, it is believed that while it would not be expedient to abolish them entirely, as some have proposed, it would certainly be advisable to regulate and restrict them. There are at this moment more than 200 proprietors of salmon-fishings on the sea-coasts of Scotland, worked by means of fixed nets, which provide for the market a large and steady supply of salmon in the best possible condition, and fetching, in consequence of their higher condition, a larger price than salmon caught in fresh water. It is plainly, therefore, not for the interest of the public—though it may be for that of the river proprietors—that this large and steady supply of a wholesome and nutritious article of food should be stopped; and it is vain to suppose that an increase in the river fisheries would ever compensate, either in quantity or quality, for the loss of the salmon supply that would inevitably result from the total suppression of fixed engines. But while this is true, it is, at the same time, undeniable that, in many cases, the existing bye-laws allow stake and bag nets to be placed much too close to the mouths of rivers—in some instances within 400, 300, 200, and even 150 yards of the middle of the channel where the river joins the sea. Fixed nets in such positions are most injurious to the fisheries, and most unfair to the upper proprietors. We consider, therefore—*1st*, That no stake or bag nets should be allowed within half-a-mile of the mouth of any river, and that in some cases it would be advisable to remove them to a distance of two miles; but the distance to which they should be removed would depend very much on the size of the river, and the configuration of the coast; *2d*, That no fixed engine should be permitted *between* the mouths of rivers that fall into the sea so close to each other as the Ayr and Doon in Ayrshire, and the Dee and Don in Aberdeenshire; *3d*, That there should likewise be some restriction on the number of stake or bag nets allowed along a certain stretch of coast. At present a single bay sometimes contains forty or fifty such nets, and these are frequently joined so as to form a continuous wall of netting extending seaward from high-water mark for 1500 feet; *4th*, That the junction of stake and bag nets should be prohibited. Stake-nets should be allowed on the shallow shores, to which they are suitable, and bag-nets on the steep rocky coasts, where the depth of the water prevents the use of stake-nets; but two or three bag-nets stretching out into deep water beyond the end of a stake-net which occupies the whole space between high and low water mark should not be permitted; *5th*, That the number, position, and extent of the existing fixed engines should be officially registered, and that no addition to their number should be permitted without the consent of the Secretary of State."

that there is a good deal of evidence on the other side, and it is backed up in many cases by actual proof. A useful pamphlet, published by Mr. Alexander Jopp in 1860, contains a large quantity of valuable statistics relating to the Aberdeenshire fishings bearing upon this point. It is shown conclusively that salmon had greatly decreased, both in number and weight, since the introduction of stake-nets, though of course his results referred more particularly to the rivers, and not to the sea. But the number of boxes of salmon exported tells the same tale, and a stronger proof still that the total number of fish is diminished by stake-nets, is derived from the fact that several proprietors of fixed nets on the coast obtained a large increase of the rentals of their whole fisheries by giving up these fixed nets. The Duke of Richmond, for example, increased his rental from £6000 to £13,000 in eight years by removing his fixtures at the mouth of the Spey, and the Duke of Sutherland and Earl of Fife, by adopting a similar policy, attained similar results. There are proofs of the same kind in connection with the fishings on the Solway and elsewhere. Not only therefore do fixed engines diminish the number of fish which reach the rivers, but they diminish the total annual number of fish caught, and the statistics of the present day bear out, on the average, those just referred to in this conclusion, though of course there are also other causes at work, and considerable fluctuations. It is undoubtedly the case that fish taken in the sea are in superior condition to those caught in fresh water, but of what avail is that if we take them in such numbers that there will soon be no more left to be caught? In some places on the coast no other mode of fishing is properly available except fixed nets, but the same may be said of the rivers, and yet fixed engines have been abolished there without compensation. The assertion that no other mode can be followed with profit is subject to qualification—it should be with so much profit—seeing that the capital is also encroached upon to a greater or less degree. Besides, from the point of view of the public interest, these stake and bag nets are objectionable on account of the expense involved in working them, which considerably increases the price of the fish to the buyers. I have seen various estimates of the difference of cost of working stake-nets and net and coble, and it is in all cases very marked.

Many exhaustive inquiries have been instituted by Parliament on this subject, and the almost invariable result has been that Commissions and Committees have recommended that fixed engines should be entirely suppressed, and accordingly suppressed they have been in England, and in Ireland at least checked and strictly regulated. But if it should be deemed inadvisable to put them down altogether in Scotland, they can and ought at least to be placed under strict regulations, and adequate measures taken to insure that these regulations are carried out to the letter, and in this view the suggestions contained in the Special Commissioners' Report of 1871 (see footnote, page 141) are admirable, and should be adopted. The distance from the mouths of rivers, however, recommended by the Commissioners, might with advantage be extended in most cases, including the Tweed, to from one mile to three miles, according to the configuration of the coast; stake-nets should in no case be allowed to extend further than from high to low water mark, and bag-nets, in addition to being restricted to steep rocky coasts, and not allowed to be joined to stake-nets, should not be permitted within three miles of the mouth of any river. This is the law in Ireland as to stake and bag nets. Very severe penalties should be enacted for breach of weekly or annual close-time, as there is reason to believe that in many cases at present the law is simply ignored, and if any complaint is made, stress of weather or absence of employees is pleaded. It has been suggested that in any case where stress of weather prevents the due observance of the weekly close-time, the owners or tacksmen of the nets should be bound to report the matter to the Chief Constable of the county, or other official, and satisfy him that the nets were closed for fishing for an equal period when the weather allowed it; also that the close-time should be by tides and not by hours, as is already the case in the Tweed.

With regard to reducing the number of fixed engines now plying, a great deal of power rests with the Crown as owner of all the fishings on the sea-shore ungranted, and surely the public are entitled to look to the Crown to exercise that power. (1.) If the Crown were to carry to its legitimate issue the inquiry set on foot in 1859 as to the titles of all persons exercising fishing on the sea-shore, a large number of persons now fishing without a title would be turned off. (2.) Every proprietor whose title had been examined and found satisfactory should be entered on a register (a copy of which should be supplied to District Boards), and a certificate to that effect should be granted him by the Commissioners of Woods and Forests, which he should be bound to exhibit at all times when asked by proper authority, care being taken, of course, to provide that this was only a certificate of title, and not of legality of any mode of fishing. (3.) After a reasonable interval to allow proprietors to send in their titles for examination, it should be declared that all persons not in this register, and not provided with certificates of title, should be liable to prosecution and penalties for illegal fishing, which should be rigorously enforced. Any proprietor producing a good title after prosecution instituted to be liable in all expenses. (4.) In all the fishings which would thus lapse to the Crown, and all those presently in its possession, let or unlet, the Crown might be expected to forego making profit at the expense of the public good, and prohibit the use of fixed nets to all its lessees. If these suggestions were carried out the number of fixed nets would be greatly reduced, and it would then become much easier to make regulations regarding the number of nets to be allowed on a certain expanse of shore, distance from rivers, etc.

Pollutions.

Pollution has arrived at such a stage that the Legislature cannot longer delay applying stringent remedies. Notwithstanding all the Acts that have been passed with regard to the preservation of fish, removal of nuisances, and river pollution generally, and also in spite of the common law, legislation has proved well-nigh a dead letter, and the evil is increasing day by day. The longer, too, it is allowed to go on without being effectually checked, the worse it will be to put down when the attempt is actually and earnestly made. There is scarcely a river in Scotland which is not made a common sewer of to a greater or less extent, killing all the fish, and making the water totally unfit for primary purposes. Things ought never to have been allowed to come to the pass they have reached. The health of the community ought to be the first consideration, not to speak of fish life at all, and it is difficult to see how it will ever be possible to stamp out those zymotic diseases which are the scourge of the country until pollution of rivers is put down with a strong hand. It is a great question no doubt, but it is perfectly possible to handle it. It has been shown over and over again, both by the Rivers Pollution Commission and other competent authorities, that there are plenty of means whereby the noxious matters may be entirely destroyed or removed in the manufactories, or in sewage works, so that the liquid which is ultimately allowed to flow into the river is rendered entirely harmless. It is not expected that profit can be made out of these methods of purification, but manufacturers ought to be very thankful if they can destroy or use up the noxious matters on their own premises without any cost to themselves. Let it cost them what it may, there ought not to be a shadow of doubt that they should abstain from polluting any stream so as to deteriorate it even slightly for primary purposes, or render it injurious to fish life.

The cost of purifying sewage must, of course, be borne as a tax by the inhabitants of the town or district concerned. In connection with this branch of the question, there is an interesting paper by Lieut.-Gen. Sir J. E. Alexander, C.B., printed in the Appendix to the first Report of the Scotch Fisheries Improvement Association, giving an account of the Sewage Purification Works at Hawick, from which it appears that the sewage, both from the town and the mills, is so treated that the liquid entering the river is perfectly innocuous to fish life when mixed with 9-10ths of river water to 1-10th of sewage, and the engineers state that the outflow from the purification works during the day is about 1-20th of the minimum flow of the river, or 1-40th of the average summer flow, leaving floods out of account. The cost to the ratepayers is from 4d. to 5d. per £. When one town can attain these results, there is no reason why all should not do so. The same Report contains a short account by the late Sir Robert Christison of a method by which paper-manufacturers, or others, instead of using and polluting the large quantities of water which they do at present, could effect their purposes quite as well by using very small quantities, so that evaporation would be rendered easy, and the residuum could be burnt up with the waste heat of the works. But there is no lack of methods if the manufacturers will only adopt them, and if they will not do so spontaneously, then the law must step in. Of course, this question is of too much importance to the community at large to be entirely disposed of in a Salmon Act. There must be an Act solely dealing with the whole subject of pollutions in all its bearings, and that in no half-hearted manner. Any new Salmon Act, however, should contain stringent pollution clauses, and give powers to District Boards and inspectors to deal with the matter in a way that will be effectual. Very heavy penalties should be enacted, and where there is good ground of suspicion, as shown by samples of water, dead fish, or absence of life generally, the onus should be laid on the manufacturers to prove that the water was not polluted to an extent injurious to fish life, or rendered unfit for primary purposes, and if the offence is repeated, in addition to increased penalties, power should be given to cut off the water supply altogether, where it is taken from the river, or indeed wherever obtained. For persistent repetition of offences, the penalties might even be allowed to culminate in a power of imprisonment, if nothing else would do. The sewage of towns might be dealt with by ordering every town to construct sufficient purification works within a certain limited period, under penalties to be laid on the individual members of the Corporation for failure to do so.

In any new Salmon Act, of course, the correction will not be forgotten of the careless error made in the 16th section of the 1868 Act, which, while taking out of the 13th section of the Act of 1862 a re-enacted provision as to pollution by sawdust, leaves half of the clause which belonged to it, with the result of making it necessary to prove that poisonous matters are discharged into a river "to an extent injurious to any salmon-fishery," a reading which is evidently absurd, but which has nevertheless done great harm.

Mill-dams, etc.

Manufacturers are largely responsible for yet another serious interference with salmon interests, but fortunately there is reason to hope that this may soon be brought within satisfactory limits. I refer to obstructions in the bed of streams for milling and manufacturing purposes, which prevent the fish from getting up to the spawning-grounds.

Before the Act of 1862, the construction of dam-dikes was regulated by the Act 1696, c. 33, which provided that there should be a constant "slop" in the mid-stream of each mill-dam dike, as wide as convenient, without prejudicing the going of the mill, and prohibited all fishing at these dikes. The 1862 Act gave power to the Commissioners "to make general regulations with respect to the construction and alteration of mill-dams, or lades, or water-wheels, so as to afford a reasonable means for the passage of salmon," which they did accordingly by bye-law (G.) annexed to the Act. With regard to this bye-law, Mr. Stewart, in his *Treatise on the Law of Scotland relating to Rights of Fishing*, says: "It will be observed that the Commissioners' bye-law leaves existing mill-dams, etc., as they are, and, however obstructive they may be to the passage of the fish, no alteration in them is required, until a reconstruction is undertaken by the proprietor; then, and then only, must the regulations of the bye-law be given effect to." This does not seem exactly correct. It is only the first paragraph of the bye-law, relating to the making of dams water-tight, that refers to new dams, or dams requiring to be renewed or repaired. It is not clear that there is any authority for applying this restriction to any other paragraph in the bye-law, in which the expression used is always "every dam," "every mill-lade," etc., etc. This difference is particularly of consequence with regard to salmon passes or ladders, which are to be "on the down-stream face of every dam, weir, or cauld." This distinctly includes every dam, etc., whether new or old. The District Boards, therefore, have full power to insist on salmon-passes being placed in every dam or weir in any salmon-river in the country, and it may be observed that it was decided in the case of Kennedy of Dunure in 1869, that the Commissioners had power to make regulations affecting all dams or weirs, whether in course of being constructed or repaired or not. If there is any doubt on the point, however, it should be removed in any new Act. There are still many dams in existence with no passes at all; others where the pass made is quite insufficient, and others still where the pass makes a greater obstruction than existed before, although this is in express contravention of the last paragraph of the bye-law; and in all such cases the powers of District Boards should be put into use, and would, no doubt, prove sufficient, though they should, in addition to statutory powers, have the common law powers of riparian proprietors to put down obstructions. But there is still room for improvement in the regulations as to artificial obstructions, and many valuable suggestions have been made. The Commissioners allow a gradient of 1 in 5, which experience has shown is too steep. It should never be greater than 1 in 9, or 1 in 8. It seems worth consideration whether, in cases where an easy gradient is difficult or impossible to obtain, it might not be advisable to make a hole in the weir, to act as a pass. This plan has been approved of by a good many experienced persons, though some think it would not do. It has been considered quite feasible, however, with regard to natural obstructions, as will be seen from the Special Commissioners' Report of 1871. The dimensions, etc., of the hecks on mill-lades fixed by the Commissioners in their bye-law have been proved to be insufficient, especially to prevent smolts getting into the intake lade, and eye-witnesses have stated that they have seen the bottom of some lades absolutely whitened with the bodies of unfortunate smolts killed and mutilated in all sorts of ways by the mill-wheel. Smolt-proof guards should be placed on every intake-lade, and the tail-race should also be protected against ascending fish. As Mr. Young points out, there is a clause relating to gaps in fishing-weirs (which were not affected by the Commissioners' bye-laws) in the Irish Act of 1863 (§ 9) which might advantageously be adopted in a Scotch Act. All dams and weirs, whether old or new, industrial or fishing, should be made water-tight; and it should be compulsory to shut the sluices of intake-lades on Sundays or when the mills are not working. At present much water is wasted because this precaution is not taken. Cruive dikes should also be made water-tight. Any destruction of fish-passes, whether for the purpose of preventing fish passing or not, should be added to the offences in § 15 of 1868, as it is not uncommon for rod-fishers to stand on the steps of ladders in order to get a convenient spot for a cast.

There are a good many natural obstructions on the Scotch rivers, which shut up large tracts of spawning-ground, but it is difficult to deal with these. While it might be too extreme a step to give power of compulsory removal of these unless there was clearly no destruction of amenity, compulsory power might certainly be granted to attach fish-passes to all those where it was practicable. If any questions should arise such as are indicated in the Report of 1871, they might be settled by the Crown giving a right of salmon-fishing to the upper proprietor.

As every dam or weir is more or less differently situated as to circumstances affecting the passage of salmon, and no hard and fast rule can therefore be laid down as to construction of ladders, etc., it should be provided that no ladder or pass should be constructed until plans had been laid before and approved by the inspectors, and that it should be constructed at the sight and to the satisfaction of the inspectors, or some person delegated by them for the purpose. This would avoid the possibility of placing ladders in wrong places, and other mistakes which have been common. It should be clearly laid down who is to place, pay for, and maintain these passes, hecks at mill-lades, and other alterations on dams and obstructions. A bye-law should be made on the subject of obstructions other than mill-dams, etc., and compulsory power might be given to purchase, at so many years' purchase, all non-industrial obstructions presently existing by charter.

Annual Close-time.

The annual close-time is susceptible of improvement. The hard and fast period of 168 days, though it works well on the whole, is in some cases more than enough, and in others less than enough. There are early rivers and late rivers, and experiment has proved that the natural condition of these cannot be altered, as we can easily understand, if Mr. Archibald Young's temperature theory[1] be correct, which seems very probable. The period ought certainly to be made not less than 168 days, as in Ireland, though a discretionary power might

[1] In the *Scottish Meteorological Journal* for 1879 (pages 258, 259) this theory is explained by Mr. Young in the following terms :—"The theory is that the earliness or lateness of a salmon river is dependent on the relative temperatures of the river water and of the sea into which it falls. The Scottish rivers flowing into the German Ocean are almost all early rivers. They have comparatively long courses, and fall into the sea at considerable distances from their mountain sources, after running, during some part of their career, through districts not greatly elevated, and possessing a moderate climate. But the German Ocean, into which these comparatively warm rivers flow, is a cold sea, and the slight difference between its temperature and that of the rivers running into it in winter and spring induces the salmon to ascend early. Take the Tay for example. It is well known that salmon run into it in great numbers in the months of December and January, so that, when the fishing begins in February, Loch Tay is fully stocked with clean and heavy fish. On the west coast, on the other hand, the rivers that fall into the Atlantic are all

safely be left with the Commissioners to make it less in exceptional cases, after careful inquiry.

Weekly Close-time.

The weekly close-time is too short—it should be extended to 48 hours. There is an almost universal consensus of opinion on this point. The amendment would act beneficially in more ways than one,—it would allow more fish to get to the spawning-beds, and it would still further enlist the protection of the upper proprietors by introducing more fish to their waters. The Irish close-time is 48 hours, and the English was made 48 by the House of Commons, though reduced by the House of Lords to 42. It is well worthy of consideration, also, whether the whole period of 48 hours should not be made to commence at different times in the upper and lower netting portions of rivers. It seems of little use to let fish pass one series of nets if they are to be caught in another series higher up, because they have not had time to get further. This plan, which goes by the name of a "double slap" has received the approval of several experienced fishers.

Poaching.

Sufficient poaching clauses should be introduced into any new Act, with penalties which shall act as deterrents. Poaching goes on in many districts at present with impunity, notably on the Tweed and on the west coast of Argyllshire. When committed in close-time the penalties should be cumulative—both for fishing without a title, and for fishing in close-time. Power should be given to watchers and police to stop and search all suspicious persons, and everything belonging to them, wherever found, without a warrant, and, if fish is found in their possession, they should be held guilty of contravening

late. They have short courses, and their sources are much silted up, as they rise in that lofty and singularly picturesque chain of mountains which, beginning not far from Cape Wrath, skirts the coasts of Sutherlandshire, Ross-shire, and Inverness-shire for more than 100 miles, at distances varying fom 5 to 20 miles from the Western Sea. In winter and spring these mountains are snow-clad, and every partial melting of their snows brings down torrents of ice-cold water, which run through the short channels of these rivers into the sea. But the water of that sea, unlike that of the German Ocean that washes our eastern shores, is warmed by the soft influence of the Gulf Stream, and the salmon, consequently, remain in it until the snow-water has run off, and the milder weather of May and June has raised the temperature of the river waters, and then they begin to ascend. This marked difference in the physical characteristics of the rivers of our eastern and western seaboards is very clearly shown in the hydrographical map prepared for the Rivers Pollution Commissioners, which faces page 24 of their sixth and last Report."

the Act, unless they can prove that they came by the fish legally. It is thought this would be an improvement on the 25th section of the Act of 1868. The impunity with which poachers are allowed openly to carry on their practices on the Tweed is equalled, if not surpassed, in the case of the "scringers" on the west coast of Argyllshire. Seeing that there is so much difficulty in catching these people in the act, other methods must be adopted, as, although the law has made what would appear sufficient provision for dealing with the offence, it seems to have proved of little use. What is necessary, is some plan to prevent the disposal of the fish, which at present seems as easy as in the case of fish legally taken. If every box or package of salmon entered for transmission at a railway station, or harbour, had to have an official permit or brand affixed to it, without which confiscation by the railway or harbour officials would be compulsory, and if no unpacked salmon were allowed to be sold at any quay, or to any person without the production by the seller of a licence by the Chief Constable or District Board, showing that he was legally entitled to fish salmon—the buyer to be punished equally with the seller for breach of this regulation—a sensible diminution of the reprehensible practice would soon be effected, at least in the more serious cases. If a compulsory registration of all owners and tacksmen of fishing were enacted, this plan would simply be an offshoot of that system, and it would not be found difficult to carry out in practice. Poachers are almost always well known to the watchers and police, and special attention could be paid to their movements. Any legal dealer who might be disposed to assist the poachers might be subjected to such a heavy penalty as not to make it worth his while to run the risk. Adopt what precautions one may, however, the law will be evaded in some cases, but the risk of detection and the severity of punishment can at any rate be augmented. The absence of District Boards in so many districts of course tends to leave poachers in comparative freedom, but by the appointment of inspectors, and the reconstruction of Boards with the proper powers, this state of affairs may be materially changed.

It is difficult to see why there should be any difference in the law relating to poaching salmon and that relating to poaching game. Yet there is a great difference. The latter offence is punished by three months' imprisonment without the option of a fine, which may be increased on failing to find caution, and, on a third offence, five or seven years' penal servitude may be given. For salmon poaching, on the contrary, a fine of ten shillings may be imposed, and can never be increased to more than five pounds, though repeated twenty times.

Imprisonment is only competent (for three months) for night poaching by three or more persons, under the 27th section of the Act of 1862. This section provides also that failure to pay the fine shall be punished by imprisonment not exceeding three months, while the next section gives power to imprison for a period not exceeding six months, in default of payment of all penalties and expenses incurred under the Act, which of course includes the penalty under the previous section. The two sections are plainly inconsistent with each other on this point, and if the former rules as to the penalty for night-poaching, it follows that if the fines for all minor offences be not paid, the offender can be imprisoned for six months, but a night poacher can only be imprisoned for three months in the same circumstances. A supplementary penalty for each fish caught by night-poachers should also be added, as in other cases of illegal fishing.

Licences.

The system of licences, which has already worked so well both in England and Ireland, can only receive a passing reference. The licences in Ireland vary from £1 to £30,—the minimum licence for rods having been raised in all districts in 1870, from 10s to £1. In England they run as low as 2s. or 3s. for rods, and £1 for fifty "putchers," to £20. In the latter country the total amount of licence-duty raised in the forty-four districts in 1879 was £7176, 1s., and in 1880, £7936, 9s. 6d. From this it may be seen what might be done in Scotland were this system adopted. The system of assessment is not satisfactory, and it is hopeless to expect subscriptions or loans to purchase the removal of cruives and obstructions.

Miscellaneous Suggestions.

The proviso appended to section 6 of the 1862 Act, which has caused great confusion and doubt as to the powers of the Commissioners to make any effective regulations whatever, should be struck out or made intelligible; the sale, as well as the exportation (provided for by 1868, section 22), of fish caught by rod during the net close-time, should be prohibited, and when salmon are sold or exported after close-time has commenced in any district, though not in others, the onus should be laid on the seller or exporter of proving that they were caught in an open district. Persons who may catch diseased fish should be empowered, or rather ordered, to destroy or bury them instead of returning them to the water, and it should be permitted to take salmon, as well as smolts and fry, for propagating purposes, in close-time, with leave of the owner. A minimum penalty should be fixed as well as a maximum, and one-fourth of the maximum has been suggested. "Parr" should be included *nominatim* with smolts and salmon fry in the 1868 Act, § 19. The Commissioners' bye-laws should be revised, and clerical errors corrected, such as "island" for "bound," "north" for "south," etc., and the words "of the net" should be added after "top to bottom," in the first section of the bye-law as to weekly close-time,—the river Eden, which falls into the sea within the limits of the Tay district, but which is excluded on the principle "*Expressio unius est exclusio alterius*," should be included in that district. "Fixed engines" should be defined, as is done both in the English and Tweed Acts, and the provision of those Acts which prohibits using draught or wear shot-nets within a certain distance of each other, until the one adjoining is fully landed, should be adopted. The distance in the Tweed Act is only thirty yards, but in the English Act it is one hundred yards, which is preferable. Over-fishing by net and coble has become a serious evil in some rivers, and there is good ground for believing that were it not for the weekly close-time, not a single fish would ever reach the upper waters.

The question of land-drainage and storage of water seems, at present at least, not within the province of legislation, nor is the important subject of artificial propagation, though power might be given to District Boards to apply certain portions of the income received from licences, if introduced, towards the establishment of breeding-ponds. It seems also worthy the consideration of proprietors of fishings, whether arrangements could not be made to work the fishings jointly, so as to save much of the expense at present incurred, on a plan on the lines of that suggested by the late Mr. Alexander Russel in the *Edinburgh Review* for 1851, and subsequently enlarged upon in his book on *The Salmon*. Joint arrangements have been carried out successfully in some instances already, *e.g.* in the Nether Don fishings in Aberdeenshire, and on the Tweed.

Tweed and Solway.

The Tweed and the Solway are in exceptional positions. All of the remarks and suggestions above made will, however, apply to the Tweed also, particularly those regarding pollutions, poaching, and obstructions. The pollution of the Tweed is notorious all over the United Kingdom, and poaching is so only to a less degree. The 39th section of the Tweed Act should be amended, so as to afford no doubt of a fine being exigible for resisting a private person acting in execution of the Act. The penalty of £20 incurred under section 73, for each salmon, etc., caught while fishing for trout, is out of all proportion to the offence, compared with the penalties for other much worse offences. The law as to fixed engines should be applied to the extended limits of the Tweed fixed by the Commissioners under the Act of 1863. The Tweed Acts, however, as a whole, are much more perfect than the general Scotch Acts, and it will be much easier to amend them satisfactorily.

The recommendations contained in the Report dated 30th November 1880, on the Solway, by Messrs. Walpole and Young, recently published, form the most perfect solution of a difficult question that it is reasonable to hope for, as the situation at present stands, and they should be carried out in their entirety. These "whammelers" do more injury to the fishings and to the fish than the fixed nets ever did, and if they cannot be altogether abolished they should be strictly controlled. The conflict of the various Acts affecting the Solway is also very inconvenient, and has been severely condemned. The Acts themselves have occasionally been subjected to severe criticism also.

Conclusion.

In concluding, I cannot do better than quote the results of the inquiries made by the Scotch Fisheries Improvement Association, and given at page 15 of their Report, as showing to what a condition of deterioration and disorganisation Scotch salmon fishery matters have arrived, and the consequent necessity there is of immediate and energetic reform. It is shown—

"(1.) That there are seven counties in Scotland with thirty-two rivers, which have ceased to be frequented by salmon, owing, first, to dams built across the rivers, which prevent the fish getting up to spawn; and secondly, to manifold pollutions from town sewage, bleachfields, chemical works, and other manufactures.

"(2.) That in eight counties with salmon rivers there are no District Boards.

"(3.) That in one of these counties (viz., Ross and Cromarty) there are no less than thirty-two salmon rivers without official protection.

"(4.) That in Argyllshire, where there are also about thirty salmon rivers, there is only one District Board, whose place of meeting is in the Island of Mull."

The foundation of the Scotch Fisheries Improvement Association is one of the best things that could have happened for the interests of salmon in Scotland. "L'union fait la force," and an organisation such as this is certain of success.

X.

THE BEST MEANS OF INCREASING THE SUPPLY OF MUSSELS FOR BAIT;

INDICATING THE MOST SUITABLE LOCALITIES FOR MUSSEL BEDS.

BY J. C. WILCOCKS.

FOR many years past the yield of the two most important shell-fish of the British seas, used both for food and bait—the oyster and the mussel—has not kept up with the demand for them, and much inconvenience has been the result. With the various attempts which have been made, successful or the reverse, on behalf of the oyster there is no concern in this Essay, attention being specially directed in it to the mussel, not as food, but for bait.

The whelk is a very important bait in the North Sea Fisheries, but it is not so attractive as the mussel. It is more used by the large welled smacks, its toughness allowing it to stand a great deal of trouble before it gets detached from the hook. It does not, however, exist in such abundance as to be entirely relied on, and, consequently, it is supplemented with the lampern by the cod smacks in the North Sea Fishery.

Proceeding to discuss the best means of increasing the supply of mussels for bait, the writer would plead for legal protection to the culturists as the first essential requirement. The law must be made sufficiently stringent to protect all persons or corporations who may be willing to undertake shell-fish cultivation, in exclusive rights over certain portions of selected grounds below and above low-water mark. Substantial fines should be inflicted, or imprisonment in default of payment, with forfeiture of boats and instruments used in trawling, dredging, seining, or in any way disturbing the ground or erections thereon, or removing any of the shell-fish found or placed on it. No person or corporation will make the outlay necessary to the cultivation of shell-fish without adequate protection.

The selected grounds should be marked out by buoys, or stakes, or both, and held on leases for terms of years to be agreed on between the contracting parties; and a certain portion of each area so leased should be required to be annually cultivated, on pain of forfeiture of the whole.

Such a penal clause in the lease would seem to be necessary in order to insure the ultimate cultivation of the grounds, or one corporation or individual might obtain possession of an enormous area, cultivate an inconsiderable portion of it, and thus exclude others more enterprising from entering on the work. Estuaries must be looked on as nurseries for the fisheries, from a national point of view, and considerable portions of them should be set aside as shell-fish farms.

The depredations on beds of shell-fish, which have occurred from time to time, have been mostly effected by very needy persons, who, having little or nothing to lose, cannot be punished by a fine, and imprisonment therefore is the only punishment which could be inflicted by the law in hope of deterring offenders.

To resume: it is hardly possible to overrate the importance of the mussel as a bait for both hand- and long-line fishing, especially in the haddock fishery. In fact, all ground-feeding fish devour the mussel with avidity, as do most other fish when they have the opportunity. As to all other baits, they may be looked on as supplementary, being less efficacious, or not obtainable with the same regularity, or of too perishable a kind to be relied on. The demand for mussels as food has very much increased of late, in consequence of the decrease in the supply of oysters, and unless strenuous efforts are made to increase the supply, they will in time become too expensive for purchase as bait, for mussels have for some time been used to a large extent in place of oysters in fish sauce.

There are three methods by which the supply of mussels may be increased—the British, the French, and a combination of the two.

The British method is by removal of the young mussels, when they are of sufficient size to bear it, from the grounds where they have been deposited, to positions up estuaries, often at some distance from the sea. There they generally uncover at low-water, and fatten and grow, partly by the admixture of fresh water with the salt water, and partly by the greater space allotted to them in an artificial than in a natural bed.

The French method is altogether different from the British, and consists in intercepting the spawn of the mussel by wattled palisadings, on which the spawn or spat settles as it drives along with the currents. It has been successfully practised in France for above six hundred years.

The combination method would be to adopt both the above in one, by encircling existing or artificial beds or scalps with wattled palisadings, so that the spawn, when extruded by the mussels, might at once be caught by these wattlings, instead of drifting away in the currents of the tide, and probably chiefly lost, in default of meeting with any or few favourable positions for attachment.

By this combined method, the wattled palisadings being so close to the spatting mussels, the bulk of the spat would be saved.

The requirements of the British method are banks of gravel or coarse sand, on which but little mud has accumulated. Beds of mussels are formed naturally on these gravel banks and on rocks, and such beds may be restored by planting them again with young mussels, unless the ground should have become too muddy for the purpose. The mussels must not be removed from their natural beds whilst too small, or the shells will be broken and the fish killed. About an inch in length is a safe size for removal, for if smaller they are apt to crush under the pressure of the rake, dredge, or other instrument used in gathering them. They must not remain in heaps, but be spread over the ground, to which they will anchor themselves by throwing out their filaments—threads of silk-like fineness—in a few hours.

Even on clean ground they gather more or less mud. They should, therefore, be often examined and moved with a fork or rakes, by which process much of the mud will wash away from them, and they will then thrive and fatten. If neglected, so much mud will soon accumulate as to choke them, which has constantly happened in many harbours, where beds have been laid down at some distance from the sea. This method of rearing mussels seems very simple, but is not found adequate to supply the wants of fishermen, and the public for food purposes, the demand being now so great, and being continually on the increase. The greater part of the beds are between low-water and half-tide level of the spring-tides. The older the mussels are, the higher up they may be placed with advantage.

The leading feature of the French method of mussel culture is the dealing with the creature at an earlier stage of existence, by catching the spawn or spat on wattled palisadings, when it is carried along by the circulation of the tidal currents, and treating it afterwards in the special manner about to be described. Like many other useful inventions, the French method originated in an accident — the shipwreck of an Englishman of the name of Walton on the coast of France. This man with two companions was conveying some sheep to England in a small vessel, from Ireland, in the year 1235, when, being driven from his course by a gale, he was wrecked at the creek of Aiguillon near the port of La Rochelle. Being, with his companions, very hard put to it for a living, he conceived the plan of setting nets on poles or stakes for the capture of sea-fowl at night, the muddy shores of the bay being frequented by these fowl in immense numbers. The stakes were driven into the muddy shores of the bay in rows, and before long he noticed that myriads of young mussels had become attached to them, and that, being above the level of the deep mud, they grew rapidly. After this he interlaced branches of trees between the posts, thus forming a coarse kind of wattling or wicker-work, which also became coated with the young mussels. He erected more and more lines of posts and wattlings, and thus established a system of mussel culture which still prospers as a most important industry, and which has been introduced elsewhere in France with success.

It is stated that in fourteen months after the young mussels are discovered on the woodwork, they have attained the size of a broad or Windsor bean. They will then bear removal, and are scraped off by iron hooks, enclosed in bags of old netting, and placed on the wattled palisadings at a higher level. In this manner they are changed four times, and are then ready for sale. Long before the old netting has decayed, the mussels have firmly attached themselves to the wattlings, and the writer has known mussels after removal firmly re-attach themselves by their filaments in a few hours.

The wattled palisadings are termed "bouchôts," and the men who work the fishery, "boucholeurs."

The mud into which the posts are driven, and of which the whole shore consists at low-water, is too soft to bear a man's weight, and as it is constantly necessary for the "boucholeurs" to traverse the mud alongside the "bouchôts," small flat-bottomed boats are used. They are the same kind as Walton built for this purpose, and are made of four thin planks,—two form the bottom, and two the sides, the bow being turned up with a slope. The man, wearing a pair of long boots, rests on one knee with his hands on the sides of the little boat, and propels it over the mud by pushing with his right foot. These little boats are called "acous," but a larger kind are used to carry two persons. They pass over the mud at a greater speed than might be supposed; some of our British wildfowl punts are built sufficiently small and light to be launched over the mud in the same manner after birds.

The yield from this industry at the village of Esnaudes on the Bay of Aiguillon, is stated to be four hundred thousand pounds sterling per annum, and the same method is successfully carried out at St. Valéry-sur-Somme, where a space of six hundred and twenty acres has been conceded for mussel culture.

As there are immense expanses of similar ground in Scotland and elsewhere, naturally inhabited more or less by mussels, there can be no doubt that the same method could be successfully carried out in these localities.

The British method of mussel culture must be carried out on either hard ground or ground with very little mud on it, or the mussels are choked and die; and it so happens that many estuaries are largely composed of mud-banks, from which the British method is excluded. On all such ground the French method could be carried out with facility, and thus the area of production be immensely increased, to the benefit of the fishermen, and the public as well. This feature alone should commend the French method to all interested in the subject.

The question of the lines of palisades crossing the mud banks, and being in the way of boats or vessels, naturally arises in connection with the subject, but these erections should not cross the navigable channels, and openings should be left to form passages, marked by poles with bushes at the top to form beacons, which should also be placed at the ends of the "bouchôts," where they reach the navigable channels. This arrangement should meet any objection in regard to the navigation. It must be remembered that by mussel culture a great want is sought to be supplied, and the fact of boats or vessels undergoing a slight inconvenience in going up or down an estuary, must not be allowed to weigh against a great public benefit.

From his own observations confirmed by those of others, the writer has ascertained that the spat of mussels is shed for at least six months in the year; and if this is the case in most parts of the kingdom, the question arises, Why are not mussel beds more frequent? The answer is not far to seek, and is this: that only when the spat *finds substances congenial to its welfare, does it vivify* and *prosper*, otherwise *it perishes.* It should be our care then to provide extensive receptacles to strain the water, so to speak, and these "bouchôts," or wattled palisadings, are found most effectual strainers. They catch the spat on the woodwork as it drives along with the currents, and thus preserve it from being destroyed by becoming deposited on uncongenial ground.

The most suitable localities for the cultivation of mussels, either by the establishment of beds, or the French method, or the two combined, are obviously those portions of the firths or estuaries, which afford more or less protection from the drift of the sea in heavy gales. The writer would specify the Firth of Forth above Granton, the Firth of Tay, the Esk estuary above

Montrose, the estuary of the Findhorn, the inner part of the Moray and Beauly Firths, the Shin estuary near Dornoch, the estuary between the last-mentioned place and Golspie. There are sundry spots in the lochs of Sutherland which could doubtless be fixed on by a personal examination. The localities on the East Coast would naturally receive the first attention, for it is desirable that the fishermen should obtain their bait as near their own homes as possible, and be able to go to sea at every opportunity. The uncertainty of the elements is quite enough for the fisherman to contend with, without his being kept on shore for want of bait. Having been fishing more or less for above forty-five years, and frequently kept on shore for want of mussels, the writer quite understands the absolute necessity there is for a good supply of this bait being always attainable.

There is probably not one of these firths or estuaries without naturally sown beds of mussels, which spawn regularly as the seasons come round, and were the spawn caught by the French system, the yield might be almost indefinitely increased, such an immensely augmented area being opened to cultivation by this method.

The writer would propose that lines of posts and wattlings be erected in Nigg Bay in the Firth of Cromarty, where mussel-scalps exist to a considerable extent. From the west end of Nigg Sands abreast the Red Buoy to Majicks Point abreast of Cromarty town, is a distance of over three miles, and for the breadth of a mile to a mile and a half, nearly the whole of this space is suitable to the application of the French system. The lines of posts and wattlings should be at 30 feet distance apart to catch the spat, and an enormously increased yield would be added to the natural beds, when all these wattled palisadings became covered with mussels. The same process could be carried out in Udale Bay, near Chapeltown Point, and abreast of Jemimaville. Higher up the Firth beyond Invergordon also is a considerable space of ground available for the same method. In the Firth of Inverness, in Munlochy Bay, in the Beauly Firth and many other places, this method could also be carried out.

SUBSTITUTES FOR MUSSELS AS BAIT.

In the growing scarcity of mussels we naturally turn to substitutes for them. These may be either other shell-fish, or baits consisting of fish cut up into a size adapted to the hooks we are about to use. The writer will enumerate various shell-fish of the British seas, which either have been or could be rendered useful as bait, premising, however, that he looks on them more as supplementary aids to the supply of mussels, than as complete substitutes for them. For he considers the application of the French system of mussel-culture in the various estuaries of Scotland to be the solution of the difficulty regarding the supply of bait.

As these shell-fish are often known locally by special names, and may not be recognised under the English appellation in all instances, the Latin names are appended, so that identification may be easy on reference to any work on Conchology.

Shell-Fish.

English Name.	*Latin Name.*
Two kinds of Queen or Squin,	*Pecten subrufus, et varius.*
Clam or Large Smooth Cockle,	*Venus mercenaria.*
Rough Ribbed Forth Cockle, .	*Cardium aculeatum.*
Prickly Cockle, . . .	*Cardium echinatum.*
Smooth Cockle, . . .	*Cardium lævigatum.*
The Hen Cockle, . . .	*Venus literata.*
The Whelk or Buckie, . .	*Buccinum undatum.*
Two kinds of Gaper, . .	*Mya truncata et declivis.*
The Razor Fish, . . .	*Solen ensis.*
The Sculpin, ...	*Pholas dactylus.*

Fresh Water.

The Swan Mussel, . . .	*Mytilus cygneus.*
The Duck Mussel, . . .	*Mytilus anatinus.*
The Great Mussel, . . .	*Mytilus modiolus.*
The Limpet or Flidder, . .	*Patella.*

Fish Baits.

Herrings.	Sprats.
Mackerel.	Sand-eels.
Pilchards.	Launce.
Garfish or Longnose.	Lamperns.

The Cuttle Family.	*The Crab Family.*
Squid.	Tail of Hermit Crab.
Cuttle.	Green Shore Crab (ready to peel), other Crabs when soft.
Octopus.	

Sea Worms.

Lug Worms, and Sea Tape-worm.

The Shell-Fish.

One of the most plentiful shell-fish next to the mussel is the Queen, or Squin as it is called. It belongs to the Pecten or Scallop family; and two sorts are commonly met with, *Pecten subrufus*, the red kind, and *Pecten varius*, the variegated kind. They are often dredged from oyster-beds. Both shells are convex; they are sometimes known as fan-shells from the striations on them, which radiate like the fingers of a fan from the hinge of the shell. They are caught in great quantities by the trawlers, and sold at from fourpence to eightpence per peck, according to the demand. In Devonshire they are used as food, not as bait; and after purchase by the fishwomen, are taken out of the shell, washed, and sold by the pint. They are nearly equal in taste to scallops, although so much smaller in size, which is from 2¼ to 2½ inches across the shell. The difficulty would be to obtain them in sufficient quantity where there are no trawlers or dredging-vessels. They are not confined to the open sea, but are numerous in some of our deep harbours in England, where they are taken by dredges, as at Falmouth. They must be plentiful in many places in Scotland.

The Scallop, another shell-fish of the same family, is much larger, and has the upper shell flat instead of convex, but, being considered rather a luxury, is, of course, too expensive to use for bait.

The Clam is a good bait, but not sufficiently abundant on the British coasts for our purpose. It is in appearance a huge smooth cockle, and belongs to the *Venus* family of shells. Its shell is strong, thick, and heavy, covered with a brown skin, and sometimes measures 10 to 11 inches round. They are salted in on the American coast, where they abound, for the cod-fishery, and a celebrated dish known as "clam chowder" is made with them at New York and elsewhere. The shells are cut up and made, or were formerly made, into the North American Indian money, called "wampum." On the British coasts they are mostly found below low-water level, but are sometimes driven up in quantities in sandy bays by heavy gales. On our coasts they are sometimes to be obtained from dredgers and trawlers.

The Rough-ribbed Toothed Cockle, the Prickly Cockle, and the Smooth Cockle, are also sometimes met with: the first very large, the size of a man's fist, the second about 6 inches round, the third 6½ inches. The hen cockle, another smaller smooth shell, breadth 2½ inches, is often very abundant in sandy gravel in harbours or at their mouths, especially those of bar harbours. It has a thick shell.

The Buckie or Whelk, well known as a cod-bait, is obtained from dredgers, trawlers, is caught in wicker pots or cages, by baited hoop-nets, or by long lines baited with the common green or shore crab strung on snoods, without any hooks. The whelks cluster on these crabs, and are thus drawn to the surface.

Two kinds of the fish are called the Gaper, from one end of the shells always being open. It is found under slutchy ground near low-water mark, and is discovered by an opening in the slutch, under which it is found in coarse gravel.

The Razor, another shell-fish, is found in sandy beaches, a dimple in the sand showing its burrow. It is best taken by a barbed dart of wire, a ¼-inch thick, and about 2 feet long, which being thrust down into the fish in the hole, is to be wrenched side-ways, when the razor-fish can be pulled up, or dug out if the sand is very firm. It often escapes when dug for without the aid of the spear, as it can descend rapidly through the sand when alarmed.

The Sculpin or Pholas, is another shell-fish, sometimes known as the white mussel. It burrows in the peat, the remains of submerged forests, found here and there along the seashore. It also bores into the limestone rocks, and others, on the margin of the sea.

The Swan and Duck Mussels are a large kind, inhabiting fresh water, and in some of them in Scotland pearls have been found. These mussels are also found in the lakes of Newfoundland, and have sometimes been used with success as a bait for cod on that coast.

The Great Mussel, *Mytilus modiolus*, is met with in deep water at sea, and closing itself on the fishing-lines is thus drawn to the surface. It is not often met with.

Fish Baits.

Herrings are the most important substitute for bait in lieu of mussels; and it is well known that, in Scotland, the fishermen constantly shoot their nets to obtain herrings for bait alone, and also catch them with the dandy line.

Pilchards are more attractive even than herrings as a bait, the oil exuding very readily from this bait, when it is cast into the water. Owing to the fact that pilchards can be so often obtained at Plymouth and in Cornwall, and also mackerel, from the drift boats, and by other methods of fishing, mussels are only exceptionally used for bait, but at Brixham and eastward, as mackerel and pilchards are not so often obtainable as at Plymouth, mussels are very much used for ground-fishing.

The Dart, the Teign, and Exe estuaries breed large numbers of mussels, and from the two latter, a large trade is done to London and elsewhere.

From the estuary common to the rivers Taw and Torridge, also in Devonshire, a large trade is done in mussels.

At times these rivers are worked so hard, that one or other of them is almost cleared of mussels; but this never happens to more than one at a time, and it is always found that in a year or two the crop of mussels restores itself.

There are probably no more prolific sources of supply in the kingdom, for their size, than the Exe, Teign, and Taw, and Torridge estuaries, but the cost of carriage to Scotland would be too great for the fisherman to pay.

Garfish, or Longnoses, are used by fishermen as bait for ground-fish, when, as it sometimes happens, the supply of mackerel or pilchards may run short.

Sprats are an oily fish, and are eagerly taken by ground-fish of all kinds.

The Sand-eel and Launce are both much used as bait, and might be much more used with advantage in the Scotch fisheries. This bait can be used alive, dead, or even when quite stale, the writer having made a good catch of whiting more than once with stale sand-eels cut up into pieces of an inch long. For immediate use they can be dug out of the sand, but in the Channel Islands, in Guernsey and Jersey, they are taken in a small seine or circle net, having a calico bag or bunt to it, to prevent the sand-eels getting their noses fast in the meshes, and injuring themselves.

The object is to keep them alive, and to this end they have floating baskets, termed "courges," the shape of a nun buoy, *i.e.* the figure made by two cones joined at the base. When the net is drawn to the side of the boat, the sand-eels are all gathered into the calico bag part of the net alongside, and having a number of these baskets ready, the sand-eels are dipped up in balers and poured into these baskets, which are then placed at the stern of the boats, and towed away. One shot of the net is sometimes sufficient to supply several boats with bait for three or four days, or even more.

The cost of these seines for sand-eels is about £13 or £14, and the net is owned by one man, who receives tenpence a week towards the expense of keeping the net in good condition, from those who have the benefit of the net. The men who assist in working the net share equally, each boat taking its portion. If this method were followed in Scotland, the sand-eel might be made a fruitful source of bait for both the hand- and long-line fisheries. As it regularly takes its place as a bait in the Labrador and Newfoundland fisheries, there seems to be no reason why more use should not be made of it in Scotland. The method of keeping the sand-eel alive is a very important feature, which the writer never met with in England before he resided in Guernsey, and he has introduced it to the Devonshire fishermen, with advantage, since his return from the Channel Islands. Sand-eels and launce of 8 inches or more in length can be split in two from head to tail, and cut up into pieces of the required size, after the manner of herrings, mackerel, and pilchards, and garfish, when used for bait. Sand-eels and launce are known as "horn eels," from the protrusion of the lower jaw. This is their common name in the North of England.

The Lampern or Seven-eyes, and the Blind Lamprey or Pride, are both very useful baits. The former is much used by the Dutch in the long-line cod-fishery, the latter by the Cornish fishermen. They can both be obtained in most small rivers and brooks having a direct communication with the sea. The lampern is found adhering to stones, and is also taken by the Thames fishermen in wicker traps at Teddington. The pride or blind lamprey is easily obtained from mud banks in brooks, by enclosing the bank with a dam, and digging them out. In Cornwall it is the recognised bait for pollack, known as lythe in Scotland; and coal-fish (saithe) also take it. It is used as a towing bait in Cornwall, the boat being slowly pulled or sculled along. It is so tough that a couple will catch a score or more of fish. The lampern is larger than the blind lamprey or pride, and not so hardy. The blind lamprey may be kept alive in a pan of fresh water for months, in a cool and dark place, changing the water at first twice a week, then once a week, and afterwards adding a little from time to time to make up for loss by evaporation.

The Cuttle Family.

The Squids and Cuttles are much used in the Newfoundland and Labrador fisheries for cod, and on the Devonshire and Cornish coasts for baiting the long-lines—there known as bolters—for conger, skate, ling, and cod. They are taken in trawls, in seines or circle-nets when shot for other fish, and also by lowering a small fish without a hook, suspended by the tail. The latter method applies only to the squid, which seizes the bait, and being then slowly raised to the surface, is to be warily gaffed with a grapnel-like arrangement of four hooks lashed back to back on the end of a slender rod about 6 feet in length. As they always discharge their ink on feeling the gaff, it is desirable to drag them sideways in the act of gaffing, as you then escape the fountain of ink which may otherwise be showered over you. For the Newfoundland fishermen unbarbed hooks are specially made for squidding, but on ordinary haddock-hooks or small cod-hooks it suffices to file the barbs off, or bend them down after softening that part of the hooks by fire. Squid may also be taken by a jigger made by casting a number of squid-hooks into a conical piece of lead or pewter, and working it as a pilk or two-hooked fish made of that metal, well known to my readers as used for cod, and scraped bright to attract the fish.

The Octopus is a bait much used in the Channel Islands and by the French fishermen as a long-line bait. This is the Devil Fish of M. Victor Hugo, and is often now to be seen in our large public Aquaria.

It is taken by a hooked rod, being dragged out from holes in the rocks, and is either kept alive in floating boxes, or, if required for immediate use, is impaled on a sharp stick cut with a fork left on it, thus, √, the stick being about 4 feet long. You may sometimes see a fisherman with a stick nearly full of these octopi, dragging them after him in quest of more.

The Crab Family.

Two varieties of the crustaceans are very much used for bait, and must be well known in Scotland. These are the Hermit Crab, *Pagurus Bernhardus*, and the Green Shore or Harbour Crab, *Carcinus mœnas.* The former is an interesting creature. Being unprovided by nature with any shell for the tail portion of his body, he generally takes possession of that of a whelk, although sometimes he is found in other shells. These hermit or soldier-crabs are taken in crab-pots, in hoop-nets purposely set for them, and when trawling or dredging. The tail part is an excellent bait for all ground-feeding fish. It is best used whole, as if cut, it wastes too quickly. It is a common bait with the Isle of Wight fishermen, and is there known by the name of a "gann."

The Green Shore or Harbour Crab is an excellent bait for ground-fish when about to cast its shell, just previous to which it seeks out some place of shelter, where it may remain hidden from fish generally, as well as from its mail-clad relations. Taking advantage of this habit, fishermen provide artificial shelters for these crabs, consisting of old broken pans, pots, kettles, saucepans, or any old tin or iron ware, which will form a hollow shelter when turned bottom-up on the mud in tidal harbours or estuaries, between the levels of half-tide and low-water. These traps must be frequently examined and cleaned out, or, strange to say, the crabs will not enter. When used, the shell is cracked with a knife-handle, and the crab can then be peeled like a hard-boiled egg, the claws also when cracked can be peeled in the same manner. Immense numbers could be procured by this method in the Scotch estuaries, and sent along the coast, for when covered with damp sea-weed, they will live a week or more out of water. These crabs may be found under stones and hollow rocks, but to obtain them in sufficient quantity, it is necessary to provide artificial shelters. At Exmouth and Teignmouth and Appledore in Devonshire, not a few men get their living by using this bait on hand- and long-lines for flounders, plaice, and fresh-water eels.

The eatable Crab, when found in a soft state, can also be used for bait, but is difficult to obtain with any regularity or in sufficient quantity. The green shore-crab, on the contrary, when about to change its shell, can, by the method above-described, be taken in more or less abundance the whole year, some of these crabs casting their shells every month.

Sea Worms.

Of these the most abundant and important is the Lug-worm, which is well known and extensively used as a bait for both hand- and long-line fishing. It is the *Arenicola piscatorum* of the naturalist. Another very excellent bait is one known as Varm or Sea Tape-worm, a flat worm from 6 inches to a foot long, and from a quarter to half-an-inch broad. It is found, mostly at low tides, in the soil or under pieces of broken granite rock. It is a hard and tough bait, and ground-fish of all kinds feed greedily on it. A third bait is the Rag-worm, dug out of clayey gravel, and also found by forcing open the cracks in rocks at low-water. The difficulty is in obtaining them of sufficient size for hooks used on long lines.

Bullock's liver is sometimes used, but it is a poor substitute for any fish-bait.

SUGGESTED APPLICATION OF THE FRENCH SYSTEM OF MUSSEL CULTURE TO THE FIRTHS OF FORTH, TAY, AND CROMARTY.

Firth of Forth. (Plate I.)

In the Firth of Forth collections of wattled palisadings might occupy three positions,—the first near Abercorn, the second abreast of the Carse of Kinneil, between Borrowstounness and Grangemouth, the third on the north side of the Forth, between Torryburn and Culross, on either side of Preston Isle.

At Abercorn the collection of stakes and wattlings would extend a mile alongshore at about the low-water edge of the bank, and in width, towards the land, about the distance of three cables, or 1800 feet, with an unobstructed opening at nearly the middle for passage of boats or vessels, this opening to be marked by beacon posts. Beacon posts should also mark each corner of the collection of posts, that is to say, of the wattled palisadings.

The second collection of wattled palisadings would extend between Borrowstounness and Grangemouth, about two miles and two-thirds along the low-water line or thereabouts, say six cables in width, or 3600 feet, for the most part narrowing towards the ends. Three wide openings for navigation would be left through this arrangement of wattle palisading, the one following the course of the channel of the river Avon, a cable's length, or 600 feet, in width, the second with an opening to the south towards the Kinneil Ironworks of the same width, and a third opening, also of the same dimensions, abreast or north-east of the entrance to the river Avon. The north-west end of the rows of posts would be about 1000 feet south-east of the buoy at the entrance of the channel to Grangemouth.

On the north side of the Forth there would be a collection of wattled palisadings abreast of Torryburn, of about 3½ cables' length, or 2100 feet frontage, at or about low-water mark, by three cables, or 1800 feet, general width.

Abreast of Culross there might be a fourth collection of about a mile and a cable's length of low-water frontage, by 3½ cables, or 2100 feet, of medium width, leaving a passage of a cable-width between the causeway, or Pow, and the channel known as the Strath, running round easterly to the back of Preston Isle.

Doubtless much more of the banks in the Forth could be utilised, but even these collections of wattled palisadings would afford a very large additional supply when covered with mussels.

The River Tay. (PLATE II.)

The first position proposed by the writer on this estuary is on the seaward side of the harbour of Port-on-Craig, or Tayport, for a collection of wattled palisadings, measuring nearly eight cables' length, just beyond the limit of low-water, along the shore, or 4800 feet, with a width of two cables, or 1200 feet. The outer portion of this collection would extend into the bay at the south-east, leaving a passage between, for the passage of boats or vessels, a cable's length in width. A very large space offers itself on the north side of the Tay, namely, Monifieth Sands, occupying the bay between Broughty-Ferry and Buddon Ness; but as this is a very exposed position, only one line of posts might be set up by way of trial,

to ascertain how they would stand the gales from the south-east.

The Abertay Sand, extending more than three miles east-south-east from Tentsmuir Point, affords good shelter from the south-east as the tide falls, portions of this sand becoming dry, and very little water remaining on the greater part of it; but as the tide rises the chief part of this protection disappears, when a heavy sea, as a matter of course, breaks on the Monifieth Sands, and therefore only a small experiment should be made, to ascertain if the wattled palisades would stand in a position of so great exposure. The line of posts should here run south-east and north-west, for, thus being end-on to the point of greatest exposure, they would not offer the same resistance to the waves as if placed in any other direction. A series of three collections of wattled palisadings might be placed much higher up the estuary of the Tay, on the Carthagena, the Newfoundland, and other banks abreast the Carse of Gowrie. The first collection would be 3½ miles west of Dundee, and an imaginary line drawn from Birkhill Hall on the south side of the Tay, just west of the red buoy of the Cross Sand, would pass through its midst. This collection would measure, at low-water mark, about nine cables, or 5400 feet, by about 5½ cables, or 3300 feet, towards the shore. The next collection of palisadings would be on the Newfoundland Bank, eight cables, or eight-tenths of a sea-mile, to the south-west, a wide opening having been left for the access to three hards or causeways extending from the shore of the Carse of Gowrie. This frontage of almost a sea-mile along the low-water line, and about seven cables, or 4200 feet, in width towards the shore, is proposed to be divided from another collection of palisadings on Carthagena Bank, by a low-water channel about two cables, or 1200 feet, wide, leading up towards Mr. Hunter's property. This collection of palisadings is proposed to extend about two miles along the low-water line, and is of a long triangular shape, seven cables, or 4200 feet, wide at the east, and tapering to a point at the west end.

The writer has not recommended collections of palisadings in Invergowrie Bay, as a salmon batt is marked thereon, abreast of Kingordy. Much more of the banks could doubtless be turned to account, in the Tay, for mussel culture, but these several collections of wattled palisadings alone would add largely to the supply of mussels in the Firth.

Firth of Cromarty. (PLATE III.)

As to the Firth of Cromarty, the writer has been somewhat explicit at page 160, and he need not say very much here.

Since writing the remarks in the paper, he has ascertained that natural mussel-beds have existed on the banks of Nigg Bay, on the north side of the Firth of Cromarty, for a long period, and thus feels himself confirmed in his choice of this locality for the application of the French system. The proposed length, at or about the low-water line, would be three miles, for the wattled palisadings,—width, two miles at the east, and one mile at the west end.

Various channels through the banks should be left unobstructed by the proposed application of the wattled palisadings, so that boats or vessels may still have the usual access to the shore line as heretofore. At Udale Bay, also, there is a suitable portion of ground, of irregular shape, about a mile along the low-water line, and half a mile in width. In Munlochy Bay, in the higher parts of the Firth of Inverness, in the Beauly Firth, and other places, convenient localities could doubtless be found for the extensive application of the French system.

At Nigg Bay, in consequence of the existence of mussel-beds, the erection of wattled palisadings would combine the French and English systems in one.

The writer proposes that the whole of the estuaries of the East and North Coasts of Scotland should be carefully examined, and that mussel culture, both by the French and the English methods, and the two combined, should be established in them. Eligible positions should first be chosen on the East and North Coasts, and the West Coast might afterwards receive attention. There can be no reason why the artificial culture of mussels should not succeed as well in Great Britain as in France, where it is well known to have been successfully practised for above six hundred years.

A free flow of the salt water is necessary for the young mussels to attach themselves to stones, posts, or other objects, but if it settles on objects in brackish water it dies. Beyond a certain distance up all river harbours the water loses the required saltness, and neither spat nor mussel can exist in it. Mussels, although they will not breed, will increase in size and fatten, even though a considerable amount of fresh water will, on the ebb-tide, be mixed with the salt. In fact they are of better quality often high up than low down an estuary.

From observations made by an extensive mussel culturist, it has been ascertained that mussels do not spat with success, that is to say, the spat does not become alive, unless the water in which the operation takes place, or the spat settles, is as salt as the sea itself. Sea-water has been found on the English coast to have a density of 1026½, distilled water being 1000. The best degree of saltness for fattening mussels and oysters is said to be 1014.

The following is a list of the various estuaries on the coasts of the East and North of Scotland, in nearly all of which the French system of mussel culture might be successfully introduced.

One or two of the smaller estuaries might possibly be found to be deficient in the adequate flow of salt water, but a few posts and wattles would soon settle this question, and on account of the importance to the particular district, no tidal river should be passed by as unworthy of attention.

Estuary of the Tweed, Berwick.
Tyningham Sands, Haddington.
Abercorn, Near Grangemouth, Culross, Torryburn, } Forth Estuary.
Eden Estuary, near St. Andrews, Fife.
Tayport, Abreast Carse of Gowrie, etc., } On the Tay.
Esk Estuary or Hake, North Esk Estuary, } Montrose.
Dee Estuary, Don Estuary, } Aberdeen.
Ythan Estuary, Newburgh.
Ugie Estuary, near Peterhead.
Deveron Estuary, Banff.
Spey Estuary, Garmouth.
Findhorn Estuary.
Firth of Inverness.
Firth of Beauly.
Firth of Cromarty.
Firth of Dornoch.
Loch Fleet Estuary.
Kyle of Tongue.
Loch Eribol.
Kyle of Durness.

XI.

THE SALMON DISEASE.[1]

BY ANDREW BROTHERSTON.

ABOUT four years ago, when the salmon disease was brought into prominent notice in the Solway district, it was considered by many to be a "new and mysterious" disease. It is neither!

That it is not a new disease, I have no doubt; indeed it is probable that *S. ferax* is as old as the salmon, and that it will exist as long as there are fish in our rivers and flies in our houses.

My first recollection of it dates back about thirty-five years. It appeared on bull-trout (*Salmo eriox*) in the Eden, a small tributary of the Tweed. After spawning, which was usually all finished by the early part of January, there were no floods until the end of April or beginning of May, to allow these spent fish to reach the sea, consequently they were in very bad condition, and easily captured, which we schoolboys soon found out. If any of them were wounded, and escaped for a time—which was frequently the case,—they were invariably, within a few days, spotted with whitish, mouldy-looking blotches, commencing on the wounds, and rapidly spreading over the rest of the body. They had a most disgusting appearance.

Since that time I have frequently seen fish similarly affected,—mostly sporadic cases. But in the spring of 1872 there was a virulent epidemic in the Tweed. Many thousands of fish died that season. In May of that year I counted, in a length of 100 yards, thirty-six dead salmon, all large fish.

Many old anglers recollect the same disease in the Tweed for a much longer period; and all the poachers have known these diseased fish, from their youth upwards, by the name of "raggies"—a very appropriate name—from the ragged appearance given by the fungus. Only one other instance to show that it is not new:—The late Mr. A. B. Stirling, in his third paper on the salmon disease, read before the Royal Society of Edinburgh (*Proc.* 1879-80, p. 372), mentions several epidemics that occurred at Ightham in Kent, one of which was so far back as 1850—thirty-two years ago.

[1] Saprolegnia ferax.

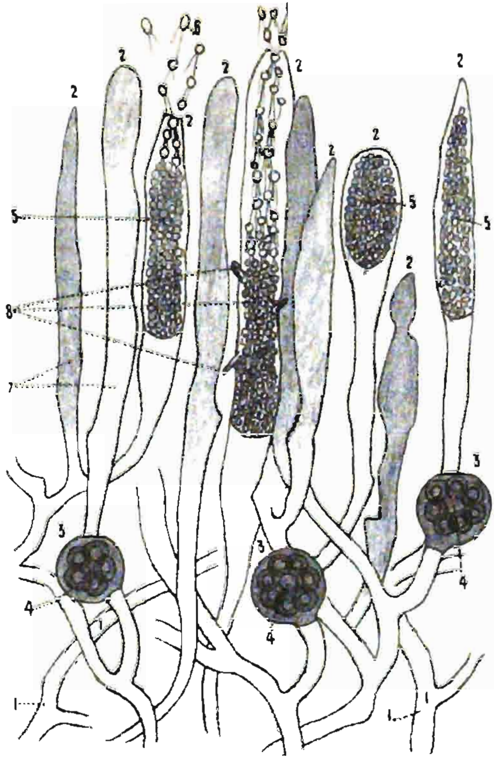


FIG. 1.—*Saprolegnia ferax.*

1. Mycelium.
2, 2, etc. Zoosporangia, various forms of.
3, 3, etc. Oogenia.
4, 4. Oospores (resting spores).
5. Zoospores.
6. Do. escaping, showing the cilia.
7. Protoplasm.
8. Zoospores, germinating before escaping.

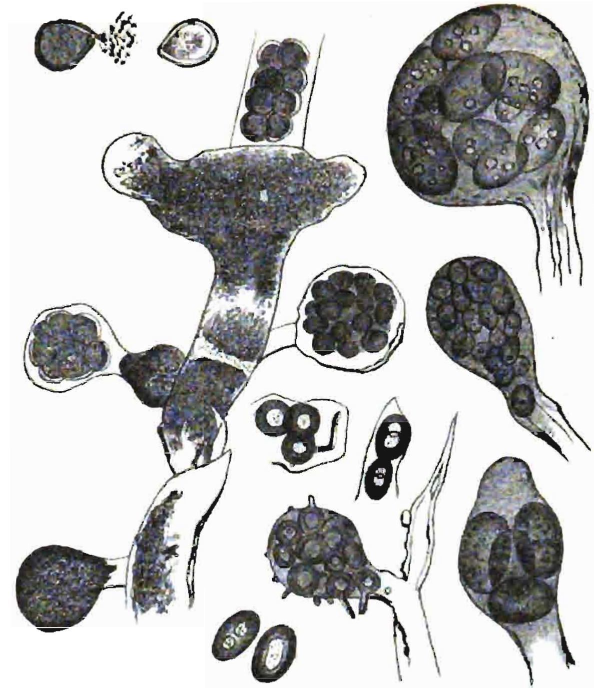


FIG. 2.—Saprolegnia Ferax (*from Cooke's "British Fungi"*).

T. & A. Constable, Printers to Her Majesty, Edin.

As to *S. ferax* being a mysterious disease, if the germination and propagation of any plant in its usual way on its natural habitat is mysterious, then *S. ferax* is a mysterious disease. It may as truly be said that the corn-rust (*Trichobasis rubigo-vera* and *T. linearis*), the potato-fungus (*Perenospera infestans*), the various mildews, moulds, etc., or indeed, that the growth and development of any plant, is mysterious.

It is also a wide-spread disease, having been found in rivers and lakes, both in the Old and New World. Besides the *Salmonidæ*, many other species of fresh-water fish are liable to the attacks of *Saprolegnia*—grayling, pike, perch, gold-fish, sticklebacks, etc. Minnows are also said to be affected with it, —which is probably the case,—but any examples with a fungoid growth upon them that I have examined, was not *S. ferax*, but another organism of the same order—*Achlya prolifera*.

The *Saprolegnieæ* are an order of plants, the affinities of which are somewhat uncertain; some authorities considering them "to belong to Algales, others to Fungi" (Cooke's *Handbook of Brit. Fungi*, ii. 638), and Mr. Worthington G. Smith says, "The Saprolegnieæ have the habits of moulds, and the fructification of Algæ" (*Science Gossip*, xi. 250). *Saprolegnia* appears to be a connecting link between the fungi and algæ, at one time having the characters of a fungus, at others of an alga. The parasite which causes the silk-worm disease—*Botrytis bassiana*—and the now too well-known potato-fungus, are both allied to *S. ferax.*

Usually *S. ferax* commences to grow on the head, and the other scaleless parts of the fish; but this is not always the case, as many fish may be seen with the posterior part of the body completely covered, and not a spot on the head. I have a parr 4 inches in length, which was caught in the Tweed in October 1881. In front of the dorsal fin it is free of *S. ferax*; at the base of that fin there is a small spot just commenced to grow, but 1½ inches of the posterior extremity was completely enveloped by the fungus, it apparently having commenced at the side of the anal fin, where there was a wound. Although apparently healthy, "clean" fish are sometimes attacked, it is generally those that have been some time in the river, and more especially after they have spawned. Occasionally severe epidemics occur, before any of the fish have deposited their spawn, as was the case in the Tweed and Teviot last autumn.

On dissection, these diseased fish are frequently found to be infested by parasitic worms. But the same parasites are not uncommon in apparently healthy fish. Others have the liver or other parts of the viscera in a diseased state, while others again have wounds and abrasions on the skin and scales, while not a few appear to be perfectly healthy—except the fungus,—without the slightest appearance of a wound or bruise on the parts attacked by *S. ferax.* These wounded fish, however, are more susceptible of the disease than those that are unhurt, the fungus usually germinating on the damaged parts, from which it spreads over the rest of the body. Addled ova are also very subject to it.

The spores of *S. ferax*, on germinating, send out a slender, tubular, jointless filament, which forms a circular patch, consisting of a dense matted mass of mycelium, which produces numerous elongated zoosporangia. The zoosporangia are very variable in form, some tapering to a point, others cylindrical, clavate, and pyriform. They are at first full of protoplasm, which in a short time breaks up into minute ovate zoospores, which, when mature, escape by a terminal opening. Many of the zoospores are furnished with two fine ciliæ, of unequal lengths, by means of which they are enabled to move about in the water. In a very short time the tails disappear. Whether they drop off or are absorbed into the spores is uncertain, but after that the spore assumes a round shape. It is very probable that the zoospores soon lose their vitality, but judging from analogy, it will not be so with the oospores, as they will be able to remain a long time inactive, although they are capable of germinating in a comparatively short time if they find a suitable host. The accompanying sketch will give a general idea of *S. ferax.* Of course all these forms of zoosporangia cannot be seen on one specimen (see Fig. 1).

S. ferax is essentially a skin-disease, but if allowed time it destroys the tissues beneath, especially when on the head and fins. The connecting membrane of the fins is sometimes wholly wanting, only the bony spines of the fin-rays being left, but which, I think, is assisted by the fish rubbing themselves to get rid of the fungus. Unless by suffocating or blinding its host, it is very rare, if ever, that *S. ferax* caused death, although in certain stages it appears to produce acute pain, judging from the manner in which the affected fish are sometimes seen madly rushing and plunging about, as if in great agony.

In those cases where deep wounds and sores are seen after the removal of the parasite, I believe that there was some damage to commence with. If a fish is in good condition otherwise, which is frequently the case, these diseased fish are perfectly good and wholesome to eat.

I will not enter into the statistics of the numbers of dead and diseased fish that have been taken out of various rivers during the last four years, but will proceed to notice the different causes that have been assigned to account for the disease.

1. *Pollution from the refuse of manufactories, artificial manures, sewage, etc.*—That none of these are the cause numerous

instances might be given where diseased fish have been seen in pastoral districts, where there was no chance of pollution from any of these sources. Town and house sewage, instead of being hurtful to fish, appears to be a benefit, as the largest and fattest trout are often got near the outlet of sewers.

2. *Overcrowding and Overstocking.*—These may sometimes appear to be a cause. Wherever there are many fish when the disease is prevalent there will be more diseased fish than where there are few. In the winter and spring of 1880-81 salmon were very scarce in the Tweed, consequently very few diseased ones were seen, but the next season, when they were extra plentiful, there were many diseased, but probably no more, in proportion, than in 1880-81. Besides, when the disease broke out in the autumn of 1881 the Tweed was seldom under two feet above summer level, often above it, and never so low but fish could either ascend or descend.

3. *Absence of Frosts.*—The winter of 1879-80 was very severe, yet the disease was very virulent. A long-continued frost, when it keeps the gravid fish from the "redds," has a tendency to increase the disease, but as to its killing or even hindering the increase of *S. ferax*, frost has no effect whatever, as the above-named winter proved.

4. *Parasitic Worms* are supposed by some to be the sole cause. As mentioned before, many diseased and also apparently healthy fish are found to be infested with them. But there are others, both diseased and healthy, which are free from these parasites.

5. *Diseased Livers.*—Many dead and diseased fish, when opened, show that the liver is perfectly healthy. Fish that are found dead frequently have the liver in a bad state, being soft and easily broken up.

6. *Wounds caused by Fighting or otherwise.*—Any abrasion of the skin or scales of a fish, when the disease is prevalent, is almost certain to be attacked by *S. ferax*. But again, fish are often attacked by *Saprolegnia* that have no appearance of having been bruised or wounded in any way.

7. *Protection of Kelts.*—Undoubtedly kelts are grand hosts for *S. ferax*, more especially the larger males, when they are in a weak and exhausted state after spawning, and often wounded when fighting during that operation. This cause, like all the others, does not always hold good, as the disease broke out in the season of 1881 in the Tweed and Teviot before any of the salmon had spawned.

Various other reasons have been assigned for these epidemics of *S. ferax*, but although they, like most of the above alleged causes, may render fish more susceptible to the disease, still none of them can be said in any case to be the sole cause.

It is certain that whatever tends to lower the general health of the fish helps to induce the disease.

Many of those who have written on the subject appear to have lost sight of the fact that *S. ferax* is a plant, and, like other plants, has its own season of growth, and habitats whereon to vegetate and grow, and that when its "seed" (zoospores and oospores) meets with circumstances suitable to their development, then it will grow. Probably these spores are always present in our rivers, ready to germinate when they find a suitable *nidus*. It is very probable that the resting spores—which are much rarer than the zoospores—as in the case of the potato fungus, keeps up the stock from one season till the next.

Professor Huxley has, in his article "Salmon Disease" in *Nature*,[1] advanced the opinion, "that the penetration of the hyphæ of the *Saprolegnia* into the derma renders it at least possible that the disease may break out in a fresh-run salmon without re-infection."

Various remedies have been suggested—amongst others—

1. *Purifying the water from pollutions.* Certainly this should be done, but it will not prevent the disease from appearing.

2. *Removal of obstacles to the ascent or descent of the fish, and artificial floods when the water is low.* The autumn of 1881 proved, as has been already stated, that these will not remedy the evil, as there was plenty of water to allow the fish to go where they pleased.

3. *Netting the diseased fish and taking them down to the sea.* It is now generally admitted that sea-water kills *S. ferax*. But what effect would it have on fish whose instincts keep them in the fresh water? Probably the stronger would re-ascend the river at once, while the weaker would most likely succumb.

Stamping it out by killing every fish in the river has even been recommended. The cure would be worse than the disease! But if every fish in the rivers were killed it would not stamp out *S. ferax*. In addition to the resting spores, which retain their vegetative power for a long time, there is a terrestrial state of the same fungus (*Empusa muscæ*), which is very common in the autumn, both as a parasite and as a saprophyle, on the common house-fly. Though very different in its general appearance (see Fig. 2, from Cooke's *Handbook*) from *S. ferax*, when a fly that is infested with it (*E. muscæ*) is immersed in water, it soon assumes the form of that species. Some interesting experiments were recently made by Professor Huxley, by propagating *S. ferax* from a salmon to a dead house-fly, and from it to other flies.

[1] See *Nature*, March 9, 1882.

Some rivers in this country appear to be free from the disease, at least it has not been detected in them, but it is very likely that they are all liable to it more or less. Why it is that *S. ferax* is more plentiful in some rivers and in some seasons than in others is at present unknown. Possibly the geological formations through which the water passes, or a stronger race of fish, may have something to do with it. The geographical and altitudinal range may also have some effect. Every botanist knows how very limited is the range of some plants, while others may almost be said to be "citizens of the world."

Achlya prolifera, another of the *Saprolegnieæ*, has been long known as a scourge in aquariums, goldfish and minnows being very susceptible to its attacks. It is still an open question whether a salmon ever gets rid of *S. ferax* until its return to the sea. But I have no doubt that minnows sometimes get quit of *Achlya*, so it is possible that salmon may sometimes do the same with *Saprolegnia*. In 1881 I had a few minnows and a water-beetle in a large bottle. They kept healthy for several months, when a small patch of mycelium appeared in the tail of one of the minnows. I had tried to infect them before this with *Saprolegnia* by putting patches of it in the water amongst the minnows, but without effect. Having to be from home for a week, I gave instructions not to disturb the minnow, and if it should die to keep it. When I came back the minnow was lively, but tailless, and free from any fungoid growth. But the beetle was dead, completely enveloped in a shroud of mycelium, which had killed it in three days from the time it was noticed. On examination of the minnow's tail, which was at the bottom of the bottle, the fungus turned out to be *A. prolifera*, not *S. ferax*, as I had expected. Like *S. ferax*, it is possible that *A. prolifera* passes as two species. The Rev. M. J. Berkeley, one of our greatest mycologists, has expressed the opinion that *Achlya* may be an aquatic form of *Botrytis bassiana*, the parasite which preys on the silk-worm, the same as *S. ferax* is the aquatic state of *Empusa muscæ*.

The following preventives and remedies naturally suggest themselves:—

1. Everything possible should be done to encourage a healthy, strong race of fish, as there is no doubt that they are not so susceptible to disease, and if affected are more able to stand it than weakly, wounded, or unhealthy specimens. Some old anglers assert that the fish in the Tweed are not so strong as they were in their younger days. Mr. J. Brunlees, C.E., who has angled in the Tweed for many years, writes: "That the tone of the fish has been gradually lowering for some years back has been made apparent to me from the more languid

manner in which very many of them take the fly, which they slowly suck in, and seldom rise to the surface to seize."[1]

2. *Destruction of Kelts.*—Most anglers and fishermen agree that the kelts should not be preserved, if it was for nothing else than the large numbers of their own kind and other young fish that they consume before they are "mended." The offspring of these old fish are not so likely to be as healthy and strong as those of the younger fish, which they chase off the redds on every opportunity. Besides, a kelt that has been hooked, run, and landed, and then returned to the river in a half-dead or dying state, is in the best condition as a habitat for *S. ferax.* Better kill them at once, and, if not edible, bury them. In the "good old days," when everybody could take salmon when and how they pleased, whether by leistering, netting, or any other means, there was then many more fish, and probably less disease,—for the weakly and diseased ones would be easiest captured, leaving the healthiest fish to propagate their species.

3. Although pollutions from manufactories, etc., does not directly cause the disease, they may indirectly assist in its development by lowering the tone of the fish, and therefore predisposing them to its attacks. There is another and incomparably worse source of pollution, which until four years ago was allowed full scope. I refer to the diseased and dead fish which are left in the rivers. The only way to prevent the mischief which is done by them is to take out every fish as soon as they are seen to be affected, and not to wait until they are covered with fungus or dead, as the fungus will then have disseminated innumerable spores, ready to grow whenever they find a suitable *nidus* whereon to germinate. The more spores that are floating in the water, the greater the chance is that more of the fish then in the river will be affected than if there were few spores.

A farmer or a gardener, if he wishes to keep his land clear of weeds, does not allow them to ripen and shed their seeds before killing them; and until some specific is discovered that will kill *S. ferax* in fresh water, similar means ought to be applied to it.

The following extract from Professor Huxley's paper, already referred to, in *Nature*, on the "Salmon Disease," will give some idea of the rapid rate of increase in *Saprolegnia*:—"At a very moderate estimate a single fly may bear 1000 fruiting hyphæ; and if each sporangium contains 20 zoospores, and runs through the whole course of its development in twelve hours, the result will be the production of 40,000 zoospores in a day, which is more than enough to furnish one

[1] *Land and Water*, vol. xxvii. p. 456.

zoospore to the cubic inch of 20 cubic feet of water. Even if we halve this rate of production, it is easy to see that the *Saprolegnia* on a single fly might furnish spores enough to render such a small shallow stream as salmon often ascend for spawning purposes dangerous for several days. But a large fully diseased salmon may have as much as two square feet of its skin thickly covered with *Saprolegnia*. If we allow only 1000 fruiting hyphæ for every square inch, we shall have 280,000 for the whole surface, which, at the same rate as before, gives over 10,000,000 spores for a day's production, or enough to provide a spore to every cubic foot of a mass of water 100 feet wide, and five feet deep, and four miles long. Forty such diseased salmon might furnish one spore to the gallon for all the water of the Thames (380,000,000 gallons per diem) which flows over Teddington weir. But 2000 diseased salmon have been taken out of a comparatively insignificant river in the course of a season."

From the above extract, and I believe the estimate is much too low, it will be seen how necessary it is to try and keep the disease down on its first appearance, when it is only sporadic, and not to stop until it becomes epidemic, which it will assuredly do if let alone, and the conditions necessary to its development are present.

XII.

THE MESH OF HERRING NETS;

SHOULD IT BE FIXED BY LAW FOR HERRING NETS?—IF SO, OF WHAT SIZE?—OR SHOULD FISHERMEN BE AT LIBERTY TO USE ANY KIND OF MESH THEY PLEASE?

BY C. W. MORRIS.

To discuss whether there should be a fixed mesh for herring nets requires that it be decided first what is a mature fish. Is it a fish which is of a certain size? Or is it one that is of any size, but of a certain quality or in a certain stage?

Literary authorities give the meaning of the word "maturity" as ripeness or perfection.

By some authorities a mature herring is considered a fish which is ready for spawning, and which in that state is considered at its most healthy state, and certainly is of the best quality. By others a herring is not considered mature till it reaches a size of 9½ to 10½ inches, and is ready for spawning. As a matter of fact, a herring grows a little less than half an inch in a month, and in about eighteen months will be between 8½ and 9 inches long, and at that age will be an adult fish and ready for spawning. But fish of this size are not the most desired by any class of buyers or merchants. They are rather too small, and cannot be called "perfection" in a *bona fide* way. It may therefore be considered for the purpose of discussing this question, that a mature fish is one which is of an average size, say about 10 inches long, and is also in its last stage previous to spawning, or full-roed.

The next point to be decided is, whether the mature fish only should be fished for; or whether the present fishing for matties or maidens, and shotten or spent herrings, should be prohibited, or not.

As regards matties, they are wholesome for food, and if the fishermen can find a market for them there does not appear to be any reason why they should not be caught. They would certainly, if left about six months longer, be about 10½ inches long (matties usually averaging about 8 inches), and be of greater value as food; but still, as at present there does not appear to be any prospect of the herring becoming scarce, either from anything that man or its natural enemies can do against it, the fishermen may as well take them at that size, if he can, as wait till they are larger.

The same remarks will apply to the taking of the shotten herrings, which are for the most part taken as bait for cod, ling, and other line fish. They are of no quality, being dry eating when used as food, and are known in some parts of the country as "sticks." It is very probable that if they were not caught by man, their natural enemies would catch the greater portion of them. There does not appear therefore to be any sufficient reason for prohibiting the catching of this class of herring.

Now we come to the point: Should there be a mesh fixed by law for herring nets?

As the fecundity of the herring has been proved to be so enormous, and the operations of man bear so small a proportion to the destruction caused by its natural enemies, there does not seem to be any call for having a mesh fixed by law for herring nets.

The self-interest of fishermen, merchants, and curers, will in this as in other cases be the best law. Curers and merchants engaging boats to fish for them for the season, begin now to consider not only the class of boat they are engaging, but whether the nets to be used are of a mesh which will catch a good marketable herring, or otherwise.

The difficulties in the way of carrying out a law which imposed a fixed mesh would be enormous, though, of course, not insuperable. As is well known, it has been done, in times gone by, when nets were made of twine (which does not shrink so much as cotton), and were very heavy and coarse compared to what they are now that the manufacture of cotton nets has reached such a state of perfection.

To make the difficulties in the way of having a fixed mesh clearly understood, it will be necessary to give a brief explanation of the nets and other means by which the herring is at present fished for.

The number and various sizes of craft employed in prosecuting the herring fisheries is greater than that prosecuting any other fishing at any one time. These sizes are from the longshore or beach punt capable of carrying not more than five thousand herrings, with its little fleet of nets extending about 300 yards, to the large French lugger and "chasse-marée" capable of carrying fifty lasts of herrings, and a fleet of nets which would extend a mile and a half or two miles. The nets of the former would be of 9-ply cotton, of the lightest description in every way, about sixscore meshes deep, with a length varying, according to locality, from 20 to 60 yards, and numbering about thirty-eight meshes to the yard. They would simply be dressed with oil, and be quite capable of catching a perfectly matured fish, while, at the same time, they would catch either a shotten or half-grown fish. The latter would have nets of 21-ply cotton, numbering about thirty-six meshes to the yard, twelvescore deep, and about 25 yards long, and everything of the strongest. They would probably be dressed with coal-tar and bark till they were as stiff as a piece of wire; and, consequently, when shot would hang in the water stiffly, and would catch a matured fish, but a shotten or half-grown fish would go through the meshes with ease, and thus escape, especially if the nets were not hauled immediately the fish had struck them.

The net that a vessel of this latter class would use to catch shotten or spring herrings (as they are termed on the Norfolk and Suffolk coasts) would be about the same length and depth as that given, but the mesh would number from forty to forty-two to the yard.

It will be as well here to explain why the light oiled nets of the smaller craft will catch large and small fish at the same time. It catches the small fish because the mesh is small enough; and being soft, pliable, and light, when the matured fish strikes it powerfully, the net yields to the force and the shape of the head of the fish. A stiff, coarse net would defy the strength of the fish, and, by not yielding, would prevent it from passing its head and gills into the net and being caught. It is to be remembered that the size and dressing of the cotton regulate the size of the mesh. Imagine a diamond-meshed piece of stout net nearly as stiff as wire—the stiffness caused by the method of dressing,—the mesh of a given size; and imagine also a piece of fine net, the mesh to be of the same size, with its natural softness and pliability, both of these suspended in the water, and a fish darting at each of them. The former, being stiffer and heavier, would withstand the force of the fish, and not yield in the least degree to the form of its head, whereas the lightness and softness of the latter would allow it to yield to the force of the fish, and the diamond-shaped mesh would adapt itself readily to the oval form of its head. Thus not only would the mesh of the net when first made have to be regulated, but also the method of dressing it, as dressing in most cases means shrinkage.

Dressing is for the preservation of the net, and is done with linseed-oil, coal-tar, alum, tanning with cutch or oak-bark. Tanning with cutch is the method most generally employed, and it is an established fact that frequent dressings reduce the size of the mesh, though it may be only in a slight degree. At certain times it is necessary to scald the nets, especially after large takes of fish, and more especially during the seasons when the fish, being of good quality, leave much oil in the nets, which would soon heat and destroy them if they were not scalded at once. This process also has the effect of making the mesh smaller. Fishermen will use the same nets of stout ply to catch shotten or spring herrings, which originally would only catch matured fish; but will not do so now, owing to stiffness and the reduction of mesh caused by frequent dressings and scaldings. The use of pine oil will to a great extent prevent the nets from shrinking in course of dressing. It is sometimes used for that purpose, and the use of it might be made compulsory if it was ever decided to fix a regulation mesh. Knowing that the nets of large mesh will not catch immature fish (though a small mesh will catch all classes of light make), the fishermen frequently have a fleet of nets composed of large-meshed nets mixed with those of a smaller mesh. They make this provision in case the fish may be immature or shotten in the locality in which they may happen to shoot the nets, and they will stand a chance of catching some which they otherwise would not catch if the nets were all of a mesh which would only secure matured fish.

There is another point which must not be forgotten, and that is the cotton of which the nets are braided. To the trade it is known as 9, 12, 15, 18, and 21 ply, which means that it is composed of any of these numbers of single threads spun together. But to any one unacquainted with the article in question and the various makers, such a definition is no real guide, as it is obvious that if the threads which are used by one maker are only stouter in the least degree than those used by another, it will make a considerable difference when they are all spun together. Thus it has been known that a cotton supplied by one maker as 9-ply has been the same size as that sold as 12-ply by another. From this explanation it will be gathered that a law imposing a regulation mesh would have to deal with, first, the cotton supplied by the spinners to the net factors, laying down a standard of size; secondly, the size to which all lint would have to be braided; thirdly, the method to be employed in dressing the lint, and the number of times such dressing should be resorted to; fourthly, the ingredients to be used in the dressing; fifthly, to insure that all boats carried all their nets of regulation size.

The law would also have to be carried out as an international law, or otherwise it would be restrictive on our own fishermen and not on foreigners, and would probably drive some of our English fishermen to sailing out of foreign ports.

Referring to the fifth provision above mentioned, owing to the various sizes of craft now engaged in the herring fisheries, it would be obviously unjust and arbitrary to compel the small beach punt, Yorkshire coble, Scotch boat, and large lugger, all to carry nets of the same size cotton. For, in the first place, if the smaller craft were able to shoot heavy nets, they would not have the means or be able to haul them in, especially if the take of fish was large, or unless the weather was very fine. In the second place, it would so limit the lengths of fleets, which the various sizes could carry, as would prevent the crews from earning a living. It would also be useless to think of having the standard nets of light cotton, for larger vessels would soon spoil them, even by once shooting in only freshy weather. But since the size of the cotton plays such an important part in the mesh of the net, it may be said, Why not have a standard size of mesh adapted to each ply of cotton, say thirty-six to the yard for 18-ply, and increasing the number of meshes to the yard down to the 9-ply? One answer to this would be, that then the fine nets would capture large and small fish; another answer is, that it would be impossible for any Government to carry out this provision, as it would be impossible to examine every fleet of nets to see that each net of a certain ply was of its proper mesh.

Another point that would have to be considered, if a regulation mesh were fixed by law, would be as to how a net might be set up. Setting-up is the term applied to the hanging of the net to the net-rope. A piece of stout twine is run along the lint, and then this is hung to the net-rope by means of pieces of twisted twine called norsels, placed at equal distances along. But all fishermen do not set their nets up alike. Some prefer the diamond well open, or longer in the horizontal; some like a perfect diamond when it is hanging; some think that the diamond not quite so open is the best; and some do not study the diamond at all. A fisherman, then, after having obtained his lint of the Government standard, might set his net up, so that the diamond shape of the mesh would not be quite open, and would have a tendency to stop immature fish. This would be more effectually the case if he were to use certain means for weighting the bottom of his net, so as to keep the mesh closed to a certain extent.

Another difficulty presents itself, and that is that mature herrings differ in size on various coasts. Just, by way of example, compare the herring of Iceland with our East Coast herrings,—and boats are every year fishing farther to the north, —in this case the regulation mesh would prevent fishermen from prosecuting both fishings. The herrings on the Labrador and Icelandic coasts run to enormous sizes,—to 18 inches in length!

The second question put as subject for discussion in this Essay—"If so, of what size?"—may be briefly disposed of thus: If a regulation size be hereafter found desirable, it would have to be fixed on a sliding scale, according to the size of the cotton and the method and ingredients of dressing permitted to be employed.

The third and last question proposed for discussion is, "Should fishermen be at liberty to use any size of mesh they please?" And I answer it in this manner: the average number of eggs deposited by the female herring may safely be stated at 25,000. Of course, not a tenth part of these arrive at perfection, for nearly all the fish of the sea prey on the eggs of the herring. But assuming that a twentieth part of them come to perfection, what an enormous increase! It is clear, then, that nature has provided these enemies to keep the equilibrium of the finny tribes correct. Everything of the aquatic tribes in the air and water preys on the herring or its ova, more especially whales, dogfish, cod, hake. The gannet will eat from twenty-five to thirty-five herrings a day. The gannets of Scotland consume more herrings by far than man can catch with all his labour and gear. So that, bearing in mind that fishermen are only a minor consideration as regards the possible decrease of the herring, there does not appear to be any call for restrictive regulations on them in the prosecution of this fishery. If restriction should be required, it would have to begin with the reduction of the birds who prey on the herring. Fishermen should be allowed to fish for the herring where they like, when, and how they like.

XIII.

THE ARTIFICIAL PROPAGATION OF SEA-FISHES SUITABLE FOR FOOD.

By W. Oldham Chambers.

Public attention has frequently been directed to the failure of the deep-sea fisheries along our coasts, notably industries that existed in connection with the long-line trade; and the gradual scarcity of soles and turbot; and the consequent high prices of these fish when brought to our markets. The writer determined to commence a series of scientific experiments in deep-sea fish-culture with a view to the replenishment of the waters by artificial reproduction, and selected the Cod (*Gadus morrhua*) for the first trial.

As these investigations are the first that have ever taken place in this country,[1] they must of course be looked upon as in every respect experimental, and to be the pioneers of more extended researches in the future, tending to the elucidation of facts that at present are involved in doubt and mystery—particularly the nature of the bottoms of the sea in the fishing stations, the temperatures of the spawning-grounds, and the strange erratic migrations of the fish, which to understand will be of the greatest possible interest.

A remarkable feature in the cod is its great tendency to variation. Dr. Günther divides its genera and species into numerous varieties, several of which can easily be recognised by close observation. Whether this is caused by their food or by the nature of the sea which they select as their habitat, is at present uncertain.

The migrations of the cod, as with other fish, appear to be governed by some of the well-known laws of nature. Instinct teaches them to select the shoal waters for spawning; and one can easily understand the great assistance rendered in the impregnation of the ova by the disturbed waters generally met

[1] In the Report on Cod Fisheries of Cape Ann, Mass., by R. E. Earll, published in the United States Commission of Fish and Fisheries, 1880, p. 685, will be found the first experiment instituted by the direction of Professor Baird on this subject. Mr. Milner, at Gloucester, Mass., in August 1878, commenced experimenting, but died before the conclusion of the investigation. This was completed by Captain Chester, and the whole process detailed, pp. 718-727.

with in the neighbourhood of our sand-banks. Again, the natural food of the sea in these localities is certainly more in harmony with the requirements of the young fish than the coarser quality met with in deeper waters.

It is well known that, during the period of spawning, members of the *Salmonidæ* family lose all inclination to feed. So with the common cod; and it is a matter of observation to find, on its being opened in the fish-markets, an almost entire absence of food in the stomach during this process.

The time of spawning along our coast is from January to April, but it is most difficult to determine an exact date, on account of climatic and other influences. A long cold winter will considerably retard the spawning, while, on the other hand, a mild and open spring will accelerate the action.

Another feature to remark in the cod is the length of time that spawning extends over. If portions of the ovaries are placed under a microscope, it will be found that the eggs increase in size as maturity advances. The eggs close to the outlet are considerably larger than the products of the inner bed of the roe-bag, clearly showing that the period of spawning must extend over several weeks.

From weighing and measuring certain known quantities of eggs, it may be fairly estimated that a full-grown cod-fish contains the enormous number of nine millions of eggs in its ovaries. We may consider it a happy provision of nature that the cod is ordained to be one of the most prolific of food-producing fishes, notwithstanding the numerous adverse circumstances it has to contend against before it reaches maturity. Among these may be enumerated the non-impregnation of the eggs from storms or other causes; the ravages of a multitude of predaceous fishes, particularly the *Medusæ* family; and the tendency of the eggs to reach the surface and be carried about by winds and tides, and be thereby lost.

The eggs of the herring and many other sea-fish are adherent in their nature. The female first sheds her eggs on aquatic plants, or other fixed objects at the bottom of the sea, over which the milt of the male fish is spread for the purpose of impregnation. With the cod-fish, the reverse is the case. Spawning takes place near the surface of the sea, where the eggs remain during the entire period of incubation, and also while the fry are in their alevin condition.

During spawning, the female cod-fish is nearer the surface of the sea than the male; and here one may with advantage pause a while to admire a most beautiful provision of the Great Architect of the Universe, who has perfectly ordained all things. The specific gravity of the egg is much lighter than that of water; the heaviest portion of the egg is naturally turned downwards, and it is here that the micropyle is situated, being the point of impregnation of the sperms contained in the milt. If, therefore, the position of the male and female fishes was reversed during the process of spawning, but few, if any, of the eggs would reach maturity, on account of the impossibility of the sperms coming in contact with the egg.

In arranging a series of investigations at Lowestoft for the artificial spawning and hatching of the eggs of sea-fish, the first consideration was the supply of suitable water to the hatching-house, free from sand, dirt, or other impurities. With this object in view, the writer placed himself in correspondence with the General Manager of the Great Eastern Railway, who very kindly allowed free use of the sea-water from the depositing tanks of the Company; and an acknowledgment is here given for the concession. Without water of this description, it would have been impossible to have commenced operations during the present year (1882).

Attention was next directed to a suitable apparatus, capable of hatching floating eggs; and, in designing such an invention, several difficulties presented themselves. The writer felt, the nearer the natural condition of the eggs in the sea could be approached, the greater would be the success. An apparatus was therefore devised, that retained a constant tide-like flow in the water, caused by a peculiar turn given to it on its entrance, which held the eggs in perpetual motion. The results realised every anticipation, and left nothing to be desired. The apparatus may, therefore, be considered as the first attempt ever made in this country for the hatching of floating eggs, and may, possibly, lead to the invention being patented.

Large tanks, capable of storing the sea-water, were fitted up contiguous to the hatching-house, with a force-pump to raise the water from the waste or overflow tank to a high-level cistern for re-use again and again, the water being freshened by a daily supply. Everything being in readiness at the hatching house for the reception of the eggs, a large tank was fitted up and placed on board one of the long-line fishing smacks, and taken out to sea for the reception of the live cod-fish, with special instructions to the master of the smack only to bring in to harbour fully ripe milters and spawners. Probably heavier fish could have been obtained from the large trawl vessels, but they would not have answered the purpose; for most of the fish are brought to the surface, in the trawl net, either dead or so much injured, that for the purposes of this investigation they would have been useless. Obviously, then, the fish taken off the long-lines would have a better chance of retaining life than the fish obtained by trawling. But, owing to adverse winds, it was some time before fish could be caught suitable for the requirements of the hatching-house.

As this was the first attempt at the artificial spawning of the cod, the writer was unacquainted with the most favoured method; and, for the first experiment, he tried the Russian, or dry system of M. Vrasski. He selected a 10 lb. female fish and stripped a portion of her eggs into the spawning-pan, perfectly free from water; and over this was partially stripped the milt of the male fish of about equal weight. The whole was well mixed together, and gradually brought up by adding a little water at intervals; and, in half an hour, the contents were placed in a jar lettered No. 1.

The next experiment was reversed in order. A little water was previously placed in the spawning-pan, into which was stripped the milt of the male fish, and, as quickly as possible, the female fish was operated upon; the whole was thoroughly incorporated and washed off with sea-water as before, and the contents transferred to a jar, labelled No. 2. Both these jars were quickly taken to the hatching-house, and the ova placed in the apparatus awaiting their reception. And, with delight, the eggs were seen gradually to rise to the surface and enter the artificial stream, with every disposition to acclimatise themselves to their new habitat.

Although these experiments in spawning were, to a large extent, satisfactory, it was felt that one thing was yet desired, namely, to strip the fish immediately they were removed from the sea, and carefully note any difference in the eggs from those already operated upon in the harbour. With this object in view, the writer went to sea in one of the small long-line boats, armed with spawning-pans, jars, microscope, etc.

The fishermen were most desirous to render every possible assistance; and, when the lines were hauled, in the early morning, the men looked on with the greatest amazement when the spawning operations commenced; and an air of compassion appeared on the faces of some of them, who, by their demeanour, evidently thought the operator was suffering from an incipient cerebral affection. The same procedure was repeated in spawning as before mentioned, namely, the dry and the moist systems, and the jars were severally labelled, Nos. 3 and 4.

As considerable time elapsed before the boat entered the harbour, the time was employed in microscopic observations on the ova and milt separately and conjointly. Although there was some amount of difficulty in keeping the instrument steady on account of the pitching of the boat, still it was proved beyond a doubt that there was no appreciable difference in the vitality of the sperms or the readiness of the egg to be impregnated therewith. Perhaps the micropyle was a little more defined, but that might, or might not, be accounted for by the degree of ripeness in the eggs then before me. The eggs were quickly placed by themselves in the hatching-house on landing. And the result of this experiment proved a very important feature in future work: namely, that it is not necessary to spawn the fish directly they are taken out of the sea, but that, for all practical purposes, the fish brought to harbour in the long-line boats are equally efficacious for artificial spawning, provided they have not left the water many hours. Subsequent experiments were made, accompanied by microscopic observations, such as impregnating the eggs of dead females with the milt taken from live males, and again in reverse order. The results varied in accordance with the vitality of the milt and the ripeness of the eggs operated upon.

The milt of the male fish is dependent for its fecundative properties on the presence of animalculæ (spermatozoids), the movements of which are of the most erratic nature. Immediately the animalculæ die, all fecundative power is at an end. The properties of vitality are preserved by the milt being kept in a low temperature, and being undiluted with water. The fertility of the egg depends entirely upon its degree of ripeness. If any force has to be used in stripping it from the roe-bag, the egg is rendered useless for reproduction: Therefore, to effect artificial fecundation, it is necessary that only perfectly mature eggs are used.

It being obligatory that this paper should be sent to the Edinburgh International Fisheries Exhibition by a certain date, it is to be regretted that time did not permit of the experiments being continued, in order that the report should embrace the embryo or alevin condition of the fry, as well as the development of the egg; but sufficient has been shown to prove the fact that the artificial propagation of the cod is, in every respect, practicable. And it is to be hoped that these scientific observations, on behalf of an industry so important to our country, may lead to favourable results.

If, by the aid of fish culture, millions of eggs are artificially hatched off—which, with the greatest ease, can be accomplished, as is proved by the writer's experiments—and these eggs distributed along our coasts to places, specially selected for the purpose, free from the disturbing influences of wind and waves, who is there that can foretell the result to our fisheries in the future!

As pisciculture has been so successful in re-stocking our rivers and lakes, why should not similar attempts be made along our sea-board, especially as a well-known law of nature proves to us that fish return to spawn in the waters which first gave them birth? We have therefore no fear as to the cod thus hatched leaving their early habitat and reproducing on other coasts.

It is the writer's intention to follow up his hatching experiments still further, and combine therewith investigations into the early life of the cod. However willing and anxious a private individual may be to further this object, still there must be some limit to personal outlay; and it may be fairly advanced that, in the light of national economy, it forms a most fitting subject for the expenditure of public money.

XIV.

THE BREEDING AND REARING OF FRESH-WATER FISH.

BY W. OLDHAM CHAMBERS.

FISH culture is now no longer a question of experiment and scientific interest, but one of national economy. It aims at the production of food-fishes for our cities and towns, and in this respect we are bound to consider the subject. There are noble works being carried on in fish culture, as a national enterprise, in China, Australia, New Zealand, Canada, Switzerland, Algeria, Holland, Italy, France, the various States of Germany, and, above all, in America, while we, as a nation, are far behind these countries in this important industry. It is time that we began to look the matter in the face, and consider how we can contribute to the amelioration of mankind by assisting to feed our teeming cities with a wholesome and plentiful food.

Having determined by scientific investigation the most convenient waters to repopulate, and the best food-fishes to acclimatise, experiments and observations would follow as to the natural food of the waters in question, the rearing of the best description of aquatic plants, and the preservation of the spawning-grounds of the several species of fish destined for the re-stocking of our inland waters. Often have entire rivers been depopulated and valuable species of fish lost through the growth of some pernicious weed, or the introduction of a water-insect detrimental to fish indigenous to certain districts. Observations should also be made on the temperatures of the waters.

Having arrived at such information, the next duty would be to erect, in approved localities, fish-culture establishments, consisting of spawning and hatching houses, fed by well-filtered water, stored in tanks of sufficient content to provide against an insufficient supply. In the grounds should be constructed stock ponds for reproducing fishes, nursery and yearling ponds for the young *Salmonidæ*, hatching and rearing ponds for the cyprinoid and other adhesive spawning fish. In order to make fish-culture a real success, the young fish should be carefully fed, nursed, and tended for not less than two years; they will then be able to hold their own against the rapaciousness of their finny brethren. Ponds for the culture of aquatic food-insects should be added, while matters of detail would naturally follow in the development of an establishment thus briefly sketched. Attached thereto might be a School of Pisciculture, in order to create an extended knowledge of the science. Experiments would here be worked out in Embryology, which would form a fitting opportunity for prizes to be given, under State recognition, to successful competitors.

We have thousands of acres of inland waters in the United Kingdom, entirely neglected, which would, under scientific cultivation, produce a food supply for our nation rich and productive in the extreme, and, one might almost be inclined to say, inexhaustible.

Many of our rivers are supplied with superior anadromous fish, and many more, equally fertile in food resources and spawning-grounds, are altogether unknown to these fish, simply because the pisciculturist has not directed his attention to their reproduction in these particular waters. Instead of seeing salmon and trout a luxury to the few, surely there can be no practical difficulty in establishing a system of culture that would, in a few years, by a wholesale importation into the market, render them a cheap source of food for the people.

Greater attention should be given to the best means of cultivating our so-called natural coarse fish, or, as the Germans call them, "Summer Spawners." And particularly may be named tench, roach, carp, perch, pike, etc. etc. Many of our rivers, streams, and water-courses are altogether depleted of them, more especially in the neighbourhood of our large cities and manufacturing towns. Approved methods should be adopted for rendering innocuous to fish-life streams polluted by sewage and chemical or other works. In this direction we must ask for more stringent legislation, in order to restrain offenders in the pollution of our food-producing acres.

Happily the State has taken up the question of the preservation of our fish; and protection is granted, by the aid of "close-times" during their spawning seasons. A watchful eye must be kept on our fish in their embryo state, for by the protection of the young they will the better be enabled to arrive at a state of maturity, and contribute to the development of their species.

Remedial measures should be taken, by properly constituted authorities, for an efficient re-stocking of our rivers with indigenous food-fishes. For, the principle being recognised that the extensive culture of our own home fishes is a source of wealth to the nation, no difficulty would be found in supplying nature with assistance, by means of the hatching and rearing establishments before mentioned, to enable culturists to repopulate our beautiful rivers and lakes with teeming shoals of food supply.

Certain rules should be instituted and regulations enforced for carrying on our fisheries, with a view to their improvement. Great care should be taken in the spring and summer not to disturb the natural vegetation in those places used by the fish for their spawning-grounds; and also to keep the gravelly bottoms of the tributaries to our rivers free from mud and refuse. Coarse fish generally select grassy bottoms in our brooks and rivers for the purpose of spawning, after which nature teaches them to descend to deeper waters.

Observations should be attentively made on the migrations of the different kinds of fish, and also a careful examination of the nature of the bottoms of the waters in the various fishing stations. Without statistics of this nature it is impossible to arrive at results, with a degree of certainty, as to where fish may be found at certain periods of the year.

By following up the laws of nature, our fisheries may to a great extent be very considerably improved, and the grounds made more suitable for the spawning of the fish.

Most of our inland fishes spawn in the spring and summer, and shed their ova on pieces of wood, aquatic plants, grass, etc.; and as the roe is of an adherent nature, it remains *in situ* until the young are hatched. But the free spawners, such as the *Salmonidæ* family, shed their eggs in winter on gravelly and stony bottoms.

In order to improve our fisheries, careful attention should be given to the spawning of these fish in their natural state, and from the experience thus acquired we might assist nature during this period. For instance, if we distribute on the bottom of the waters branches of wood and fagots, or encourage the growth of suitable grasses, and aquatic plants, the spawning-grounds will not only be much improved, but fish will thus be induced to visit the waters, for the purpose of reproduction. Ponds may be constructed, as mentioned in a former part of this Essay, plentifully supplied with fagots, grasses, etc., upon which fish will deposit the ova in due course. After the young fish are hatched, they can either be allowed to go free in the rivers, or be removed to ponds for re-stocking purposes.

Although attention has been devoted in this Essay to the *natural* spawning of our inland fishes, still the writer is able to testify to the ease with which the eggs can be stripped from the fish by *artificial* means, and after fecundation has taken place, to hatch the young in properly constructed boxes, fitted with either strips of glass or muslin, according to the nature of the egg to be hatched. After exposure to water of a regular temperature, the young fishes will soon burst from their tiny shells; and when the umbilical sac is consumed, they must then be removed to ponds and fed, as before stated.

XV.

FOREIGN FISH MOST SUITABLE FOR INTRODUCTION INTO BRITISH RIVERS AND WATERS.

By W. Oldham Chambers.

The first consideration involved in working out a scheme for the acclimatisation of foreign fish in our waters is a selection of species that in their reproduction would not be detrimental to those that are indigenous.

Among the anadromous fish must not be overlooked the *Salmo quinnat* or California salmon, since it is the most productive of all migratory fishes. It thrives well in varied temperatures of water; it has extraordinary vital powers, and can sustain life under circumstances that would kill half our European fish. It is, therefore, in the light of economic interest, well worthy our consideration. It may be mentioned that a few years ago very few salmon were found on the banks of the Columbia river, but now, by the aid of pisciculture, the annual returns exceed one million sterling. By the introduction of this species of fish into our kingdom may be anticipated the opening of an industry in canned and preserved fish, such as is carried on in California. In the establishment of a commerce of this description large proportions would probably be assumed; and, to meet the exhaustion of the species by the help of the pisciculturist, thousands of fry might be poured into the rivers and sufficient assistance given in their reproduction.

The newly-discovered land-locked salmon next deserves attention. This fish was at first considered to be a distinct species, but is now recognised as the ordinary *Salmo salar*. While it preserves all the sporting attributes of the migratory salmon, and averages from 3 to 15 lbs. in weight, one can hardly conceive a fish more invaluable to the grand rivers, lochs, lakes, and broads of this kingdom, cut off from the sea as many of them are. Every possible attention ought to be given to this species; in stocking our waters hardly any act of acclimatisation more beneficial to a district can be conceived. Experiments have been most successfully carried out on the Continent with these fish, and the results have been most widely appreciated.

The next food-producing fish deserving our attention, with regard to its acclimatisation, is the *Cyprinus carpio* of the *Cyprinidæ* family. This fish originally came from Central Asia, but has been introduced into Europe for many centuries. As a matter of history, the culture of the carp has been extensively carried on as far back as the eleventh century. The particular species recommended for culture, as food-producers, are the *Cyprinus carpio communis*, or common scale carp, the *Cyprinus carpio specularis*, or the mirror carp, and the *Cyprinus carpio coriaceus sive nudus*, or the leather carp, almost entirely bereft of scales, and with a beautiful soft, thick skin.

There is perhaps but little difference in the quality of these fish. One great advantage the latter species has over the former is the peculiar voidance of scales; it can, therefore, be removed from one district to another without fear of any confervaceous growth which is naturally created by injury to the scales.

It will be necessary to obtain from Germany the true breeds; because many persons imagine that the tough muddy products of some of our English ponds are actual specimens of the carp—which resemble the true strains in the same proportion as the flesh of a sheep newly imported from the Continent has to the delicate flavour of our Southdown mutton.

It is a lamentable fact, and one that has often been animadverted upon, that in the United Kingdom we have hundreds and thousands of waste acres of land partially covered with water, which, for agricultural purposes, are valueless. To bring these waste districts into *aqua*cultural use, and to distribute a delicious food-fish throughout the nation, would in itself be an act of the greatest possible service. British farmers ought to be induced to follow the practice of their German and American brethren, by laying out their waste districts for carp-farming, in order that pisciculture and agriculture may advance hand in hand. As a matter of fact, the fine alluvial deposits of waters very considerably increase the value of the soil for farming purposes; and there need be no difficulty in alternating land so that an enclosure used, say for seven years, in pisciculture can be changed to suit agriculture with very beneficial results to the farmer. It is an ordinary sight in Germany to see from 200 to 2000 acres of water devoted to carp-farming. Agriculturists should be educated to this fact—now so thoroughly established in other nations—that any given area of water can, under proper cultivation, be made more productive than the same area of land by the pursuit of fish culture.

The cultivation of the carp presents to us very many advantages as a source of national wealth. This fish inhabits stagnant waters, and delights in loamy bottoms interspersed with vegetation. It also flourishes in brackish waters; and can even live in localities most unfavourable to other fish. It feeds on vegetable products, as well as on aquatic insects, or even on the refuse of slaughter-houses and breweries.

The carp is a hibernating fish, and the greatest percentage of growth takes place in the month of July. Feeding is only advised in small ponds of say 20 acres. Above that carp flourish best when left to their own resources.

The carp, like other members of the *Cyprinidæ* family, are adherent spawners, varying in this particular from the *Salmonidæ;* and care should be exercised in providing shallows for this purpose in the hatching-ponds. It is well adapted to artificial culture; and, in constructing the ponds at the hatching establishment, suitable provision should be made for the boxes in which are deposited the adherent ova.

The carp possesses many advantages unknown to other fish, not only from the ease with which it might be acclimatised to the natural waters of this country, but also from the simple manner in which it matures in artificial ponds and waters. It is exceedingly prolific, a four-pound fish containing 400,000 ova. Its growth is very rapid; in three years it will attain the weight of three pounds, while in warm and protected districts the growth is almost double. Its greatest excellence consists, however, in its delicacy as a food-fish.

Although it is desirable, in the construction of artificial ponds, to have a series of three—namely, the hatching, the breeding, and the stock pond—still it is practicable to design and carry out a mixed pond, capable of embodying in one all the advantages of the series system. It is usual to place 500 fish in an acre of water in the stock or culture pond, which when taken out for the market will weigh about three pounds per fish, or an aggregate of 1500 pounds. Multiplying this by the thousands of waste or uncultivated acres of land in the kingdom, surely the advantages of carp culture as a food-producing fish for the million is a proved fact, and in the light of national economy deserves considerable attention.

The Americans have of late years given much care to cultivating the Shad, and the results of their labours have been most satisfactory. What is practicable in America with this fish is equally so in the United Kingdom. As a matter of history the river Thames was once celebrated for the shad, and a great industry flourished at Shadwell and Shadthames. Let the fish-culturist direct his attention to the reproduction of this fish, and who shall say that the day may not be far distant when Father Thames may once more be replete with the shad to the benefit of all concerned.

There are, of course, other food-fishes, besides those named, that with advantage to the public could be introduced into British waters, such as the Rhine salmon, the great lake trout of Switzerland, and the *Salmo fontinalis* of America; but the writer from long experience in hatching and rearing the latter description of fish cannot say very much in its favour, with the exception of its handsome appearance, and after a trial extending over several years has discontinued hatching it.

Any attention given to the acclimatisation of the Black Bass (*Grystes nigricans*) would be amply repaid. It is considered that this Canadian fish would be well adapted to the stocking of many of our waters, and would, in course of time, present to us a grand sporting fish, perhaps second to none in our lakes and rivers.

It has been advanced by some, that in order to improve indigenous breeds of fish, it is essential to introduce a superior description of the same family to cross therewith. This is, however, a great fallacy. The introduction of new species of fish into rivers and waters should not be with the idea of hybridising. Such fish if reproduced are valueless as food, being rank growers; the practice has in consequence been condemned as unprofitable. In order, therefore, to arrive at strains that grow the fastest, make the most flesh, and possess the most sporting attributes—first seek entirely new species, which, with the aid of fish culture, will soon repopulate the waters.

We may probably live to see the day when the Government will cause investigations to be made, followed up by the foundation of schemes tending to the development of results creditable to us as a nation; and may the time arrive when our depopulated rivers, lakes, streams, and water-courses, shall teem with life, ready and sufficient for the nourishment of our fellow-men!

XVI.

THE UTILISATION OF FISH OFFAL.

BY W. ANDERSON SMITH.

FISH offal is a term demanding explanation to start with. The technical meaning to fishermen is "lower-class fish," but to the general public it is fish garbage, and those parts of fish that are not utilised in drying and curing.

We shall deal with this offal under two heads:—

1. What is unsuitable for human food.
2. What is largely wasted or thrown aside with the former, but might be much more usefully employed.

The question of the Utilisation of Fish Offal

is an important one to the fishing and angling as well as the agricultural community; for it means, in many instances, the turning an unremunerative fishery into a most satisfactory one, and has a wider bearing on the great question of the successful stocking of our rivers than will generally be allowed. Any one standing in an agricultural country after a heavy storm of rain, and observing the drains, the burns, the larger streams, and the rivers, must be satisfied that beyond the physical injury caused by these sudden floods, followed by comparative scarcity of water, there is the further injury to organised beings caused by the artificial manures often so largely employed to stimulate a season's crops. Heavy drainage without artificial manures is not conducive to the stocking of waters; but when to this is added a supply of chemicals filtering through as the water lessens, the result is every way inimical to fish life.

It is therefore a matter of quite national importance that the large quantity of fish manure, at present much wasted, except in a cottar or crofter district, should be turned to the utmost advantage.

The value of fish as a stimulant to crops is well known. In Malaysia the natives frequently thrust a small fish at the side of the root of each coffee or other valuable plant to stimulate its growth. But every fish is not alike valuable for this purpose; and employed directly in this way they are not nearly so useful as in a compost. To have a better idea of the value of sprats, so largely and recklessly used as manure in many parts of the kingdom, I subjoin their composition:—

Water, ...	64·6
Organic matter, . .	33·3
Ash, ...	2·1
	100·0

Showing one-third to be useful to the land, while the whole might perhaps have been used as food directly, to greater advantage than in raising less valuable food.

Besides what passes to our gardens and fields through the kitchen, there is calculated to be 70,000 tons of utilisable fish garbage from the British fisheries alone. This ought to be an important addition to our supply of manures, and should represent a value of upwards of £300,000; while the great Newfoundland fisheries should supply far more, as well as the Icelandic. Our Highland crofters are thoroughly alive to the value and importance of fish garbage to enable them to make the most of their small patches of cultivable land, especially when made up into the composts that they gather at the corners of their crofts. Where the greatest waste goes on at present is, strange to say, in those large fishing centres in which the evil could be most readily remedied.

There are two sources of fish manure,—the one the native fisheries close around our coast, the other those at a distance from our shores, but prosecuted by our own vessels and fishermen. Roughly speaking, there are 10,000 tons of herring garbage at our principal Scottish curing stations every year, that could readily be made the most of at small cost. Such garbage applied at once to land is often injurious, not only "burning" the ground, as the people say, but as a rule being a great source of injurious insects. So that, if to be used at all in its natural state, it ought first to be made into a compost with at least its own bulk of whatever is most readily obtainable: in some instances three or four times its bulk is preferable. These substances may either be derived by the farmer or crofter from the land, or by the fisherman from the sea. The land is certain to provide in many parts of Scotland turf (peat)—which makes an admirable compost with all fish garbage—brackens, furze-bushes, with humus, or even sand.

If it is to be deposited afterwards on peat land, ordinary fish garbage will take a great deal of sand with advantage. From the sea the fisherman can make a compost either with seaware or, preferably, with shell sand, which is to be had in quantity on many parts of our coasts. Even when this is largely intermingled with silica it does not fail to make a capital compost for peat or clay lands. Clay itself, if broken up and half dried, may be used with advantage, more especially if peaty or sandy soils are to be operated upon. Where any public works, or the gas-works of the place, are near at hand, no better compost could be made than by mixing the garbage with the fine ashes and cinders from the fires, materials that are too often considered more in the light of a nuisance, and which thus applied would be of manifest value.

Those who know what a trial it is to the farm-servants to spread ordinary police manure from a great city, mostly enveloped in a fine dust through being so largely composed of road scrapings, will best appreciate the advantage it would be to the town, and the farmer, if it were employed in making a suitable compost with a proportion of fish garbage gathered from the fisheries. The garbage would add that nitrogen in which the other manure is so poor, while the police manure would give that subdivision required, and act as a sponge to sop up the exuding oily matter. This brings us to a principal consideration connected with fish garbage. Except when it is formed of the heads and back-bones from the cod and ling fishery (when it may be used at once), it is full of oil; the 10,000 tons of herring garbage ought, indeed, to yield nearly 4000 tons of dark-coloured, but good oil, that has sold as high as £50, and may be calculated at £15 a ton. By removing the oil from the garbage, the remaining phosphates and salts are in much better condition for immediate application to the soil, and we may safely assert that the 10,000 tons are worth manipulating so as to produce—

4000 tons of fish oil at £15, . .	£60,000
5000 „ manure at £3, . .	15,000
1000 tons loss.	£75,000

The great fisheries carried on at Newfoundland, the Faroe Islands, and Iceland, yield incredible quantities of offal, little of which is locally utilised. The rapidly exhausting guano islands should direct our attention to this fish guano, of which we ought to procure important supplies with little cost for transit.

The cod and other *Gadidæ* are not so rich in oil as the herring, the liver monopolising the greater part of it, so that their garbage is in a better condition for readily preparing as a compost. A steamer could ship a cargo in a very short time in the regions mentioned, either direct from the boats, or at the curing ports; and might possibly reach a port with a cargo of value in a crude state, in tanks, by watering daily with a sprinkling of dilute crude carbolic acid, and spreading the ashes and cinders from the engine-fire over it. But if the garbage could be previously landed at a station and treated, it would be in every way preferable. By this, I do not mean the manufacture of phosphates, or expensive over-manipulation, but simply the extraction of the oil and the after desiccation of the material, so as to be in a fitter state for carriage. In any case, where steam is available, the oil could be readily removed, and the remainder greatly compressed, if not desiccated, on board the vessel before storage. For compression is quite cheaply performed, and rids the refuse of the bulk of useless moisture; while desiccation is at all times, and under almost the most favourable circumstances, a comparatively expensive operation. As the value of a manurial supply is in its cheapness, so long as it is useful, and the additional cost of desiccation adds mostly to the portability and appearance, and not to the value of the garbage; I consequently would not advocate an expenditure which cannot be looked upon as adding to its value, in proportion to the addition it makes to the cost.

At the same time, no doubt, fish garbage would pay in quantity for individuals to make into fancy manures. But I do not hesitate to state my conviction, that most fish garbage will not pay to manipulate for all the phosphates contained, nor for the nitrates; while it would yet be most valuable as a compost, and equally useful in a dried or compressed state, in which all the mineral matters would be retained. But the drying must be done simply and cheaply. Dried, and with the oil removed, the following is the chemical composition per cent. of two of the richest fishes:—

	Carbon.	Hydrogen.	Nitrogen.	Oxygen.
Eel, . . .	52·999	7·474	14·644	19·296
Mackerel, .	51·515	6·902	15·836	19·608

But fish offal does not begin and end with what is fit for manure. Dependent upon the character of the fishery, it includes the bones, the liver, the head, the roe, the sounds, and the air-bladder.

Upon our own coasts the poorer classes of fishermen are too much alive to the value of all this in their domestic economy to permit it to pass from their hands except at exorbitant prices: but where the fisher class is richer, and more constantly employed at their business, much waste goes on.

The bones, if procurable in quantity, are rich sources of gelatine, which may be obtained by the application of steam. This does not injure the phosphates, which are simply left entirely disintegrated by the removal of the gelatinous binder that keeps them together. In France, a little dilute sulphuric acid is used with the steam, the more readily to free the gelatine.

Glycerine is also obtainable from fish-bones. They are easily decomposed by high-pressure steam, when stearine separates out, being solid below about 50° C. This would give glycerine and stearic acid in two liquid layers, and the phosphate of lime. I have not succeeded in this to my own satisfaction, but others seem to have been more successful.

To show the exact chemical composition of dry cod bones, I give the following table:—

Phosphate of Lime, ...	57·29
Carbonate of Lime, ...	4·90
Phosphate of Magnesia, ...	2·40
Sulphate, Carbonate, and Chlorate of Soda,	1·10
Gelatine and Chondrin, ...	32·31
Oil, ...	2·00
	100·00

Fish-bones, however, cannot well compete commercially in the *manufacture* of phosphates.

The livers of the cod family should be carefully hand-picked, the attached gall removed, as well as any other impurity —for liver-disease is a very common complaint among fishes— and the whole carefully sliced with a clean knife, and thrown into a vat, where they ought to be subjected to steaming at a temperature not above 180°. At this temperature all the fine oil comes away of a clear colour, but above it the organic matter of the livers is decomposed, and colours the oil a rich brown colour, when it is only valuable for curriers and saddlers. The finest oil is further purified of margarin, etc.

Other classes of fish, such as skate and dog-fish, yield a plentiful supply of oil from their livers, not so well-coloured, and stronger tasted, but equally useful with the above. All the livers of young coal-fish and pollock are rich in oil, which was largely used for lamps in the Highlands before the invasion of paraffin.

In the interior of the conger-eel, along the back-bone, there is a quantity of fine fat that is almost perfectly white, and if procurable in quantity it is most valuable for consumptive patients, and highly prized when made into oil. The liver of the burbot is very large, and much esteemed for food.

The sounds of cod and other large members of the *Gadidæ* are salted in barrels in quantity, and sent to the London market. If split up and properly prepared, they make a coarse isinglass, not equal, however, to that of the large fine sounds and air bladders of the sturgeon. These latter are prepared, after thorough washing, by exposing sufficiently to the air to permit the outer cuticle to be readily removed, when what remains is prepared in the shapes and sizes that suit the trade. It forms the foundation of Russian glue, the best of all. The best isinglass is made in summer. Isinglass now enters so largely into our ordinary *cuisine*, as well as into our wine and beer trades, that more attention ought to be paid by our fishermen and fish-merchants to the supply of the sounds and air-bladders of our *Gadidæ*, in a more presentable shape than they come to the market in at present—when they do come.

The roe of all fish is so greatly prized, both by man and marine creatures, that nothing need be said in its favour. A very extensive traffic is carried on between Norway and France in salted cod-roes, which are used in the Biscay provinces as bait in the sardine-fishery. Potted roes are most excellent, and might be a source of considerable profit in rich fisheries, like Norway or Newfoundland, if well potted and spiced in little stoneware dishes. The roe of the sturgeon is the source of the famous caviare, which may be eaten raw, with salt, as it comes fresh from the fish. It is considered a great treat, and is sent in all haste from the Volga to St Petersburg, where it is eaten spread on butter. It may not be generally known that excellent brown and white caviare may be made from cod roes and milts, liver being added in the case of the roes. They require careful manipulation, and demand some expenditure of labour and spices.

The heads of cod-fish, ling, tusk, and other similar fishes, are always removed before salting and drying; and although, around much of our coast, these go to supply the family of the fisherman, in other quarters the supply far exceeds local requirements, and they go to the compost-heap. This is a great misfortune, as far the richest part of a cod is the head,—rich in gelatine and full of delicacy. Any one who would turn these to good account by preparing tins of cod-head sauce, or by boiling them down as stock for fish soup, would not only benefit the public, but himself. They could be had for a trifle in important stations, and each head would supply enough, even of very condensed gelatine, to make several tins of a delicious character when taken fresh from the deeper seas. These are much superior in flavour to the fish caught in the shoreward seas, and would be prized by those who are unable to taste a cod except of a very inferior kind, and in still more inferior condition.

The minor portions of offal include the tongue and the gills. The former is a delicate but neglected portion of the fish, although pies of carps' tongues were a regular dish at Christmas tables in former times. The gills of sturgeon in compote is a regular Chinese dish, but I do not think it likely to become fashionable in this country. I think, however, that cod tongues properly prepared would find a good market in considerable quantities, and would also suggest their being done up in tins at the great cod-fisheries, while the remainder of the heads was boiled into gelatine or made into fish soup.

The enormous takes of dog-fish may really be considered offal, in so far as they are commonly utilised on the fields. Not only the livers, however, but the whole fish, are extremely rich in oil, and this ought to be extracted. The English show us one example in economy by skinning these fish and drying them, and in this state they are largely used by the poorer classes in the Midland towns; the skins finding a market as shagreen in the cities, where they are used for polishing, by carpenters and cabinetmakers.

It is plain that a great quantity of so-called "offal is thus valuable as food, and only requires care and attention in the manipulation to add an important item to the supply of our own cities, or those of other countries where they are more highly thought of: while what remains ought to have the oil extracted by boiling, where it cannot be done by steam, and the refuse thrown into heaps at home depots with at least its own bulk of humus or other ingredient, as above noted: and at a distance it should preferably be condensed under hydraulic pressure, and rapidly brought home to be treated, along with the oil previously extracted. I think steamers engaged in this trade might quite well utilise their engine-power in the fishing-ports for the purpose of removing the oil from the garbage, desiccating, or drying, and then condensing the remainder, and thus arriving with a cargo of oil and manure, each ready for the market.

XVII.

SUR LA PÊCHE DE LA TRUITE À VALLORBES.
(SUISSE, CT. VAUD).

PAR ALBERT MATTHEY.[1]

L'ORBE.

VALLORBES est un bourg industriel du Jura vaudois. Son altitude est de 768 m. et sa population de 2000 habitants.

La vallée au fond de laquelle se trouve Vallorbes a au sud les prolongements de la Dent de Vaulion (1487 m.); au nord ceux du Risoux et du Mont-d'Or (1463 m.); elle est fermée à l'ouest par un groupe de montagnes moins hautes, dont le point principal est le Mont-d'Orzeires (1035 m.).

Essentiellement calcaires, ces montagnes offrent, par ci par là, de magnifiques parois de rochers; c'est ainsi, par exemple, que se termine le Mont-d'Orzeires par un roc à pic d'environ cent mètres de hauteur.

C'est au pied de cette paroi que naît de nouveau l'Orbe, qui a coulé dans le sein de la montagne sur un parcours d'environ quatre kilomètres.

La véritable origine de l'Orbe est le lac des Rousses (1075 m.) dans le Jura français. Les quelques ruisseaux que ce petit lac reçoit constituent l'Orbe à son extrémité inférieure.

Les contrées que l'Orbe arrose dans son cours supérieur n'ont rien de particulier; des forêts, des forêts, et encore des forêts; ceci presque sans interruption, sur une longueur de quatorze kilomètres. Un peu au-dessous du village industriel du Sentier, elle forme le lac de Joux, long de huit kilomètres sur une largeur de deux à peine, et ensuite le lac Brenet, long de deux kilomètres et demi sur une largeur de un à deux. L'altitude de ces deux lacs est de 1009 m. Ils sont très-poissonneux; on y pêche la truite, la perche, la tanche, le brochet, la lotte, le gardon et le vairon. La pureté et la fraîcheur de leurs eaux ont donné à ces poissons une réputation bien méritée.

Autrefois une large ouverture située sur les bords du lac Brenet, qui n'était alors qu'un marais, suffisait à l'écoulement souterrain des eaux des deux lacs. Cet écoulement doit être

[1] Instituteur à Montreux.

souterrain, car le lac est enfermé entre des montagnes dont la plus basse est le Mont-d'Orzeires, dont nous avons déjà parlé plus haut. Lorsqu'on eut bouché cette ouverture, les eaux s'élevèrent et cherchèrent de nouvelles issues. Actuellement on en compte sept ou huit. Les principales sont celles de Bonport, où un moulin et une scierie sont mis en mouvement au moyen de l'eau qui va quelques mètres plus loin s'engouffrer sous le rocher.

D'après les géologues les plus dignes de foi, toutes les eaux de ces différents conduits souterrains se réunissent et viennent former la nouvelle source que nous avons mentionnée plus haut.

Plusieurs personnes cependant mettent en doute le fait que l'eau des lacs de la Vallée de Joux vienne sourdre au pied du Mont d'Orzeires. A ceux-là nous poserons la question suivante :—Pourquoi l'eau de l'Orbe mesurée à la source donne-t-elle dans les plus grands froids 4° centigrades, tandis que dans les mois de juillet et d'août on en compte jusqu'à dix-sept ou dix-huit? Les eaux de la Venoge, du Toleure, et d'autres sources beaucoup moins puissantes et sortant de beaucoup moins profond ne varient que d'un demi-degré à peine. Ceci est évidemment une preuve des plus irrécusables.

Quoique nul ne l'ait vu, on peut être certain que l'Orbe durant sa captivité a dû filtrer. Cette circonstance lui a permis de se dépouiller de tout corps étranger; aussi à sa nouvelle source l'eau de l'Orbe est-elle d'une limpidité sans exemple.

Le pinceau d'un maître, la plume d'un écrivain habile peuvent seuls rendre ce que la nouvelle source de l'Orbe a de majestueux et de poétique tout à la fois.

Peu après avoir recouvré sa liberté, l'Orbe fait mouvoir des usines de fer, mais elle est là simplement employée comme force motrice et aucun résidu quelconque ne vient troubler le cristal de ses eaux.

Plusieurs cascatelles et forts courants ont donné à l'eau l'air qui lui est nécessaire pour que le poisson s'y trouve à l'aise, et maintenant elle va couler, sur un développement de quatre kilomètres environ, tranquille et laissant apercevoir avec la plus grande netteté les plus petits objets jusqu'à sept ou huit mètres de profondeur.

Passé le village, qu'elle partage en deux, elle devient plus vivante et au bout de deux kilomètres et demi de parcours, elle reçoit un affluent, la Jougnenaz, qui, par ses résidus empoisonnés, cause des dommages immenses au frai et aux jeunes poissons.

Toutes les pétitions adressées à cet effet aux autorités françaises sont jusqu'ici restées sans résultat.

Nous laisserons maintenant l'Orbe couler entre des rochers, le plus souvent à pic, pour nous reporter vers le village et voir de quelle façon la pêche à la ligne s'y pratique.

La réputation de la truite de Vallorbes n'est plus à faire. La finesse de sa chair provient sans doute de la limpidité exceptionnelle de l'eau et de la variété immense d'insectes qui vivent dans les algues et les mousses noires qui tapissent partout le fond de la rivière.

Mœurs de la Truite.

Pour la pêche de jour aussi bien que pour la pêche de nuit, il importe de bien connaître les mœurs du poisson qui nous occupe.

En décembre et janvier la truite fraie. (La loi vaudoise interdit la pêche pendant trois mois, octobre, janvier, et février—sauf pour l'Orbe, voir plus loin.)

En hiver, à part durant l'époque du frai, la truite sort beaucoup moins de ses retraites que pendant l'été.

Les eaux froides du printemps, provenant de la fonte des neiges sur les montagnes, ont pour effet de faire cacher le poisson.

Dès qu'arrivent les beaux jours, la truite sort et pâture avec avidité tout ce qu'elle trouve; sa nourriture préférée à cette époque est la larve de la perle, appelée vulgairement "bête" par les pêcheurs vallorbiers.

Elle commence aussi à venir happer à la surface les mouches d'eau et les phryganes dont l'éclosion s'effectue au premier soleil. Plus la chaleur s'accentue, plus la truite aime à venir prendre sur l'eau les insectes qui passent. A ce propos, nous dirons que la vue de la truite doit être excellente; on pourra se convaincre du fait dans les nuits les plus noires de l'été alors qu'elle vient sans interruption clapoter sur l'eau pour y saisir sa proie.

Pendant les chaleurs la truite préfère les courants aux endroits calmes. Il est de fait qu'elle pressent les variations atmosphériques. Si la pluie doit venir, elle "plonge" (c'est le mot usité à Vallorbes) sans interruption, sortant parfois d'un demi-mètre hors de l'eau. La pêche est alors tout-à-fait infructueuse, la truite s'amuse et ne fait que toucher l'amorce sans s'y laisser prendre.

Dès le mois de juillet, elle se met volontiers à la poursuite du seul autre poisson que nous possédions, le "vairon."

Dans la nuit, elle s'avance souvent jusqu'à l'extrême rive et il s'en trouve parfois des quantités où l'on aurait vainement cherché d'en voir pendant le jour. Celles qui ont établi leur séjour dans des creux se retirent volontiers vers l'extrémité inférieure où l'eau est moins profonde, probablement pour y surprendre plus facilement leur proie.

Les saisons influent aussi sur la demeure de la truite ; tel emplacement donnera au printemps d'excellents résultats, tandis qu'en automne on n'y prendra rien ; le contraire a lieu encore plus fréquemment.

La quantité de nourriture qu'absorbe la truite est énorme. Pour s'en convaincre on n'aura qu'à ouvrir l'estomac de l'une d'entre elles pendant les mois chauds : débris d'écrevisses, gamarus, sauterelles, coquillages aquatiques, fourreaux de phryganes, s'y trouvent mélangés et prouvent son appétit vorace.

Si au printemps il survient après de beaux jours une averse de neige, les mouches se trouvent prises dans les flocons et tapissent la surface de la rivière, la truite en profite largement. C'est un moment excellent pour pêcher à la mouche.

L'approche des orages ou des grandes pluies produit des effets bien divers sur les truites : ou bien elles sortent et pâturent avec avidité, ou bien elles se cachent et le plus habile pêcheur ne parvient pas à en capturer une seule. "Les poissons sentent du temps," disent les habitués du bord de la rivière.

Pour terminer, un dernier fait, assez curieux à noter. Les truites prises à l'hameçon et mises dans des réservoirs refusent toute espèce de nourriture (du moins pendant qu'on les observe) vers, perles, sauterelles, rien ne les tente, seuls les œufs de truites, même ceux qui sont devenus blancs, leur font oublier leur prudence habituelle ; elles fondent dessus avec impétuosité et les mangent jusqu'au dernier.

Perche, Ligne, etc.

Par les eaux les plus basses l'Orbe, jaugeant à sa source plus de quatre mètres cubes par seconde, devient parfois assez large.

Depuis nombre d'années on se sert à Vallorbes du jonc ordinaire mesurant en moyenne cinq mètres et demi. L'extrémité étant trop roide, on lui adapte une pousse de troënne, d'alizier, d'if, ou simplement une baleine.

Ces différentes pousses doivent être cueillies en automne si l'on veut être au bénéfice des meilleures conditions.

Le troënne est généralement préféré à cause de son élasticité, de sa légéreté et de sa force. Si on laisse trop sécher l'if, il devient cassant, l'alizier manquant d'élasticité se courbe trop facilement et la baleine rend l'extrémité du jonc un peu trop lourde.

À l'extrémité du "rinton" (c'est ainsi que les pêcheurs nomment la pousse fixée au jonc), on adapte une boucle, ordinairement faite de ficelle, de mortapêche tressée ou de cordes à boyau. A cette boucle vient se fixer la ligne ("crin" dans le langage vallorbier). Malgré le grand choix que l'on a dans les magasins de pêche, les amateurs de la localité préfèrent les fabriquer eux-mêmes. En voici la raison : Le "crin" doit être pesant, et cette pesanteur ils l'obtiennent par des nœuds qui relient entre elles les sections du tout; les "crins" que l'on achète dans les magasins en sont dépourvus et flottent ainsi trop facilement au gré du vent. L'extrémité supérieure a généralement six à huit brins de plus que l'inférieure.

Quelques pêcheurs ont fabriqué des "crins" avec des fonds de paquets de mortapêche. Nous en avons vu qui après avoir servi plus de dix ans sont encore en très bon état de conservation.

À l'extrémité du crin, qui a de deux mètres à deux mètres et demi de longueur, on a un mètre et demi de mortapêche très-forte, qui reste constamment fixée au crin, quelle que soit la pêche qu'on pratique. Cette mortapêche est nommée "rallonge" dans le langage du pays.

La "rallonge" est terminée par une boucle à laquelle on fixe la ligne proprement dite (vulgairement "fil"). La ligne est de mortapêche forte ou fine, un peu plus longue ou un peu plus courte, fortement chargée ou très peu plombée suivant l'amorce que l'on veut employer et aussi suivant l'état de l'eau.

Le crin, la rallonge, et la ligne doivent être combinés de façon que l'extrémité inférieure arrive à environ un mètre de différence (en moins) avec le jonc. Ceci pour les pêches de jour.

Pour les pêches de nuit, on a une ligne de longueur égale à celle du jonc ou qui le dépasse légèrement.

La mouche artificielle demande une longueur de ligne beaucoup plus considérable, nous verrons cela plus loin alors que nous traiterons cette pêche en particulier.

Chaque pêcheur a un portefeuille ad hoc. Ce portefeuille est muni de deux poches; dans l'une se trouvent les lignes pour le jour, dans l'autre celles pour la nuit. Des épingles tiennent fixés aux feuilles de papier les hameçons, mouches, etc., préparés d'avance, en cas de malheur.

Différences entre la Pêche de Jour et la Pêche de Nuit.

La pêche de jour et la pêche de nuit diffèrent du tout au tout. Tandis que pour la pêche de jour, on recherchera les courants, les creux bouillonnants, le pied des chutes; pour la pêche de nuit, au contraire, on s'appliquera à trouver des endroits calmes, où l'eau, sans y dormir tout à fait, n'aura pourtant pas un courant très appréciable.

Les creux dormants, les canaux et autres endroits de ce genre ne devront pas être laissés de côté.

Les armes du pêcheur seront aussi bien différentes. Tandis que pour le jour le fil est chargé de cinq à quinze grains de grenaille, de nuit il en sera complètement dépourvu, on n'en possédera qu'un seul placé à trente centimètres du dernier hameçon.

À l'eau haute, on pourra quelquefois mettre deux grains.

Dans les nuits orageuses, alors qu'il fait du vent, on ne pourrait guère se passer de plomb, sans cela il serait très difficile de savoir quelle direction la ligne a prise.

Le fil aussi sera plus long, la mortapêche plus forte, pour la même amorce, les hameçons seront aussi plus gros de nuit que de jour.

On se sert pour la nuit d'amorces plus grosses que pour le jour. On prendra les mâles des perles, les mâles des sauterelles, les petites larves des perles, tandis que pendant la nuit on emploiera les femelles de ces insectes.

Bien connaître les mœurs de la truite est pour le pêcheur une chose essentielle.

De jour la truite est impossible à prendre dans les endroits calmes, il n'y a d'exceptions que lorsque la pluie agite la surface de l'eau ou que le vent y produit des vagues simulant le courant.

Le courant empêchant à la truite de distinguer la mortapêche c'est là que se feront les captures pendant le jour.

Nous allons maintenant passer en revue les diverses amorces employées et indiquer sommairement de quelle façon on en use, soit pendant le jour, soit pendant la nuit.

Nous les prendrons dans l'ordre suivant :—

1. Le lombric ou ver de terre.
2. La tête de ver.
3. La larve de la perle ("bête" dans le langage local).
4. La perle ("meunière" dans le langage local).
5. Les larves de la phrygane, du sirex géant et d'un capricorne.
6. La sauterelle.
7. Le vairon.
8. La cuillère et le poisson artificiel.
9. La mouche artificielle.

Nous parlerons ensuite des instruments employés pour capturer les amorces et pour les conserver, après quoi nous terminerons par quelques mots sur l'établissement de pisciculture de Vallorbes, fondé en 1864 par M. Matthey-Martin, instituteur, bourgeois de la localité.

La Pêche au Ver.

Par les grandes eaux.

Cette pêche est la plus facile; c'est la pêche des commençants; elle peut rarement se pratiquer pendant plus de deux jours consécutifs, car l'eau redevient claire très-rapidement.

Ligne.

Lorsque l'eau est très trouble, la ligne doit être de forte mortapêche, car outre que l'on est exposé de crocher souvent le fond de la rivière, on peut avoir à faire à de grosses pièces.

Dix à quinze grains de grenaille moyenne sont la charge que l'on donne généralement. L'hameçon est proportionné à la grosseur du ver.

La pêche à l'eau haute est souvent très fructueuse, elle réussit surtout en été quand depuis longtemps on n'a pas eu de pluie.

Les endroits où l'on ne pouvait pêcher à cause du trop de tranquillité et de clarté de l'eau deviennent propices, c'est même où se font les plus belles captures. La raison du reste en est simple: la truite ayant été tranquille depuis longtemps prend l'amorce avec beaucoup plus de confiance qu'où elle est pêchée chaque jour.

Si plusieurs grandes eaux se succèdent dans un court espace de temps, il arrive souvent que le rapport en est peu considérable. La rivière prend alors une couleur verte, signe certain de mauvais jour de pêche. Les grandes eaux du printemps, lorsqu'elles proviennent de la fonte des neiges sur les montagnes, ne sont pas propices; le poisson se cache. Ce fait est dû fort probablement à la basse température de l'eau dans ces circonstances.

La grosseur du ver varie avec la hauteur de l'eau, ainsi la rivière est-elle très grosse, et très trouble, on prendra de gros vers.

Un peu d'habitude apprendra le moment que l'on doit saisir pour sortir le poisson. Deux secousses, trois ou plus, suffiront généralement. Il est cependant des cas où l'on doit tirer au premier coup comme d'autres où l'on doit attendre quatre, cinq, ou même six secousses.

Quelquefois le poisson est saturé de nourriture, alors il s'amuse, coupe le ver jusqu'à ras la pointe de l'hameçon, ou même n'en prend qu'une très petite partie.

Il arrive souvent que le pêcheur le mieux approvisionné voit ses vers disparaître, les uns après les autres, sans pouvoir capturer une seule truite. Si l'on a de petits vers, ils peuvent alors devenir utiles; pour cela on laisse à l'hameçon la tête d'un beau ver et l'on complète le corps au moyen de l'un de ces petits vers qui, sans cela, ne seraient d'aucune utilité. L'amorce ainsi composée est excellente et donne d'aussi bons résultats que le ver entier.

Eau Basse.

L'eau vient-elle à baisser, on met un fil un peu plus mince terminé par un hameçon moins gros ; comme l'eau est devenue plus claire il faudra pêcher dans les courants et dans les creux.

Le petit ver (fil mince, hameçon petit) constitue une des meilleures amorces à l'eau basse. Beaucoup de personnes l'ignorant, c'est ce qui fait une bonne partie de sa valeur. La pointe du jour, onze heures, et la tombée de la nuit sont les meilleurs moments pour cette pêche.

En automne on fait de très belles pêches au moyen d'un petit ver blanchâtre, chez lequel se font remarquer les organes sexuels ; cette circonstance l'a fait nommer "ver à collerette."

Il va sans dire que le nombre des grains varie avec la hauteur de l'eau, plus l'eau est basse et claire, moins la ligne doit être chargée.

Pêche au Ver de nuit.

La pêche de nuit se pratique comme nous l'avons dit plus haut dans les endroits calmes ou peu courants. On met généralement deux hameçons, celui de l'extrémité se nomme "grande mouche," l'autre que l'on place à 0.60 m. du premier se nomme "moucheron."

De nuit à l'eau basse le ver doit être plus gros que de jour ; on le coupe à deux centimètres de l'hameçon.

La Tête de Ver.

Certaines mouches aquatiques nommées "phryganes" sont, ainsi que leurs nymphes, un mets délicieux pour la truite.

On a essayé de les reproduire artificiellement : un peu de laine enveloppant le manche de l'hameçon et quelques plumes de canards simulant les ailes, ont donné une amorce qui a réussi quelquefois.

D'autres amateurs ont procédé autrement et ont mieux réussi : ils ont une ligne plus longue que le jonc, d'environ un mètre, et pourvue d'hameçons de même grandeur que pour le petit ver. À l'extrémité du manche est fixé un peu de plume de perdrix ou de canard, suivant la saison. Du coude de l'hameçon à l'extrémité du manche, on place une tête de ver (petit ou moyen). Les anneaux de l'annélide ressemblent assez exactement à ceux de l'abdomen de la phrygane et constituent pour le poisson un trompe-l'œil qui fait merveille.

Le meilleur moment pour cette pêche est la tombée de la nuit. On pêchera dans les endroits où le courant sans être fort fait pourtant frétiller l'eau passablement.

De nuit.

La ligne est pourvue de deux hameçons et d'un grain de plomb.

La tête des gros vers se prête très bien à l'imitation de larves à l'aspect de chenilles grises vivant sous les pierres dans les endroits courants de la rivière. Ces larves crèvent trop facilement si on les met à l'hameçon; c'est pour cela qu'on a cherché à les imiter.

On reproduit aussi assez exactement d'énormes mouches nocturnes, probablement aussi une espèce de phrygane, avec de la plume rousse en guise d'ailes et une grosse tête de ver en guise de corps. (PLATE I.) On peut prendre plusieurs truites avec la même amorce. Deux ou trois têtes de ver suffisent pour toute une nuit et constituent ainsi une amorce très commode.

Au mois de juillet, quand les dernières perles sont mortes, on met la queue de ver au lieu de la tête; cette masse aplatie ressemble beaucoup au corps de la perle. Les plumes que l'on fixe à l'hameçon, dans ce cas, sont grises, ou rougeâtres.

De nuit aussi bien que de jour cette pêche a été jusqu'à il y a peu d'années le secret de quelques pêcheurs seulement, qui avaient été conduits, par leurs observations, à essayer de cet excellent procédé.

LA LARVE DE LA PERLE (*Vulg.* LA BÊTE).

Les eaux de l'Orbe nourrissent en quantité énorme la larve de la perle. On en rencontre de deux espèces de "brunâtres" appelées vulgairement "noires," et de "jaunâtres," appelées vulgairement "blanches."

Autour de ces deux espèces principales viennent se grouper un assez grand nombre de variétés, mais qui diffèrent très peu des deux types principaux.

Pour plus de commodité nous nous servirons des noms vulgaires indiqués plus haut.

Plus allongées, moins massives que les autres, les "blanches" se tiennent sous les pierres où le courant est très fort, elles ne souffrent aucune saleté à leur proximité. Elles abandonneraient bientôt leur demeure si quelque immondice venait à se fixer à la pierre sous laquelle elles habitent.

Les "noires" sont beaucoup moins délicates, et à l'inverse des blanches, habitent les endroits tranquilles, les mousses. Elles craignent beaucoup moins la saleté que les blanches.

Une fois l'an, elles changent de robe; elles sont alors d'un blanc jaunâtre très-pur. Cette période est très critique pour elles, car leur agilité habituelle leur fait défaut, et ainsi elles deviennent beaucoup plus facilement la proie de leurs nombreux ennemis. Si l'on en conserve dans une boîte, les premières qui changent de peau sont mangées par les autres.

En été, en automne, et en hiver, elles habitent volontiers le milieu de la rivière; vient le printemps, alors elles se rapprochent des rives, occupent en quantité immense les pierres des bords.

Leur taille a beaucoup augmenté, les appendices de leur corselet se sont allongés et ont pris dans les deux espèces une couleur roussâtre.

Cet état dure environ deux mois, après quoi on les voit sortir de l'eau et se fixer sur une pierre ou sur une branche d'arbre. La vie de la larve est terminée. Si on l'observe un instant on verra bientôt l'insecte parfait percer la tête de la nymphe et sortir ses membres et ses ailes comme s'ils fussent dans des étuis. L'enveloppe reste fixée par la matière gélatineuse que la larve a laissé suinter de ses pattes avant de se transformer. La perle s'envole bientôt en remontant le cours de la rivière.

L'accouplement a lieu bientôt après. Nous ferons remarquer que les femelles ont le corps beaucoup plus volumineux que les mâles. Elles pondent une quantité énorme d'œufs, ténus comme du fin sable. Ils restent fixés à l'abdomen où une substance gélatineuse les tient fixés. La mère se pose sur l'eau, souvent à plusieurs reprises, et abandonne ses œufs au courant. Il arrive souvent que les routes poudreuses sont prises par elles pour la rivière; c'est cette raison qui fait qu'on les rencontre parfois en si grande abondance sur les arbres qui bordent les voies de communication.

La perle vit quelques jours seulement.

La larve de la perle est carnassière, elle a des mandibules et des mâchoires acérées. L'insecte parfait ne prend aucune nourriture.

Larve et insecte parfait sont deux excellentes amorces.

Parlons d'abord de la larve:

Pendant longtemps on n'usait à Vallorbes que des larves brunes. Un préjugé absurde faisait mettre de côté les "blanches." Plus tard on essaya et l'on put se convaincre de la grande supériorité de ces dernières. On chercha alors les lieux qu'elles fréquentent de préférence, et l'on mit les noires presque totalement de côté.

De jour.

A l'eau basse, comme à l'eau louche, les pêcheurs vallorbiers tiennent la larve de la perle bien au-dessus des autres amorces qu'ils emploient.

C'est surtout au printemps, après que les neiges ont disparu (avril, mai) que se prend le plus grand nombre de truites avec cet appât.

Le fil doit être plombé plus ou moins, suivant la hauteur de l'eau. Sept à douze grains suffisent généralement.

On met souvent deux hameçons; l'un se place à environ 0.60 m. de l'extrémité et sert plutôt de guide au pêcheur. Avec cela il sait à quelle profondeur se trouve l'autre hameçon.

Il est à remarquer que l'on prend beaucoup moins à l'hameçon supérieur qu'à l'inférieur.

Quelques amateurs pêchent au fond tandis que d'autres laissent flotter leur amorce à mi-eau. Ces derniers prennent plus en nombre, mais ils reperdent la différence sur la grosseur des poissons pris. De jour on emploie des mâles ou des femelles qui ne sont pas arrivées encore à leur complet développement. On pêchera dans les mêmes endroits qu'avec le petit ver. Quand l'eau est haute on peut mettre des amorces plus grosses.

Lorsque la rivière est très trouble, on obtient quelquefois de meilleurs résultats avec la larve noire, qu'avec la blanche c'est probablement parce que, dans cette circonstance, ces dernières échappent plus facilement à leurs regards.

À l'eau haute comme à l'eau basse, il faut tirer au premier coup de dent. Avec la larve de la perle on manque beaucoup de poissons, probablement à cause de la petitesse de l'hameçon.

Généralement on enfile l'insecte par la tête en faisant sortir l'extrémité de l'hameçon entre les deux cornes dont son abdomen est pourvu; il faut bien avoir soin de ne le faire percer nulle part ailleurs, avant qu'il arrive là; sans cela, le liquide qui donne la couleur au corps de l'insecte se perdrait, et avec lui la valeur de l'amorce. L'attitude doit être très naturelle, on doit laisser dépasser la pointe de l'hameçon depuis le coude. Le poisson se méfie beaucoup plus d'une posture peu naturelle que de l'extrémité de l'hameçon.

Quelquefois la truite s'amuse à donner un seul coup de dent à la tête de la larve; celle-ci se trouve alors ou fendue, ou complètement emportée; on est sûr alors que la pêche ne sera pas abondante, pourtant voici un moyen de les tromper: on enfile l'amorce d'une manière complètement différente; la queue au haut du manche et la tête vers le coude de l'hameçon. Ce procédé réussit, pourtant on ne l'emploie pas souvent.

On prend quelquefois deux et même trois truites avec une seule amorce, mais dans la grande majorité des cas, on doit la renouveler à chaque poisson qui a mordu.

Lorsqu'on a épuisé sa provision d'amorces de grosseur voulue, s'il en reste de petites, on peut les utiliser en laissant la tête d'une grosse, et en mettant pour l'abdomen tout le corps d'une larve plus petite.

De nuit.

Cette pêche se pratique comme les autres pêches de nuit. On emploie les femelles en raison de leur grosseur.

Les nuits claires sont particulièrement favorables pour cette pêche.

LA PERLE (ÉTAT PARFAIT), *Vulg.* MEUNIÈRE (PLATE II.).

Lorsque les premières perles sont écloses, on peut pour quelque semaines mettre de côté les larves, car les poissons ont pu en prendre à profusion lorsqu'elles se préparaient à quitter l'eau. Pour quelque semaines ils en sont rassasiés.

Le fil de longueur ordinaire est de mince mortapêche. On pêche quelquefois à fil flottant, mais plus ordinairement avec quelques légers grains de plomb. On met aussi deux hameçons, à l'inférieur on adaptera une femelle et au supérieur un mâle.

Cette pêche est bonne, mais un peu ennuyeuse, vu la délicatesse des amorces.

On doit conserver les perles dans des boîtes où l'air peut circuler facilement ; sans cela, elles périraient bientôt.

De nuit.

Il faut pêcher sans plomb et si quelquefois l'on en met, c'est très peu, un très petit grain suffit.

Si l'eau monte durant l'époque des perles, on pourra faire de très belles pêches.

De nuit la pêche à la perle est encore plus ennuyeuse que de jour. Son corps mou ne permet souvent pas aux doigts de discerner la tête, dans tous les cas, il faut une grande habitude pour cela. On évitera avec soin de lancer la ligne avec violence si l'on veut que les amorces restent fixées à l'hameçon. Le moindre vent suffit pour qu'on doive constamment changer d'amorces.

Pendant la nuit les perles sont douées d'une agilité extraordinaire, ce qui cause parfois de tristes surprises aux commençants. Elles courent sur les mains sans qu'on les sente et ont bientôt toutes évacué la boîte si l'on n'y fait excessivement attention ou que l'on n'ait une grande habitude de la chose.

De nuit on n'emploiera que des femelles ; les mâles seraient aussi utilisables, mais ils sont trop difficiles à fixer à l'hameçon.

Du reste, pendant la nuit les grosses amorces sont toujours préférables aux petites.

Pour éviter la disparition des perles, on construit des boîtes à très petite ouverture, de façon qu'il n'en puisse sortir qu'une seule à la fois.

Larves des Phryganes, sirex (Plate I.).

La pêche à la larve de la phrygane, du sirex, etc. se pratique de la même façon que celle à la larve de la perle. Elles sont de très bonnes amorces, mais elles ont un inconvénient capital, c'est d'être très difficiles à fixer à l'hameçon ; on n'y parvient souvent qu'après avoir essayé vainement plusieurs fois.

Les larves de phryganes se conservent assez facilement, seulement par leur propre humidité.

On conserve les larves de sirex et de capricornes dans de la sciure, mais elles n'y vivent pas longtemps.

La Sauterelle.

Dès le mois de juillet dans les prés, les champs et les prairies, on voit de nombreuses variétés de sauterelles, les unes phytophages, les autres carnassières ; les unes munies d'ailes au moyen desquelles elles peuvent se transporter assez loin, d'autres ne possédant que des rudiments d'ailes qui leur sont parfaitement inutiles.

Un grand nombre d'espèces de ces insectes peuvent être employées pour la pêche.

De jour on emploiera les mâles à cause de leur petitesse et de l'éclat de leur abdomen. En plaçant la sauterelle à l'hameçon on doit chercher de lui donner une attitude très naturelle ; comme pour la larve de la perle, on fait dépasser la pointe de l'hameçon dès le coude. On fait généralement ressortir l'hameçon à la face supérieure de l'abdomen ; d'aucuns pêcheurs préfèrent le contraire et dirigent la pointe sous le ventre.

La pêche se pratique comme celle à la larve, de la perle. Il faut beaucoup de prudence et d'adresse.

Les hameçons sont de même numéro.

De nuit.

On prend les femelles à gros abdomen bien coloré. Quelques pêcheurs n'utilisent que celles qui ont des ailes, tandis que la plupart préfèrent celles qui n'en ont pas.

On manque beaucoup de poissons avec la sauterelle ; aussi faut-il lever au premier avertissement.

La sauterelle réussit par les eaux basses comme par les eaux hautes, c'est une des meilleures amorces que nous possédions.

Avant de terminer ce chapitre nous dirons deux mots des maladies qui atteignent les sauterelles.

Quelquefois leur ventre se remplit d'eau; elles sont alors impropres à la pêche. Il leur arrive d'être attaquées par le dragonneau, long ver intestinal qui remplit leur abdomen. On rencontre encore dans le ventre des sauterelles un ver blanc ayant quelque rapport avec l'oestre du cheval, mais beaucoup plus gros comparé au corps dans lequel il se trouve.

Le Vairon.

Dans les endroits calmes, à bords marécageux, on rencontre le vairon. Il vit par troupes, ce qui donne de la facilité pour s'en emparer.

Les vairons sont conservés vivants jusqu'au moment de leur emploi; alors on les passe dans un gros hameçon dont on fait ressortir la pointe dans le flanc vers la région anale. Un second hameçon plus petit se croche à la tête et sert à maintenir le petit poisson dans la même position pendant tout le temps que dure la pêche.

La ligne est plus longue que la perche; à une distance de 0. 60m. de l'hameçon on place un " émerillon."

On lance l'amorce vis-à-vis de soi (dans le courant) et on la retire en haut le courant de temps à autre. Les mouvements ne doivent pas être trop rapides afin de permettre à l'amorce de descendre insensiblement avec l'eau. Un mouvement giratoire est effectué par le petit poisson, à cause de la forme qu'on lui a donnée et surtout à cause de l'émerillon. Tout ceci pour simuler les efforts que ferait un vairon pour vaincre la résistance du courant.

L'eau louche des derniers mois de l'année se prête très bien à cette pêche; les résultats en sont insignifiants avant le mois de juillet. Un fait curieux c'est que, malgré les deux hameçons, il arrive fréquemment que la truite enlève jusqu'au dernier atome du vairon sans se laisser prendre.

De nuit.

La pêche au vairon de nuit donne des résultats excellents, mais jusqu'ici elle est restée le secret de deux ou trois amateurs seulement. Il paraîtrait que l'on pêche dans les endroits indiqués plus haut pour les pêches de nuit. La ligne a un ou deux grains de plomb.

La Mouche artificielle.

De toutes les pêches dont nous avons parlé, celle à la mouche artificielle est la plus difficile et la plus délicate.

La diversité énorme de mouches éphémères (Plate II.), qui sortent de l'Orbe, la limpidité de l'eau, le fait que l'on doit pêcher où le courant n'est pas très fort, sont les principales causes de la difficulté de cette pêche.

La ligne complète doit avoir au moins sept mètres à sept mètres et demi. Il importe beaucoup qu'elle soit faite avec grand soin, les nœuds doivent être très serrés, petits, afin qu'ils ne produisent pas d'onde sur l'eau, les derniers brins de morta-pêche doivent être très longs et très fins, les mouches petites et en rapport avec la saison (Plate III.).

Voici une faible partie de celles qui sont utilisées:

Au premier printemps vole une mouche grise à corps rouge. Quand les hêtres s'ouvrent, éclot une mouche complètement rouge avec un corps velu. Des mouches grises et brunes de différentes nuances se succèdent jusqu'au mois de juin; alors on aperçoit une quantité de mouches d'un rouge-vif. Ces dernières sont très goûtées des truites; on les imite très bien avec les plumes de la queue des rouges-queues, dont on fait les corps, et avec des plumes de coq rouge qui servent à fabriquer les ailes. Au mois de juillet on a de très grandes mouche d'ungris-blanc (très difficiles à imiter), d'autres avec le corps brillamment nuancé, que l'on contrefait avec des plumes noires pour les ailes et des plumes de paon pour le corps.

Quelques mouches peuvent être utilisées durant toute la saison de la pêche. De ce nombre sont les grises et les noires.

On pêcherait vainement avec des mouches qui ne sont pas de saison. Ainsi telle mouche est très bonne aujourd'hui, qui demain passera devant quantité de truites sans qu'aucune veuille la prendre.

Il faut avoir une grande habitude et une bonne vue pour pêcher à mouche. Les deux mouches doivent tomber sur la rivière comme le feraient des mouches naturelles. On fait sautiller la seconde sur l'eau.

Les endroits où l'eau frétille, les endroits calmes lorsqu'il pleut, ou qu'il fait du vent, sont les meilleurs postes pour la pêche à la mouche. Au printemps, si après quelques jours chauds il survient une averse de neige, on prendra une quantité de truites en pêchant dans les creux ou endroits calmes. Les pêcheurs vallorbiers préfèrent fabriquer leurs mouches eux-mêmes plutôt que de les acheter. Ils obtiennent de meilleurs résultats.

Capture et Conservation des Amorces.

Vers.

On cherche les vers dans n'importe quelle terre, pourvu qu'elle ne soit pas trop fumée. En faisant dissoudre du vitriol dans de l'eau on obtient une solution qui, versée sur la terre en fait sortir les vers au bout de peu de temps. Ce procédé a l'inconvénient capital de les rendre malades; ils ne survivent dans les boîtes que quelques jours seulement. Un troisième moyen beaucoup plus en vogue que le précédent consiste à piétiner dans les prés humides; les vers effrayés viennent voir sur le terrain ce qui s'y passe; là, on les capture très facilement.

Plusieurs personnes recommandent pour les conserver la terre glaise jaune. Après bien des essais nous avons reconnu que le meilleur procédé consiste à mettre au fond de l'ustensile où ils doivent vivre une forte motte de gazon bien fourni; le tout est recouvert de terre végétale de bonne qualité. Le gazon donne l'air et fournit la nourriture nécessaire aux pensionnaires.

On met volontiers les vers quelques jours avant de les employer dans une boîte. Ils s'y débarrassent de la terre qu'ils contiennent et sont beaucoup meilleurs pour la pêche. Il est important que l'air puisse s'introduire dans les boîtes.

La Larve de la Perle (Plate II.).

Comme nous l'avons dit plus haut, la larve de la perle (blanche) habite sous les pierres des courants. Pour s'en emparer on retourne les pierres et on saisit avec la main les perles qui se trouvent, soit au fond de l'eau, soit attachées à la pierre que l'on vient de retourner. Il est à remarquer que, quoiqu'en disent les livres, ces larves possèdent une très grande agilité. Il faut une longue habitude pour que la plus grande partie d'entre elles n'échappent pas. Quelquefois des bottes sont nécessaires pour s'avancer un peu dans la rivière, car il arrive que les pierres des bords ont déjà été retournées.

Lorsqu'on ôte subitement l'eau qui passe sur une écluse dont le talus est en pierres, les perles qui en habitent l'intérieur, se trouvant tout à coup privées de leur élément, sortent en quantité considérable et courent sur la mousse, qui recouvre les pierres de l'écluse. Il est alors très facile d'en faire provision. Dans ce cas on trouvera presque exclusivement la larve brune.

Les procédés que nous venons d'indiquer n'étant pas praticables quand l'eau a monté, on se sert alors d'un autre procédé, trouvé il y a quelques années seulement. On a un recueilloir composé de la façon suivante : un cadre de fer passablement fort d'environ 0.45m. d'épaisseur, percé de quelques trous qui laisseront passage aux vis qui doivent le fixer à un autre cadre de bois de mêmes dimensions (en général 0.4m. dans les deux sens) comme forme, mais d'épaisseur beaucoup plus forte ; sur la partie libre de ce cadre on fixe un treillis. Un fort appendice du cadre sert à fixer le tout à un manche solide. Voici maintenant la manière de s'en servir : on entre dans l'eau, et, au moyen de la partie inférieure de l'instrument on lève les pierres en leur imprimant un mouvement violent contre le courant; on place alors lestement le recueilloir au-dessous ; tous les insectes qui habitent sous la pierre sont entraînés par l'eau et viennent s'appliquer contre le treille du recueilloir. Ce procédé est de tous le meilleur et le plus expéditif.

Un recueilloir en ficelle, à mailles fines peut aussi servir. L'inconvénient est que la ficelle de la partie du recueilloir qui doit tourner les pierres se trouve usée très vite.

Conservation des Perles (larves).

Si l'on veut utiliser tout de suite ces amorces on les place dans des boîtes de zinc percées de trous pour laisser pénétrer l'air. En les mettant au frais et à l'humide on peut les conserver plusieurs jours.

Veut-on les conserver plus longtemps, on a d'autres boîtes aussi de zinc et percées de trous, mais de dimensions plus grandes et de forme cylindrique; les boîtes après avoir reçu la provision de perles sont placées dans l'eau. Chaque pêcheur ayant son réservoir, il les place dedans ; c'est en même temps un endroit sûr et commode où il pourra les prendre quand bon lui semblera. On a essayé quelquefois de mettre de la mousse dans la boîte, croyant ainsi leur donner un moyen de subsistance. Il a été reconnu que ce moyen ne réussit pas mieux que de les laisser sans aucune nourriture; en tout cas si l'on voulait persister à mettre de la mousse, il faudrait la renouveler souvent.

À l'état d'insectes parfaits on prend des perles sur les saules au bord de la rivière ou sur les arbres qui bordent les grandes routes.

Le Vairon.

Les vairons se prennent à la ligne, à la trouble, ou avec de grosses bouteilles blanches dont le fond est percé d'un petit trou. On met quelques pains à cacheter dans la bouteille, puis on la remplit complètement d'eau. On la place ensuite dans un endroit fréquenté par les vairons, en ayant soin de placer le fond à l'opposé du courant. Ces petits poissons vivent par bandes très nombreuses, et comme ils sont très curieux, lorsqu'ils voient un des leurs faire mille évolutions pour essayer de sortir de la bouteille dans laquelle il vient d'entrer, ils vont voir ce qui se passe et se prennent jusqu'au dernier.

On les conserve dans des boîtes de même nature que celles dont nons avons parlé à propos des perles; elles sont seulement un peu plus grandes et percées de trous plus larges.

Comme aux perles on ne leur donne aucune nourriture. Malgré cela, on peut les conserver vivants de l'automne au printemps.

Remarques.

Ces dernières années quelques pêcheurs sont parvenus à faire de belles pêches *à la lune* pendant le mois de juillet; jusqu'ici ils ont gardé leurs procédés secrets.

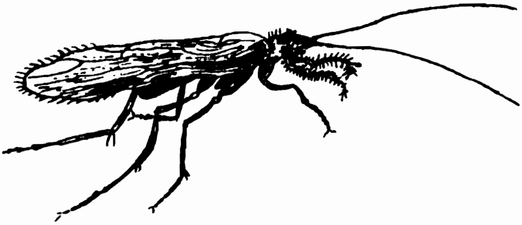
Chaque pêcheur lorsqu'il va à la pêche prend avec lui son baquet (*boille,* vulg.) de zinc dans lequel il gardera ses poissons afin de pouvoir les vendre *vivants* à l'hôtel.

D'après la loi, tout poisson n'ayant pas dix-huit centimètres de longueur doit être immédiatement relancé à l'eau. La pêche est défendue à Vallorbes pendant les mois de novembre, décembre, et janvier.

L'Établissement de pisciculture de Vallorbes.

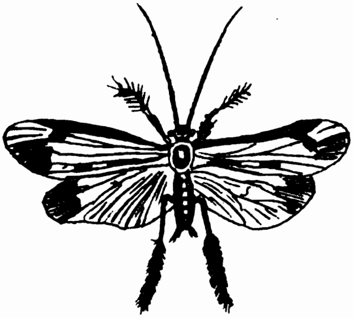
La truite de Vallorbes étant très estimée, il s'en est suivi qu'on lui a fait une chasse acharnée. Du commencement du siècle, jusque vers 1850 l'État de Vaud louait la rivière pour des prix variant de 60, 80, 160 fr. (ancienne monnaie), annuellement. Ainsi l'Orbe rapportait de 600 à 800 fr. par an au preneur. La pêche au filet poussée á l'extrême de 1840 à 1850 détruisit presque complètement la truite. On supprima la pêche au filet pour repeupler la rivière, mais ceci ne suffit pas, et en 1864, M. Matthey-Martin, instituteur, fit les premiers essais de pisciculture. On douta des résultats lorsqu'après quarante-cinq jours (temps indiqué dans les ouvrages comme époque d'éclosion) on ne vit rien paraître. Les plus patients finissaient par se décourager lorsqu'au bout du quatre-vingt-onzième jour la première truite sortit de l'œuf. L'expérience était faite. Les soins minutieux et les intelligentes améliorations apportées à l'établissement par son directeur lui ont fait produire de magnifiques résultats; 82 pour °/₀ en moyenne. Les autorités municipales, cantonales et fédérales ont apprécié ces heureux résultats. Elles l'ont prouvé en primant à deux reprises et l'établissement et son dévoué directeur.

SUR LA PÊCHE DE LA TRUITE À VALLORBES. PLATE I.

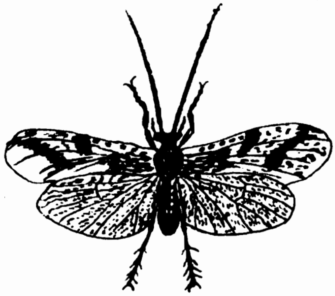


Phryganea striata.

Lymnophilus rhombicus.



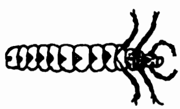
Limnophilus bicolor.



Phryganea minor.

Limnophilus fuscus.

Larves de phryganes en fourreaux.



Larve nue.

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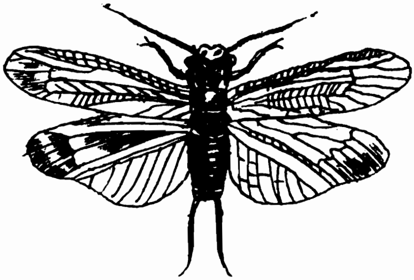
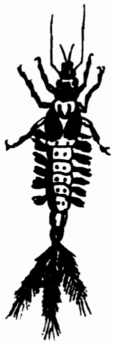
SUR LA PÊCHE DE LA TRUITE À VALLORBES PLATE II.

Perle à double queue (mâle).

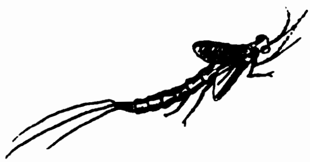


Perla marginata (femelle).

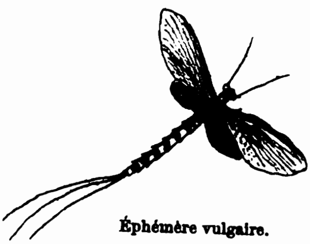
Éphémère abandonnant la Subimago.



Larve d'éphémère.



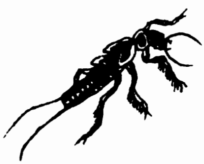
Nymphe d'éphémère.

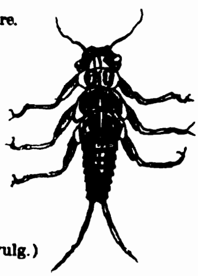


Éphémère vulgaire.

Éphémère.

Éphémère.





Larves de perles (bêtes vulg.)

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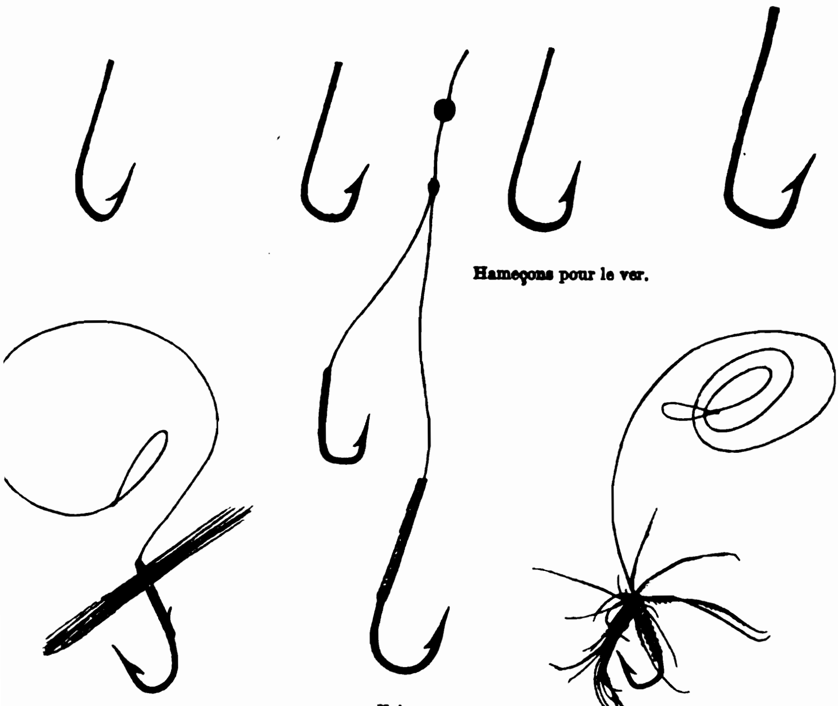
SUR LA PÊCHE DE LA TRUITE À VALLORBES. PLATE III.

Grosseur des hameçons employés.

Hameçons pour la mouche.

Hameçons pour la perle, sauterelle, etc.



Hameçons pour le ver.

Vairon.

Tête de ver (de nuit).

Tête de ver (jour). (Mouche).

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Dès sa fondation à 1881 l'établissement a produit :—

De 1864 à 1870, . . .	450 mille alevins.
En 1872, ...	13 „ „
„ 1873, ...	90 „ „
„ 1874, ...	150 „ „
„ 1875, ...	225 „ „
„ 1876, ...	130 „ „
„ 1877, ...	60 „ „
„ 1878, ...	34 „ „
„ 1879, ...	120 „ „
„ 1880, ...	116 „ „
	1,388 mille alevins.

tous mis dans les eaux de l'Orbe. Actuellement l'établissement a 64 mille œufs en incubation qui produiront très probablement 51 mille alevins.

Notice Statistique sur le produit de la Pêche à Vallorbes.

Ce tableau montrera la différence qui a eu lieu pour le prix par demi-kilogr. et pour le produit approximatif annuel de la pêche.

	Prix du ½ kg.	Prix approximatif annuel de la pêche.		
	Francs.	Francs.		Francs.
De 1800 à 1835, . . .	0.60	900	à	1200
1840, . . .	0.75	1000	„	1300
1845, . . .	1 fr. 00	1200	„	1400
En 1850, . . .	1 fr. 20	1200	„	1500
„ 1857, . . .	1 fr. 50	1300	„	1800
„ 1866, . . .	2 fr. 00	1500	„	2000
„ 1871, . . .	2 fr. 50	3000	„	4000
„ 1875, . . .	2 fr. 50	5000	„	6000
„ 1877, .	De fr. 2.50 à 3 fr.	6000	„	8000
„ 1879, .	fr. 2.50 à 3 fr.	8000	„	10000
„ 1880-81-82,	fr. 2.50 à 3 fr.	10000	„	12000

La pêche aux écrevisses a produit annuellement 5000 à 6000 fr. pendant les 5 ou 6 dernières années. Cinquante personnes pratiquent cette pêche. Une centaine de personnes pratiquent plus ou moins la pêche à la ligne.

XVIII.

THE FISH SUPPLY OF GREAT CITIES

WITH SPECIAL REFERENCE TO THE BEST METHODS OF CATCHING AND PACKING, AND OF DISTRIBUTION, AND OTHER MEANS CALCULATED TO FACILITATE THE DELIVERY OF THE FISH IN GOOD CONDITION FOR MARKET.

By W. Anderson Smith.

With half-a-million tons of a most delicate and perishable article of food to bring annually before the public, a considerable quantity of which is at present wholly destroyed through inability to distribute it with sufficient promptitude or retain it in good order, the fish supply in all its details is, without doubt, a most important national question.

This great trade has gone on increasing on the old lines, and under the pressure of the exceptional progress of the trade these old lines have proved wholly insufficient, and quite unable to bear the strain of the demands of a dense population, everywhere reached by railways, and with money to pay for both the necessaries and luxuries of life.

But the trade and the country having reached such a position, it will no longer be satisfied with a haphazard organisation, and therefore it is that we have fish trade organisations endeavouring to stimulate a progress which the individual members, following traditions and forced to consider immediate results, cannot reasonably be expected to inaugurate. It would be wholly unfair to expect one or two fishermen to influence the market by supplying fish at greater cost but in finer condition, for which the dealers, knowing their own side of the market, were unable to pay, or unwilling to risk paying, more. Equally, the fishmongers could not individually be expected to thrust upon an ignorant and unwilling public changes beneficial to the public and themselves, but which the natural conservatism of our people lead them to resent as innovations.

The hope of progress is, therefore, in trade organisations, strong enough to adopt what is manifestly an improvement, yet shrewd and sound-headed enough not to injure the interests of the trade. For the "trade," broadly speaking, is not one class or another, but the captors, the distributors, and the purchasers of fish, all of whose interests ought practically to be closely identified.

Seeing the improvement of the fish supply is thus a somewhat complicated question, demanding that any distinct improvements should carry along with them the goodwill and appreciation of those intended to be benefited, it will be necessary at starting to show clearly the various departments, and how they are interdependent.

The fisherman, whether he be an owner of a coble and lines or a hired servant in a large fishing-boat, is practically responsible for the capture of the fish in as good condition as possible. The carriers, of whatever class, are required to convey the said fish to market with the least possible deterioration through delay, or rough usage on the way. The packers ought also to have performed their duty, by despatching them clean and not liable to be bruised, or in a condition likely to develop the germs of putrefaction. Those to whom they are consigned ought to see that no undue delay be permitted ere they are in the hands of the distributors; and, if such delay is not preventible, the fish ought meantime to be kept with the utmost care, and in the best situation. The distributors, be they wholesale fishmongers or peregrinating dealers, are last of all responsible that the results of the preceding care and labour are not lost, but that the public—for whom all are really catering—receive fish at as reasonable a price, and in as sound condition, as can be managed, in order that the whole capture be taken by the public, and no national loss of food and individual loss of outlay ensue.

Occasionally these various departments are under the same control; but, as a rule, we may consider them as separate, and that each in turn is responsible to the public for the best possible conduct of what is virtually the national harvest, seeing it is raised from ground that pays no rent and is wholly untilled, and, consequently, belongs to the individual fisherman only through mutual consideration. Really rent is paid for the ground by the nation itself, that has retained a three-mile limit for its own fishermen, and maintained a fleet sufficient to insure security beyond the said limit. The nation consequently paying this rental, the fish harvest, as gathered free from foreign interference, is, properly speaking, held in trust for the nation by the captors. I will now consider the several departments in detail, and endeavour to show how they may be severally improved.

First, as to Mode of Capture.

I would divide this into two divisions, each of which might be considered separately as pertaining to different classes in the community—namely, the fish of a lower class and of great plenty, that are captured in multitudes without much regard to condition, and go to supply the poorer inhabitants of our great cities, to whom cheapness is of more real consequence than any slight difference in quality; and, again, those fishes of finer quality, such as the cod, that are mainly purchased by the more comfortable classes, who are willing and able to pay a little more that their purchase may be of the best, and in the finest procurable condition. We have both tacitly and admittedly acknowledged that our poorer brethren of the city are entitled to as much consideration in their struggle for nourishment as their richest neighbours; and, consequently, while acknowledging that the various systems of trawling may do some little injury, while the captures they secure are in inferior condition through the physical violence with which they are taken, we have accepted these trawls as legitimate fishing engines. If these only captured lower-class fish, the trade might not have suffered greatly, but, unfortunately, what are more properly looked upon as line-fish—viz., cod, haddock, turbot, etc.—are also largely taken, and reach the market in a greatly inferior condition, either for cooking or keeping, to what line-fish do. It is now too late to discuss the best mode of capture in a general way, as all systems of trawling and seining have become as much integral parts of the fishing industry as either hand or long-line fishing. Nor do I think it at present for the national advantage to interfere greatly with their operations. But it is proper to state clearly that fish captured by trawling in most instances are inferior to those taken by the hook, or the drift-net, or shore-set nets, and consequently ought, if possible, to be distinguished in their treatment all through, from the fishing-boat to the purchaser. Line fishing has not hitherto been looked upon as so important as trawling or net fishing, yet when the number of people employed is considered, not only in the capture of fish by this process, but in the previous and subsequent operations, it is really the most valuable of any to the nation.

A mode of capture followed in Cornwall for pilchards ought, I think, to be more widely employed where great shoals of fish frequent the coast in their seasons. This is to surround a large section of the shoal with a great seine net, which is not drawn, but simply used to keep the fish from escaping, and afterwards the enclosed fish can be taken as required, and forwarded perfectly fresh to market. This seems both a legitimate and most advantageous mode of improving the supply of such delicate fish as the pilchard and herring; and more especially might it be used in the capture of mackerel, when the quantities of that fish that reach market in a very inferior condition might in this way be greatly reduced.

There is a mode of fishing that might be wisely encouraged on parts of our coast much frequented by certain classes of fish, but which would perhaps require to be regulated by Government ere the various conflicting interests were settled with. I refer to the mode of cutting deep trenches into the shore at an angle, with a gate seaward, and spreading bait, such as garbage or buckies therein, at entering tide, when the gate is opened, and closing it ere ebb commences. Many fish would thus be taken in good condition; and especially would great numbers of fry be taken that could be reared in similar ponds, as is now done on a considerable scale in the Bay of Arcachon.

Having acknowledged the comparatively legitimate character of our various modes of capture as they stand, I have yet to say that they are susceptible of organisation to an extent that has never yet been attempted. Where such modes of capture as the hook and line, or the stationary engine, are proved sufficient to garner the fish supply of a limited district in superior condition, it is questionable whether the other more hashy modes should not be, by general agreement, removed to more open and distant grounds. For if the fish harvest can be gathered in a condition that will better stand carriage and keeping, and obtain a better price in the market, it seems reasonable that an effort should be made to obtain as large a proportion as possible in superior order.

Line-fish, and those captured by stationary engines, are not only of an average good quality, but they do not at any time deluge the market with such quantities of any class of fish that they cannot be utilised or profitably got rid of. Therefore I consider that they should be kept apart all along from the sea to the consumer, in which case their market would never be overcrowded, and this careful catch could always be got rid of, while the other markets containing the less carefully captured fish, if overthronged, would be so only to the injury of the inferior article.

Let us follow the subject all through. These line-fish cost more to procure, the mode of fishing being comparatively costly, and therefore the captors are willing to pay a little more for their careful carriage, naturally anticipating a higher price from their superior condition. Having added this additional cost of carriage to the original cost of capture, they are ready to expend still more on securing proper storage and distribution, in place of which they find themselves met with the same reception as the trawled herring or hashed haddock that cannot await a new day, and that elbow the smaller bulk of fish into a corner.

If the rougher modes of capture, such as seine and beam-trawling, are permitted principally on account of the important supply of cheap fish they can send to the poor of town and country, arrangements ought to be made that they may reach such a destination without delay, and without detriment to more carefully secured fish. I would, therefore, recommend that markets be established in the less fashionable districts of cities, where fish thus captured in multitudes should be forwarded, to the more readily supplying of poor localities, and the easing of the regular and more fashionable markets from the pressure of such fish.

Packing.

The question of proper packing is largely one of space, and, consequently, of expense. No fish, coarse or delicate, that is one of a heap can be sent thus to market in the same condition as if it were single. To make the most of a cod or even a fine haddock, hook-captured, they should be "hung by their own head" clear of their neighbours. But this demands both space and care, and these could only be expended upon fine fish that were to fetch a good price in the market. If these fine fish thus carefully handled are to be met on the same footing as the fish caught and packed in quantity, of course such extra care is out of the question. But I believe that a large market exists in our principal cities for fish carefully caught and carefully manipulated from the beginning.

Such manipulation depends upon the character of the fish, and in nothing more than in this is it desirable that a strong organisation of the trade should teach the public—who cannot afford to pay for what are technically termed *line-cod*—that ordinary fish are far better, and more likely to keep fresh, if the viscera and gills are removed. These are the first to undergo putrefaction, and if fish are not fresh enough almost to be crimped—although crimping properly should precede the *rigor mortis*—they are better if immediately eviscerated. This should be done with all the larger class of fish, which should then be hung in rows in the fish vans for rapid transit, each fish hanging clear from its neighbour, and thus being secure from the injury caused by crushing in heaps, which makes them flabby, and greatly spoils their appearance. There need be no difficulty whatever in thus conveying cod, which could be arranged on rows of spring clips as rapidly as they could be laid down, and a van could carry about as many the one way as the other, or more.

Haddock and smaller fish, as whitings, might be strung on wires if desired specially good, or preferably laid in shallow trays of galvanised wire netting, holding only one deep, and thus piled in the van, where they could not be crushed or hashed. Herrings and sprats would probably require more careful treatment than at present, even if caught in drift nets, ere they could be expected to appear among the first-class fish in the fashionable markets. We have not yet directed our attention sufficiently to the gutting and cleaning of such fish in quantity, but no doubt this will come in time; and, meantime, I would suggest an arrangement by which such fish would pass under a large revolving brush of very soft material, that would clear away all the superfluous matter from them, while only the unbroken fish would then be packed in neat layers in shallow vessels, so as to reach the market in superior condition. It has always been considered an advantage to a trade when it is worked so that additional returns are received to correspond with the additional labour expended. This would certainly be the case with fish, as more would benefit at the port of capture where they are manipulated, and less would be lost at the market from putrefaction; while the buyers would also benefit from the enhanced quality of the purchase at a comparatively trifling increase in the cost.

Of recent years our fishmongers have paid great attention to the cleanliness of their premises, but a much greater expenditure of care and labour is demanded during the previous operations before the fish will reach the public, in quantity, of the quality they may reasonably demand.

Carriage.

Closely allied to the necessity for improved modes of packing, is the demand for increased facilities for the safe carriage of fish over a length of railway in the summer time. Perfect cleanliness, thorough ventilation, and the maintenance of a low temperature in transit, is what is primarily required, and there should be no difficulty whatever in supplying these at a very moderate cost. We offer the following suggestion for a fish van for the carriage of better-class fish lengthened distances, which we believe could be carried out at a comparatively reasonable expenditure. A well-built van is lined with lead and painted white outside, the door opening outward, and provided with a rubber-edged flange, fitting into a corresponding flange so as to be air-tight. A rude air-pump affixed to the van would have its driving-wheel connected by a belt with a pulley on the axle, either direct or through a countershaft. It could be readily made so as to be thrown out of gear as soon as the exhaustion reached a certain pressure. If the journey were greatly prolonged, the guard might again throw it into gear for a short time. This would enable a small quantity of ice to keep a large quantity of fish fresh during a considerable period.

It would be very advisable to improve the material and construction of the packing-cases and baskets in which fish are at present despatched. These can rarely be properly cleansed, and consequently are soon just in the state most suitable for encouraging putrefaction. We cannot, as a rule, advise metal as a material to come in contact with delicate fish for any length of time; but if common fish must be sent in bulk, we think they might advantageously be packed in crates of galvanized iron wire netting, which could be thoroughly cleansed after each journey, and by being shaped like the compressed meat tins to which we have been of late accustomed, could be readily returned made up in nests. But if fish vans were fitted up with rows of trays of enamelled iron, with guttered edges for the water to get away, nothing cleaner or more satisfactory could be offered to the public, while they could be readily washed in a few minutes with an ordinary hose.

Let us suppose that the fish have been caught by the best methods, and forwarded express in well-fitted vans; or else, if caught *en masse*, cleaned, or even gutted by machinery—and this presents no insuperable difficulty—and despatched in sanitary receptacles in clean well-ventilated vans, the next point is to secure their proper reception in the city.

Storing.

The safe storing of fish can only at present be conducted on an important scale, and this is exactly what is best suited for the market-places of great cities. All fish-markets ought to have an extensive cellarage, kept at or about freezing temperature by means of a refrigerating machine constantly going, and into this cellarage all fish not immediately disposed of, or arriving in such quantities that only a proportion need be exposed, ought to be transferred. Here they might remain in perfect safety until the glutted markets were freed, or until continued supplies demanded that they should be otherwise preserved by curing or pickling, etc. In any case, the market would be freed from the unpleasant and unwholesome presence of masses of fish, only not coming under the lash of the inspector, and causing by their proximity the more rapid deterioration of fish that had arrived in sounder condition. The poorer inhabitants could also be supplied over a longer period with cheap food, in place of it coming as it does with a rush that chokes up all the avenues of exit, and only struggles through at last in a very questionable condition.

Such stores ought certainly to be established at all the more important fishing ports, as well as at the markets, so that in times of excessive pressure—which are after all the rule and not the exception in our great fisheries—the great proportion could be retained until the news from the cities told of open markets. At present far too large a proportion of herrings, mackerel, pilchards, etc., captured, are obliged to be used salted, owing to markets being at once glutted the one day, perhaps to be empty the next. There is no question whatever that, with proper arrangements for storage in a fresh state, the greater proportion of the fish captured around our coasts should be eaten fresh; and, until this consummation is arrived at, we cannot consider our sea-harvest properly attended to.

Distribution.

Distribution is one of the greatest difficulties connected with such a considerable amount of food of a very perishable character, and its successful management will demand more serious changes in our ordinary system of conducting the sale of fish in great cities than any other department of the trade we have yet touched upon.

No sooner has any of our cities received important consignments of perishable fish than the fish are disposed of, as far as possible, at an early hour to the various retailers and merchants. What cannot be thus disposed of in a fresh condition must be got rid of somehow, to clear the market, and prepare the way for the next day's supply, and so it is commonly disposed of later to the costermongers and peregrinating dealers, who traverse the outlying wynds and streets, with the fish exposed to the full glare of the sun, and occasionally spoiled by the wet, fortunate if they can dispose of the last ere it comes under the ban of the law.

This system—if system such a haphazard effort at distribution can be called—was no doubt sufficient when a score or two of smacks reached Billingsgate three centuries ago, and London was a town; or when Glasgow could be readily reached at every point in one hour from the Broomielaw. But all our great cities have outgrown any such mode of supply, and we are at present in the transition period, when we have discovered our weakness, but have not yet girded our loins to grapple with it. We very much fear that any proposal, to be effective, must be of a drastic character, and will consequently be received with suspicion by ordinary vested interests. But, in reality, we take so long to move in this country, that before any serious progress is made the old wheels have had plenty of time to work themselves into the new grooves. The objections to the present mode of distribution, outside of the more important fishmongers' shops, are mainly directed towards its inadequacy, and the cumbrous as well as inferior character of the machinery, that allows the public to wait for a supply until it is almost unfit for use, and at all times permits the loss of a heavy percentage through delay.

Let us take London as an example, all supplied as it is from one market in swaddling bands, the entrance to and the exit from which are equally difficult. It looks to an outsider as the perfection of absurdity that such strenuous efforts should be made to get a perishable product into a most unsuitable corner, with the full knowledge that only by the most desperate efforts can it be got out again in time. London, in reality, to be properly served, should have half-a-dozen markets under one central management, and all reached by rail from certain points. To those in the poorer districts the cheaper classes of fish, and those caught in the roughest manner, and despatched with the least care and cost, would naturally be sent; while the more fashionable districts would be supplied with those captured, packed, and forwarded with cost and attention. Both classes of fish would have fairer play, and each section of the city would be better served; for the cheaper fish would not be thrust aside in order to accommodate the purchaser from the more aristocratic quarter; and the superior quality of fish would not be injured either by competition with, or by infection from, those inferior in quality and condition.

Attached to these great markets a series of well-constructed vans should have the various parts of the district divided among them, over which they should have to travel within a reasonable time, returning with their unsold contents to the market before a particular hour, when the remaining fish could, if necessary, be stored in the refrigerating cellars. These vans might be built like omnibuses, around which the fish could be carefully laid on enamelled iron shelves, the windows being provided with awnings to keep off the sun. In such rapidly peregrinating shops the better class of customers could even be supplied with live trout, in aerated carboys hung from the roof, as they need never be too long absent from the aquaria, with which every important market should be supplied.

Fish from first to last ought to be treated with the full knowledge that they are extremely delicate, and susceptible to injurious contact either with decaying matter, or with unwholesome surroundings. A broken or "hashed" fish will decay more readily than an uninjured one; while any broken portions of fish among whole ones will facilitate their decay. It is therefore necessary that fish should, as a rule, be picked and cleaned—but not with water; and for the best fish, that they should be entirely free even from contact with their equally good neighbours. Cleanliness and complete absence of all insanitary conditions are essential; and not only the markets themselves, but the neighbourhood in which they are situated ought to be most thoroughly and carefully attended to. Indeed, no new fish market should be instituted without a mechanical arrangement for thoroughly cleansing it periodically when in use. We do not know why it is, but we do know that it ought not to be the case, that many of the women who distribute fish in our large cities are not of the cleanliest appearance. This may arise from their poverty, but it ought by all means to be prevented as a public injustice, and we question whether the insanitary condition of fish-distributors is not as worthy of legislation, locally, as the condition of our milk-shops and milk-salesmen.

In fine, we have an important supply of fish caught by a system that secures them in good condition, in which every care in packing, carriage, and distribution ought to endeavour to retain them, until brought before the higher-class purchaser.

We have likewise a very large supply, captured by ruder and perhaps more effective methods, that are less successful in securing it of fine quality, and, perhaps for that very reason, require greater care than is at present bestowed upon it to carry it in a wholesome state to the table of the poorer customer.

Lastly, we have a few markets badly situated, and of limited accommodation, and inferior sanitary and business arrangements, where the interest of the salesmen is merely to pass the day's fish under their hammer at the day's rates, without consideration for the fishermen, and with still less for the public. Who can blame them? They merely follow their business like their neighbours, and the wise conduct of markets, and supply of suitable facilities such as we have indicated, are for communities, not for individuals.

Our sea-fisheries have outgrown our markets, and those that at present conduct them, and the whole system ought to be taken in hand by the Trade Organisation, and re-organised on a broader basis; ever bearing in mind that the public must always be the final arbitrators, and that the better the fish-eating public is served, the wider the trade will grow, and the better paid will be the servitors.

XIX.

THE HERRING BRAND.

By W. Simpson Miln.

Before proceeding with the subject, I consider it necessary to state that I am a thorough believer in the Branding System; and being so, I find it difficult to think of any argument that would materially affect, or prove to be a disadvantage in connection with, the brand. On that account, the remarks and statements that I may venture to make in the composition of this Essay may appear one-sided, and even prejudiced. I trust not. My opinions, though all in favour of the brand, will only consist of, and be taken from, the arguments that at present are advanced by those who have an interest in doing so; and my endeavour will be to write with moderation and impartiality, leaving the reader to judge as to the merits of the herring brand, as far as I can present them to him.

As briefly, then, as possible, by simple facts, nevertheless concise and to the point, I will write concerning the history of the brand; its practicability and results; its effect on sale, consignment, and with the commission agent; arguments in favour of the brand; and arguments against the brand.

The History of the Brand.

Although the Scotch fisheries are heard of as far back as the 13th and 14th centuries, no prominence, in particular attaching to herring fishery, had arisen till nearly the end of the 16th century; when we read, "that for a time the Scotch herring fishery rivalled that of the Dutch." Such, however, was not of long duration. There must have been great mismanagement, or lack of perseverance, or perhaps the disordered state of the times had something to do with it;—at any rate, the reputation and, likewise, the practical work gradually receded till, in 1782, the total catch of Scotch herrings was, for that year, only 12,522 barrels.

At various intervals, Government had come forward to assist in developing and encouraging the trade; and had given extra facilities to companies whose capitals exceeded £10,000; but it all tended to the same result—failure. We read also of premiums, or bounties, as high as £18 and £20, having been paid by Government on the tonnage of the herring fleet, or "busses," as they were then called, but, in 1782, instead of this, a bounty of 30s. per ton on fish landed was paid. The year after saw the bounty raised to 50s. per ton.

It is in 1808 that we first find mention of a "brand." In the 36th clause of an Act of Parliament, passed in that year, it is decreed that the "brand," or "Government mark," on the barrel entitles and qualifies the curer to receipt of two shillings. In 1815, the bounty per barrel was raised to four shillings, remaining at that figure till 1830, when it was altogether withdrawn. I presume that was done on account of the trade assuming a healthier and wealthier aspect.

We have, therefore, a bounty paid by Government, from 1808 to 1830, to the curer, for a certain quantity of fish, and also during that time, a brand to certify as to the quality of the fish. The bounty, as before stated, was abolished in 1830; yet the brand was not; and branding under the old regulations, but without any bounty whatever, was continued without interruption till 1859.

About that time curers held diverse opinions as to the practicability of the brand. The opposing party, by reason of their discontent, made it necessary for a Parliamentary Commission to judge the question. There had been several Parliamentary Commissions prior to this, but the one in 1859 must be considered the most important, we acting, up to the present time, conformably to the laws arising from the Commissioners' report.

The Commissioners, after mature deliberation and inquiry into all details, gave their opinion that the brand was beneficial to the fishery. As a test, and to prove its strength with those in the trade, a fee of 4d. per barrel branded was imposed in 1859; which charge has remained in force ever since.

On several occasions there has been an agitation against the branding system by a number of fish-curers; but the majority, I may say an overpowering majority, of curers, are willing to pay for the brand, approve of, and appreciate the benefits arising therefrom. By a vote of 12 to 3, the brand was, during the late Parliamentary question thereon, considered advantageous, and therefore deserving of continuance.[1]

Practicability and Results.

The brand is simply a certificate that the barrel containing the herrings is of the legal standard measurement, that the herrings are properly selected and packed, and are up to the

[1] See Addendum to this Essay, p. 244.

requirements of the Board of Fisheries. The curer selects and makes up his herrings as follows, viz., fulls, matties, spents, mixed, and tornbellies. The first four mentioned may receive the brand, if qualified. Methodically, the curer has to fill up a "form" requesting the brand for a given number of barrels, on a given date. The accuracy of the statement in the "form," relative to the date of the catch of the herrings, has to be sworn to—a precaution against illegal presentment.

It is obvious that the brand, apart from being a mere certificate as to character, serves to facilitate the transfer from seller to buyer, without the necessity of examination as to quality or packing. Thus the brand is sufficient to keep the barrel intact, from the date of removal from the curing-yard, till it is actually opened for retail sale at the merchants'. Any barrel of herrings, no matter what quality or packing, will suffer more or less by being frequently opened and closed to allow of inspection.

Again, what herring dealer would make advances—such as are generally given—without a guarantee as to quality? Without the brand, the curer would have to guarantee. What is the curer's guarantee worth after the arrival of the herrings in the Continental markets? But the Continental herring dealer will only too readily grant advances, and guarantee minimum price on all Crown brands when desired. This shows that the brand not only facilitates, but guarantees, and therefore preserves the curer from loss.

Since 1830, the brand has served as a trade-mark throughout Germany, Russia, and elsewhere on the Continent, and numerous transactions are continually taking place on the mere faith of the words, "Scotch Crown-branded herrings." True, there are a few cases where words stipulating as to quality have been placed in the buyer's order; for example, the word "Prime," but, as such words are dangerous to the curer, and very seldom met with, further comments on them are useless.

The computation that over two-thirds of all the barrels of herrings, on an average for the past ten years, have been sold on the mere faith of the brand, and that no serious interruption or disputes have arisen from the transactions as to what quality the brand should in a manner certify, is a satisfactory evidence that the brand has the full confidence of the buyer generally.

Continental dealers will not pay cash for herrings without the brand, unless after inspection and guarantee. They do rightly. The barrels may contain anything for all that they know. But the brand being applied makes the case different, and is a certificate of character to be relied on.

From this it may be inferred that the results I have just mentioned are highly gratifying to the branding officers. As far as I know, they work assiduously, give strict attention, exercise due vigilance, and give no preference, thereby giving equality to all curers.

The following statistics show the progress of the brand:—

Year.	Barrels Branded.	Fees therefrom.	Increase on Barrels.	Increase on Fees.
1859	158,676	£2,644 12 0	...	...
1869	244,522¼	4,075 7 6	85,846¼	£1430 15 6
1879	342,323	5,705 7 8	97,800¾	1630 0 2
1880	689,286	11,488 2 0	346,963	5782 14 4

The results for the season 1881 will not be issued till June. 1880 was the heaviest on record, therefore it cannot be expected that 1881 will prove an increase on that year, but I am certain that it will show a proportionate increase over 1879.[1]

The total income since 1859 is over £130,000, the expenditure about half that sum,—leaving a revenue to Government not to be despised.

Effect on Sale, Consignment, and with the Commission Agent.

We will suppose a curer has a quantity of branded herrings, as also an equal quantity of unbranded herrings, lying in the curing-yard awaiting sale. Buyer calls, states price, curer willing to sell at the price, bargain is concluded there and then. A few minutes' work. Perhaps might buy the unbranded also. Where are they? Shown. Quality good? When caught? When packed? And a host of other questions are asked. The coopers have to leave their work, open the barrels, stand idly by while buyer and seller endeavour to come to a price. The buyer has not a definite order to buy unbranded herrings; however, may be able to do something next day; duly takes a note of the fish, and departs. The

[1] The Report of the Commissioners of the Fishery Board for 1881 shows for that year—Barrels branded, 494,182¼; Brand Fees, £8236, 7s. 6d. The Report says that "The herring fishing of 1881 was, with the one exception of 1880, the largest upon record." It also says: "Again, as in 1880 and in former years, the demands for branding were very great, and proved a continuous strain upon the attention and care of the Fishery officers. There was much difficulty in supplying the various districts with a sufficient staff of officers for the duty to be performed." It further says—and this explains the decrease in the number of barrels branded—"It was at the great branding stations upon the North-east Coast that the fishing of 1881 proved so unsuccessful, thus accounting for the falling off in the number of barrels branded." It will be observed that the anticipated "proportionate increase over 1879" took place.

coopers now close the barrels. They have been comparatively idle, and have lost a good bit of their regular work to the curer thereby. If time means money, and bother no gain, then here is a loss. Such is given to illustrate the facility the brand gives to the curer in effecting sale.

Or, a curer who can afford to keep his herrings till they are sufficient to form a cargo, can charter a vessel, load, and then wire Continental buyer offering cargo. Very seldom it is that the cargo cannot be sold to advantage. His offer contains no restrictions as to quality; none but the branding officer and the curer himself have judged as to the quality. Could this be done without the brand? It could not. Unbranded herrings are never bought without undergoing minute and careful inspection, or, failing that, restriction as to quality, which of course, necessitates guarantee by the curer or seller.

Mostly all curers have done a little in consignment, but that is only in times of extra dulness on this side, or in the expectancy of a rise in the market-prices at no distant date. The Continental herring-dealer may give an advance on unbranded herrings to those curers with whom he is acquainted, or has had considerable transactions, but, in the event of the sale being a bad one, he is justified in demanding back, if necessary, the difference between sale and advance. While Crown brands readily sell ex-ship, unbranded herrings are for the most part stored to allow of inspection, and many a time, after frequent offers, are sold at 1 or 2 marks less than the quoted market price. The curer is naturally displeased with the sale, considers himself unfairly dealt with, and after a haggling correspondence thereon, cuts the acquaintance of the agent. It would not matter much if it ended there, but he must needs greatly, and often wrongly, exaggerate his grievance to his brethren in the trade.

The commission agent greatly benefits by the brand also. As an example, we shall say a Russian house gives an order to their Stettin correspondent or agent, to buy on commission a cargo of Crown brands. The Stettin agent in turn orders from the Scotch or local buyer. The transaction is of the easiest. Seller is found, shipment made and paid for. Commission agent is enabled to pay cash by drawing against bills of lading and policy of insurance on a London bank for the full amount, and including commission. Has had no difficulty or trouble in this transaction. No time had been lost in looking out for a certain quality of herrings. Sale and payment were executed promptly. Having been ordered to purchase Crown brands, the mere fact of which dispenses with the trouble and loss of time in inspection, and having got them, no guarantee as to quality is required. If unbranded goods were wanted, then the agent would have had to satisfy and protect himself by obtaining the sellers' guarantee, and that only after personal examination. In many cases differences of opinion might arise as to his judgment of the quality among buyers, perhaps resulting in loss to the agent. If so, would it be worth a commission agent's pains to take such risks for a commission of 1 per cent., or, as it may be, 4d. per barrel?

When we remember that the enormous business of the East Coast of Scotland Herring Fishery has its beginning and end within three months, we cannot fail to appreciate the brand for the facility it gives in the buying and selling part of the business, thereby enabling the work to go on day by day in a methodical, expeditious, and comfortable manner.

Arguments in favour of the Brand.

There are a few instances where Crown brands on delivery and inspection have been found fault with, for either being under quality, or perhaps having a slight smell. The instances are few, and only heard of in years like 1874 and 1880. Excuses that might be pleaded for such are—(1.) That by and during their transfer abroad, they are liable to be damaged. I hold if a barrel is damaged, allowing the pickling to leak out, or admitting air, then the herrings will be damaged also. (2.) Should a herring having a bad smell be inadvertently put in at the time of curing, it certainly will, in three months' time, have contaminated the whole barrel. But how often has the falling market to do with rejection and fault-finding as to the quality? Let there be good consumption and steady market, and the quality of Crown-branded herrings will never be complained about.

It cannot be disputed that the brand facilitates the business in connection with the sale of herrings; neither can it be disputed that the brand to a certain extent guarantees the character of the herrings. But in my opinion the best reason for the continuance of the brand is, that it places the struggling curer on a level with his wealthy neighbour as to the cure of the herrings. A hard-working and respectable cooper has saved enough money to gratify his ambition of starting on his own account as a fishcurer—perhaps he has a capital of £200; practically, he is equal to his late master in the knowledge of selection and packing; is prepared to prove such; proof sufficient is given by the officer having branded his herrings. By the brand he is enabled to sell for cash, and that in turn enables him to pay off his boats at the end of the season. Without the brand he could not get cash at all times when wanted, and would most probably have to consign, and that method his capital would not allow of.

Curers are not bound to have their herrings branded. They can cure as they have a mind to, can have a private brand, and sell or consign to please themselves; but they must have their barrels of the proper standard size for exportation.

Therefore, the brand is to be prized for the following advantages:—1st, For certifying the barrel to be of the proper legal size, and the contents up to the required quality and cure; 2d, That in buying or selling, business is greatly facilitated thereby; 3d, Abuses are prevented, to a great extent, by its certificate as to character; 4th, It gives to the rising curer and medium capitalist an equality with his neighbours; 5th, That cash transactions as a rule accompany the sale of Crown-branded herrings; 6th, That a banker will more readily grant a temporary advance to a curer, at the time when he pays off his boats, knowing that he holds a stock of Crown brands, than to a curer of equal circumstances, who holds a stock of unbranded herrings. Apart from the respectability, character, and means of the curer, the banker is enabled to calculate at once as to the safety of an advance; he knows also that, in case of accidents, it will be easy to effect a sale of Crown brands, but that unbranded fish means consignment, doubtful returns, and loss of time.

That the aforementioned advantages are generally known, greatly esteemed, and worthy of continuance, will be sufficiently proved, if reference is made to the late Parliamentary question on the Herring Brand,[1] and to the yearly increase in the revenue derived from the brand.[2]

Arguments against the Brand.

The arguments that are brought against the brand are,—1st, That the quality and packing, which may merit the brand in the present, is of too low a standard; 2d, That it cannot be improved unless a greater number of officials are employed in the work, and degrees of merit introduced; 3d, That the opposers are desirous of selecting the fish so that a very high standard may be reached, and a very high price also; 4th, That the trade may remain in a healthy state by being in the hands of practical, enterprising, and money-made men.

Let us briefly look at what these arguments are worth. The branding officers must have served an apprenticeship as coopers. They are experienced as to selection; and know more about the herring generally than the average curer. They will not brand the fish presented to them, unless the fish are deserv-

[1] See *Addendum*, page 244. [2] See page 239.

ing. They are known to be punctilious as to the size of the barrel, and equally careful to give no preference to any of the curers. They say the standard is not too low. Who can say it is? Where is the line to be drawn as to what is to be considered above or below the standard quality?

The officers have always done their duty, without grumbling of having been overworked. Increased branding will soon necessitate an increase in the staff of officials. As to degrees of merit, if the curer wants his herrings to be considered of extra merit, let him put a private brand on the barrels, consign them with full declarations as to quality, and patiently await the result. What was the result for the season 1880? Just this, that the average returns have been less than the price paid for Crown brands on this side. The opposers seem to think their name, or mark, or their particular care in selection, will stand against all. Certainly, let them continue in the belief, but at the same time let them allow those curers who have not a particular selection, or name, to boast of, or mark other than that given them by the branding official, to do as they please. And seeing the majority of curers use the brand, the minority should either accept of the brand, or do without it, whichever way suits them best.

Summary.

Taking the brand as having been established in 1808, we find that up till the present time it has been greatly taken advantage of. It has, at all times, given, and at present appears to give, satisfaction to the great majority of curers. Year by year the number of barrels branded has been steadily on the increase. The buyer and seller are benefited by the brand as a facilitater in business, and as likewise to some extent acting as a guarantee, as before shown. Therefore, if any Government act confers benefit on its subjects, such an act is generally duly appreciated. Why should this act not be so?

I fail to grasp any argument against the brand. There is one item, however, I must speak of before finishing, which is, that the branding system, having now attained such dimensions, resulting financially in an annual surplus, Government might either reduce the charge per barrel, or make grants to the various deserving sea-ports where the herring industry is the principal support.

I feel quite unable to do this subject justice, but, very briefly, is it not reasonable for fish-curers to expect a reduction in the charge, seeing the expenditure to be only half of the income? It is optional whether the curer gets the brand or not, and I cannot deny that if the curers combined, they could do away with the brand. I am not aware of the charge being made as a tax, else all curers would have to pay. But if it is to be considered as a tax, then nothing further need be said on that point. If it is not to be considered as a tax, then who has the best right to the overplus?

Government may have occasion at an early date to consider this question, unless in the interval they wisely see their way to make a suitable reduction, or grant sums out of the overplus for the development and encouragement of the herring trade.

Lately, the brand may be considered as having received a new lease of life; still, many curers are discontented. Either of the two ways I have just mentioned would have a soothing effect, and tend to unity. Unity is strength. Therefore, united voluntary conformity, by all curers, to a general practice,—such as the brand has become,—together with the individual determination to improve the herring trade in all its branches, will have the effect of making a reputation not easily destroyed, and difficult to rival.

ADDENDUM.

Herring Brand Committee of the House of Commons.

The Report of the Commissioners of the Fishery Board for 1881 says:—A Select Committee of the House of Commons was appointed in March 1881 to inquire into the expediency of continuing the system of branding herrings, and into the appropriation of the revenue raised from the brand fee.

The Committee, after taking the evidence of fishermen, of herring curers, of herring merchants, and of others interested in the herring trade, made their Report, and recommended:—

That the present system of branding should be continued.

That the existing Government regulations as to measures and barrels should continue in force.

That the surplus from the brand fees should be appropriated to the improvement of piers and harbours, and a portion of it to the extension of telegraphic communication to remote fishery districts.

That the functions of the Board at Edinburgh should be extended so as to take cognisance of everything relating to the coast and deep-sea fisheries of Scotland.

That the Board's branding officers and the Board's cruiser should be made available for scientific investigations similar to those carried on in America; and

That the Secretaries of Legation abroad should be requested to furnish the Fishery Board with an annual report giving information upon those scientific investigations.

A remit of the Report of the Select Committee was made to the Board, and the Board's observations thereon have been duly submitted to the Lords Commissioners of Her Majesty's Treasury.

XX.

THE MIGRATIONS AND SPAWNING OF SEA-FISH SUITABLE FOR FOOD.

BY J. EPTON.

THE *Cod* being so generally distributed in our seas, its migrations are not easily defined. Large shoals of cod follow the herrings during July, August, and September; but they are not to be found in the same place periodically. At this time so erratic are their movements that the fishermen may suddenly fall in with a shoal of fish, catch a great many, and then as suddenly lose trace of them. These are what are commonly termed shoaly fish, and are very fat and large, but they seldom live long after they are caught. During the autumn and winter, cod-fish are to be found in moderate quantities in Clay Deep, along the north side of the Dogger Bank, the Deep Water, and the Fisher Bank, but not in large migrating shoals. These fish are strong, well fed, and, as the season advances, full of roe. With favourable weather they live a long while. There are various other places where cod are found thinly distributed all the year.

In regard to spawning, the cod prefers deep water—thirty or forty-five fathoms, the grounds just mentioned affording these depths. But it does not appear that the quality of the bottom has anything to do with this preference, as clay, fine sand, black mud, ground covered with weed, and stony ground, are all to be found at these different parts of the sea. The male fish are found in the largest numbers first; but, as the time of spawning draws near, the female fish outnumber the males. After they have spawned, the greater number migrate away. From the time the eggs leave the parent fish till they are matured, and the fish have grown to the size of from 12 to 18 inches, almost nothing is known by fishermen.

The period of hatching or incubation is unknown to me. I have seen a few young fish, from 3 to 5 inches in length, in the month of March, and these fish I believe to be from twelve to fourteen months old. I have come to this conclusion for the following reasons: It would not be reasonable to suppose the eggs to be deposited and hatched, and the fish grown to this size, between the latter end of January and the beginning of March; and from what I have observed of all sea-fish, their first year's growth is very small—not to say they do not grow fast, but they are so small to begin with, that they have to grow a lot before they show it. After the first year they increase in bulk quickly, and are in a condition for spawning at from five to six years old.

If by any means the eggs could be hatched, and a suitable expanse of enclosed, or nearly enclosed, sea-water could be found, I believe it would be an easy thing to establish a cod-fish farm; the cod not being over particular as to what he has to eat, and being very easily tamed.

The *Ling* is a valuable fish, and considerable numbers are caught in the northern parts of the North Sea, but I am not familiar with its habits.

The *Hake* are but very thinly distributed in the North Sea. A few years since large quantities were to be found off the Jutland coast in the summer; but for some reason they have deserted those grounds at present.

The *Haddock* is the most plentiful of all the bottom-fish in the North Sea, and is found periodically in immense shoals in various parts. In April a large quantity of haddocks are found on the northernmost edge of the westernmost shoal, and in the swashway between the westernmost and easternmost shoals of the Dogger Bank. After a few weeks they get scattered about.

In May, shoals of haddocks will sometimes visit the shoal water of the Sylt. These fish all run large, are well fed, and have their stomachs crammed with the small sand-eel or sand-launce. They seldom stay on these grounds a month. During June, July, and August they do not appear to form shoals in any particular place or ground, being scattered indiscriminately about the sea. Towards the latter end of August, large quantities of haddocks congregate on the north-west and south-west spits of the Dogger, and in the swashway to the south of the east end of the Great Silver Pits. These fish are in search of herring spawn, of which they are immoderately fond, eating it till their stomachs are distended almost to bursting. They stay on these grounds till the latter part of October.

About the middle of January the haddocks begin to congregate along the northernmost side of the Great Fisher Bank, in the deep water to the west and south-west of the Great Fisher Bank, and around the tail end or easternmost point of the Dogger Bank. These are their proper spawning-grounds. This migration I believe to be purely caused by instinct; and, considering they are gathered together so thick over such an immense space of ground, their numbers must be countless.

As usual with all sea-fish, nothing is known of the early days of the haddock, the smallest size at which it has ever been seen being about 4 or 5 inches, sometimes on the easternmost shoal of the Dogger, on the outer part of the Well; but the greatest quantity are to be found in the large expanse of the deep water to the northward of the Dogger. I believe the haddock produces eggs in its fourth or fifth year.

The *Whiting* is not very plentiful out in the open sea. In fact, it rather appears to have become more scarce than formerly. Whitings are found in the winter in the Great Silver Pits, around the westernmost edge of the Dogger off-grounds and the flat of the Well. In the spring they migrate towards the shore, perhaps to spawn, but more probably in search of food, in the shape of young fish, shrimps, etc., which are more plentiful in the bays and round the headlands.

The *Cat* or *Wolf Fish* is in every way suitable for food, but its ungainly and repulsive appearance militates against its introduction. It chiefly inhabits the northernmost side of the Dogger Bank, in depths of seventeen to forty-five fathoms. This fish does not appear to roam about.

The *Turbot* is but thinly distributed about the North Sea. Its chief resorts are about the banks off Flamborough Head, the lower part of the Dogger, and the rising ground on the German coast. A few are also found on the Great Fisher Bank, tail end of the Dogger, and the Well. The turbot appears to migrate towards the German coast about March; and formerly considerable numbers were caught on these grounds. The larger part of them were very small, averaging from one to four pounds weight. Notwithstanding the enormous quantity of eggs produced by this fish, it is gradually but surely getting scarcer.

The *Brill* is not a migratory fish. It is chiefly found in the westernmost Rough and about the Dowsing Sand, and is also thinly distributed about the sea, more especially on stony ground. I believe this fish's spawn sinks, or has some provision of nature whereby it may be fixed to stones, weeds, etc.

The *Sole* is very erratic in its migrations. Sometimes it is found in shallow water in very cold weather, and at other times, when the weather is warm, it will be in deep water, and *vice versa*. One week you may find a lot of soles; the next they will all be gone. I have studied this matter, but cannot come to a satisfactory conclusion. A few years ago larger quantities of soles annually migrated to the Dutch and German coasts in the months of April, May, and June, probably in order to spawn. This migration has greatly fallen off since the winter 1878-9, when an enormous quantity were caught in the Great Silver Pits. An article of mine giving an account of this appeared in *Land and Water*, November 26th, 1881, under the head of "Diminution of Flat Fish."

In the summer, during the year 1880, whilst fishing on the Well, I observed small bunches or clusters of spawn adhering to the warp. I carefully examined them, and compared them with the eggs of soles, at that time spawning, and I came to the conclusion that they were soles' eggs, and that they hung in suspension, at least for a time. I never saw any after that trip.

I do not know how long it takes the spawn of soles to hatch; but at one year old they appear about 2 to 4 inches in length; at two years from 5 to 9 inches; at four years some contain spawn, and at five years they are large soles. They still grow slowly a few more years.

The *Lemon Sole* somewhat resembles the brill in its habits, not appearing to migrate. It lives on stony or coarse ground, and large and small fish are found together; therefore I judge the eggs adhere to the ground.

The *Plaice* are a fish that are very regular in their migrations. In March they are found on the rising ground off Horn Reef, and the Sylt; in the latter end of March and through April, on the shoal of the Dogger; during the summer, on the Flat of the Well, and below the north-west Rough. In October and November they congregate in immense numbers on the north-east part of the Great Fisher Bank, staying on these grounds till the latter end of January, in order to spawn. They are also found thinly scattered about the sea all the year round. This fish is greatly on the decrease.

The *Skate* is a non-migratory fish, inhabiting deep water. The eggs of this fish are a long time in developing. I have only seen two specimens with fully developed eggs. As this fish has at no time been what may be termed plentiful about the North Sea, it might be thought that, with the various devices for capturing it and the fewness of its eggs, it would soon become extinct. But it appears that, whilst many of the more prolific are gradually decreasing, the skate holds its own, as it were; and its cousin, the ray, is if anything increasing. This is partly owing to the formation of the egg, which from its size, combined with the long stiff tendrils projecting from each corner of it, render it extremely difficult, if not absolutely impossible, for any of the larger fish to swallow, while its tough covering preserves it from smaller enemies.

The *Ray* is gregarious, and arrives in vast quantities in March on the westermost Rough, and about the Dudgeon and Dowsing Sands. It is also found, at the same time, off Borkum Reef. It chiefly inhabits the southern parts of the North Sea, and in its spawning habits it somewhat resembles the skate.

The spawning of sea-fish, in general, is a subject of which very little is definitely known; and it is very remarkable, considering the millions of eggs there are in the sea at periodical times, none are ever seen, excepting those of the herring. Sea-fish are continually shifting about in search of food; and, when it is plentiful, they will make what may be termed a halt for a short time. In these movements in search of food they are very irregular, but in their annual spawning migration they are very punctual. I do not see anything remarkable in this, as I consider that the same instinct which guides them in search of food will also lead them, at the appointed time, to suitable grounds or waters in which to deposit their spawn. In mentioning both grounds and waters, I wish it to be understood that some species deposit their ova on the bottom, and I believe this is always deposited amongst gravel, or on stony or rough ground, while the spawn of those species which congregate on fine sandy or muddy grounds floats, or is held in suspension for some space of time.

Amongst the former, more particularly, is the herring, and, I believe, the brill and lemon sole, although those two latter are open to conjecture. The other floating-spawn species comprises principally the cod, haddock, plaice, and sole, and, I believe, the turbot. In the deep-sea trawling business one of the most necessary things is frequent cast of the lead, clean grease being applied generally every time. This is done in order to test or find the quality of the bottom; anything unusual is immediately noticed, and although this cannot be looked upon as an infallible rule for finding spawn or ova on the bottom, it is not to be lightly passed over. It is well known that many of our fresh-water fish deposit their spawn on gravel, etc., in the beds of rivers and brooks, where I have been told it is not difficult to find it. In this there is an analogy to the herring. Although I have not included the herring in my paper, in regard to spawning I think it proper to mention it, as the ease with which the spawn is found offers a remarkable contrast with the ova of other sea-fish. It always deposits its eggs on gravelly grounds. The herring has an affinity for particular grounds on which to spawn; steep bank-sides, such as are found on the spits of the Dogger Bank being favourite places. It has before been mentioned that at this time haddocks congregate in immense shoals in order to feed on the ova of the herring. In general, the spawn in their stomachs is intermixed with small stones, in the proportion of one-third stones to two-thirds spawn. When fishing for these haddocks, it is not uncommon to find herring spawn imbedded in the grease on the sounding-lead. This is a strong argument that the eggs lie on the bottom, and also, that if the lead drops on any other kind of eggs it will bring them up.

I have also seen several small clusters of herring-eggs at the size of walnuts, and one as large as a man's head. This shows they adhere together—I believe these clusters were dead; and in this there is a contrast between the eggs of the herring and those of the cod, haddocks, and the plaice, they being non-adhesive, each egg being disengaged. It will be observed that I have mentioned two kinds of fish, viz., the brill and the lemon sole, as depositing their eggs on the ground. The only reason I have for believing this is because young and old are all found together; and as it is an uncommon thing for sea-fish in their different sizes to be found intermixed, and they not being migratory fish, I can come to no other conclusion; and although no eggs of these fish have been found on the lead, it may be because these grounds are very seldom frequented.

Plaice deposit their spawn a long way northerly, principally on the Great Fisher Bank; but the young fish are found on the German coast, many miles to the southward and eastward from the spawning-ground. Many soles deposit their eggs as far north as lat. 54°; but young soles are found principally in the southern parts of the North Sea; young turbots also are apparently more southern than the full-grown fish.

The young haddocks and cods are not found so southerly as the flat fish. This, I think, is owing to their eggs sinking, or else maturing more quickly than those of the plaice.

It will be observed that the general spawning-grounds of deep-sea fish are northerly from their usual feeding-grounds. This also favours the theory of floating spawn. The indraught of the currents in the North Sea being stronger to the south than they are to the north, the young fish when hatched are in grounds where they will find abundance of suitable food, whereas if the eggs were deposited three or four degrees further south, the principal part of them would be carried up into the narrow parts of the North Sea, a great portion of which is barren and hard ground, and contains no suitable food whatever for young haddocks.

I have not the least hesitation in saying that trawling does not injure the spawn of sea-fish,—in fact, trawling supplies an argument in favour of floating spawn; because, if the spawn was on the bottom, in all likelihood some would get entangled in the foot-rope or about the net, in some way or other, so that it would be noticed.

I have also examined the stomachs (not microscopically) of a large number of bottom-fish, both large and small, at all times of the year, in order to see if I could find out whether they feed on spawn, and the only instances are the haddock and dab, which were filled with the eggs of the herring.

From these observations I have come to the conclusion that the spawn of cod, haddock, plaice, and soles floats, or is held in suspension for some space of time; and although it may in time sink, it will be so scattered that to drop the lead on it would be almost a miracle.

Apparently but a very small percentage of the eggs deposited arrives at maturity. I have no doubt a large proportion of them are devoured, whilst in their floating condition, by herrings, sprats, and young mackerel, which abound about these parts of the sea. And as in the latter end of the egg existence it is to be surmised they will sink, many will be immediately pounced upon by the multitude of small crabs and other forms of sea-scavengers. It might be expected that the very young fish or small fry would sometimes be found in the stomachs of the larger fish, but up to the present I have not been able to detect any. It may be that the young fry being so delicate and tender will quickly decompose.

During the month of September 1881, after lying becalmed about forty-eight hours on the Well, being surrounded with shoals of herrings, my attention was drawn to the surface of the sea being covered with a substance resembling red dust, which, on nearer inspection, proved to be some kind of living things. After bringing a vessel of water up containing a large number, and straining it, I placed some of them on a clean blade of a knife. They then appeared to be about the size of a small pin's head, of a shrimp-like form, from one end of which projected either a feeler or tail, barely perceptible. These small objects swam with a jerking motion. The cause of the redness was produced by a very minute speck in the middle of the body. Excepting this speck, the fish was perfectly transparent. I judge these were young fish of some species just hatched out; but whether they were food for the herrings I cannot say. It is almost needless to add that as soon as the sea was ruffled by a light breeze they immediately disappeared.

In conclusion, taking sea-fish generally, they are not so long in growing to their full size as was formerly supposed. As a rule, from four to six years is sufficient for them to arrive at a state of maturity or reproduction. If it could be definitely settled how long the different species of eggs are in hatching out, and what the small marine insects, with which the bottom of the sea is literally covered, feed upon, many things that are at present perplexing would soon be understood.

XXI.

ANGLING ASSOCIATIONS,

WITH CODE OF RULES FOR THEIR MANAGEMENT.

No. I.

BY H. BRADFIELD.

THE true Angling Association is a society of modern growth, and has little in common with the great majority of ordinary fishing clubs or societies, whose chief object is the provision of prizes for their members. The Angling Association is the outcome of the keen spirit of preservation manifested throughout the country during recent years, and many influential associations have been formed for the purpose of providing legitimate sport for their members, and for preserving, in the interests of anglers in general, waters that hitherto it had been the custom to foul or poach to an unlimited extent; and associations of this kind have, by inculcating a high standard of sportmanship, done much towards educating the general body of anglers in the true principles of sport.

On forming an angling association the first matter for consideration should be the object for which the association is to be formed, and as success entirely depends upon this, it is a subject for very careful consideration. In most undertakings of this character it is extremely difficult to get persons to associate and to subscribe unless some direct advantage or benefit is held out to them. The promoters of an association should therefore take care at the outset to show that some substantial benefit will accrue to anglers from their scheme.

The *first object* of an angling association should be the acquiring of rights of fishing in certain waters, and the preservation, for legitimate sport, of the fish in such waters. The success of most angling associations must depend on the way in which this object is carried out; but no well-ordered association should stop short here, or much good work within the power of such an association would be left undone.

The *second object* should be the culture of fish by artificial or other means for the stocking of such waters.

Finally, power should be taken for doing all such other things as are incidental or conducive to the attainment of the above objects.

An association taking these objects as its charter will probably find that they are amply sufficient to cover everything within its province.

The *first object* especially will be found to cover a wide range of work—viz., the acquiring of fishing rights in private waters for the use of the members only, and, where practicable, the control of waters in which the public fancy they have a prescriptive right of fishing, so that they may be preserved and managed in the true spirit of sportsmanship in the interest of the public in general. The carrying out of this latter branch of work by wise regulations will do much to insure popularity, and to obtain the support of anglers and all those interested in the provision of rational health-giving amusements for the people. This part of the work will probably be looked upon at first as an encroachment upon the rights of the public, and will meet with the open opposition of some and the passive resistance of others; but before long, the innovation proving itself an improvement, will be warmly accepted and supported. The prevention of pollution, one of the most grievous causes of the deterioration of angling, as well as the prevention of poaching and all illegal modes and times of taking fish, will also come within the working of this object.

The *second object*—the culture of fish—is a most important branch of the work open to an association, and should by no means be neglected; for artificial hatching is now so cheaply and easily managed, that it may not only be adopted as the most ready means of stocking waters, but also as a source of profit; and if the work can be carried on in the local museum or institute, as has been done in some instances, it can be made the means of educating the public in the importance of fish-culture, and of enabling them thoroughly to understand the subject. Under such circumstances the operations could then be so conducted that visitors might see the various stages of the development of the eggs and the subsequent growth of the fish, and students have the opportunity of studying the embryology of different kinds of fishes. The acclimatisation of foreign fishes might fairly claim to come within the scope of this object, and, where the funds permit, would be to the advantage of an association and the community at large. The reading of original papers on sport, fish-culture, etc., before the members of an association would do much to further a proper appreciation of the advantages of legitimate sport and fish-culture, and should therefore be heartily encouraged.

Having carefully settled the objects for which an association is formed, the next question is the *code of rules.*

The rules as to *meetings, committee of management, etc.*, are mere matters of detail; but the members of the committee of management should certainly be chosen for their known character as genuine anglers and true sportsmen; the chairman and secretary especially should undoubtedly be men of that class, with the additional qualification of unbounded enthusiasm for their work; and, if possible, one member of the committee should be a scientific man, with a taste for pisciculture or natural history, whose particular turn of mind would especially fit him for superintending and managing the operations for the artificial propagation of fishes.

The rules as to *membership* and *subscriptions* may be so framed as to be a great element for insuring popularity and success. To do this it is necessary that the subscription of the ordinary members should be reasonable, and fairly within the reach of all; and, as the main object of an association should be to foster the cultivation of a love for the art of angling, it ought readily to open its ranks to receive every recruit, provided he is, or desires to be, an angler. To make an association really popular, it is absolutely necessary that it should be popular in its constitution, and open to all who may wish to become members. If it is to be exclusive, and the subscription prohibitive, an association will, in many cases, at once become unpopular, and have to encounter difficulties and opposition at the outset to which it will most probably succumb. There need be little fear that popularity and numerous membership will spoil the chances of good sport, if the rules as to fishing are based on true principles, and are enforced with stringency and strict impartiality. Further, with regard to subscriptions, it may be found advantageous, in many instances, to admit honorary members, as in most localities there will be found many who, although they are not anglers themselves, will be only too glad to avail themselves of the opportunity thus offered them to help forward the work of an association, and to encourage the pursuit of angling by others.

The framing of the rules as to *fishing* should receive most careful thought and consideration, as the application of these rules will govern the action of the members for good or evil in a matter of vital importance to the future of an association. These rules, if wisely framed in the true spirit of sportsmanship, may, under the management of a well-conducted association, be made the vehicle for securing a high standard of sportsmanship among the members, who by their example will do much towards educating the general body of anglers within the district in all that is best and truest in sport. Anything tending to allow of the taking of unsizable fish, or the taking of fish by other than strictly sportsmanlike means, and at what may be considered unfair hours, should therefore be excluded from such rules; and if it is contemplated to adopt the prize system, care should be taken that prizes are not given for gross weight catches, but for specimen fish, the standard for which should be a high one. It would be a great step in advance if all anglers' societies would combine for providing sport rather than prizes, as anglers would then realise the fact that their interests are better served by the provision of good sport than they are by the provision of prizes. All well-regulated societies or associations now make provision in their fishing rules for restricting the number of fish that may be taken in any one day, and some even go so far as to prohibit fishing at all for a certain period during the trout season, for the simple reason that at times the fish may be taken at such an advantage that, if a restriction of this kind were not introduced, an association water would very soon be seriously damaged. If such a restriction—as to the number of fish to be taken in any one day—as is here suggested is embodied in the rules, the members will soon be brought to see that true sportsmanship consists in returning fish to the water, for sport in the future, rather than in carrying away a heavy creel.

With angling associations of the kind here sketched rest the realisation of the hopes of anglers for the preservation of our fisheries, and if anglers desire to follow one of the most delightful of occupations with a moderate degree of success, it behoves them to do their utmost in furthering the formation of such associations, and in supporting them where already formed; for, as has been truly said by Mr. Francis Francis, "there is no way in which a water, or a reach of water, can be made to yield so much sport, or so much fish, as under the management of a well-conducted association."

RULES OF THE ——— ANGLING ASSOCIATION.

The name of the Association is "The ——— Angling Association."

The objects for which the Association is formed are:—

For acquiring the rights of fishing in waters in the neighbourhood of the [city, burgh, etc.] of ;

And for the preservation, for legitimate sport, of the fish in such waters;

And for the culture of fish by artificial or other means for the stocking of such waters; and for doing all such other things as are incidental or conducive to the attainment of the above objects.

General Meetings.

1. The annual general meeting shall be held in the month of January in every year, on a day appointed by the committee, to receive the accounts, to form, revise, or confirm rules; to appoint the officers and committee, and to transact the general business of the Association.

2. The committee may, whenever they think fit, and upon the receipt by the secretary of a requisition in writing signed by five members, and stating the object of the meeting, they shall forthwith, convene a special general meeting.

3. The quorum at general meetings shall be ten members.

4. The president of the Association shall be the chairman at every general meeting of the Association, and if at any meeting he is not present, the members present shall choose one of their number to be chairman of such meeting.

5. The chairman may, with the consent of the meeting, adjourn any meeting from time to time, and from place to place.

6. Questions arising at any meeting shall be decided by a majority of votes. In case of an equality of votes at any meeting, the chairman shall have a second or casting vote.

Committee of Management.

7. The business and affairs of the Association shall be conducted by a committee of management, consisting of the president, treasurer, secretary, and nine members, who shall be elected at the annual general meeting in every year, but in the event of no new election, the committee of management of the last year shall continue in office as if re-elected. Any casual vacancy occurring in the committee of management may be filled up by the committee.

Committee Meetings.

8. The committee shall meet for the despatch of business on the   Monday in every month at   o'clock in the   , and at any other time they may think fit; five shall be a quorum. Questions arising at any meeting shall be decided by a majority of votes. In case of an equality of votes, the chairman shall have a second or casting vote.

9. The president shall be the chairman at every meeting of the committee, and if at any meeting he is not present, the committee present shall choose one of their number to be chairman of such meeting.

Membership.

10. Members shall consist of persons residing, or having places of business or property, in the [city, burgh, etc.] of   or within   miles thereof; and there shall be ordinary and honorary members.

11. The name of every candidate for election as a member shall be sent in to the secretary, who shall give written notice thereof to every member of the committee previous to the next committee meeting; and the committee shall at such meeting proceed to the election or rejection of such candidate. Every candidate shall be proposed and seconded by members of the Association.

12. No person shall be considered a member until he shall have paid his annual subscription to the treasurer, and shall have subscribed his name to a memorandum of his approval and adoption of the rules of the Association.

13. Any member selling his fish, lending or refusing to show his ticket, violating any existing Acts of Parliament for the preservation of fish, or who shall at any time infringe any of the rules of the Association, shall forfeit his ticket, and shall be liable to be expelled from the Association, upon a resolution to that effect, passed by a majority at a meeting of the committee.

Subscriptions.

14. The annual subscription of ordinary members shall be   per annum, which shall be paid to the treasurer within the month of January in every year, and they shall receive therefor a non-transferable ticket.

15. Every subscriber of   per annum shall be an honorary member, and have all the privileges of an ordinary member, and shall be entitled in addition to obtain, on application to the secretary, a ticket entitling any friend of such honorary member to the privilege of fishing in all the waters of the Association, subject to the rules of the Association.

16. Any person, not being a member, can, by applying through a member of the committee to the secretary, have a weekly ticket at   , to be available only in the company of an ordinary or honorary member, who shall be responsible for his due observance of the rules of the Association. Such ticket to be returned to the secretary on its expiration.

Accounts.

17. The committee shall cause true accounts to be kept of

all moneys received or paid on account of the Association, and shall lay before the members at the annual general meeting a statement of the income and expenditure for the past year.

Audit.

18. The members shall elect at the annual general meeting in every year an auditor, who shall audit, previous to the next annual general meeting, the accounts for the past year.

Alteration, etc., of Rules.

19. The committee shall, if they deem it necessary for the efficient management of the fisheries or affairs of the Association, rescind, revise, or make new rules, provided that such rescission, revision, or new rules be passed and accepted by at least three-fourths of the members of the committee present at an ordinary monthly committee meeting, and the same shall have effect until confirmed or otherwise at a general meeting.

20. The rescission, revision, or making of new rules in general meeting shall be passed and accepted by at least three-fourths of the members present at the annual general meeting, or at a special general meeting called for that purpose.

Fishing.

21. The taking of fish by any other means than by rod and line is strictly prohibited, and proceedings shall be taken against any person taking fish by netting, snaring, fouling, snatching, trailing, gleaving, spearing, setting trimmers, bank runners, or night lines.

22. No member shall use more than one rod at any one time.

23. *Trout.*—The fence-time for trout shall commence on the 15th September and end on the 15th April in every year. The taking of trout by any other means than by fly-fishing with an artificial fly is prohibited. No trout shall be taken between one hour after sunset and sunrise. No trout shall be taken under 1 lb. in weight [or 14 inches in length], and if caught under that weight [or length], whether killed or not, shall be immediately returned to the water. No member shall take more than   brace of trout in any one day.

24. *Grayling.*—The fence-time for grayling shall commence

on the 1st March and end on the 31st July in every year. The mode of taking grayling, the hours of fishing, and the number of fish to be taken in any one day, shall be the same as those hereinbefore respectively set forth with regard to trout. No grayling shall be taken under ¾ lb. in weight [or 12 inches in length], and if caught under that weight [or length], whether killed or not, shall be immediately returned to the water.

25. *Pike.*—The fence-time for pike shall commence on the 1st March and end on the 1st August in every year. The taking of pike by any other means than by spinning is prohibited, and no gorge-hook shall be used for any bait. No trout or grayling shall be used for bait in any case. No pike shall be taken under 3 lbs. in weight, and if caught under that weight, whether killed or not, shall be immediately returned to the water. No member shall take more than   pike in any one day.

26. *Other Fresh-water Fish.*—The fence-time for fresh-water fish (other than trout, grayling, and pike) shall commence on the 15th March and end on the 30th June in every year. No fresh-water fish (other than trout, grayling, and pike) shall be taken under the lengths hereunder respectively set forth, except for bait, and if caught under those lengths, whether killed or not, shall be immediately returned to the water, except as aforesaid:—

Barbel, . . .	14	inches (extreme length).
Bream, . . .	10	" "
Carp, . . .	9	" "
Chub, . . .	11	" "
Dace, . . .	7	" "
Gudgeon, . . .	4	" "
Perch, . . .	8	" "
Roach, . . .	8	" "
Rudd, . . .	7	" "
Tench, . . .	9	" "

27. Any member taking fish during the fence-times hereinbefore respectively set forth, or otherwise in contravention of Rules 21, 22, 23, 24, 25, and 26, shall forfeit his ticket, and be liable to be expelled from the Association as aforesaid.

28. Every member, or other person, fishing in the waters of the Association shall show his ticket and the contents of his bag or basket when requested by one of the committee or a bailiff so to do, and a member, or other person, shall show his ticket and the contents of his bag or basket on any member producing his ticket and requesting him so to do.

29. Any member who, whilst fishing, or in going to or returning therefrom, shall do any wilful damage to fences or

otherwise, shall pay for the same or forfeit his ticket, and be liable to be expelled from the Association as aforesaid.

Hirings.

30. All hirings of the Association shall be in the names of the president and secretary.

XXII.

ANGLING ASSOCIATIONS,

WITH CODE OF RULES FOR THEIR MANAGEMENT.

No. II.

BY ALEXANDER LOW.

THERE is no sport which is so accessible to all classes as trout-fishing in Scotland. The country is intersected by numberless streams, and studded with many lochs, and the general rule is that trout-fishing is open to all. That this is a great public boon it is impossible to doubt; for no sport meets so many requirements as angling does. It gives scope for the exercise of great manual skill and dexterity; it invites close observation of nature; it leads its devotees among the most beautiful scenery; to the strong and the young it gives hard and healthy exercise; to the delicate, the old, and the overworked, it gives recreation without over-exertion; and it is pre-eminently the sport of the poor man, because the appliances required are few and inexpensive. It is no wonder that such a sport should be popular, and that the number of anglers should yearly increase; and yet it is only in comparatively recent years that angling has become anything like universal. Forty years ago each stream had its few local anglers and its few yearly visitors; but now, from March till October, every available piece of water is daily invaded by crowds of fishermen. This change is doubtless due to some extent to railways, which have brought distant streams and lochs within easy reach of the great towns, but it is also due to the fact that the knowledge and love of angling has greatly increased. The tendency of recent years has been to give greater prominence and encouragement to the practice of manly sports and athletic exercises, and the same causes which have produced the village cricket club have also produced the village angling association, and trained up an immense number of more or less skilful anglers. But we cannot shut our eyes to the fact that concurrently with the great increase in the number of anglers, there has been an alarming deterioration in the quality of the fishing, especially in the southern counties of Scotland. The late Mr. Stewart, in his admirable treatise on angling, called *The*

Practical Angler, says, "There are not three days, perhaps not even a single day, from May till October, in which an angler, thoroughly versed in all the mysteries of the craft, should not kill at least twelve pounds weight of trout in any county in the south of Scotland, not excepting Edinburghshire itself." *The Practical Angler* was published some thirty years ago, and about twenty years later, and shortly before his death, the author, referring to the passage which I have quoted, said that fishing in the southern counties had so fallen off that it was only when skill was united with the most favourable circumstances that the angler could secure even eight or ten pounds weight of trout. This statement will be indorsed by every one whose angling experience carries him back a quarter of a century.

The fact that trout-fishing has so deteriorated suggests the questions, What are the causes, and what the cure?

I believe that many of the causes are preventable, and that angling associations furnish the machinery by which much may be done to restore trout-fishing to something of its former excellence.

Some of the causes, however, are not preventable, and among these may be mentioned the two following:—The completeness with which the land in the southern districts is now drained has diminished the supply of food in the rivers. In former times the rivers rose slowly into flood, and ran slowly down. After a heavy rainfall the river would continue for days, and, in the case of a large river like the Tweed, for weeks, above its normal level, running full, though clear, and bringing down large supplies of worms, grub, and other food. Now the spate sweeps down the drains into the water-courses, and the rivers rise rapidly to a great size, and when the rain stops they as rapidly subside, and in a few days are as small and clear as if a flood had never existed.

Another agency which has injured trout-fishing in many streams is the strictness with which the salmon laws are now enforced in regard to bull-trout. Take, for example, the river Whitadder in Berwickshire, long famous as a trout stream. Very few salmon enter this stream, but it is a great favourite with bull-trout. In former times it required an unusual flood to enable the bull-trout to ascend in any great quantities, on account of the numerous caulds or weirs. Of late years the Tweed Commissioners have caused salmon-ladders to be made in all the caulds, and bull-trout now ascend the river in thousands. The result has been great deterioration in the trout-fishing. The bull-trout take possession of the spawning-beds, consume vast quantities of food which would otherwise benefit the trout, and also devour numbers of small trout. And the fact that in late autumn the river is full of bull-trout does not compensate for the injury done to the trout-fishing, because "the bullies" are sluggish, sulky fish, which do not take readily, and give little sport when hooked. As, however, bull-trout are a valuable commodity, especially, it is said, for the French market, I do not suggest that any steps could be taken to prevent their free entrance into those rivers even of which they are the sole migratory inhabitants. Moreover, this is a cause of deterioration which applies only to a limited number of rivers.

These are the two chief causes of deterioration which are not preventable, and I shall now mention some of the causes which are preventable.

First.—The first cause is over-fishing. I have already alluded to the great increase in the number of fishers in Scotland, and to these must be added the numbers of Englishmen who employ their summer holiday in trout-fishing in Scotland. Go to the Clyde, or the Whitadder, or the Gala, or the upper reaches of the Tweed, on a May day, and you will find it hard to get a single pool to yourself. In the stretch of water (about three miles) between Bowland Bridge and Stow, on the Gala, I have frequently counted as many as thirty anglers. It may be true that the average catch of each angler is small, but the aggregate over the season must be enormous. And besides those who fish for sport and pleasure, there are a number of professional, or *quasi*-professional, anglers, who capture trout for the purpose of selling them, and who are constantly on the water, fishing by day or by night according to the season.

Second.—A very serious cause is the destruction of trout by illegal means. Miles of our best streams are yearly depopulated by netting, or liming the water, or other means of a similar sort.

Third.—In late autumn, when trout are out of condition and ready for spawning, they may frequently be captured with great ease. If the water is slightly swollen they take a worm readily, and if salmon-roe is used there is no limit to the number which may be taken. It is true that angling with salmon-roe is now illegal, but in retired districts great quantities of unseasonable fish are yearly killed with it.

Fourth.—From experience I am convinced that great injury has been done to trout-fishing by the use, during April, May, and early June, of creeper and stone-fly as a bait. I do not suggest that the use of this bait is unsportsmanlike. On the contrary, it requires both skill and knowledge to use it efficiently, but in the hands of a practised angler (and their name is now legion) there is no lure by which the best trout in the river can with such certainty be secured. You hardly ever get a small trout, never one in bad condition, with creeper or stone-fly.

Fifth.—Immense injury is done to fishing by pollution from mills and manufactories. Take the Teviot, a trouting river of great capabilities: during every summer thousands of trout in that river are poisoned by the discharge from the Hawick mills.

Such being the chief preventable causes of the deterioration of trout-fishing, I shall endeavour to show how most of them can be cured or diminished through the agency of angling associations.

Angling associations may be divided into three classes:—

1. Associations which rent and preserve a piece of water for the exclusive use of members;

2. Associations in the large towns for the purpose of holding competitions on Lochleven, or on rivers within reach of the towns; and

3. Associations in the country connected with rivers and streams of a particular district.

I shall have a word to say by and bye on the first two classes of associations, but it is evident that it is the third class from which aid must be chiefly sought for the preservation of trout-fishing.

Half a century ago associations of this class were almost unknown, now every village in an angling district has its association. And it is this fact which lends the hope that angling associations may do much to restore trout-fishing to its former excellence. In the angling associations of the south of Scotland you have existing organisations which may be used and developed, and I shall try to point out the way in which this is to be done.

Angling associations of the class now under consideration generally content themselves with holding one or more competitions every year, the prize being awarded to the competitor who captures the greatest weight of trout. Such competitions are not without good results: they promote fair and sportsmanlike angling, and induce good-fellowship and friendly rivalry. And even when the association does not aim directly at the preservation of trout and the improvement of the fishing, it has that effect indirectly. For country associations are largely composed of labourers, gamekeepers, and tradesmen, who have good means of knowing when poaching goes on in the district, and the persons who engage in it, and can thus do much in a quiet way to prevent it. Sometimes the avowed object of the association is to improve the fishing, as in the case of the Gala Angling Association, which has made a praiseworthy and, I believe, to a great extent a successful, effort to prevent netting, which had been carried on to such an extent in the Gala as to threaten the absolute extinction of the trout. This is clearly a step in the right direction, but to any one who remembers the Gala twenty or thirty years ago, it is needless to say that much more requires to be done before that most excellent of streams is restored to anything like its former glory.

The two things which angling associations should seek to accomplish are, the prevention of poaching and the prevention of over-fishing. Poaching is capable of being absolutely stopped, and the principal means which must be employed is watching. Over-fishing is a more delicate matter to deal with, because the problem is to prevent over-fishing, without taking away the benefit which is derived from so much trout-fishing being open to the public. The solution of the problem lies, not so much in decreasing the number of fair anglers, as in increasing the stock of trout. The prevention of poaching would of course go far to effect this, for a skilfully-worked net will, in a single night, make a clean sweep of pool after pool. Then a close-time should be established, to prevent the capture of trout when out of condition and full of spawn. The close-time should never be shorter than from the 1st of October to the last day of February. It is true that, except in an unusual season, the beginning of March is too early for trout-fishing, but it will not do to draw the curb too tight, and ill-conditioned trout in early spring are, unlike trout in late autumn, exceedingly difficult to take. Further, there should be in all rivers a limit of size under which no trout can be retained, but must be returned to the water. What the limit is to be must depend upon the character of each particular stream. In a stream with a gravelly bed and abundance of spawning-ground, a comparatively small trout might be retained, while in sluggish, muddy streams, which are not capable of producing so large a number of trout, the limit should be more stringent. In no case should a smaller trout than 6 inches in length find its way into the angler's basket. In a great number of streams, too, I should like to see angling with creeper and stone-fly (commonly but erroneously called May-fly) prohibited. It has already been admitted that angling with this bait is a difficult and highly attractive branch of the art; but it is too destructive. On a favourable day a skilful angler can, with creeper or stone-fly, take almost all the large trout out of a suitable reach of the river; and the anglers who do most execution with this bait are those who make a business of angling, and who, being constantly on the water, are sure to have a good many days during the creeper and stone-fly season, when the trout are taking really well. I know from experience that angling with creeper and stone-fly is often disappointing. The amateur often goes out expecting to do great things, and hardly moves a fin. But any one who has had the luck to hit off a day when the trout are rising greedily at the stone-fly will not soon forget the experience, and will admit the force of the remarks I have ventured to make on the subject. I have mentioned the professional, or *quasi*-professional, trout-fisher, and should like to see a check put upon his depredations. The quantity of trout killed by this class of men in every South-country stream is, there is good reason to believe, much greater than is generally supposed, and proprietors who throw their waters open to the public do so for the amusement of the public, and not that the waters may be fished morning, noon, and night, for purposes of gain.

But how are angling associations to carry out these much-needed reforms? To illustrate the method I propose: Suppose a river or stream of moderate size, which is not a salmon river, and the whole of which is open to the public. Suppose also that there is an angling association in the district, whose competitions are carried on in this stream and its tributaries. The first thing to be done is to make an arrangement with the riparian proprietors, whereby the association will obtain a title to enforce its rules. There should not be much difficulty in doing this, for although there might be one or two individuals who would refuse their consent, the bulk of the proprietors who have allowed the public to enjoy the right of fishing could hardly refuse to concur in a scheme by which the public would benefit, and the private proprietory rights in the fishing be made more valuable. Assuming then that the proprietors, or the bulk of them, have given the necessary authority, the next step is to provide watchers, who will prevent poaching, and see that the rules of the river as to close-time, the size of trout to be taken, and the lures to be used, are kept. But to do this requires money, and where is that to come from? I propose that it should be raised by the sale of tickets, no one (with the exceptions which will afterwards be mentioned) being allowed to fish without a ticket. Freedom of fishing will not be taxed in any material degree by this proposal, while the corresponding advantages will, out of all sight, be greater than the burden imposed. In most cases the price of tickets should be fixed upon a sliding scale, founded chiefly upon the distinction between inhabitants of the district and strangers. Tickets to inhabitants of the district should be fixed at a very low rate—so low that the labourer who looks forward to a few hours' angling in the evening after his day's work would willingly pay it in order to improve the fishing. Probably from one shilling to half-a-crown would be enough. Then for strangers, season tickets could be furnished at say ten shillings. As, however, this would be a large sum for any one who only wanted one or two days on the stream—as, for example, a clerk coming from town on a general holiday—any one might be allowed to angle at the rate of a shilling a day, or other small sum. The watchers could each be provided with a book of these daily tickets, which they could supply on the spot to any stranger. In regard to tickets to inhabitants of the district, although the price should be fixed so low as not to exclude any class, I do not mean that no one in the district should not be expected to pay more than one shilling or half-a-crown. It might be made optional to give, in exchange for a ticket, a subscription of an amount greater than the price of a ticket, or the cheap ticket might be for working men alone, and a five-shilling or ten-shilling ticket provided for the richer classes. In this manner ample means for watching the river and enforcing the rules could be obtained, for it is just on those rivers which would require a considerable amount of watching that anglers are numerous, and that the sale of tickets would be large. Although practically every person who desired to fish the river should be able to obtain a ticket, I would arm the executive of the association with power to refuse tickets. This power would be seldom if ever exercised; but it would give the association a means of insuring that the privilege of angling would not be abused, and in particular it would enable them to check angling for gain.

The difficulty of course would be to start the system, because until it was actually started the full funds which would ultimately be received would not be forthcoming. It is to be hoped, however, that in each district there would be found persons with sufficient public spirit to guarantee the funds necessary to give the system a start and a fair trial. And it is not to be doubted that the angling community would so appreciate the benefits to be obtained from improved fishing, that when it was made known that the river would be protected, and no one allowed to fish without a ticket, applications for tickets would come in very rapidly.

There is an exception which might be made to the rule that no one should be allowed to fish without purchasing a ticket. In almost every district there are a number of men whose employments tie them up, except on Saturday afternoon and evening. It is then a great boon to them to get a few hours by the river-side, and, as they generally catch very little, they might grudge even the small sum payable for a ticket. Then the schoolboys of the working classes delight in angling on the weekly holiday; and where are they to get a shilling or half-a-crown wherewith to purchase a ticket? So the fishing might be made absolutely free on Saturdays. It is true that the number of anglers on a Saturday afternoon on any South-country stream is enormous. I once heard an old keeper complain that there was "a tyler on ilka stane." But there is safety in numbers. Most of the Saturday fishermen are indifferent anglers; the streams are all disturbed by being whipped every quarter of an hour, and the host of sportsmen return home with light baskets, but happily also with light hearts. To make Saturday an open day would do little harm, and would be popular.

Of course the proprietors would wish to retain right for themselves, and their families, and guests to fish at pleasure, but as a rule it may be expected that the proprietors would subscribe to the association.

I do not submit the above scheme as one which could be universally, or in its details, applied, but as suggesting the general lines upon which an attempt to check the serious falling off in trout-fishing might be made. To do more than make a suggestion is impossible, for the circumstances of each district, it may be of each stream within the district, vary, and every association will have its own particular difficulties to meet. Further, it is admitted that these suggestions apply principally to that numerous class of streams which do not fall within the category of salmon rivers. For salmon rivers are generally under the control of the proprietors or lessees of the fishings, and there is little trout-poaching in them. And trout are not encouraged in salmon rivers, as it is said that they destroy large quantities of salmon spawn. It is, however, chiefly to streams which do not contain salmon, or which do so in small numbers, that the trout angler looks for sport.

It may be said that such a scheme as I have proposed is so complicated that there is no chance of people bestirring themselves sufficiently to carry it out. The answer is that the evil is pressing. Year after year we hear complaints of the way in which rivers are falling off, and unless the angling public do bestir themselves, either the fishing will go on getting worse, or proprietors will shut up their rivers and preserve for their own benefit. It is a pity that either of these two alternatives should come about without an effort to prevent it. A scheme of the nature of that which I have suggested is practicable. Something of the sort has been tried on the Gala with good results. And the upper parts of the Blackadder are now under the control of the Greenlaw Fishing Club, who allow no one to fish without a ticket, for which the small sum of 1s. is charged, to defray the expense of watching on a small scale. This rule has only been a short time in operation, and already a marked improvement has taken place in the fishing. If so large a scheme as I have suggested cannot be adopted, let some smaller scheme be tried. To stop poaching, to enforce a close-time, and to prevent the destruction of small trout, are the great objects to be aimed at, and so long as these objects are attained the precise method of attaining them is of comparatively little importance. But half-measures are proverbially futile, and we know how ineffectual have been the attempts made in several districts to obtain the observation even of a close-time, when there was no machinery to enforce the rule. If rules are to be kept there must be watchers, and I see no other means of raising the money required for that purpose than those which I have suggested.

In many districts there are several angling associations, all connected with the same waters. In such a case preservation would be best carried out by a union of the different associations for that purpose. The associations could at a common general meeting agree upon the rules and regulations to be enforced, and the executive would consist of a council composed of representatives chosen by each association. In some cases, again, the association would only be able to obtain control over a portion of the river, but it is better to have a part of a river under salutary regulations than to have the whole of it poached and harried at pleasure.

If a well-considered scheme for the protection of fishing were established on one or two of the best known rivers, the practice would, without a doubt, become general, and in course of time there might even be established on many rivers, under the auspices of the associations, breeding and rearing ponds, from which the stock of trout might be recruited, and fresh blood introduced.

There has recently been established in Edinburgh a society for the protection of fishing. That society has before it a much wider and more important field of work than that which we have been considering, but we hope and believe that it will do what it can to assist in preserving and restoring the trout-fishing of the southern districts of Scotland. And it can give great assistance. It has members connected with all parts of the country, through whom it can obtain and diffuse information, and bring its influence to bear, especially in the way of persuading riparian proprietors to allow preservation by means of angling associations. And it might in time stand towards the associations throughout the country in the position of the parent or central association, through which the common work would be bound together, and what would otherwise be individual effort on the part of each association would become united effort with the efficiency and force of union.

It will be observed that there is one very important cause of the deterioration of trout-fishing which I have merely mentioned, viz. pollution. The importance of preventing pollution, both from a fisherman's point of view and as a matter of public health, is not to be undervalued. But the consideration of the means by which pollution may be checked does not seem to fall within the scope of this Essay. Angling associations, as such, can do little to prevent pollution. That must in the meantime be principally left to proprietors and public bodies.

As regards the rules under which angling associations of the class with which I have been dealing should be managed, it is obvious that they must consist of two parts,—1st, The rules of the association as an association for the preservation of a particular river, or rivers; and 2d, The rules of competition.

It is of great importance that competitions should be maintained. They attract members to the association, they give an interest in angling, and in the prosperity of angling, which mere love of the sport does not always supply. They encourage skilful and fair fishing, and they bring together, in a friendly way, a number of men who would otherwise have little in common.

For rules of competition I would suggest the following, subject of course to modification to suit different circumstances:—

1. In general, the competitions should be confined to the river, or rivers, with which the association is immediately connected, and over which it exercises control. This would give the members a keener interest in improving the fishing. Further, competitors should not be allowed to fish in waters which are preserved by private proprietors, unless these waters are always open to members of the association.

2. Competitors should fish solely with the rod, and should receive no assistance whatever, with this exception, that each competitor might have an attendant to carry his basket.

3. An hour in the morning should be fixed, before which the competition should not commence. This hour should not be too early, as the older members may be deterred from competing by the fact that without an excessively long day's work they would have no chance, and nothing tends more to invigorate an angling association than large competitions. An hour which would give eight hours' fishing would seem sufficiently early.

4. An hour, and a place, should be fixed at which competitors should lodge their baskets with the office-bearers of the association.

5. It adds to the interest of the competition, and removes any suspicion of favouritism, if it is provided that each basket

shall be accompanied by a sealed envelope, distinguished by a motto, and enclosing the competitor's name.

6. The prize should be awarded to the greatest weight, and not to the greatest number.

7. Every trout measuring less than [the limit fixed in the particular district] in length, and all fish which are not river-trout should be rejected.

8. If in accordance with the rules of the district, fishing with creeper and stone-fly should be prohibited.

9. Any question which may arise in regard to the competition should be decided by the council or office-bearers of the association.

10. Before the prize is awarded, the successful competitor should declare, upon his word of honour, that he has in every respect conformed to the rules of competition.

To frame rules for Angling Associations, apart from the rules of competition, is more difficult, because the circumstances of different districts and different associations vary widely. I shall, however, attempt to sketch the groundwork of a set of rules which I think would be generally applicable:—

1. Provisions should be made for the election of a president of the association. In general, the president should be elected for a term of years, not less than three, and should be eligible for re-election.

2. Provision should be made for the election of a secretary and treasurer, to hold office *ad vitam aut culpam.* In small associations these offices might be combined in the same person.

3. Provision should be made for the election of members of the association, and for the amount of the entry-money and yearly subscription.

4. In each association there should be a council, varying in number with the size of the association, to whom, along with the office-bearers, the management of the association should be intrusted.

5. In event of the association having the control of the streams in the district, the council would be the executive for carrying out the rules and regulations. They would have power to engage and dismiss watchers; to fix the price of angling tickets, and the terms upon which they were to be issued; to refuse a ticket to any person who had abused, or was likely to abuse, the privilege; to take such action as they might think necessary to enforce the rules, and to expend the money raised by the sale of tickets, or by subscriptions, in the manner which seemed to them most advantageous.

6. A close-time should be fixed.

7. A limit in the size of trout which might be taken should be fixed.

8. Angling with creeper and stone-fly might be prohibited.

9. The rules of the district as to tickets, the duties of watchers, and so forth, should be stated in terms distinct, but sufficiently elastic to leave the council free to settle details.

10. The council should be bound, within a certain period prior to the opening of the angling season in each year, to publish by advertisement in one or more local, and one or more metropolitan, newspapers, the details of the rules to be enforced during the season, and, in particular, the price of tickets, the persons from whom they can be obtained, any lures which are prohibited, and the size of trout which may be retained.

11. Provision should be made for an annual general meeting of the association, at which the council should report the proceedings of the year, and the treasurer should submit the accounts.

12. The association should be empowered at the general meeting to make such bye-laws and such alterations upon the rules as should seem best suited to carry out the objects in view, provided that such bye-laws and alterations should have been intimated to the secretary, in writing, a certain time before the general meeting, and should be assented to by at least two-thirds of the members assembled.

13. Provision should be made for auditing the accounts prior to each general meeting.

14. Penalties should be fixed for the breach of any of the rules of the association.

15. It should be provided that the members should support and forward the objects of the association by every means in their power, in testimony of which, and of their consent to the rules, they should, at the time of their admission, be required to sign the same.

In conclusion, a single word about the first two classes of Angling Associations enumerated.

Associations which rent water for the use of members only are generally connected with salmon-fishing. But there is no reason why trout-fishing should not be taken in the same way. Trout-fishing is more reliable than salmon-fishing, which is a great advantage for those who can only spare a few weeks in the year. And there are many places where a stretch of excellent trouting-water could be obtained for a small rent, while the wages of a keeper would not be heavy if divided among the members of even a small association. Such associations are common in England, and it is a wonder that there are not more of them in Scotland, for to the angler who could afford to pay a moderate sum for his sport, it would be a great advantage to have a few miles of water restricted to a limited number of rods. And associations of this sort would not injure the public, because the water of the association would not be nearly so much fished as the public water, and would form a kind of sanctuary, or nursery, by which the whole river would benefit.

Associations for competitions on Lochleven are also to be commended, for, although angling on running water is the higher art, many can enjoy loch-fishing who have neither skill nor strength for river-fishing. The class for whom Lochleven Associations are peculiarly suited are city men, whose days of recreation are limited. A professional man, as he gets up in life, becomes more a creature of routine, and less disposed to make opportunities for a holiday out of holiday-time. And yet, an occasional day in the clear country air, with just enough exercise and excitement to banish for the time the cares of life and the worries of business, is, to such a man, a great tonic, and sends him back to his work with fresh vigour and renewed ability. A day on Lochleven is a model holiday of this sort. The breeze comes from the hills laden with health; the scenery is charming; the exercise may be great or little, as inclination prompts; and when a glorious three-pounder rolls up in the hollow of the wave, what a tingle runs through the nerves, and what satisfaction pervades the whole being, as skill and patience win the day, and the speckled beauty is safely encircled in the landing-net! Truly, angling is the "gentle art." "A tranquilliser of the mind, a cheerer of the spirits, a calmer of unquiet thoughts, a diverter of sadness." It is an art which has been fostered and taught by Angling Associations. Let us hope that by their agency it may also be preserved.

XXIII.

THE BEST MODES OF PRESERVING ICE.

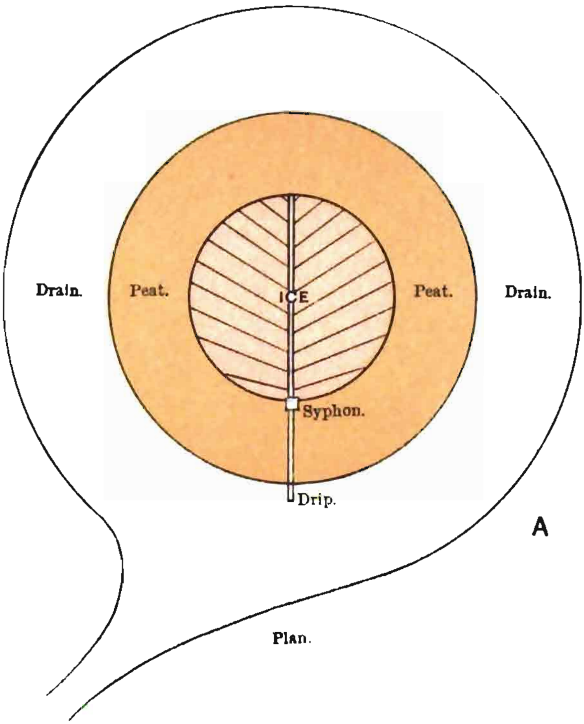
No. I.

By Archibald J. Maclean.

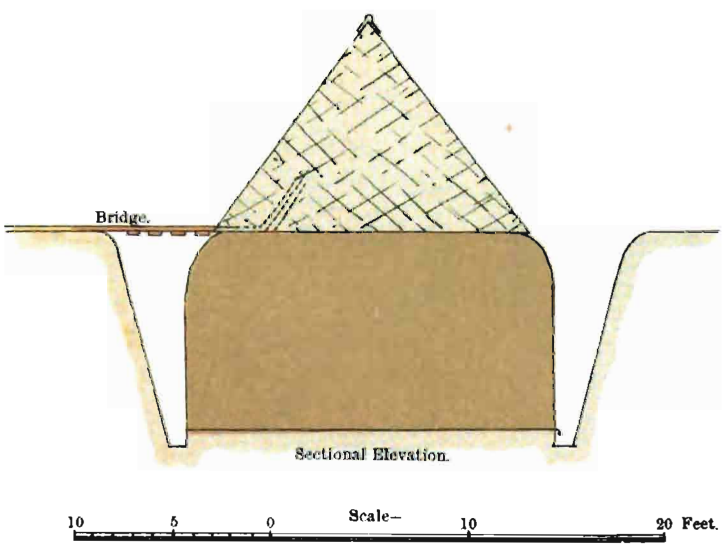
As the result of fourteen years' practical experience as the proprietor and lessee of salmon-fisheries on the west coast of Scotland, and having devoted a considerable time to the careful study of the various modes hitherto generally observed by fishermen and others, not only on the west coast, but in many other parts of Great Britain, for preserving ice, I have found that although sometimes elaborately constructed, at great expense, the houses used for this purpose often prove entire failures. Some simple flaw in the construction renders them practically useless to serve the purpose for which they are intended. As a rule, I have found that about seven-eighths of the ice stored in these houses goes to waste, and, in many cases, it altogether disappears; but, of course, there are exceptions. After several trials of various methods which I thought likely, in some measure at least, to prevent this waste, I discovered that nothing can compare with the kind of ice-house now in use at my fisheries, a sketch of which is shown on the accompanying designs. The total expense of providing one of these peat-houses need not exceed 50s., and the cost of the others will not, under ordinary circumstances, be greater than between £7 and £8—a very small sum when compared with the amount of money expended on the houses generally used for the preservation of ice. The advantages to be gained by adopting my plan will be an incredible saving of time, labour, material, and, consequently, of expense, combined with a comparatively small waste of ice, thus putting within the reach of fishermen and others of limited capital, a cheap and useful means of conveniently storing and preserving any quantity of ice. I will now endeavour to show how this can be done.

In preference to one or more large houses, I make choice of several small ones—each of them capable of holding, say, about twenty tons—because I find that, an ice-house once opened, its contents, exposed to the atmosphere, are more liable to waste than the ice in one which has not been opened. The advantage of adopting the smaller houses will thus at once be seen; the opening of one exposes but a small quantity of ice at a time. Again, these houses can be rapidly filled, and should one, through any cause, fail to serve its purpose, there are others to fall back upon. These remarks, of course, apply to my peat-houses only, which are constructed on the following principle, being the most useful to meet the requirements of my own fisheries, which, previous to the extension of the railway to Oban, were difficult of access to the market. Having selected a peat-moss of the required depth, convenient to a road, and near the margin of a small sheltered lake, I mark out the ground to the dimensions shown on Plan for the interior of the house; the divots removed from the surface are placed in a circle round the edge of this space so as to strengthen and protect it during operations. Six men in a few hours can make the necessary excavations: two are employed clearing out the space required for the storing of the ice; one to cart; one to assist in filling the cart from the *débris*, and two are employed in cutting the drains; a seventh man is simultaneously engaged in preparing the roof. The space intended for the ice being completed, the whole of the men, except the one preparing the roof, join in making the drain. By the time the drain is half finished the supports for the roof are put up. These are made of rough pieces of oak, and rest on barrel staves placed at the required intervals across the top of and at right angles to the wall. The spaces between the couplings are filled up with hazel or oak branches of about 2 inches thick; a layer of divots, heather side inwards, is now put on; over that there is laid a coating of the best and softest moss taken from the drain and tramped into a solid mass all over the roof to a uniform thickness of 15 inches. After this another layer of divots is put on, heather side out, and the whole covered over with straw or heather-thatch to the thickness of 2 inches, and secured with heather-rope or coir in the usual way. The apex is protected from destruction by birds by covering it over with a piece of old tarpaulin to the breadth of 15 inches. The drains are dug one foot below the level of the floor of the house. A hole is cut in the north side of the house to admit of a syphon being placed in it. Small drains, as shown on Plan, are cut, and the syphon—which I have found to answer well in the peat, and which is made of indiarubber tubing one or one and a half inches diameter, and lashed to a bit of iron bent to shape and served over with marlin—is placed. It has a bell-shaped mouth-piece made of wood or metal, with a rose covered over

PEAT ICE-HOUSES.



Plan.

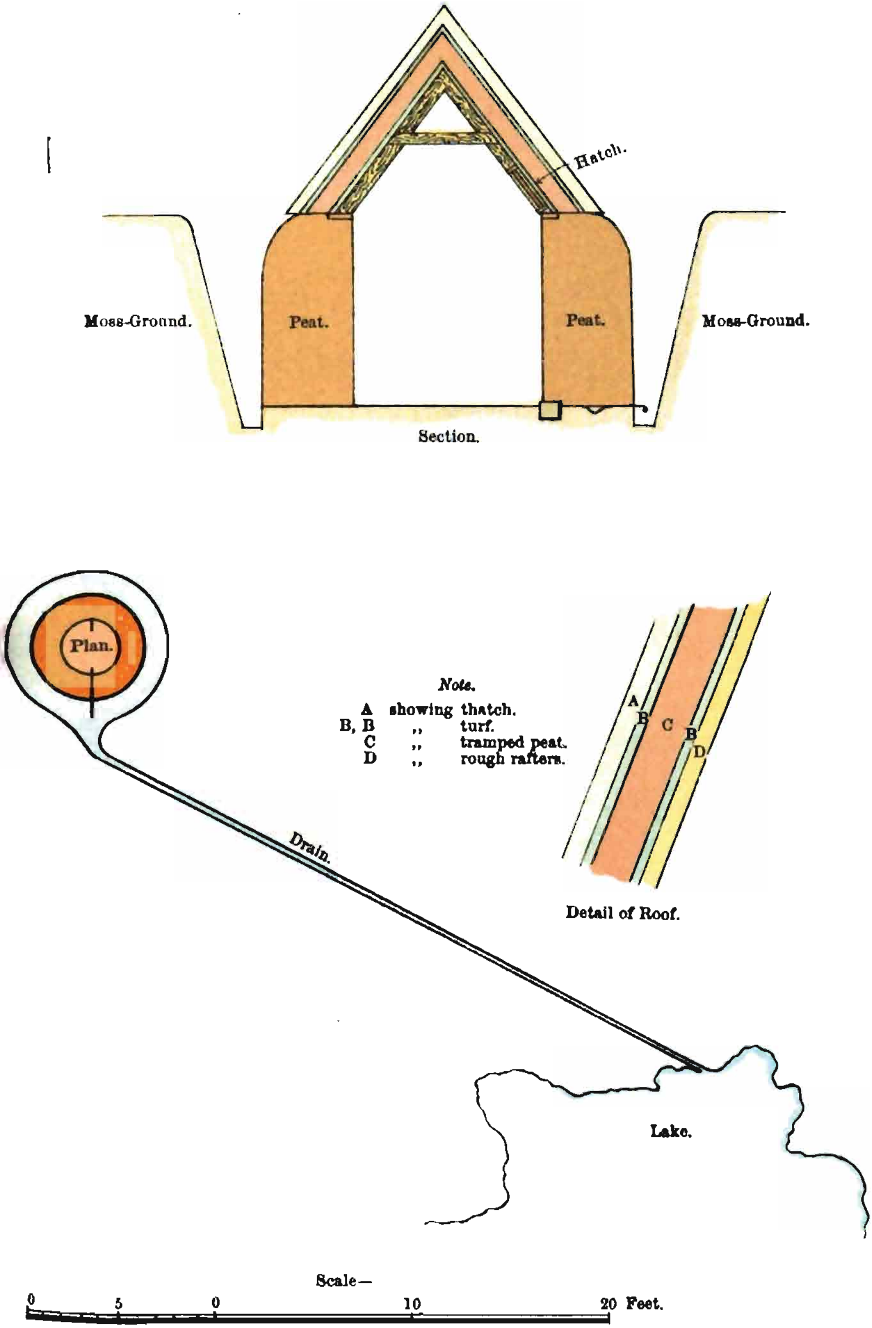


Sectional Elevation.

Scale— 10 5 0 10 20 Feet.

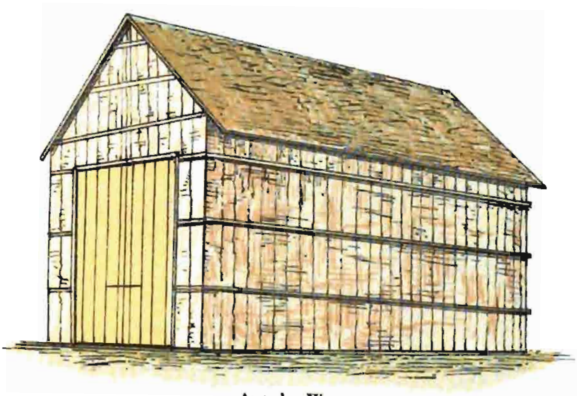
BEST MODES OF PRESERVING ICE PLATE II.

PEAT ICE-HOUSES.



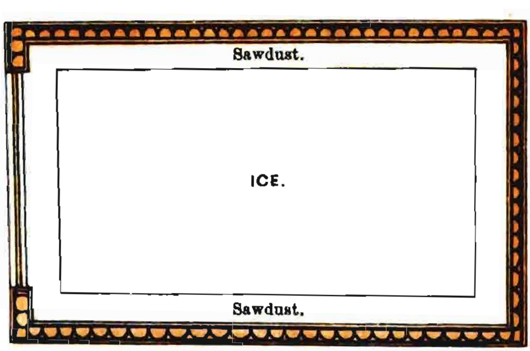
BEST MODES OF PRESERVING ICE PLATE III.

PEAT ICE-HOUSES.



Angular View.

Note.—Roofs of peat and wooden huts thatched with straw or heather in usual way.



B

Plan of Wooden Ice Hut.

Scale—

10 5 0 10 Feet.

T & A Constable, Printers to Her Majesty Edin^r

with a small wooden perforated box to protect it from injury. If, by any chance, I notice that no drainage is coming from the house, or that the water is exhausted by evaporation, I attach a small piece of leather over the nozzle of the syphon which when the wind blows against it acts as a valve. A few branches placed in the bottom will keep the drains clean and the filling of the house may at once be proceeded with. The ice should always be broken up into as small pieces as possible well packed and salted with snow. When the house is filled to about a foot above the level of the walls I pack the remaining space with sawdust.

As there are many places where peat cannot always conveniently be found, I would, as the next best means of preserving ice, recommend it to be stored in a house constructed on the following plan marked B in the accompanying design:—Drive pieces of split larch of the required height into the ground so as to enclose a sufficiently large space, and placed as close to one another as possible, any rough edges being previously cut off. Tie them inside and outside by strong rafters of the same material in a horizontal position—three will suffice in ordinary cases; line the inside of the structure with rough sarking boards, filling up the crevices with sawdust well rammed in courses corresponding to the depth of the sarking boards all along to and underneath the baulks; thatch in the usual way with turf and straw or heather; put a coating of coal tar outside the sides of the house, and give the floor a gradual slope towards the door; cut a drain round the outside to carry away the surface water and any waste that may take place. A space of one foot to be packed with sawdust should be left between the ice and the wall and filled up gradually as the ice is being stored. The space immediately inside the door should be carefully and tightly packed with sawdust: the small door made in the larger one admits of this being easily done.

A house of this kind costs between £7 and £8.

As the object which I have in view is to endeavour to show how sufficiently useful ice-houses can be constructed, at a small expense, so as to put them within the reach of ordinary fishermen, I do not wish to compare their merits or demerits with those of stone houses, made on an elaborate scale. The wealthy alone can afford these. I am quite satisfied that my peat-houses must recommend themselves, and am also convinced that houses similarly constructed will give entire satisfaction to any one who may adopt their use.

XXIV.

THE BEST MODES OF PRESERVING ICE.

No. II.

BY JOHN ROSS, JUNR.

THE old-fashioned plan of storing ice under ground was assuredly a good one, but had the disadvantages of occasionally being impracticable, from the character of the subsoil, and always expensive.

An ice-house, to be thoroughly efficient, need not be underground. The chief requirements of such storage are that it be formed of non-conducting materials, so far as heat is concerned, and so constructed as to give easy access, and drainage without unduly admitting the external air. Added to these, and the better to insure an extended sphere of usefulness, low first cost must be mentioned.

These indispensables to the modern ice-house are happily not far to seek. In wood we have the first requirement admirably met, while its adaptability and cost leave nothing to be desired; and, if care be exercised in the selection of the kind of wood used, and in its subsequent preservation by an occasional coat of paint, it will prove to be by no means the ephemeral material many suppose. The sole remaining difficulty is the design of the structure. So far as surroundings are concerned, a shaded situation is preferable, but not indispensable; and, as for the external elevation, it can be modified to meet the taste and purse of the owner. By adopting any of the many modifications of the circular form, the ventilation is the better assured, while the cost is not in any degree enhanced.

The entire floor, extending at least a foot beyond the exterior of the walls, should be of thoroughly laid concrete, not less than a foot above the surrounding level, attention being given to have foothold for the wall-posts and slope from the centre for drainage. By this form of floor we guard against excessive terrestrial radiation and vermin.

The walls can be raised with any required number of angles, and the structure may range from a pentagon upwards. They must be double, with an interspace of 18 inches at least, and of sound pitch pine,—the interspace to be filled with the most efficient and cheapest non-conductor we have, viz., sawdust. Two doors are needful, one in each wall, and they must fit pretty tightly. The roof must be lined internally on the couples, and the interspace filled with sawdust as before. Felt is preferable as a roof covering, and the apex of the roof must be of the "Lutther" class of ventilator. The whole exterior to have three coats of best silicon white paint. For drainage, surface gutters in the concrete, radiating from the centre, and having trapped termini debouching at the underside of the concrete.

The house finished, it has to be filled. This is best done by pounding down the ice, from whatever source derived, and packing it closely in, and ramming it well together as it accumulates.

To use ice economically is at all times a desideratum, but so long as the stores secured in the country are meagre, economy in its use is imperative on all. For economical purposes in general the modified "Tube Cold Chamber" answers all requirements best. Externally of wood, with a double wall, and door in the front side, it stands for ordinary family use about four feet high on corner supports 9 inches high. The wall interspace is filled with sawdust, and internally it is fitted around the walls, and raised roof, with U-shaped tin tubes of 1½ inches internal diameter, placed about 5 inches apart, and extending down each wall and across the floor. Each has a small tap at the lowest point and communicating directly with the outside for drainage. They are filled with pounded ice, and simply corked at the mouths, which project through the tops for convenience.

The bottom of the chamber is fitted with bottle-bins for wine, and the remaining space shelved throughout. The shelves extend to and touch the tubes, but no further, thus affording sufficient intercommunication for the equalisation of the temperature. Ventilation is provided by air-ducts secured with wire-gauze at the bottom and extreme top of the cover. The upper ventilator can be protected by lapped cover raised 1 inch from the top.

This refrigerator also forms an extremely effective ice-bin for family storage of small quantities of ice. The tubes are of course not then required, and it is better to line the bin throughout its interior with best galvanised iron, and having trapped drainage in the bottom.

The cost of the ice-house, as described, for a hotel or large establishment, would not exceed £30. For smaller families, from half that sum. The refrigerator, on a scale suited to the first-mentioned classes, would cost from £5; smaller sizes, from £2, 10s. The bins for temporary storage from 10s. upwards.

XXV.

SEINE-TRAWLING AND BEAM-TRAWLING IN ESTUARIES AND SEA-LOCHS IN SCOTLAND;

THEIR ADVANTAGES AND DISADVANTAGES.

BY J. C. WILCOCKS.

IN his work on *Deep-Sea Fishing and Fishing-Boats*,[1] Mr. Holdsworth, secretary to the Sea Fisheries Commission, whose report was presented in 1866, states that Campbeltown, the Kyles of Bute, and Lochfyne, were for some years the seat of an active struggle between two sets of fishermen, both engaged in catching herrings, but by different methods.

The disputes between the long-line men and the trawlers at Sunderland, and also at Galway in Ireland, were of a similar nature. In 1863 a Government inquiry was held on the subject, and the result was that trawling was not considered detrimental to the fisheries, the damage of a few hooks lost being unavoidable.

The ordinary method of drifting for herrings has been practised in the waters of the west of Scotland from time immemorial; herrings used to be taken by no other method. But about the year 1838, Mr. Holdsworth states, an innovation was made by the introduction of the seine or circle net, known as the trawl, or "herring trawl." It is the same kind of net known as the seine, sean, or segne, draught or sweep net, and is the most ancient form of fishing-net known. It was used by both the Greeks and Romans, and very possibly long anterior to them. The very name is not very much altered from its Greek appellation, σαγήνη; which became in the Latin, *sagena*; in the Saxon, *segne*; and in the French and the language of South England, *seine*. The word is still pronounced according to the Saxon way of spelling in Devonshire, and in some parts of Cornwall; and in both counties these nets are much used, herrings being not unfrequently caught by them in Devon. And in Cornwall the chief part of the export pilchards to Italy was formerly taken by this net. A seine of moderate size is always supplied to Her Majesty's vessels on a foreign station, as the crew receive so much benefit from a supply of fresh fish.

[1] London: Stanford, Charing Cross. 1874. Page 321.

Seines are made of all dimensions, according to the purpose for which, or the depth of water in which, they are intended to be used. This net is used near the shore, in moderate depths of water and easy tides, and where the enclosed pip can be hauled on to the beach, or be "tucked"—the term used when a seine is hauled up into a boat—which is often done with large seines, when there is no beach, or the shore is too rocky for landing the net. Very heavy takes of herrings, pilchards, and mackerel, besides any other fish which may happen to be in the way, are made by the seine; and, on one occasion, the writer of this Essay witnessed the capture of a small pike-headed whale, 21 feet long, in a mackerel seine on the South Devon coast.

The difference between the two methods of fishing is very great. Drift-nets are shot out in as straight a line as possible, and are suspended in the water by buoys and casks, the boat hanging on to the line of nets, and drifting with wind or tide, whence the term "Drift Nets." There is also this marked distinction between the two kinds of nets, that whilst the drift-nets can be used at any distance from the shore, and in any depth of water more than the nets themselves, the seine, or seine-trawl as we have agreed to call it, can only be used in moderate depths and easy tides, and is most effective when rather deeper than the water where it is used. True, it is sometimes hauled in deeper water than its own depth, but chiefly for ground fish, and the net is then termed a "ground seine." When this is done, numbers of round or floating fish, which swim at various depths, as is to be expected, escape over the sunken cork line.

As the drift-net fishermen have thus so many more opportunities of using their nets, and a field of work of almost unlimited extent, they have as a rule much more opportunity of catching fish than the men who use the seine-trawl. But, at certain times, or rather, times uncertain, opportunities do occur when very heavy hauls of fish are made, and many boat-loads are captured in an hour or two by seine-trawling, but these heavy catches occur only occasionally. Such heavy catches of fish as have been sometimes taken by a different kind of net from that commonly in use, could not be made without giving rise to complaints from those who only used the old style of drift-net. Accordingly the drift netters accused the seine-trawlers of catching fish of all sizes, both those too small to be stopped by the drift-nets, and those too large to be meshed in them, which they termed the "mother fish;" of making such large enclosures of fish that only a portion could be saved; of breaking up the shoals and frightening them away; of intercepting the fish at the entrance of Lochfyne, and preventing their passage up the loch; and of damaging the drift-nets, if they came in their way, and lowering the price of herrings. Some of the curers asserted that herrings caught in the seine-trawl were not fit to cure, because they did not bleed at the gills like those caught in drift-nets; and that, owing to the large catches made by the seine-trawl, prices varied so much from day to day, that intending buyers did not know when to purchase, and when not to purchase.

In consequence of these complaints, the Acts 14 and 15 Vict. c. 26, were passed in 1851, to put an end to seine-trawling for herrings in Scotland. This Act not proving effective, other Acts, 23 and 24 Vict. c. 92, 1860 and in 1861, 24 and 25 Vict. c. 72, were passed, and seine-trawling for herrings was entirely put down. But a large number of fishermen and the public, believing that the prohibition was injurious to both the fishermen and the public generally, exerted themselves, so that in 1862 a Royal Commission was appointed to investigate the subject; and also in September 1864, the question was again gone into by two of the members of the General Sea Fisheries Commission, the third Commissioner being purposely absent from the inquiry, as he had acted on the previous inquiry.

The conclusions arrived at by both Commissions were that the fishing in Lochfyne had suffered no diminution by the seine-trawling; on the contrary, that the fishing had been steadily progressive, when periods of comparison were made sufficiently long to correct annual fluctuations which are always considerable in this as in all other herring fisheries. They say: "The selected years of bad fishing, brought as proofs that trawling was destroying the fishery, have, when examined, no application to the question, as an equal number of years of quite as bad fishing are found in every decennial period before the system of seine-trawling had been discovered. Seine-trawling for herrings has been an important means of cheapening fish to the consumer, by the large and sudden takes, and has thrown into the market an abundant supply of wholesome fresh fish, at prices which enable the poor to enjoy them without having to come into competition with the curer. It is this circumstance, which, in our opinion, has produced the demand for repressive legislation, for the gains of the drift-net fisherman are much affected by the sudden and great captures of the seine-trawler, who, working with less capital and with a more productive kind of labour, is able to undersell the drift-net fishermen, and to derange the market for the curers." [1]

[1] See also, as regards seine-trawling, the Report of 1878 by Messrs. Buckland, Walpole, and Young, on the Herring Fisheries of Scotland, pp. 30-33.

It happened that in 1860, the last year of seine-trawling before its entire suppression, the fishing in Lochfyne was the largest ever known. In 1861 it fell off, but in 1862 it was again very large, and that was followed by fluctuations as before, although the drift-net men had the whole fishery to themselves. In the meantime the recommendations of the two Commissions were embodied in an Act 30 and 31 Vict. c. 52,—passed in 1867, by which any legal mesh was permitted, without reference to the kind of net; and by the Sea Fisheries Act, 1868, the last restriction as to mesh was removed.

As Mr. Holdsworth observes, however, it is quite impossible to make people contented by Act of Parliament, and strong feelings against the seine-trawl continued in many quarters, and were much increased by the unusual scarcity of fish in Lochfyne during the season of 1873.

On their part the seine-trawlers allege that the scarcity is owing to the great increase of the length, depth, and number of nets in use in Lochfyne, by the drifters, which bar the passage. But it must be remembered that Lochfyne is of immense depth; and, with water of from 30 to 70 fathoms, it seems impossible that the passage of the fish can be prevented except to those that are actually taken.

The places where the seine-trawl can be profitably worked are few as compared with the area of the loch open to the use of drift-nets; and even at the other point, the most contracted part of the loch, where there is shoal water suitable for working seine-trawls, there is a depth of 29 fathoms between the two shores. If the space were covered with seine-trawls, the depth below them would be at least 20 fathoms; so that it does not seem possible that the passage of the herrings into the upper loch could be prevented.

The two kinds of nets, both drift and seines, or seine-trawls, are often owned or worked by the same men for herrings on the south coast of Devon, and they do not interfere with each other's fishing or chances. In fact they use either one or the other kind of net as may seem advisable.

In Cornwall, in the pilchard fishery, the drift-nets are restricted by law from coming in the way of seines, not the seines from coming in the way of the drift-nets; and the Acts of Parliament, 31 and 32 Vict. cap. 45, sect. 68, have been passed to protect the seines from the interference of other methods of fishing.

On the coast of Cornwall, it is enacted, except so much of the north coast as lies east of Trevose Head, no person between the 25th of July and the 25th of November in any year—" (*a.*) shall, from sunrise to sunset, within the distance of two miles from the coast, measured from low-water mark (whether in bays or not), use a drift-net or trawl-net; or (*b.*) shall within half a mile of any sea-boat stationed for seine-fishing, anchor any sea-fishing or other boat (not being a boat engaged in seine-fishing), or lay, set, or use any net, boulter, or implement of sea-fishing (except for the purpose of seine-fishing);

"Any person who acts in contravention of this section shall be liable on summary conviction to a penalty not exceeding £20."

From the very heavy takes of pilchards sometimes made with the seines, and the importance to the neighbourhood particularly of St. Ives, where particular positions are made use of, this enactment has given general satisfaction, as it has been found to work well.

As it appears from the above inquiries that a good supply of herrings has often been obtained in Lochfyne and elsewhere by seine-trawling, which has been the means of cheapening the fish to the public; and as it also appears that none of the charges alleged against the seine-trawling have been proved, the writer cannot hesitate in recommending that full liberty be given to the seine-trawling. As regards the mesh, however, he is of opinion that a certain mesh should be by law established, so that immature fish may not be taken. The causes of abundance or scarcity of the herrings the writer believes to be quite beyond the power of human conjecture to define, the capricious movements of the herring having been always known to be one of its most marked characteristics.

Beam-Trawling.[1]

We will now consider the subject of trawling, or beam-trawling as we have agreed to designate it, to distinguish it from seining or seine-trawling. It is somewhat difficult to understand how the term "herring-trawling" originated in Scotland, in connection with the use of the seine; the two nets, the seine and the trawl, being so very different from each other both in their size, form, materials, and manner of using. But, as this has unfortunately become the appellation of the seine or circle net in Scotland, and has misled so many writers on the subject, notably that great writer on ichthyology, Mr. Jonathan Couch,[2] F.L.S. of Polperro in Cornwall, it was necessary to find some distinctive appellation, and the term "seine-trawl," proposed by Mr. Holdsworth, is now accepted. As regards the misapprehension by Mr. Couch, after noticing the

[1] See also, as regards beam-trawling, the Report of 1878 by Messrs. Buckland, Walpole, and Young, on the Herring Fisheries of Scotland, pp. 28-30.

[2] Author of *A History of the Fishes of the British Islands*. 4 vols. London: George Bell and Sons. 1861-1865.

methods of capture, by the drift-net, of herrings, and also by the seine of some kind, he goes on to say, "We believe also that not long since ingenuity has contrived to render the trawl effective in the fishery for herrings, by using it somewhat on the principle of a moving stow-net. The gaping and enormous bag is sunk to the proper depth by a rope, and in this condition is carried along among the hosts of fish by the moving vessel." It is perhaps scarcely necessary to say, that a trawl is never known to be put to this use, and that Mr. Couch evolved the above idea from an erroneous conception of the term "herring-trawling." The stow-net is somewhat like a beam-trawl, but it is used in a tideway from a vessel at anchor, as described and illustrated in Mr. Holdsworth's book, *Deep-Sea Fishing and Fishing-Boats*, page 161, and is exclusively used for the capture of sprats, and the grounds are at the Thames mouth, near Southampton, and Lynn and Boston Deeps.

It may be as well to give a description of the beam-trawl, as far as possible, in a condensed form. It is a large bag-net dragged along the bottom of the sea by a boat or vessel, where the ground is free from rocks; and it captures a great variety of the best quality of fish found in our seas, namely, turbot, soles, plaice, brill, dories, red mullet, skate, hake, cod, dabs, etc., whiting, haddock, and not a few large oysters, crabs, scallops, queens closely allied thereto,—in fact nothing comes amiss to it. The small end of the net is termed the *cod*, and has a draw-string through the lower meshes, by which the "cod" is carefully closed before the net is shot or thrown overboard. The lower edge of the trawl is bordered by a stout rope named the ground-rope, so called because it works on the ground; and the upper edge of the mouth of the trawl is bordered by a small rope, which is secured to the beam, which spreads the mouth of the trawl open.

The beam is raised above the ground on the heads or irons, which approach the letter D in shape, and are each provided with a socket to receive the ends of the beam. These sockets are in some districts placed on the top, and in others inside the irons, which are not identical in form everywhere, although the same in principle and working. The lower after-corners of the irons are turned into eyes, and in some of the larger irons or heads, as at Brixham in Devon, a piece of iron is specially welded on to form the ear. The ends of the ground-rope are passed through these ears, and secured round the irons above the sole, or that part which runs on the ground.

The sides of the trawl are called the wings, and inverted bags called pockets are here formed, by sewing the back and belly of the net together about a third in breadth, at their mouths, which point downwards. This arrangement is to outwit the soles, which frequently turn round and attempt to swim out of the trawl, but are caught in these pockets, each of which forms really a *cul de sac*.

The beams are sometimes of beech, or elm or ash or oak; but beech is the best wood for the purpose, because it is so porous, drinking up the water like a sponge, and thus becoming very heavy, which enables it to keep the ground.

Whatever be the wood of which the beam is made, it is customary to place it under water before using, and spare trawl beams are constantly kept, where they are covered by the water for several hours daily. Oak in particular becomes so light if not used for some time, that trawl-beams have been known to float both trawl and irons on attempting to use them. The writer was once a witness to this ludicrous occurrence, and, no weights being at hand, the trawling had to be given up for the day. Two swivels are fixed, one to each iron, to which the spans are connected, and these to the towing-warp. The larger trawl-beams require two pieces of timber, and some are between forty and fifty feet in length. The smaller beams for boats can be made in one piece, and run from twelve to four or five and twenty feet long. The length of beams for vessels depends on the distance of the second shroud of the main reefing from the taffrail or extreme of the stem, as the beam is brought generally to the port side on the level of the rail or edge of the bulwarks, and the iron at the fore end dropped in-board between these two shrouds, whilst the after-iron is brought just clear of the taffrail, and the beam secured by a stopper of strong rope, or, in large vessels, by the dandy bridle, hove taut by the dandy wink. In regard to boats there is really no rule as to the length of the beam, for many boats have them longer than themselves, and they will be found to vary much at different ports.

The form of the mouth of the trawl at the ground-rope is that of a semicircle pointing backwards; and as the net is straight along the beam, it is many feet in advance of the ground-rope. The back of the net is over the fish before being disturbed by the ground-rope; consequently they cannot escape by darting upwards, and the rush of water into the trawl is so strong, when it is towed with any speed, that the fish have not much chance of escaping sideways when routed out of the bottom by the ground-rope.

The trawl is probably the most effective engine for the capture of sea-fish ever invented, and its birthplace is somewhat difficult to trace. It is conjectured that it originated from towing a small sieve, or bag-net, by two boats or vessels, one on each side; and trawls are still thus worked on the coast of

Spain, and in China and Japan. The hammer—or pole trawl —is in advance of this, which Mr. Holdsworth states still to be in use on the coast of Ireland. Only one vessel is required to work it, and the mouth of the net is kept open by ropes leading from wings of netting on both sides, to poles projecting on each side of the vessel. The hammers, one in front of each of the wings, serve to keep the ends of the ground-rope at the bottom, the wings and mouth of the net are corked along their upper margin or back-rope, and leaded on the lower edge or ground-rope. When used, it is towed by a rope or warp from each wing leading on board through a block at the end of a pole, 25 or 30 feet long, on each side of the boat. It is considered by Mr. Holdsworth to be a clumsy, old-fashioned contrivance, only calculated for smooth-water fishing along shore.

As regards trawling with the beam-trawl in the estuaries and sea-lochs in Scotland, with proper restrictions, no doubt it is of considerable advantage in procuring a supply of fish which would not else be obtained, as in the partial shelter afforded in these localities, boats can work and men can earn their living, at times when they could not venture into the open sea. But some restriction, the writer is of opinion, should be put on beam-trawling in very shallow water, for every one who is at all acquainted with the subject is aware that these shallows are frequented by large numbers of small turbot, soles, brill, dabs, plaice, flounders, and codlings, from the size of a shilling upwards, and as these contribute, without doubt, to the stocking of the neighbouring open waters very materially, they should not be allowed to be destroyed. The writer therefore recommends that the trawlers should be restricted to waters beyond a certain depth. For instance, trawling might be prohibited in any ground with less than two fathoms at low-water, or such other limit of depth as might be determined on, to give the young fish a fair chance of their lives.

We should sometimes be met with a difficulty in respect of the shrimp-trawlers, in which case, if it seemed to interfere with their work, a portion of ground might be selected and remain untrawled over as a nursery for the younger fish. It is a very difficult matter often to legislate for the sea-fisheries, and the utmost caution is necessary, lest by so doing we inflict a serious injury on the class we wish to aid. This has been seen particularly in Scotland, where a close-time for herrings, —resulting in extreme privation to numbers of fishermen—was established by an Act, 23 and 24 Vict. cap. 92, for the west coast of Scotland, by which herring-fishing was entirely prohibited from January 1st to May 31st, on any part of the coast between Ardnamurchan Point and the Mull of Galloway on the south, and from January 1st to May 20th, between Ardnamurchan and Cape Wrath in the extreme north. Not a herring was allowed to be taken during the close season for the purpose of sale, or to be used as bait, or to keep the fishermen from starvation. It was professed that the early fishing broke up the shoals before they entered the march, and therefore diminished the supply in June and July; and it was said that many of the fish caught between January and May were unwholesome and unfit for food.

An inquiry showed clearly that these allegations could not be proved. But a fearful mischief had been done, and, after a short experience, it was found impossible to enforce a law which brought misery and starvation to a coast population, many of whom could barely obtain a livelihood before the restriction was laid on. In 1864 the question of close-time came before the Royal Commission of inquiry into the condition of the Sea-Fisheries generally, and such overwhelming evidence of the evils of the close-time was brought before the Commissioners, that, in anticipation of their complete Report, they did not hesitate to bring the subject before the Government, with the view to some relief being given before the question could be finally disposed of. Instructions were given not to enforce the law, and in the following session of Parliament a Bill was passed by which close-time was entirely abolished north of Ardnamurchan Point. This included all the Inner and Outer Hebrides, where the restriction had been so severely felt. South of that part of the coast, close-time was continued as before, with the exception of January, which became free to the fishermen. By subsequent legislation (the Sea Fisheries Act, 1868) this close-time has been abolished beyond the three-mile limit, so that at the present time herring-fishing is entirely free everywhere round the British Islands, except within the three miles of that part of the coast of Scotland between Ardnamurchan Point and the Mull of Galloway. Such local restrictions, however, cannot be justified by anything that is known of the habits of the herring, for the cause of the annual fluctuation in the apparent numbers of these fish has yet to be discovered.

The hardship of the former close-time was felt in various ways by the west-coast fishermen. It was established for a time of year when food of any kind was often difficult to procure in some of the islands; and besides the direct advantage the fishermen were in the way of obtaining by catching herrings for the use of themselves and families, the fish, when in the worst condition for the table, and, according to the Glasgow curers, quite unfit for food, were in the best order for the purpose of bait for cod and ling. They are known to be one of the most attractive baits which can be offered to those fish. So that the restriction not only prevented the people from catching herrings for food, but materially interfered with their catching anything else. Whilst this law was in operation, the east-coast fishermen were free to fish as they pleased, and it was only on the west coast there was any close-time; and hence arose a feeling of being unjustly dealt with, which, even among the orderly and peace-loving inhabitants of the Hebrides, was one of the last things it was desirable to encourage. With a few exceptions, however, the people patiently submitted, and bore their privations as they best could. In course of time their condition became known, and the distress of the Skye fishermen in particular was brought into prominent notice by Mr. P. Fraser, the resident Sheriff of the island, whose impartial testimony to the evil working of the Act contributed largely to the relief which we may hope has now been permanently given.

I am indebted to Mr. Holdsworth's volume for this account of the evils of badly advised close-time, and it plainly shows that mistaken legislation on the sea-fisheries is productive of the most serious evils, and may bring about more mischief than that which it seeks to remedy. The greatest care possible ought to be taken before recommending any measure to become law, especially one of such a sweeping kind as prohibits the capture not only of fish to be used as food, but also of fish of incalculable value for the baiting of lines for the capture of other fish.

XXVI.

THE HISTORY AND STATISTICS OF THE PILCHARD FISHERY IN ENGLAND.

By J. C. Wilcocks.

The pilchard in England chiefly abounds along the coasts of Cornwall and Devon; and it is only in these two counties that any regular pilchard fishery is carried on. This fish, however, is not confined to the coasts of Cornwall and Devon, for it wanders up Channel long distances, and is caught in Southampton water, where the writer has met with it; and it is also found in the North Sea, for Mr. Couch, of Polperro, in Cornwall, mentions that Dale, who wrote a history of Harwich, states their occasional capture on the coast of Essex, and Dr. Parnell [1] states that it has been caught in the Forth and elsewhere on the coasts of Scotland, under the name of Garvie herring. It is very numerous along the south and south-west coasts of Ireland, amongst the Channel Islands, and along the neighbouring coasts of France—in the two latter localities under the name of Sardine. In Brittany and Normandy the pilchard is cured when of small size in oil, and when packed in pewter boxes, is known as the sardine of commerce.

In the harbour of St. Peter's Port, in Guernsey, the writer once assisted in taking between one and two thousand sardines in a meshing net shot for sand-smelts, and, size apart, there seemed to be no difference between them and ordinary pilchards.

From this fact, the writer has no doubt that the sardine of commerce and the pilchard are one and the same fish, the sardine being the pilchard at an earlier stage. A very excellent account of the sardine fishery was given some years since in *The Field* [2] newpaper by the late Mr. James Lowe (the Chronicler), who visited Concameau, in Brittany, and wrote some illustrated articles on this fishery.

[1] *History of Fishes of the River District of the Firth of Forth.* 8vo. By Richard Parnell, M.D., Edinburgh. 1839.

[2] Mr. Lowe's articles were published in 1864, commencing in *The Field* of January 2, and ending on May 14 of that year. Altogether there were about a dozen articles; those on catching and curing sardines appeared on January 30 and February 6, and an illustration of a fleet of sardine boats appeared on January 9.

The fishery for pilchards in West Devon and Cornwall was formerly little followed except during the latter half of the year; but for some years past much more attention has been given to the demand for pilchards, in many parts of England, at long distances from the places of their capture. Formerly they were little known or inquired for out of Cornwall, and had never been much liked beyond the borders of that county, not being in great request to the east of the Start Point; but through the aid of railways they have become known in the Midland counties and in Wales, and, consequently, are now taken away by train to long distances, where such a fish used never to be heard of. The trade in salted pilchards to the Italian ports is of very old date. It still continues, and will probably always do so, salted pilchards being much in request in all the Roman Catholic countries of the Continent.

In consequence of the inland demand for pilchards in England, the fishery is now carried on in every month of the year, and it is very rare that for more than a week pilchards are not seen in Plymouth market. Boats go after them almost continually off the coast of Cornwall, sending up their captures to Plymouth for sale, whence they are transmitted by rail to Exeter, Taunton, Bristol, Bath, Gloucester, Birmingham, etc., and thence distributed through the various neighbourhoods.

The great fishery for pilchards, however, is from July to December, and especially at the latter half of the year, because they are then in the condition in which they will cure or "save"[1] best—that is, when they are fat, with undeveloped roes.

As to when and where the spawning of the pilchard takes place, Mr. Couch, in his work, *A History of the Fishes of the British Islands*, says: "In April and May they are habitually ready to shed their spawn, which they now do at a further distance from the land, and over deeper water than is the case at the warmer season of autumn, when again, early or later, they perform the same function, although we do not feel assured that they are the same fishes which thus perform the duty of procreation on both occasions. I have reason to suppose that the spawn is shed at the surface, and mingled with it a large quantity of tenacious mucus, in which it is kept floating while it is obtaining the vivifying influence of the light and warmth of the sun, by the influence of which the development is considerably hastened, as we know to be the case with many other kinds of fish. My notes on the subject

[1] The term "save" is used in West Devon and Cornwall for the preservation of any food by the aid of salt, and is not confined to the salting of pilchards. The term "cured" is also used in the same sense, and applied to the state of sails, nets, and lines when tanned with catechu, oak-bark, or saturated with fish-oil and ochre for the sake of preservation.

are, that presently after spawning, a sheet of jelly, enclosing myriads of enlarging grains of spawn, has been seen to extend several miles in length, and a mile or more in breadth, over the surface of the sea, and which has been of the thickness of brown paper, and so tough as not to be readily torn in pieces. In about a couple of days this connecting mucus became decomposed, and the ova then sank to the bottom of the vessel in which they had been placed; but being thus removed from their natural situation, they did not pass through a further process of development."

On some parts of the Cornish coast the pilchards, Mr. Couch says, are ready to spawn in October, and that the process then takes place near the land. Mr. Holdsworth[1] found, from inquiries amongst the fishermen, that this October spawning was not very general, and occurred mostly among fish at the east part of the coast. There is thus, he thinks, distinct evidence of more than one spawning season, as in the case of the herring; but there is nothing to show that any special locality is preferred by the pilchards for depositing their spawn.

Mr. Couch also says: "There seems to be no reason to doubt that these fishes require two, and probably three, years to enable them to attain their full growth, and the occasional preponderance of numbers of the young above the old, will tend to explain some unusual circumstances which at times have occurred, to the great disappointment of the fishermen, and which otherwise appear unaccountable. Thus the fish which may be caught at one time will be of such diversity of size as to imply a great difference of age in the individuals; but for several years in the early part of the present century the larger portion of the schools (shoals) consisted of fish of such diminutive size as to be able to pass through the small meshes of the seines, which, therefore, were eminently unsuccessful."

There are occasions when the sardine-sized pilchards visit the coast. It was on such an occasion that the writer, as previously mentioned, met with them in Guernsey, when he assisted in the capture of part of a shoal in the harbour of St. Peter's Port, in a net set for sand-smelts.

In Brittany sets of nets of different size of mesh are used according to the progress of the season, and consequent size of the fish, the fact being thus clearly recognised that the sardine is a fish taken when on its way to maturity; and this might be adduced as another point to prove, if it were necessary, that sardines are no other fish than young pilchards.

As to the food of the pilchard, Mr. Couch observes that

[1] *Deep-Sea Fishing and Fishing-Boats*, p. 132. London: Stanford, Charing Cross. 1874.

some uncertainty exists concerning this part of the subject. In the condition of the pilchard a great difference exists at different times, and this we naturally attribute to abundance or deficiency of food. In the former part of the year they are so deficient in oily matter that they will not cure well; but later on they are believed to feed on the seeds or early growth of sea vegetables, in supposed search of which they have been seen searching the bottom in a small depth of water. On examination of the stomach, it is not usual to find anything besides a pulpy mass of what may be vegetable substance; but animal forms have also been discovered, and on one occasion, in the middle of summer, when multitudes were caught in drift-nets, as they were seen actively engaged in some pursuit close to the surface, an examination laid open the existence of vast numbers of a shrimp-like creature, on which they had been feeding to repletion. On another occasion the stomachs of several were found to contain examples of the small fish called the mackerel midge; and instances, Mr. Couch states, have occurred in which a pilchard has taken a baited hook.

In the Channel Islands the writer has met with fishermen who have taken pilchards occasionally with the hook, when sailing for mackerel near Guernsey, with the lask, float, or tail of the mackerel for bait. In common with other fish, pilchards no doubt devour the roe of any fish they can meet with; and in Brittany the roe of cod is much used in the sardine fishery, immense quantities of this roe being imported from Norway for the purpose. The fishermen shoot their nets out in a straight line, and mixing the roe with sand, scatter the mixture on one side of the net, and the sardines, being on the other, rush to devour this mixture, and are caught by the head in the meshes.

The coasts of Cornwall and Devon frequented by the pilchard consist of three districts. One eastward of the Lizard, extending along the coasts of Cornwall into Devon, beyond Plymouth into Bigbury Bay, near the Bolt Tail, thence into Start Bay, near Dartmouth. Beyond this the pilchard was formerly little attended to, and therefore Mr. Couch does not mention it; but of late years the pilchard fishery has extended itself eastward through Torbay, past Teignmouth to Dawlish, whence, although the fish are not locally in much demand, they are often caught in large quantities and sent down by train to Cornwall, to be salted for exportation during the autumn.

The second district is from the Lizard Point to the Land's End; and the third on the north coast of Cornwall, extending past St. Ives to Padstow and Newquay. But St. Ives is the headquarters of the fishery on the north side of Cornwall.

There are two methods of taking pilchards, and both, probably, are of great antiquity, and it would be quite impossible to fix any date when the pilchard fishery first commenced.

Mr. Couch states that the pilchard was admitted into heraldry at a time when coats of arms were of great importance; but finds no mention of it in public documents before the age of Queen Elizabeth, when we find that the drying of pilchards was among the monopolies granted by authority to some courtiers, the clamour against which so moved public indignation as to cause their surrender. It would seem that they must formerly have been smoked, as pilchards were sent to Spain under the name of *fumados*, and the name still survives, corrupted into "Fair Maids," by which appellation pilchards, salted and barrelled for exportation to Italy, are known at the present time.

From the age of Elizabeth the fishery had been found of sufficient importance to become the subject of particular laws, special enactments of which show that the methods of conducting it varied somewhat in detail from those practised at present, as well as the manner of preparing the fish for exportation.

There are two methods of taking pilchards, namely, with the seine and with the drift-net; and no two nets are more different from each other, for the seine can only be used with advantage on or near the shore, where it encircles the fish (from which name in Scotland it is known as a circle-net), and is generally as deep as the water where it is used, whereas the drift-nets can be used in any depth of water and at any distance from the shore, being shot out in a straight line, and hanging in the water like a curtain. Through the night the fish swim against the nets, and get hung up by the gills in the meshes, which are made of the required size to receive them.

The seine, or sean, is not peculiar to the capture of pilchards, but is made of various sizes, lengths, and depths, according to the locality where it is used, and the fish intended to be caught, whether salmon, mackerel, pilchards, garfish or long-noses, smelts, atherine, mullet, flat-fish, herrings, sprats, etc. At Teignmouth and Torbay, and Dawlish, the large seine used to take mackerel, pilchards, and herrings is termed a long hauling seine, as it is hauled considerable distances before the fish are taken up, the boats being anchored, and the nets warped towards them. The anchors are raised when the ends of the arms of the net have nearly reached the boats, and then, having been carried more inshore, the nets are again warped along, and at length hauled from one boat, when the net naturally closes, and the fish are bagged and hauled alongside.

Such large quantities of pilchards are often taken in the Cornish seines, that several days often elapse before they can be emptied. They are, therefore, kept moored by several large grapnel anchors, locally termed greeps, so that the seine forms a huge enclosure. The cork line being spread out by the grapnels, forms a ring, over which the boat with the tuck seine proceeds, and takes up as many pilchards only as can be salted in one day. This process goes on daily, weather permitting, until all the fish are exhausted.

Delays often occur through bad weather, and, should a heavy gale come on, fish and nets may be lost. St. Ives being the chief seat of the fishery with seine boats for pilchards, as there are nearly 250 seines there, a description of the boats in use to carry and work the seines will be adequate for our purpose, without adverting to any other station.

The seine boat is quite a barge in size, carvel-built, about 32 feet on the keel, with a raking bow and stern post, and 9 or 10 feet beam, and of about the burden of 15 tons; crew, eight men, six to row and two to shoot the net. Two "tow boats," 24 feet long, each carrying a stop-net, and a crew of six men, in addition to which there is another smaller boat called the lurker, which is devoted to the use of the master seiner, whose orders are implicitly carried out. This is always a smart boat to sail.

The bay of St. Ives is regularly watched by men appointed for the purpose, who are always chosen for their sharp sight, and are called "Huers." There are two of them generally to each station, and they signal the boats with a white ball on a staff, to row either to the right or left to enclose the fish. They remain on duty three hours at a time, and their pay is £3 per month, and one hogshead of every hundred taken during the season by the boats for which they act. The men employed in the boats receive 45s. a month each, and one-ninth of the fish between them. The fish are landed, and carried to the curing cellars by men called "blowsers," who also assist in heaving in the seine with capstans.

The seining-ground is on the west side of St. Ives Bay, where the fishery is carried on from September towards Christmas, as long as there seems a fair chance of success. This part of the bay is divided into six stations or "stems," as they are called, by marks on the land in positions fixed by the local Act on the subject, 4 and 5 Vict. c. 57. The stations are named Carrick Gladden, Poll, Leigh, Porthminster, Pedn Olver, and Carrick Leggoe, or Carn Croueze, and no fishing-boats, except those employed in the seine fishery, are permitted to fish or anchor within a certain distance of these stems, between an hour before sunrise and the same time after sunset, from July 25 to December 25, and any boats may not pass more than twenty fathoms off-shore to and fro. As this Act has met with general approval, it is not included amongst the other enactments repealed by the Sea Fisheries Act, 1868.

From the large number of seines at St. Ives, nearly 250, and the fact that only six positions exist from which they can be worked, it was manifestly necessary that arrangements should be made to prevent confusion, and to allow each seine to have its turn. The seines are registered, and individual owners unite into associations; and before the commencement of the season, a meeting of owners is held, and the nets arranged into a certain number of groups, so that each group may have so many times according to its size, and then the order in which they are to work is decided on. When the work is commencing, a shout of "heave-ah, heave-ah" is raised, the origin of which seems doubtful, but which many persons refer to the use of capstan or winch whilst heaving in the warp; but this is by no means certain.

The curing of the fish is done both by the fishermen in their own homes, and also in large cellars built for the purpose, as close to the water-side as possible, for exportation. Fishermen in Cornwall always retain a stock of salt pilchards at home for the use of their households through the winter, not of course that they live exclusively on this diet, but they always like to have them at hand, and if they get a good crop of potatoes also, they look forward to the winter without anxiety. Cornishmen have certainly as good an appetite for meat as other men, and when, hundreds at a time, they come to fish for the Plymouth market, they carry on board every Saturday, in readiness for the next week's work, a fair amount of groceries and provisions.

The curing of pilchards is termed "bulking," because they are salted in on the stone floors of the cellars in bulk. It is done by women, who pack them in layers of fish and salt, until the heap or bulk is 5 or 6 feet high. They remain thus a month, and the pickle and oil run off in gutters to a cistern in the ground.

When salted enough, they are packed in hogsheads, which are not made with close staves, after having been washed, and a loose head, called a "buckler," being put on top of the fish, by the aid of a loaded lever a gradual pressure is brought on the fish, until the bulk is reduced about a third, so that much oil runs from them through the openings of the hogshead, and is saved in the tank. The cask is filled three times before the pressing is complete, in eight or nine days' time, and then the hogshead should weigh 4 cwt. gross weight. There is more oil in some seasons than others, owing to the more or less fat condition of the fish, but not less than two gallons per hogshead is expected. It is used by curriers in the preparation of leather, and other purposes. A hogshead contains about 2500 fish when pressed and headed down, and on one occasion 5500 hhds. were captured by one seine. This is stated to have been the largest on record.

Seining for pilchards is carried on also at different places on the south coast of Cornwall, and at one time extended as far east as Slapton, in Start Bay near Dartmouth; but at this and many other stations in the east part of Cornwall also, seining has been given up owing to its capricious character, and fishing with drift-nets has very much increased.

In consequence of the interference of drift-boats with the working of seines on the coast of Cornwall, the following restrictions were inserted in the Sea Fisheries Act, 1868, 31 and 32 Vict. cap. 45, sect. 68:—

"On the coast of Cornwall, except so much of the north coast as lies east of Trevose Head, no person between the 25th of July and the 25th of November in any year—

"(*a*) Shall, from sunrise to sunset, within the distance of two miles from the coast, measured from low water-mark (whether in bays or not) use a drift net or trawl net; or (*b*) shall, within half a mile of any sea fishing-boat stationed for seine fishing, anchor any sea-fishing or other boat (not being a boat engaged in seine-fishing), or lay, set, or use any net, boulter, or implement of sea-fishing (except for the purpose of seine-fishing).

"Any person who acts in contravention of this section shall be liable on summary conviction to a penalty not exceeding twenty pounds."

It has been mentioned that look-out men in Cornwall, termed "Huers," are appointed to watch from the cliffs, and direct the boats how to proceed to enclose the pilchards. By an Act of Parliament, James I. c. 23, fishermen are empowered to go on the grounds of others to "hue" without being liable to actions of trespass, which before occasioned frequent lawsuits.

The smallest seines legal at St. Ives are of 160 fathoms along the cork rope, with a depth of 8 fathoms at the middle or bunt, and 6 fathoms at the end of the sleeves or wings. A certain length of rope is requisite to allow the net to be shot at a considerable distance from the shore. The net may be as much larger as can be conveniently worked, but at St. Ives they run from 160 to 200 fathoms' length, and 8 to 10 deep, the merker 18 to 20 to the foot, or $\frac{3}{4}$ of an inch square. The head or cork-line has a quantity of corks, and the foot-line weighted with leads about 2 lbs. each. The amount of netting in a seine is very great, and far exceeds the nominal measurement, for 18 feet of netting are mounted on every 11 feet of back-rope, and the same on every 10 feet of foot-rope. A good deal of elasticity is requisite to meet the pressure of a large body of fish, and this is provided by the slackness in mounting.

It is believed that in former ages none but seine-captured pilchards were exported, but this has long ceased to be the rule, and immense quantities of drift-net fish are now cured for exportation, to which method we will now give our attention.

Drift-net fishing is not peculiar to the capture of pilchards, but herrings, mackerel, sprats, and salmon are also caught by this method.

The origin of drift-net fishing in England and elsewhere is quite unknown, either for pilchards, herrings, or any other fish taken by this method, and we know only this much, namely, that it is of very ancient date, and that it has been practised certainly for several hundred years, formerly on a comparatively small scale, but during the last quarter of a century boats and nets have much increased in size, and hundreds of miles of netting are used night after night on the English coasts.

Boats of various sizes are now used for this fishery, from 7 or 8 up to 16 tons or more in size, but the larger are built for the same method of fishing for mackerel and herrings, although they use them now-a-days for pilchards, mackerel, and herrings in turn. The smaller Cornish boats come as far east as Plymouth for herring and pilchard, fishing in company with the larger; but the larger go to Ireland for herring and mackerel fishing, and to Ramsgate and up to the North Sea to the Yorkshire and Scotch coasts for the herring fishing.

The name drift-net is derived from the way in which these nets are used, for they are not hauled or towed, nor are the fish enclosed in them, but they are shot out in a straight line, at either a short or long distance from the land, wherever the fishermen may discover signs of fish. The number and size of the train or string of nets, depends on the size of the boat, and that depends on the kind of harbour out of which it may be used, for very large boats are awkward to work out of shallow harbours, as they can neither enter nor depart from there for want of water, very early or very late on the tide.

Cotton nets have of late years superseded those of hemp for drift fishing, and are gradually more and more coming into use for seine-nets also, being so much lighter to handle. There can be no doubt that in drift-nets, the fineness and flexibility of the cotton meshes the fish more readily than the hemp, which is of a harsher and stiffer nature.

There is a difference in the practice of curing or tanning nets, and they are now made by machinery, whereas formerly they were made at home by the families of the fishermen. Some soak them first in linseed oil, and after soak them a day or two in tan liquor, chiefly made with catechu from the East Indies, in lieu of oak-bark, formerly in universal use; others mix oak-bark and catechu, boiling them together, and others add coal-tar to the ley, as they call it, after two or three tannings, which certainly is an additional preservative. It is now almost the universal custom to put the nets into the hot liquor; formerly it was often done cold, and took a fortnight, instead of a day or two. New nets are always done before mounting, and the first good catch of fish should be followed by another barking, to kill the injurious tendency of the slime to rot the net.

Nets are made 60 yards long, and 9 or 10 deep; a piece is divided into two nets, 30 yards long, and is 7, 8, or 10 score meshes deep, and thirty or sixty meshes to the yard; herring-nets are thirty or thirty-two meshes to the yard.

The following explanation may help to define the size of the meshes, which is ascertained in the following manner:—"The ends of four or five rows of meshes are brought together in the hand, and the net stretched tight; the result is transverse parallel rows of knots, the spaces between the rows being the length of one of the four sides of the square or diamond, and which is taken as the size of the mesh; thus, an inch mesh is one whose sides are each an inch long, and not, as was sometimes supposed, a mesh an inch long between opposite knots when it is pulled straight. Counting the rows of knots therefore within a certain fixed length gives the average size of the meshes." This is Mr. Holdsworth's method of determining the size of mesh.[1]

Each net is mounted on a double small line, one of which is twisted right-handed, the other left-handed, the object being to prevent kinks, by the action of the twist of one line against the other. Thirty yards of net being mounted on 18 or 20 yards of the double line, it is set slack, and thus gives a little to the fish when striking against it, and catches it by the gills better than if stretched tightly on the rope.

The net is suspended on the cork line by short pieces of double-twisted twine, known as "nossles," at short intervals, and pieces of cork are enclosed between the double line, sufficient to keep it uppermost, but not to float the net, which can be lowered two or three fathoms below the surface, by the aid of buoys at intervals, by which method the nets not only catch more fish, but also often escape vessels' keels as they pass over the line of nets, which is often unavoidable. The number and length of nets depends on the size of the boat,

[1] *Deep-Sea Fishing and Fishing-Boats*, p. 101, note.

and may vary from forty to over a hundred; they reach, when joined end to end, from half a mile to as much as a mile and a quarter.

In addition to its other means of support, every net has a small keg or cask-buoy, and a good take of fish will sink these occasionally, for sometimes the fish will fill nearly all the meshes for some distance, and the weight accumulates very quickly.

The whole fleet of nets in the larger boats is connected with the boat by a strong warp, which is suspended from the cork line by two small ropes, or "seizings," to each net, long enough to allow the warp to hang down to the foot of the nets; this takes off the strain from the cork line, and if a vessel runs over the net, and parts it during the night, she tears the net, but the connection being maintained by the warp, the rest of the nets are saved; unless the vessel should foul the warp, which only happens occasionally. Unfortunately a big screw steamer will sometimes cross the nets, and if she gets them in her propeller, the damage is very heavy. The fishermen endeavour to keep their lights burning brightly, but sometimes owing to fogs, or the large number of boats, extending often as far as the eye can reach, when engaged in pilchard, herring, or mackerel drifting, it is impossible for steamers entirely to avoid the fleets of fishing-boats.

The shooting of the nets is performed by putting the boat before the wind under easy sail if there is a breeze; if a calm they are obliged to row, which is hard work on these large boats, and accordingly when this is the case they have to begin at least an hour or an hour and a half before sunset. The nets are neatly stowed away in the space called the net room, and in the larger boats pass out over rollers, which eases the friction on the nets, as they go quickly overboard, one after the other, with their buoys, until the whole string is overboard, when some more warp is paid out, and being made fast forward, the boat rides with her bow towards the nets, the wind or tide, or both, causing the boat to lighten the warp, and bring a strain on the nets, tending to stretch them more or less towards a straight line. A small mizen is then hoisted, called the watch mizen, and the foremast lowered backwards, until it rests in a crutch called the "mitch board;" the lanterns are lighted, and if there is no fish to catch with hook and line, the watch is set, and if the weather looks well, all but one man go and turn in for an hour or two. The boats always carry ground-lines with them, and try for hake and large whiting pollack, and of the former they at times catch great numbers, at other times but few. They generally cut up pilchards for bait, after which the hake and most fish are indeed most voracious.

The man on watch is always working his lines, and if he throws down a hake or two on the deck, some of the rest of the crew soon join him, and if the fish are abundant, several dozens are soon taken. The hooks are made about 8 inches long in the shank, and nearly 2 inches across from the point, for the teeth of the hake are almost like those of a pike, and would soon fray through an ordinary snooding on a short-shanked hook. Sometimes all hands, just before dark, or before they get the nets on board after daylight, will have a turn at the whiting, and catch from twenty to fifty dozen, and then get their nets on board and make for the shore.

In about three hours after the nets are shot in the evening they are examined, and if there is a good quantity of fish they are got on board; another shot may then be made in readiness for the morning fish, for it is found that the fish take the nets better in the first part of the night, and just before morning, than at other times. The reason given for this is that the water does not "brine" or "fire" at these times as much as during the night, and consequently the fish do not so readily discover the nets. In fact when good catches are made, the nets may be supposed to be invisible.

Instances however have occurred in the experience of most fishermen, when, the nets having been shot before sunset, the fish have become meshed in large quantities before dark, and under these circumstances we must suppose that some small creatures, of the shrimp or other tribes, must have passed through the meshes of the nets, and the pilchards in their head-long pursuit have caught themselves. This seems a very reasonable supposition, and will remind the reader of the method mentioned already of taking sardines in Brittany, by the attraction of cod roe mixed with sand, strewed in the water on the off-side of the net, to attract the fish into the meshes.

If the water is rippled by a breeze, fish take the nets better than in a calm, and in bright and calm nights, that is, at near full moon, good fishing is uncommon, and in the mackerel drift-fishery, boats constantly remain in port until the moon decreases.

The greater part of the Cornish drift-boats carry two lug-sails only, a mizen and a large fore lug-sail, but if moderate and going a long distance, they set a mizen-topsail, and a large staysail between the two masts. Many of the boats belonging to the port of Fowey, which includes Looe and Mevagissey, are of middle size, and carry also a jib on a running bowsprit. A few boats of this district, and at Plymouth, have sprit-sails and gaff-sails, but most of these are hook and line boats, some of which at times engage in the pilchard fishery; but nearly all the new boats are luggers, owing to the facility this rig affords for lowering the mast, and the few ropes required for running rigging. For hooking purposes the yawl or dandy rigged boats are more convenient than luggers, and as a small crew, usually of two men for hand-lining, or three for long-lining, only are requisite, and a small crew can more easily handle a gaff-sail boat than a lugger, the former rig is preferred.

One of the greatest plagues of the drift-net fishermen is the piked dog-fish, so called from having two spurs like cock-spurs on its back. These spurs make them very troublesome to handle, and they injure the nets very much, besides spoiling quantities of fish. Notwithstanding their small size they are as voracious as sharks, to which they have a close affinity. They are sometimes almost as numerous in the water as blades of grass in a field, and have occasionally been brought on shore and sold for manure.

Regarding the quantity of pilchards taken yearly and their value, it is impossible to give statistics, as there is an immense consumption of this fish fresh in Cornwall, in addition to those sent up the country packed in ice from the two counties of Devon and Cornwall, a feature which has arisen only of late years. There is also a large consumption of salted pilchards in Cornwall through the winter, most families in the fishing villages having a barrel of them for winter use. In addition to this there is a very considerable consumption by the fishermen of pilchards as a bait for other fish, for it has been proved from time immemorial that no bait is so attractive, probably from the amount of oil the pilchard contains.

As regards the salted pilchards for exportation, there is no doubt about the matter, as Messrs. G. C. Fox & Co., Falmouth, publish an annual circular on the subject, a copy of which for 1882 is appended. Pilchards are also being cured in oil by a Company at Mevagissey, in Cornwall, on the French sardine system.

G. C. FOX & CO.'S PILCHARD CIRCULAR.

FALMOUTH, 20*th April* 1882.

THE subjoined list furnishes details of pilchard shipments last season, and shows that the total quantity exported was 13,963 hhds., which somewhat exceeds that of any year since 1873. A further quantity of about 1000 hhds. remains in Cornwall, and will probably be shipped to Italy next season.

Curers obtained 75s. per hhd. for a small quantity, but for the bulk of the best of the sean fish 70s. was paid. Fish of inferior quality realised about 60s.

The earlier catches were sold at various prices, according to circumstances. The great importance which dealers and consumers attach to the quality and appearance of pilchards urgently necessitates increased care and attention on the part of curers in Cornwall, in default of which their interests must seriously suffer. Continued dissatisfaction on this point will probably result in the withdrawal from the trade of merchants who formerly engaged in it to an important extent, as only bright, sound, well-packed fish are suitable for the Italian markets.

PILCHARD SHIPMENTS, 1881.

Vessel.	Hhds.	Loading Port.	Date of Sailing.	Genoa.	Leghorn.	Naples.
			1881.			
Justitia, s.s.,	1,125	Penzance,	Oct. 2d	989	..	136
Adria, s.s.,	1,163½	Ditto,	,, 31st	898½	150	115
Sabrina, s.s.,	744	Ditto,	Nov. 8th	542	..	202
Venetia, s.s.,	582	Ditto,	,, 14th	499	..	83
Italia, s.s.,	1,251½	Ditto,	,, 22d	780	..	471½
Aurora, s.s.,	890½	Ditto,	Dec. 2d	623	..	267½
Minerva, s.s.,	1,250	Ditto,	,, 5th	478	..	772
Camilla, s.s.,	575½	Ditto,	,, 12th	363	..	212½
Andalusian, s.s.,	35	Liverpool,	,, 13th	35	..	..
Torbay Lass,	750	St. Ives,	,, 23d	..	..	750
Statira, s.s.,	822½	Penzance,	,, 28th	497½	100	225
			1882.			
Sabrina, s.s.,	782	Falmouth,	Jan. 4th	302	..	480
Ditto,	771½	Penzance,	,, 5th	591½	40	140
Venetia, s.s.,	1,185	Ditto,	,, 14th	927	100	158
Aurora, s.s.,	867½	Ditto,	Feb. 2d	497½	120	250
Minerva, s.s.,	1,167½	Ditto,	,, 13th	1,077½	90	..
	13,963			9,100½	600	4,262½

SUMMARY OF PILCHARDS EXPORTED SINCE 1870.

Year.	Genoa.	Leghorn.	Civita Vecchia	Naples.	Bari	Ancona.	Venice.	Total.	Price per Hogshead to Curers.
1870	2,623½	583½	..	1,548½	100	76	1,117	6,048½	60s. to 90s.
1871	15,551½	7,077	1,092	13,247	1010½	3,097½	4,545	45,683½	20s. ,, 68s. 6d.
1872 {	802	248	..	88		..	..	1,138½	Previous season's fish.
	10,652½	1,361½	..	2,579½	632	..	2,173½	18,406	38s. to 85s.
*1873	14,643	4,119½	470	6,263½	593½	1,862½	2,155	31,019	25s. ,, 51s.
†1874 {	819	..	..	..	..	..	..	819	Previous season's fish.
	4,467½	488	..	1,332½	155½	..	1,094	7,543½	60s. to 89s.
1875	4,994½	530½	..	1,346½	220½	84	211½	7,337½	52s ,, 95s.
1876	4,732	905½	..	3,138½	100	155	872	9,903	52s. ,, 100s.
1877	5,717½	856	..	1,886½	..	98	919	9,477	40s. ,, 80s.
1878	7,880	221	..	1,368½	537½	30	272	10,309	80s ,, 60s.
1879	7,855½	1,157½	..	2,698½	..	..	226½	11,937½	41s. ,, 69s.
1880	7,577½	744	..	2,847½	350	..	324	11,843	55s. ,, 80s.
1881	9,100½	600	..	4,262½	..	..	..	13,963	42s. ,, 75s.

* 1873—653 Hogsheads lost on the voyage. † 1874—155½ Hogsheads lost on the voyage.

XXVII.

THE HISTORY AND STATISTICS OF THE HERRING FISHING IN NORWAY AND SWEDEN.

By William Watt.

The early history of sea-fisheries is very imperfectly known. Fish-commerce on anything like an important scale is a comparatively modern development; but the art of fishing was cultivated as a means of supplying human necessities in the way of food during many long ages before the art of curing was invented and fish became an important article of merchandise. Sea-fishing would have its small beginnings among poor men impelled by hunger and not given to writing histories of their experiences. To this day fishermen are not a literary class, and as little are they experts in the very modern science of statistics.

Among historic fishes the herring compares favourably with most in the length and eventfulness of its record. It is probably the "fish" on which, so long ago as the time of the Romans, the inhabitants of the Hebridean islands are said to have to a great extent subsisted.[1] The late Mr. John M. Mitchell, to whose industry all subsequent writers on the herring are much indebted, gives us the clew to various specific allusions to this fish in the pages of writers of the middle ages; and in Swinden's *History and Antiquities of Great Yarmouth* we find a doubtful suggestion that the herring-fishing began on the East Anglian coast soon after the landing of Cedric the Saxon, at the end of the fifth century, and a hardly less doubtful legend about a church built and a "godly man" placed in it to pray for the success of the fishermen that came to Yarmouth in the herring season—the church and the godly man dating from the middle of the seventh century. By the tenth and eleventh centuries, however, we find indubitable testimony on the subject, and testimony more directly to our present purpose. In the days of those "Early Kings of Norway" of whom Mr. Carlyle has left us such vivid sketches, the herring-fishing was already carried on on a great scale in the "fiords" of the Scandinavian

[1] Mitchell on *The Herring*, p. 129.

Peninsula. Thus in the time of Harold *Greyfell*, whose death is variously dated in A.D. 965, 969, and 975, we read of herrings being fished with "large nets" along the whole Norwegian coast, while in the reign of Hakon Jarl (965-95), so many herrings were caught that the whole country bordering on the sea was "filled with them." A little later on, about the beginning of the eleventh century, Sigurd Syr, stepfather of the famous St. Olav, gave his thralls an opportunity of purchasing their freedom by lending them what was necessary for the fishing of herrings.[1] Sundry other passing allusions of a like nature are to be met with; but we pass on to the tale of a French traveller, who wrote a book in 1382 in which he asserted that on the sea between Denmark and Norway, there were 40,000 vessels engaged in the herring-fishing during the months of September and October, each with at least six persons on board, besides 500 vessels for gutting and packing, and that in all "there were more than 300,000 persons who did nothing but fish herrings." There is here a margin for exaggeration, but we may take it that the herring fishing was at that period prosecuted in the Skager Rack and among the southern fiords on a scale of no little magnitude and importance.[2]

Before this time the herring had become a subject of diplomatic proceedings between the Courts of England and Norway, leading, in 1294-5, to the conclusion of a treaty whereby King Edward and King Eric bound themselves to allow each other's subjects to fish for herrings on each other's coasts. This arrangement lasted for more than a century; but in 1415, another King Eric having made some complaint to the English monarch, a proclamation was issued to the inhabitants of the various maritime towns from Yarmouth to Berwick, forbidding them thenceforth to repair to the coasts of Norway in search of fish. The herrings had probably taken one of their capricious fits, and ceased to appear in their old quarters, and the disappointed Norwegians had attributed the failure to the foreign poachers on the Norwegian preserves.

A famous man in the history of the herring is William Benkels or Benkelszoon, the Dutchman, who, among other valuable legacies, left to posterity the word "pickle," which is said to be derived from his patronymic, and the art of pickling, which is of still greater importance. Benkels' legacies are still disputed. It is maintained that he had nothing to do with the name, and that the thing existed long before his time. Let us compromise the dispute by taking for granted that he at least improved the art of curing herrings, and had much to do with the development of the Dutch fishery, and that he fully

[1] *Saga of St. Olav.* See Laing's *Norway*, p. 370; Mitchell, p. 131.
[2] Mitchell, p. 133.

deserved the monument that Charles the Fifth erected to his memory. In the picturesque language of M. Alphonse Esquiros, the herring, "by being placed in barrels," became to the Netherlands an element of greatness and prosperity, "changing the destinies of Holland, and with them those of the world in the sixteenth and seventeenth centuries." [1]

To other nations as well as to the Netherlands the herring has been a source of greatness and prosperity. Our concern is at present with Norway and Sweden, and the next fact bearing on the relation of these countries to the fish is more curious than important, and belongs quite as much to the history of superstition as to the history of the herring. Two mysterious-looking herrings were caught on the Norwegian coast in November 1587—the summer and autumn fishery seems to have been that chiefly prosecuted in those times. They bore strange marks that looked like words in Gothic characters inscribed. The learned were puzzled; the unlettered were awe-struck. The two strange fishes were conveyed to Copenhagen, where they terrified the King. His Majesty thought they predicted his own death. He took counsel with the most learned men about his Court, and was told that the cabalistic inscription appeared to mean that "you will not fish for herrings in future so well as other nations." Still the monarch was dissatisfied, and he submitted the problem to still more learned men of Rostock, and even to German Professors, but they all failed to clear it up; and it may be doubted whether the French mathematician who wrote a book on the subject, or the other interpreter who saw in the mystical signs a prophecy of the subversion of Europe, got any nearer the true solution than the rest.[2]

By the seventeenth century the records of the fisheries begin to assume a character of definiteness and authenticity, and the most striking feature of the records is the evidence they afford of those great variations in the movements of the herring-shoals that have ever since continued to be exhibited. In no country of Europe is there anything like the same length of coast-line in proportion to population as is possessed by Norway. The physical configuration of the country marks out its people as a race of sea-faring men. As far back as history takes us, much of their business was connected with the sea. For centuries they were the sea-robbers of Northern Europe and the spoilers of distant lands. But at last there came a time when the game of piracy and rapine could be no longer played, and when the Norse who remained in Norway, as well as those who colonised distant lands, were obliged to betake themselves to more honest pursuits. Their sheltered fiords

[1] *The Dutch at Home*, i. 210. [2] Mitchell, p. 152.

were visited by great shoals of fish, and the capture of these brought wealth without the dangers that now attended the career of the corsair and freebooter. Accordingly, as we have just seen, the Norwegian fisheries began early to assume a magnitude in some degree commensurate with the unequalled opportunities that were afforded by a long stretch of coast, sheltered by outlying islands, and indented by numerous arms of the sea. In those early times the fishery was for the most part directed against the great masses of herrings that periodically visited the fiords, for the cod had not as yet become an object of much attention. The periodical visits were interrupted then as now by disastrous breaks. In the earlier half of the seventeenth century the magnificent herring-harvests of the past were a tradition with which there was little to correspond in the present. There would be success in some districts and in others the fishery would be an utter blank. A considerable export trade had gradually risen, but its vicissitudes brought harassing cares as often as exceptional gains. In 1650 and the next four years the annual export averaged no more than 8000 barrels, but from that time onward a marked improvement set in. The fish visited the coast and entered the fiords in at least moderate abundance, and the record once more assumes a tone of comparative cheerfulness. This state of matters continued without serious interruption through the greater part of the eighteenth century. Every spring the whole coast from the north of Bergen down to the Skager Rack, or say from the latitude of Shetland to that of Aberdeenshire, was frequented by the shoals of spawning herring. There were as usual considerable variations in particular places from year to year. During part of the time —from 1736 to 1756—there were successful fisheries about Romsdal, in a latitude slightly to the north of that of the Faröe Islands; but then came a period of failure. The fish deserted the more northerly parts and concentrated in more compact masses towards the south. About Bergen, and especially in the whole region to the north of that town, the "catch" fell off from about 1756, and the fishing became every year more and more precarious. The great centre of the industry was now about Stavanger, where the coast begins to trend south-eastward towards the Skager Rack; and from thence an active commerce in herrings was carried on with the Baltic sea-ports. This continued till 1785, when the shoals, which had gradually been passing farther and farther south, disappeared from the neighbourhood of Stavanger as completely as they had disappeared from the Romsdal district nearly twenty years before.[1]

[1] See Consular Reports (Commercial) 1875: Report by Mr. Crowe.

When this great southward movement was in progress the Skager Rack and the Cattegat became important seats of the fishery, and Sweden was added to the list of herring-exporting countries. The year 1752 is assigned as the date of the commencement of the fishery "to any great extent" in the neighbourhood of Gothenburg;[1] but, once begun, it rapidly developed into a great industry, so that during the seven years 1775-81 there was an average export from Sweden of no less than 122,000 barrels of cured herrings per annum.[2] This average, however, is by no means the culmination. In 1787 there were cured on the Swedish coast 400,000 barrels by the ordinary method of salting, 4000 barrels by the process of smoking, and 4000 by that of compression. In addition to these large quantities of cured fish, there was the supply to the Swedish population, which with the portion of the catch exported in a slightly salted condition, must have made up a very large total. So enormous, indeed, was the supply of herrings about that period on the eastern side of the Cattegat that it gave rise to a considerable oil-boiling industry. According to Von Wright, a Swedish official of high position, who drew up a most important report on the Scandinavian Herring Fisheries about forty years ago—a report from which many of the foregoing facts are derived—herring oil was produced in one establishment alone to the extent of 2000 barrels a year. The fishery in the Cattegat was prosecuted during the summer and autumn, considerably later than on the Norwegian coast. The fish are reported to have been large and well-conditioned, though not so large as some of the herrings visiting the northern fiords.

The Swedish herring fishery ceased in 1808. From that year the shoals no longer appeared in the Cattegat, on the old scale; and although a languid fishery has been prosecuted among the islets and creeks during the last seventy years, the results appear not to have been more than very moderate. In December 1877 there was again a great appearance of shoals in that region. Mr. Duff, the British Consul at Gothenburg, in a communication to the Board of Trade, reported at the time that great shoals of herrings "of the large kind that disappeared from this coast in the year 1809" had again arrived to the north of Gothenburg, and that great preparations were being made to take advantage of the bounty of the sea.[3] The hopes thus created were to a certain extent realised, and in his preliminary Report for 1880, Mr. Duff stated that—"The coast fishing in the north-west part of the district has been very remunerative, and what is called a herring period may now

[1] Mitchell, p. 76. [2] *Ibid.*
[3] Commercial Papers, 1878 (C.—1955).

safely be looked forward to." "The herring caught this season," Mr. Duff went on to say, "is reported to be superior to any of the two foregoing winters, wherefore curing on the spot has again taken place. Large quantities in the fresh or slightly salted state have been forwarded into the interior of Sweden, Denmark, and Germany. As an article of commerce in the smoked state, these fish occupy a place of considerable importance." The prospect of greater success in the fishery induced the Swedish Government to appoint a Commission of scientific and practical men to inquire into the methods of capture and other circumstances connected with the Herring Fisheries on the British and other coasts. The latest reports as to the abundance of fish in the Cattegat are, however, rather less encouraging.

The abundant fishery in the Cattegat, as we have seen, followed the diminution, and was contemporaneous with the almost entire cessation, of the supply of fish in the fiords and inshore fishing-grounds of Norway. When, again, the Swedish fishery failed, that on the Norwegian coast was resumed in something like its old proportions. The last good year in the Cattegat was 1808; the first comparatively good year on the coast of Norway, after the collapse in 1785, was 1809.

Three principal Norwegian herring fisheries are distinguished. One is, or rather was, carried on in the northerly latitudes between Christiansund and Loffoden during the months of December and January. A second—and by far the most productive of the three—was about Bergen and along the whole south-west of Norway, in the latter part of January, and throughout the months of February and March. It was in this fishery that the great failure of last century occurred. Since 1809 it has continued on the whole in a high state of prosperity, until within the last ten years, but has now again very seriously fallen off. Lastly, there is the summer fishery, for fat herrings, which is at present the mainstay of the Norwegian herring-trade. The fat or "mattie" herrings are found in great abundance along the whole coast, often as far north as the Arctic Circle, during the summer and early autumn.

The statistics of the Norwegian herring fishery have not been collected with the method and regularity exemplified in Scotland; but some not unimportant data exist.

The following table presents a comparative view of the Scotch and Norwegian herring imports at Stettin, the principal emporium of the trade, since 1815. I give the figures for periods of five years, as better showing the general course of the trade than the annual returns, which are more influenced by temporary causes and exceptional fluctuations:—

Five Years	Norwegian. *Barrels.*	Scotch. *Barrels.*	Excess of Norwegian. *Barrels.*	Excess of Scotch. *Barrels.*
1815-19.	123,470	96,738	26,732	...
1820-24.	64,212	97,714	...	33,502
1825-29.	68,123	68,864	...	741
1830-34.	240,912	129,552	111,360	...
1835-39.	262,317	155,076	107,241	...
1840-44.	320,074	435,572	...	115,498
1845-49.	192,771	548,489	...	355,718
1850-54.	114,584	588,308	...	473,724
1855-59.	151,473	596,178	...	444,705
1860-64.	327,612	645,787	...	318,175
1865-69.	561,833	735,931	...	174,098
1870-74.	630,062	1,073,557	...	443,495
1875-79.	594,155	1,036,108	...	441,953

The fluctuations of the Norwegian supply at Stettin, as between different years, may next be exhibited. Prior to 1865 the highest importation from Norway was in 1844, when 100,000 barrels were received. From that point there was a rapid decline to 13,200 in 1850. During the period from 1832 to 1844 the supply was never under 40,000 barrels, and generally very much higher.

The average of the ten years, 1835-44, was 58,000 barrels per annum.
„ „ 1850-59, „ 27,000 „
Showing an average yearly diminution of 31,000 barrels.

A period of greatly enhanced trade between Norway and Stettin again arrived—

Between 1860 and 1869 inclusive, the yearly average was 89,000 barrels.
Between 1870 and 1879 „ „ 122,000 „

In the first of these periods, as will be seen by the above table, the Scotch herring trade with Stettin showed a moderate expansion, while in the second the expansion was very great.

A table appended to a memorial submitted to the Select Committee of the year 1881 on the Scotch Herring Brand gave the following statement of the foreign herring trade of the three principal exporting countries during the twelve years from 1869 to 1880 inclusive. The column relating to Scotland gives the official figures of the Fishery Board:—

Year.	Norway. *Barrels.*	Scotland. *Barrels.*	Holland. *Barrels.*
1869.	1,101,173	381,333¾	156,839
1870.	932,486	530,558	210,357
1871.	631,911	551,605¼	160,331
1872.	1,246,391	549,631	139,196
1873.	769,349	668,008	191,046
1874.	937,323	737,314¾	113,997
1875.	884,676	660,970½	131,269
1876.	897,108	400,423	131,740
1877.	685,602	561,985¾	126,821
1878.	677,001	628,934	124,594
1879.	630,127	545,993½	98,026
1880.	393,044*	1,009,811	279,530

* There was, however, an important fishery late in 1880, the results of which are not included in these figures.

Adopting these figures, and dividing the period to which they apply into two equal terms of six years each, the Committee, in their report to the House, called attention to the fact that the latter, as compared with the former, shows a decrease of 38·6 per cent. on Norwegian exports; a decrease of 12·2 per cent. on Dutch exports; but an increase of 9·2 per cent. on Scotch exports. The Scotch increase was in reality higher, the returns for 1880 used by the Committee being under those afterwards published by the Fishery Board. The corrected increase is 11·4 per cent.

A somewhat different series of figures, derived from official sources, is contained in the "Statistical Abstract for the Principal and Other Foreign Countries," issued by the British Board of Trade. The data, however, are incomplete. From 1870 to 1874 inclusive, only values are given, the statement of quantities beginning with 1875. In the "Abstract" the quantities are stated in hectolitres, and the values in kroner. The hectolitre, which is the quantity generally meant when a Norwegian barrel is spoken of, is about one-sixth less than the Scotch barrel (22 gallons as compared with 26⅔ gallons imperial measure). Giving the value in terms of British currency (18 kroner to the £), the figures are as follows :—

			Quantity.	Value.
Herrings exported from	Norway in	1870.	...	£911,200
Do.	Do.	1871.	...	631,600
Do.	Do.	1872.	...	986,100
Do.	Do.	1873.	...	868,100
Do.	Do.	1874.	...	979,500
			Hectol.	
Do.	Do.	1875.	1,037,824	954,260
Do.	Do.	1876.	1,040,645	1,177,400
Do.	Do.	1877.	975,298	750,200
Do.	Do.	1878.	785,321	558,200
Do.	Do.	1879.	730,945	682,300
Do.	Do.	1880.	536,333	528,000

It will be observed that though these figures relating to quantity differ considerably from those in the last table, there is also a certain similarity between the two sets: if they were to be illustrated diagrammatically the curves would not differ very widely. Exact statistics, such as the Scotch Fishery Board collects, are not to be had in Norway. An approximation is all that can be obtained, and in the assessment of values there is necessarily a great deal of guess-work. The Scotch statistics leave out of account the large and growing home consumption of fresh fish. In Norway, though it is without such markets as are afforded by the great cities of England and Scotland, there is a considerable home consumption—chiefly for food, but partly in the manufacture of "fish guano," which has there been brought into a certain degree of prominence as a commercial commodity. Of this home consumption no proper account is kept. In another part of the "Statistical Abstract" an estimate is given of the produce of the several Norwegian fisheries, with the value of the "wet" fish as delivered by the fishermen. Reducing the value into terms of English money, as before, we find the gross raw produce, as it may be called, of the Norwegian herring fisheries to be stated thus:—

	Hectol.	Value.
1874.	1,215,000	£327,000
1875.	1,062,000	314,000
1876.	1,022,000	443,000
1877.	1,112,000	377,000
1878.	850,000	288,000

These estimates do not appear to err on the side of exaggeration, at all events, if those embodied in the preceding table are to be accepted as corresponding with the actuality. I think, however, they must be received with a certain amount of caution, except in so far as they serve in a general way to exhibit the magnitude of the Norwegian herring industry in moderately favourable years. For purposes of exact comparison, mere estimates are always of questionable value. The number of vessels and of men employed in the Norwegian herring-fishing during the three years 1876-78 was as follows:—

	Vessels.	Men.
1876.	12,463	48,831
1877.	7279	42,028
1878.	6001	31,459

The "vessels" seem to include all sorts of craft down to the smallest open boats. It may be stated parenthetically that the number of Scotch herring-boats in use is about 14,000, that they are manned by about 46,000 fishermen and boys, and that about as many persons more are employed on shore in connection with the curing operations.

The different fisheries contribute in very unequal proportions to the general result. Thus—

		1877.	1878.	1879.
		Barrels.	*Barrels.*	*Barrels.*
Spring	herrings exported,	41,000	73,000	54,000
Fat	Do.	694,000	612,000	453,000
Other	Do.	50,000	46,000	70,000

The large "northern herring" was successfully fished for, late in the year, from 1860 till 1876 when it failed to make its appearance. In 1880 there was again a productive late fishery. The spring fishery used to produce about 800,000 barrels, and showed on the whole a fair degree of regularity through the greater part of the century down to 1870. In 1871 it was again successful, but from that time onward the fish have continuously failed to enter the fiords. There has been often a considerable "appearance of fish" at some distance from the land, but for some reason or other they do not come inshore, but rather pass into the Skager Rack and the Cattegat, as they did a century ago. It seems a little remarkable that the failure of the spring fishery should have been accompanied by a vast extension of the summer fishery for fat or "immature" herrings. Probably this is not a mere coincidence, but has some connection with the change in the movement of the shoals at the other period of the year. According to a statement prepared for the Herring Brand Committee by Mr. F. W. Heidenreich of Stettin, the "catch" of Norwegian summer herring has since 1872 amounted on the average to over a million barrels, of which there have been exported to foreign countries the following quantities:—

	Barrels.		*Barrels.*
1872.	435,094	1876.	861,325
1873.	403,782	1877.	665,892
1874.	573,001	1878.	641,467
1875.	598,821	1879.	567,298

There is however great uncertainty in the fishery, and the success attending it is in considerable measure due to the use of the telegraph in conveying information of the whereabouts of shoals as soon as they make their appearance. During the last two or three years the catch of fat herrings has been large on the coast immediately to the north of Christiansund—and especially about the island of Hittern and Eidsfjorden, in Nordland. In 1880 there were also important fisheries outside Hangesund, in the south-west; but the general result was considerably under that for 1879. The discouraging results of the home fisheries led to the despatch in 1880 of a number of vessels from Stavanger and Aalesund to try their fortune on the coasts of Iceland. Regarding this fishery in Iceland, Mr. Crowe, the British Consul at Christiania, in his Report for 1880, observes that it is "carried on principally on the east coast, in the Seydesfiord and Eskefiord; also partly on the north coast. In the Seydesfiord alone, there were sixteen steamers and fifty sailing vessels from Norway. The total result to the Norwegian fishermen may be estimated at 100,000 barrels, for which 10 kroner per measured barrel was paid on the spot. These herrings found a market principally in Sweden and Russia, at 24 kroner per barrel. The prices fell later to 20 kroner, owing to the rich herring fishery on the

Scotch coast. The gross profits of those engaged in this particular fishery amounted to at least 1,000,000 kroner (£55,000). The Iceland herring is considerably larger than the Norwegian spring herring, and contains a larger quantity of roe."

There is reason to believe that the prosperity of the Norwegian herring-fisheries might be greatly enhanced, if a better system were introduced. The great abundance of herrings in past times has exercised a demoralising effect on the fishermen, who are too often content to wait until the fish enter a creek or fiord, and then to enclose and capture them with sean-nets. This is no doubt a convenient method. When the fish are accommodating enough to do their part in it, they can be entrapped and caught at leisure. But on the east coast of Scotland, the seat of the greatest herring-fishery in the world, there would be no fishery whatever on these easy terms. The Norwegian method is practised on the coast of Cornwall in the case of the pilchard-fishery, but is gradually being superseded. The Cornish fishermen, finding the sean-fishery for pilchards to be precarious and apt to fail, have provided themselves with drift-nets and gone out to sea, with the result that they have greatly mitigated the fluctuations of the fishery, and added to their own average earnings. The Norwegians are also being aroused to the necessity of adopting this policy. Their antiquated system has broken down, and they are at last in a fair way towards replacing it by a better. In the summer of 1880, the Fishery Association of Norway sent thirty-four fishermen to Peterhead to take part in the Scotch fishery, and, after a season's experience, they returned home with a first-class Scotch boat and full complement of nets, to try the effect of the Scotch method on their own side of the North Sea. The teaching of Scotch experience is very clearly to the effect that, if the Norwegians would leave their fiords, and go out to sea with well-equipped boats and ample netting, they would reach a standard of prosperity to which for many years they have been strangers. The spawning fish have not been approaching the coast, and only "matties" have been caught in anything like abundance. But the spawning fish are as plentiful as ever in the sea; it is only necessary to go where they are to be found, and to employ the proper machinery of capture.

One circumstance that militates against the prosperity of the Norwegian herring trade is the alleged inferiority of the fish. The large "northern" herring is rather coarse-grained, and "not so tender" as the fish of Scotch cure; and even the smaller fat herrings, which are now the staple of the Norwegian trade, have not a reputation at all equal to that of the "matties" from the Scottish west coast. The difference seems to be mainly due to the cure. For one thing, the Norwegian barrels are made of fir staves, which impart an undesirable resinous flavour to the contents. More trouble is, however, taken by Norwegian than by Scotch curers in regard to the assorting of the fish, and this tends to greater uniformity of quality and cure. In a Norwegian barrel the herrings are all very nearly of one size, and this is so far an advantage; but so long as only "matties" are caught in large quantity on the Norwegian coast, it will be impossible for the Norwegians to compete on equal terms with the Scotch in the great German markets. The "matties" must be loosely packed, and they neither keep well nor bear long overland carriage or rough handling. A few years ago herrings could not be exported from Norway until the barrels containing them had received a brand or "brack" from an official inspector; but since the failure of the spring fishery, the branding system has fallen into abeyance, and the foreign trade is now carried on almost exclusively by means of samples after the fish have arrived at the market.

There is, then, considerable room for improvement in the method of capture pursued in Norway, and in the treatment of the fish after they are caught. The general use of the drift-net would bring about a great increase in the produce of the fishery. It is indeed from Norwegian competition in the foreign markets that the Scotch fishermen have most to apprehend. Hitherto the resources of the eastern side of the North Sea have, on the average, been taken advantage of to only a very moderate extent; but the introduction of the drift-fishery on a great scale, and at a distance from the shore, will establish a competition on more equal terms, and may not improbably lead to considerable changes in the course of the trade.

XXVIII.

TROUT-FISHING ON OUR HIGHLAND LOCHS;

CAUSES OF ITS DETERIORATION AND REMEDIES.

BY J. STIRLING.

THE title of this Essay assumes that the trout-fishing on our Highland lochs has within no very lengthened period deteriorated. This may be, and to a certain extent is true, but the statement thus made is, I think, too broad. Trout-fishing in the majority of our Highland lochs has I believe deteriorated, but there are exceptions, and there are some lochs where it has greatly improved. There are several things to be kept in view when we are endeavouring to ascertain whether a loch is better or worse now than it was thirty years ago. For instance, when after the lapse of a quarter of a century, we hear of fabulous baskets having been taken by some veteran of the rod whose feats are now confined to his narratives, we must not forget that the days on which our old friends fished and caught nothing are but faintly engraven on the tablets of memory. We must not forget that a good fish or basket, once caught, is but too apt to increase at a greater rate in the imagination of the captor than in its native element. Again, if we trust implicitly to the statement of natives, we are leaning, I am afraid, on a broken reed; and many allowances must be made before the statement of the oldest inhabitant can be accepted. I have heard shepherds and old keepers narrate, how in days gone by they had taken great baskets at such and such lochs: after a little gentle cross-examination, I generally found that such baskets were taken in the "back end" of the year, and not in the loch at all, but in some feeder, into which the trout ran in thousands at the spawning season or shortly before it, and that worm or salmon-roe, where obtainable, were the baits used: these being the conditions, that vast numbers of fish were killed was only to be expected.

That the trout-fishing on the *majority* of our Highland lochs is deteriorating is too true, and I will now proceed to state what appear to me to be the causes of this.

First.—The most obvious cause of deterioration is the greatly increased fishing. Most of our lochs are now fished regularly every day of the season, where twenty years ago a fly was seldom cast, if ever indeed. The construction of the Highland and West Highland Railways has thrown open to the holiday-seeking inhabitants of our cities districts having the very scantiest resident population, and scarcely ever visited before, save by a few zealous tourists.

In the days of stage-coaches, the travelling itself occupied the greater part of the time, and the whole of the attention of the tourist, but now, since the facilities of locomotion are so great, the attention of the traveller is bestowed upon his destination and its attractions, not on his journey and its attendant discomforts. The angling of our Highlands is now recognised as an attraction second only to their scenery, consequently vast numbers of tourists carry their rods with them, and if they put up in the neighbourhood of a bit of water, the chances are that it will be well lashed before they leave. This increase in the number of anglers may not and should not affect perceptibly our larger lochs, such as Katrine, Earn, Tay, and Rannoch, but one can easily understand how a difference might soon be made on the stock of a loch such as Loch Ard, by even two rods fishing each day of the season.

Besides the mere difference in numbers made by increased fishing, it has another effect. In many lochs the larger trout seem to prefer remaining at a great depth, if not at the bottom, and it is only at night or on rare occasions, such as when the waters of the loch are muddy,—so preventing them from seeing their food at the bottom,—that they take a lure on or near the surface; if, however, the bottom of the loch did not afford a sufficient supply of organic matter to support its inhabitants, they would be compelled to seek food at the surface, and it is this deficiency of food, in proportion to the number of fish, that makes trout on many lochs and streams take a lure so greedily. We must not forget, therefore, that when 500 trout have been killed on a loch, the stock of ground-food left for the remaining fish is proportionately increased, and there is then less necessity for their seeking food at the surface.

Another effect of increased fishing is that the fish not caught are made more wary. Besides killing some fish, the average angler frightens many; I believe I am within the mark when saying, that for every hundred fish killed, three hundred have been pricked, and so made shyer.

The effects of increased fishing are, I think, always felt most for the first few years after its commencement. The fish at first are innocent and unsuspecting: often many of them are *always* hungry through an insufficient supply of food, but after a few seasons those left, for the reasons I have stated, become shyer; the disease has in a manner worked its own cure, and baskets do not further decrease. Thus, on the Tweed twenty or thirty years ago, baskets of from fifteen to twenty pounds were but usual; the railway came, and with it crowds of anglers from the metropolis; baskets soon decreased, until the average was down to from four to eight pounds, where, I believe, it has remained for a number of years past.

For the deterioration caused by increased fishing, the remedy which most obviously suggests itself is a further restriction of fishing; but to this I would be extremely sorry to see proprietors resort. Already an excessively strict system of preservation is in force in many Highland districts where, for centuries, fishing was unrestricted, and the change is bearing its natural fruit in poaching of the worst character, where before poaching was unknown,—but to this latter evil I will shortly refer. It is an old story, perhaps reiterated oftener than necessary, that property has its duties as well as its rights; and among their duties, I think it is incumbent upon Highland proprietors to throw open *some part* of their waters to the inhabitant of the city, whether he be the wearied brain-worker or the toil-worn mechanic. If proprietors could but realise what an infinite boon they would thus be conferring upon their fellow-men, I have no doubt many would generously open some portion of their waters. The exaction of a reasonable charge would be most just, and I believe it would not be grudged. In many cases it would pay, and always assist in paying, the expenses of watching, stocking, etc.

It is not to increased restriction that I should like to see proprietors turning in order to cure the evil, but rather to those means they possess of improving their fishings, and to which I shall afterwards refer.

Second.—The next cause to which I would attribute the deterioration is the prevalence of unfair and illegal methods of fishing.

My personal experience, though it is but small, justifies me, I feel, in saying, that such unfair and illegal fishing is rather on the increase than otherwise. Why it should be so it is difficult to say. Many reasons might be assigned. In the first place, I believe, that when railways are being constructed, the labourers who work upon them are not the best friends of the trout, and especially of the spawning ones. I recollect a shepherd, whose word I could depend upon, telling me that in company with a gang of navvies who were working upon a new line of railway, he killed in a small tributary of one of our best salmon rivers in one night thirty salmon. This, he said, was an occupation which kept the navvies out of bed more than one night a week during the spawning season. If salmon were thus treated in a river which is watched throughout the whole winter at enormous expense, we may infer how trout would fare in places where winter-watching is unknown.

I have no doubt that the increased strictness of preservation is itself responsible to a great extent for the increased poaching, and consequently for the deterioration of fishings. It is a well known fact that when people cannot get a thing it is then that they wish it most; it has been thus with the fishing in the Highlands. People there were at one time accustomed to fish when and where they pleased; indeed, the religious faith at one time compelled them to have a supply of fresh fish very often. When fishings, like shootings, became valuable as subjects which could be let, the proprietors or tenants made a change, which, though in harmony with the common law of Scotland, was but sullenly acquiesced in by those who imagined their rights were being trampled upon. As facts are always more convincing than unauthenticated generalisations, I may be permitted to note how, in one case I have personal knowledge of, this system of entire preservation has affected the fishings. One of the very largest proprietors in the central Highlands, not many years ago, notified his wish that all fishing on his vast domains should be rigorously prohibited. Why it was so, no one could explain. But whatever were the motives which prompted the proprietor, certain it was that natives and strangers were one and all "turned off." Old women in the villages who depended upon letting their houses, or parts of them, found this means of support gone, because most of their visitors had come on account of the fishing. People grumbled, but nothing was done to have the edict recalled; poaching, however, if not on the estate, at least on the neighbouring ones, increased amazingly. The people had been accustomed to eke out their salted pig with a dish of trout, and seemingly determined still to have them. What surprised me more than anything else was the fact that gamekeepers and gillies were the worst and keenest in the nefarious business. The mode of supplying their wants was simple, and they scarcely troubled themselves to conceal it. At ten o'clock in the October and November nights they started for a loch which was teeming with fish, a proprietor having some years before stocked it most liberally. The loch was fed by two burns which at that season were crowded, and a few hours' netting sufficed to kill as many trout as could be conveniently carried by three men. The numbers killed being far beyond present needs, the trout were consigned to the pickling-barrel, and so provided a fish diet till far on in the next season.

But preservation is not by any means responsible for all the unfair and illegal fishing that takes place. Apparently there are many people whose tastes incline them to fish only when they shall be certain of killing a large quantity, no matter what is the quality of their victims. It will have been observed by those who are in the habit of visiting the more inaccessible of our Highland lochs that they seldom see keepers or shepherds fishing even when they have the permission, and when they have but little else to do. The reason is to be found, I think, in the fact I have already adverted to, that they fish in the spawning season, and then kill sufficient to serve them many months. One of angling's greatest charms is its solitariness, and it is but natural that a man, whose lonely employment detains him amidst the almost oppressive stillness of the moor and the deer-forest, should not find in angling, for its own sake, the same degree of pleasure as is found by the country gentleman, who enjoys the companionship of numerous friends, and spends some part of the year, often against his dearest wishes, amidst the endless excitement of the London " season,"—by the Member of Parliament, worn nigh unto death with the interminable sittings of the House,—or by the inhabitant of the city, wearied with the glare of pavements and the dazzle of shop windows, wearied with discontented customers who will not pay, with hopeless patients, who will not recover; with grumbling clients, whose suits cannot be gained. The solitude of the lake affords to these men the relief they are longing for, and they find a pleasure in angling though but few fish are in their baskets at the end of the day. But the keeper or shepherd finds no such relief, and often no such pleasure. He fishes for the sake of the diets it will procure him, and prefers to kill twelve dozen of spawning or spent fish to one dozen of clean, seasonable ones.

It may be impossible to extirpate unfair and illegal methods of fishing, but they may be diminished by the exercise of a little generosity, which would save pounds, if it lost pence. In the first place, proprietors and others interested in fishings should endeavour to impress upon those resident in the district that not a fish should be killed from some time before the commencement of the spawning till the fish are again in good condition. In order that such endeavours may be attended with success, it is of the utmost importance that proprietors and others should gain the good graces of the natives.

The great war between the upper and lower proprietors of the Tweed is now a well-known chapter in the annals of Scotch angling, the story of it having been told by the late Mr. Russel[1] of the *Scotsman*, as few besides himself could have done it. Briefly, the facts are that before 1857 the salmon-fishing was declining at a rate positively alarming. The late Duke of Roxburghe saw where, at all events, one root of the evil lay, and

[1] See *The Salmon*, by Alex. Russel, page 147. Edmonston and Douglas, Edinburgh, 1864.

gave his whole energies and a great deal of money to cure it. The proprietors and inhabitants on the upper reaches of the river were by Statute forbidden to touch the fish when they reached them. To use Mr. Russel's words: "They were, as Sir Walter Scott expressed it, made mere clocking hens 'for the lower heritors,' and took an absolute disgust at the process of incubation. Their grounds were turned into mere lying-in hospitals and nurseries; they scarcely ever saw salmon but as infants, as mothers in a delicate condition, and as invalids only, 'as well as could be expected.' They were to nurse them when they were young, and to heal them when they were sick; and the people below were to kill and sell them when they attained health, size, and weight. The upper proprietors were to take care of them for two years without killing them, and the lower proprietors, who could take no care of them, were to kill them before they were two days, or, perhaps, two minutes within their realms. Of course, the result was that the unprofitable duties were not performed by those on whom they naturally devolved, and no other class could act as effective substitutes." The remedy was, to allow fish to ascend to the upper waters at a time when they would afford sport; and this was done chiefly through the abolition of stell nets and cairn nets, and the extension of the rod season after the net season was closed. The benefits that have accrued since this course was adopted have shown that the Legislature was justified in giving the upper proprietors, and weavers of Galashiels and Innerleithen, some interest to prevent poaching.

It was important for the proprietors of the commercially valuable fisheries at the mouth of the Tweed that they should have the assistance and co-operation of those upper residents in the preservation of the salmon while on his fresh-water sojourn; it is just as important for proprietors and others interested in our Highland trout-fishings to have the good graces of the resident inhabitants. These they can gain by granting liberally, *not necessarily lavishly*, permission to fish during the proper season, restricting the permission during the earlier and later months of the season to fly-fishing only, as the fairest method, and that by which the most seasonable fish will be captured,—no liberties being granted to those who are known to be guilty of unfair fishing, and all fishing in the streams running into lochs being prohibited with the utmost strictness after the month of September.

We now come to the *Third* reason for the deterioration of our loch-fishings.

The improved cultivation of land in Scotland, resulting in vast tracts being drained which previously were damp, and often bogs and marshes, has unquestionably affected both salmon and trout fishing. And I think some of our lochs must have suffered considerably, at least those of which the feeders are short and small, and have a rapid fall.

Where wet land is not drained the water trickles from it but slowly, the bogs having a tendency to retain the surface-water, act as reservoirs, and so the burns in undrained districts are kept at a medium height. Owing to the drainage, the burns, as a matter of course, rise and fall much faster than before; in wet weather they will rise much higher, and in dry weather they will become much lower than before.

Now, this sudden and increased rising and falling acts injuriously on several accounts, and these I shall briefly note as they occur to me.

In the *first* place, if the burn in which the trout of a loch must spawn is so small as only to admit of the fish entering it at a spate, and remaining in it while it is flooded, the time the burn is flooded being limited to the days on which the rain falls, or one, or at most, two days thereafter, the fish will very often be compelled to fall back to the loch before the operation of depositing the ova has been completed or even begun. Indeed, unless the flood lasts a week, or longer, I do not think the spawning likely to be carried through successfully.

In the *second* place, if the burn is of some size, and the ova has been successfully deposited, and fructification has taken place, on account of the great suddenness and tremendous force with which a burn in a drained district comes down, I think the gravel beds in which the ova has been deposited are most apt to be displaced, and the eggs, instead of hatching successfully, are scattered over the stream, to fill the bottomless stomach of some old patriarch.

In the *third* place, although I am not certain that the common trout are as nice in their tastes regarding a spawning-ground, especially as regards the shallowness of it, as their cousins the salmon and sea-trout—the latter in some streams run into the very sheep-drains—I think when the burns are roaring over "bank and brae," as they so often do in well-drained districts, that the fish will be very frequently tempted to deposit their ova in some channel bank which, when the flood subsides, will be left uncovered by water.

I have stated these effects of land-draining which I consider injurious to trout; it is evident, nevertheless, that any of the three evils might happen without the presence of draining; it merely increases the likelihood of their occurrence.

Fourth,—The next cause of deterioration which occurs to me is the continued existence and increase of that most hideous and disgusting of fresh-water fish, the pike. He is the natural enemy of the trout, and perhaps the worst of all its natural enemies. Many instances of lochs and rivers, where the trout-fishing has deteriorated on account of the presence of pike, might be given. Among them are Loch Derculich, Loch Freuchie, Loch Tummel, Lake of Menteith, and Loch Tulla, in the Black Mount. Mr. Stoddart, in his *Angler's Companion*,[1] page 299, calculates that a pike in the Teviot, during April and May, "as his daily meal, engrosses four salmon or bull-trout fry. This, in the course of sixty days, gives an allowance to every individual in the Teviot of 240 smolts; and supposing there are from Ancrum Bridge downwards, a stretch of water nine or ten miles in length, not more than 1000 pike, the entire number consumed by these, in less than one-sixth of the year, amounts to 240,000, or nearly a quarter of a million fry—a greater number, there is no question, than is killed during the same extent of time by all the angling poachers in the district put together." Trout fry would fare no better, and Mr. Stoddart's figures, which are, I think, without exaggeration, speak for themselves.

Wherever the stock of pike increases, so in proportion the stock of trout yields before the continued ravages of the voracious monster. I can appreciate Mr. John Colquhoun's sentiments when he says that to kill a dozen fine trout is better sport than to kill eight or nine dozen small ones; but I could not agree with him when he says that fishing in a loch where there are pike is therefore better. "If a man prefers killing eight or nine dozen, with scarcely a half-pounder among them, to a dozen fine trout from half-a-pound to three pounds weight, then he may count the pike his enemy; but the latter feat will both better prove his skill and afford him much greater sport."[2] And I am afraid the opinion of so illustrious a sportsman must have been taken by some proprietors as their authority when they introduced the pike into their lakes and streams, instead of doing all in their power to extirpate it wherever it is found.

It is the case, doubtless, that in many waters the stock of trout is far too large for the supply of food, and it is right this evil should be cured, but not by the introduction of pike. Regular angling or a haul at times with a net would reduce any stock of trout as much as can be desired. The proprietor who calls in the aid of the pike is not unlike Goethe's Faust, who, when he has summoned Mephistopheles, afterwards finds to his discomfort that he has procured a friend whom he wishes with his whole heart to get rid of, but cannot.

When pike do get a lodgment in a river or loch it is very difficult to extirpate them, but a great deal may be done

[1] *The Angler's Companion to the Rivers and Lochs of Scotland.* By Thomas Tod Stoddart. Blackwood: Edinburgh and London. 1847.

[2] *The Moor and the Loch*, vol. ii. p. 375. Fifth Edition. Blackwood.

without much expense. One man with a stake-net and fifty or sixty set lines, would in a year make a considerable difference on the stock of pike in any of our smaller lochs. A large loch such as Loch Tummel could not be cleaned in one season, but still the expense would soon be repaid by the results. Supposing that £200 was expended by the proprietor in the work, the increased annual value of the fishing, as let with hotels or separately, would, I venture to think, be sufficient to provide a handsome annual return.

Fifth,—The increase of aquatic birds, wherever they are to be found near trout-fishings, may be put down as one cause of the deterioration of the latter.

The columns of our journals have within the last few years frequently contained contributions regarding the destruction of valuable fish caused by birds, which are not of the slightest value from either the sporting or the commercial point of view. No one having any knowledge of the subject would have any doubt of the ravages committed by gulls, cormorants, and other aquatic birds, but if evidence were wanted, more could be obtained than would suffice to set all dubiety at rest.

Mr. S. L. Mason of Edinburgh, in a letter to the Editor of the *Scotsman*, dated 21st October 1880, related a remarkable experience which is worth repeating. At Stronchrubie in Sutherland, Mr. Mason excavated "in a mountain rill a good-sized pool, and transferred to it as many trout and parr as it could conveniently accommodate," in order to watch their habits. One morning, "a fine black-backed gull arrived quite casually, and unsuspectingly he was seen sitting, with great dignity and composure on a hillock close by, surveying the pool—possibly at that moment digesting a hearty meal of fine trout—for not long after he and seven or eight of our biggest fish were missing. Early next day the remainder of the smaller trout and every one of the parr had disappeared. No reasonable doubt can exist as to who was the depredator; ordinary theft in this remote county is out of the question. Escape up or down the stream was physically impossible. After leaving the pool, the water was diverted from its ordinary course for sanitary purposes, and its entrance, close by to an underground channel, was effectually barred. Against the ascent there were natural obstacles too. Nor was there any part of the stream where fifteen or twenty or half that number of fish could by any possibility lie concealed. Several of them exceeded three quarters of a pound in weight. It is probable that on seeing their natural enemy, they had in imagined security retreated to their usual haunts, whence he had at his leisure hooked them out and gobbled them up."

There is no use of proprietors stocking their waters for the purpose of providing food for vermin, and there is only one remedy for such occurrences as the above. All the species of gulls, etc., which visit our rivers, must be excepted from the Wild Birds Preservation Acts, and their destruction should be encouraged, not prevented. Doubtless some people will shriek over the shocking cruelty of killing birds, when they have helpless little young ones waiting in the nest for their return. Probably it is in a certain sense cruel, but the tender-hearted may as well say, "Man should not dig, because each time the spade enters the soil it may halve a dozen of worms, and that is very cruel;" or, "He should not kill rats, because there may be baby-rats longing for mamma's return." This creation exists by the destruction of one species for the benefit of another. Providence has ordered it so, and it is not for man to find fault with the arrangement. He must not mistake fancies for divine injunctions. His duty is simply to do his utmost to preserve and increase the animals which are for his use, while he keeps down or extirpates those which are useless. This is not expediency, but plain necessity.

Even our domestic aquatic birds, the useful duck and goose and ornamental swan, are bad neighbours to trout ova and fry, and should never be permitted to go about a spawning burn at any season. In the winter they will each day gobble up much roe, and at other times they will kill large numbers of fry, as may be seen by opening the stomach of a duck which has been resident on the banks of a stream where salmon or trout spawn.

I have stated what I think are the causes of the deterioration that has taken place in the trout-fishing on many of our Highland Lochs. Three of the causes—unfair and illegal fishing, the existence of pike, and the ravages of aquatic birds,—are under the control of those interested in fishing or of the Legislature, at least to a great extent; and on removing the causes the effects will cease.

The other two reasons for deterioration which I have mentioned, increased fishing and drainage, cannot however be removed. We must accept the altered circumstances and make the best of them possible.

Artificial stocking is the remedy which in my regard will best assist us to counteract the causes of deterioration.

Thousands of years have elapsed since man was convinced that the operations of nature, unassisted by himself, would not cause the land to produce those fruits, and would not cause those flocks and herds to come into being, which his existence implied were necessary. How then can he still expect that nature without his aid will continue to replenish the waters, which he, with his ever increasing desire for sport and demands for food, threatens absolutely to depopulate? True it is that from its boundless extent the stores of the briny deep are practically inexhaustible, but that this is far from being the case with regard to our fresh-water lochs is painfully evident. Every year we have the lesson repeated that they cannot withstand our continued and increasing ravages. Because this is the fact we need not and cannot grumble, the laws of nature are inexorable, but she only requires of us that we act rationally, and if we utilise the results of experience and the discoveries of science, she will still afford us all we can desire.

The science of pisciculture is not of modern origin, though for upwards of two centuries its existence in this country seems to have been almost unknown. Before Henry the Eighth had thrown off the yoke of Rome, and again during the Catholic reaction under Mary, it was absolutely necessary that a supply of fresh fish should be obtainable in order that the fasts might be kept; on this account the monks gave the study of pisciculture great attention, and under their care it attained a high state of perfection. Unfortunately, however, the reforming generation, carried away in a flood of enthusiasm over the divine greatness of their own accomplishments, seem to have allowed the scientific acquirements of their predecessors to sink into oblivion, and among them the science of pisciculture.

The late Mr. Frank Buckland, to whom, along with his fellow-Commissioners, our fishermen, anglers, and naturalists owe so much, in his book of British Fishes gives some interesting notes on the cultivation of fish-ponds, and shows by quotations from treatises written upon the subject as early as the sixteenth century, that the writers "knew more about fish-ponds than we do at the present day." It is mostly with the breeding and fattening of carp, roach, etc., that these old pisciculturists seem to have interested themselves, and they may not be able to afford us much assistance in the task of improving our Highland trout-fishings, but the evident care and consideration they spent on the science should make us ashamed of the lethargic state in which the public mind remained in regard to this question until the last few years.

A few noblemen and gentlemen in Scotland have for some time been devoting great attention to the breeding, hatching, and feeding of trout, and, thanks to their efforts, too long unappreciated, this important science has again attained a high state of perfection; and it has become as easy for proprietors of fishings to obtain a stock of trout fry as for proprietors of grazings to obtain store cattle. I can only express the hope that all angling associations and the general body of proprietors will recognise the change that has taken place, and take advantage of the facilities now afforded.

When they have resolved to stock a loch, associations, proprietors, or whoever may be doing it, may proceed in two ways. They may turn into the loch a number of grown fish, say two years old, or they may turn into the burns a much larger number of fry. There may be circumstances in which it will be better to put in the older fish, when these are obtainable, such as when sport is soon wanted; but in the general case it will be better to turn out the fry when ready, and if one is hatching the fry in his own boxes, the latter method will save keeping them in troughs and ponds. Mr. Buckland in the appendix to his work says: "If you have a large number of fry, I certainly advise that the greater part of them should be turned out at once into the open" (*i.e.* "as the weather gets warmer"). Care must of course be exercised not to overtax the feeding capabilities of a rivulet, or the growth of the fish will be consequently stunted. Mr. Buckland quotes an "excellent book," by the Hon. Roger North, published 1713, which contains the following sensible passage:—

"I have found a great analogy between the stocking waters with fish and pastures with cattle, and that the same conduct and discretion belongs to both. Waters may be overstocked as pastures often are: so both may be understocked. The latter is the less error, for if you overstock you lose the whole summer's feed, if you understock you lose only the rest of your profit; what you do feed is much better and turns to account by more ready sale. So also of beasts, some of the same age and feeding will not thrive so well as others."

Artificial feeding may be resorted to at times with advantage. It would be very unpleasant for a stranger to come upon a decaying horse head dangling in a tree, but one may be disposed of in a quiet corner here and there, and the larvæ which would drop from it would be a great treat to the little fellows below. There are of course many other kinds of food which might be scattered in the pools.

If there is not much shelter in the burn it might be well to remove any large trout, if that could be done, as any old fish coming out of his retreat into the shallows on an evening might dispose of a goodly number of his subjects.

As the crossing of one strain with another is not only beneficial but necessary for the successful breeding of cattle, sheep, poultry, etc., I think we may infer that the infusion of some fresh blood into the stock of a loch, especially if it be a small one, will generally be for its benefit. If the native trout of a loch are very fine then it will be safer to leave well alone, but in other cases proprietors when hatching fish might get ova from a water the stock of which was known to be hardy and good.

Agriculturists know that sheep bred in the bleak and barren districts of Caithness will thrive and fatten faster on the pastures of the Lothians than sheep bred there, and that sheep bred in the Lowlands of Lowland stock would not fatten fast on a moor. The same rules *may* apply in the case of trout, and Highland proprietors and others must not be disappointed if after turning out a stock of the fry of Loch Leven trout they find them grow up lean and ugly. Some waters, like some lands, are very barren.

If a loch is badly adapted for trout, by having bad or no spawning-ground, charr might be tried in it. The charrs do not seem to require a river or brook to spawn in. They are beautiful fish, and although they may not take the fly so long in the season as the trout, they often afford splendid sport. I have seen the charr of a Highland loch, plump and pretty, where the trout were lean and black, indicating, apparently, that the charr may feed well where the trout cannot.

Although, as I have already said, I consider that artificial stocking in its different forms is the main resource to which we must turn for an improvement in our fisheries, there are others which we should not neglect. Three of which are: the removal of all obstructions impeding the free passage of spawning fish, the institution of an annual close-time for fresh-water fish, and the prevention of pollution.

I have long waited in the expectancy, that, as an increased interest was taken in our fishings, some general movement would be originated having for its object the removal of obstructions and providing of proper fish-passes. There is now some prospect of an influential association getting some good work done in this direction, but it is mainly upon parties locally interested that the burden of the work must and should fall. All that a central association can be expected to do is to point out the evil and suggest a remedy.

The proprietors of Highland lochs can do much which will greatly benefit their fishings without undertaking any works which would involve a large expenditure. Innumerable fine burns are blocked close to their mouths, with falls often of no great height, but too high for a trout heavy with ova to ascend. A little boring and a charge of dynamite would in many cases break up the rock and convert it into an easily ascendible rapid, or the fall may sometimes be broken half way, so as to afford a rest in the middle for ascending or descending fish.

We may take a well-known loch as an example of this. Loch Earn is not greatly esteemed by the angler; it is extremely fickle, and except upon a summer night between eight and twelve o'clock, and during or after a heavy rainfall, a good basket from fly-fishing cannot be depended upon. It contains plenty of trout, and some very large ones, but I am afraid its stock would not long stand heavy fishing, because its spawning-grounds are, for a loch of such a size, very confined. No less than five burns flow into it about the west end, but of these, four are are blocked by falls at no great distance from their mouths. Several of these falls are unfortunately too high for blasting; but if it were possible to remove any of them, or render them harmless by passes, splendid spawning-grounds might be opened up, which would be of immense advantage to the loch.

Owing to the great difficulties connected with the subject, I feel it would be presumption on my part to enter into any discussion of the relative merits of the various kinds of fish-ladders. Before commencing the construction of a ladder, proprietors should have the advice of the very best authorities, so unfortunate and disappointing have been the results of many ladders from which much was expected. In his recent book on Sutherlandshire, Mr. Archibald Young mentions a very remarkable ladder designed by the late Mr. Bateson of Cambusmore, by which salmon are enabled to ascend to Loch Buie, "in spite of a fall upwards of sixty feet in height."

Where the burns which feed a loch are small, the passage of fish may often be obstructed for weeks in a dry autumn on account of a bank of gravel or sand stretching across the stream and making it too shallow for a trout of any size to pass it. It frequently happens also, that a bed of gravel gets silted up in the loch round the mouth, forming a bar to the entrance of larger fish.

It frequently happens that there is a smaller loch at the head of a rivulet flowing into a larger loch; now if the rivulet is small, by the construction of a sluice where it leaves the loch, an artificial spate could be caused at any time, and by it trout might be enabled to surmount many obstacles in their ascent to a spawning-ground, which would impede them if the stream was dry.

One point may be kept in view before obstructions are removed, viz.: that where there is already a tolerable spawning-ground, it is better to leave it as it is, than open up a wider field in a district where there is any likelihood of poaching unless an efficient system of watching can be maintained.

Some of the matters I have mentioned latterly may not be ills of great importance, and they could not account for the deterioration of fishings, but the cost of putting them right is small, and a proprietor who wishes his fishings to improve will not fail to attend to them. And where he has been at the expense of stocking his waters, it is surely short-sighted policy not to give the new inhabitants every opportunity to multiply, where that can be done without incurring a disproportionate expense.

The next matter to which I will refer, viz., the establishment of a close-time, is in the highest degree important.

The necessity for this change in the law being made at once is so self-evident, that writing arguments in favour of it is needless. The seasons for shooting winged game have been fixed by the Legislature. A close-time for the netting and angling for salmon has been fixed for every river in Britain. Under the Act 41 and 42 Vict. cap. 39, it is illegal in England "to fish for, catch or attempt to catch or kill, any trout or charr during the close season between 2d October and 1st February following, or during any close season which by bye-law may be substituted for the same." The trout and charr of Scotland, however, can be slaughtered from 1st January to 31st December. Why this is so it is needless to ask. Scotland requires little legislation, and she gets less. The Government of the day requires strong pressure to be applied to it before it can be expected to take cognisance of such a trifling matter as Scottish trout-fishing. Our county members, however, are greatly to blame for the lack of energy they display in respect to obtaining some remedial legislation regarding our fisheries. Angling associations and others interested must take up the matter, and if they cannot persuade their Members of Parliament to give it their attention, deputations from the various parties interested must wait upon the Lord Advocate and those connected with him in the government of Scotland, and perhaps their importunity may procure them what is desired.

We can hardly attribute any deterioration in our Highland *loch* fishings to pollution either from household or manufacturing sources. But those interested must ever be on the alert, and careful to prevent this great evil from getting a beginning. Where houses are being erected near lochs, and where they have water-closets, every precaution should be exercised in the way of the drainage—erection of cesspools, etc.—so that no solid matter will find its way into the loch.

Last summer I was somewhat surprised to learn that the whole drainage of a number of villas which have recently been erected on the shores of one of our Perthshire lochs, was to be discharged in its original state into the loch, and that at its shallowest part. The result may not have any effect upon the fishings for many years, but the pleasure of angling, especially in a dry summer, will be diminished.

But if our Highland lochs have not as yet been injured by pollution, certainly the fishings of many fine rivers in the north have suffered, and several streams once pure and limpid, affording a plenteous supply of water to every man and beast, on their course to the ocean, are now foul and poison-bearing, unfit for any purpose whatever.

The greatest men of this generation, among them Thomas Carlyle and John Ruskin, have spoken with no uncertain voice against the frightful system of discharging the whole filth and refuse of our cities and manufactories into our rivers; but it requires no greatness of mind to discern the evil,—it is patent to every man who is not besotted with greed or prejudiced by self-interest. Is it reasonable that any class or individual should have the liberty to convert a river—which is the property not only of riparian owners, but of mankind, one of the most beautiful things in the universe, the sight of which cannot fail to refresh and ennoble—into a noisome sewer, certain only to disgust and demoralise?

XXIX.

MODEL OF THE SAFEST AND HANDIEST SAILING FISHING-BOAT, AS TO HULL, SAILS, SPARS, AND RIG.

By James Omond.

That the merit of a model may be thoroughly understood, it is necessary that the constructor should in person be able to explain his reasons for such alterations and improvements as he may bring forward. In the author's case, the desirable personal explanation is impossible; hence the necessity of committing his ideas to paper. And it is the earnest wish of the author that some light may thus be thrown on a most important subject.

Apart from the consideration of our fisheries as a source of national wealth, the fact that many thousands of the population are mainly dependent thereon for a living, should call attention to the best means of prosecuting that dangerous and laborious calling with safety and success. Almost daily disasters are happening.

It is true that accidents will happen more or less, as long as the world lasts, but of late, fishing calamities have been so frequent and appalling, that one is forced to the conclusion that something is wrong, and the cry for a remedy is a loud one. In the course of this paper I hope to show very clearly the cause of many disasters, and if I can in the smallest degree point to some means of remedy, the principal end of my writing will be served.

Of all our seafaring population, none require a safer or better boat in all respects than the fisherman. The foreign trader very soon gets clear of the coast with its shoals and currents, and then considers himself in comparative safety. Even the smaller coaster, on getting clear of the harbour, can, on the approach of a gale, stand out to sea with much more chance of safety than fishing-craft in general.

Our fishings are mainly carried on near the coast, or in the narrows where the current is strong, and the sea, in a gale, deeper, heavier, and more broken; and even in the case of banks at a considerable distance from the coast-line, the shallowness of the water causes a heavier sea. The fisherman thus occupies the most dangerous position. Hence the absolute necessity of having a boat, not only suitable for the working of his fishing-gear, but fitted for the preservation of his life. There is special danger from the nature of his cargo. If the fisherman is so fortunate as to obtain a heavy haul, he will consider his good fortune none the less should he obtain it in fine weather. What cargo is more liable to shift than one of fresh newly-caught herrings, ling, or cod? The general trader, moreover, has the comfort of shipping his freight along a solid quay and in smooth water, while the fisherman loads in mid-channel, often pitching "bows under."

The recent calamities on the Shetland and Berwick coasts show the necessity for improvement in the smaller as well as in the larger fishing-boats, and in the course of my Essay I mean to revert to both sizes of boat.

If we are to attain a competent knowledge of what our fishing-boats should be, it is needful to know by experience personally the dangers to which they are exposed; to note carefully the boats that *were* as well as those that *are;* to understand why the former are discarded and the present preferred, and thus gain a knowledge of the defects and superior qualities of each.

We may consider the qualities necessary in an efficient fishing-boat to be speed and capacity for cargo; and with these we must combine good qualities as a sea-boat, which comprehend scudding weatherly, and lying-to. In short, we require a craft calculated to weather a gale at sea.

If we can secure a craft that is swift, can carry a reasonable cargo, works to windward well as long as she can carry canvas, scuds well before a heavy sea, or, when there is danger in running for the coast, well calculated to ride out a storm at sea, then all is attained which can in reason be expected.

In order, then, to reason the matter carefully to this happy result, we must look to the boats that *were.* Plate I.

In respect to small boats, chiefly used in fishing in river mouths, or at a few yards from the shore, in model or rig, I consider it not necessary to speak, and I confine attention to the smaller boats that venture some distance to sea, as the "sixern" of Shetland, and the larger herring-fishing boats.

About the beginning of the present century, or about one hundred years ago, more or less, the boats in use throughout the Orkneys were much inferior in model, construction, and rig, to those of the present day. The smaller boats then in use were low, "flattish" things, with straight stem and sternpost raking considerably, treenail fastened, sometimes carrying one sail, sometimes two, and very often none—oars doing the whole. These were employed for general purposes, such as carrying fuel across the sounds, conveying corn to the mill, shipping kelp, or carrying small quantities of provisions, etc., to and from the nearest town.

They came in requisition also for fishing purposes, but were not specially constructed for such a purpose, nor were the islanders then induced to venture far from land, there being no market for the fish. These were shallow, rudely-constructed, "plashy" things, from 11 feet to 15 feet keel; yet, primitive and rude as they were, they had some good points. They were easily beached and drawn up, swift under oars, and good at running before wind and sea, *i.e.* scudding. Bring them on a wind, and they were poor tools, lamentably defective in weatherly qualities.

The writer knows no locality where this type of boat has undergone greater improvement than in the small islands of Swona and Stroma, which lie in the full sweep of the rapid and boisterous Pentland Firth. Of these people it may be said they can scarce step over their threshold without their boats. Their lives depend on having good boats; hence the improvement. "Necessity is the mother of invention." The writer had the advantage of living for some time in the smaller of these two islands, and consequently speaks from experience. The boats now in use there are of the same type as the old "straight stems" already referred to, but are remarkably improved. The rake is diminished; the stem now has a fine curve; the hold is deeper, and the mould fuller in general, often copper-fastened throughout, and paint used in place of tar. The rig of these fine handy little craft is two sails and a jib. The sails are set by means of a long pole, technically termed a sprit, and this rig is called the "sprit-sail," the old sail being denominated the "lateen," setting by means of one halyard attached to the yard, about a third from the weather earing. Plate II.

The sprit-rig is found to be the most handy and safe in boats from 11 ft. to 15 ft. of keel which are in constant use in general, and are especially employed in cod-fishing not far from land, and the lobster-fishing. I will describe this rig, and some may, from the description, obtain information of which they are in need.

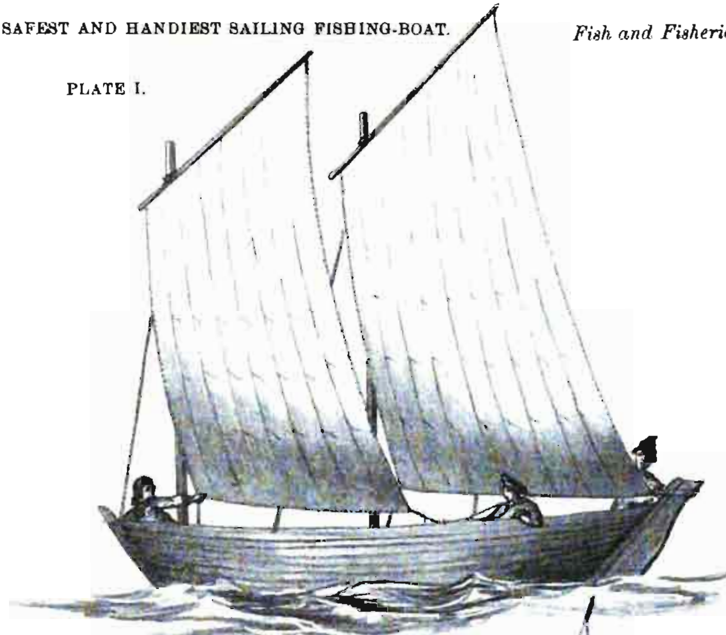
The sail has considerable "peak," and gives the craft a smart appearance, while its handiness in reefing, I consider, enables the boatman to show more canvas in fine weather than can be otherwise done.

The sail is laced to the mast, and remains so, and is stowed at the mast, and both unstepped and carried on shore, or stepped together; a slender iron ring goes over the mast-head,

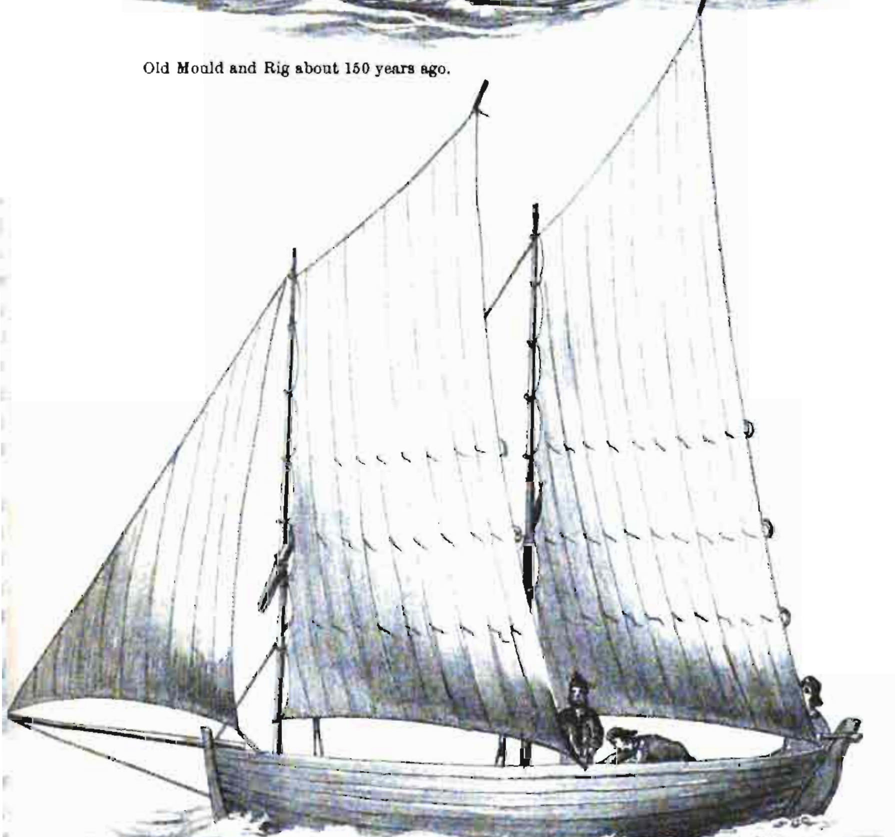
DEL OF SAFEST AND HANDIEST SAILING FISHING-BOAT.

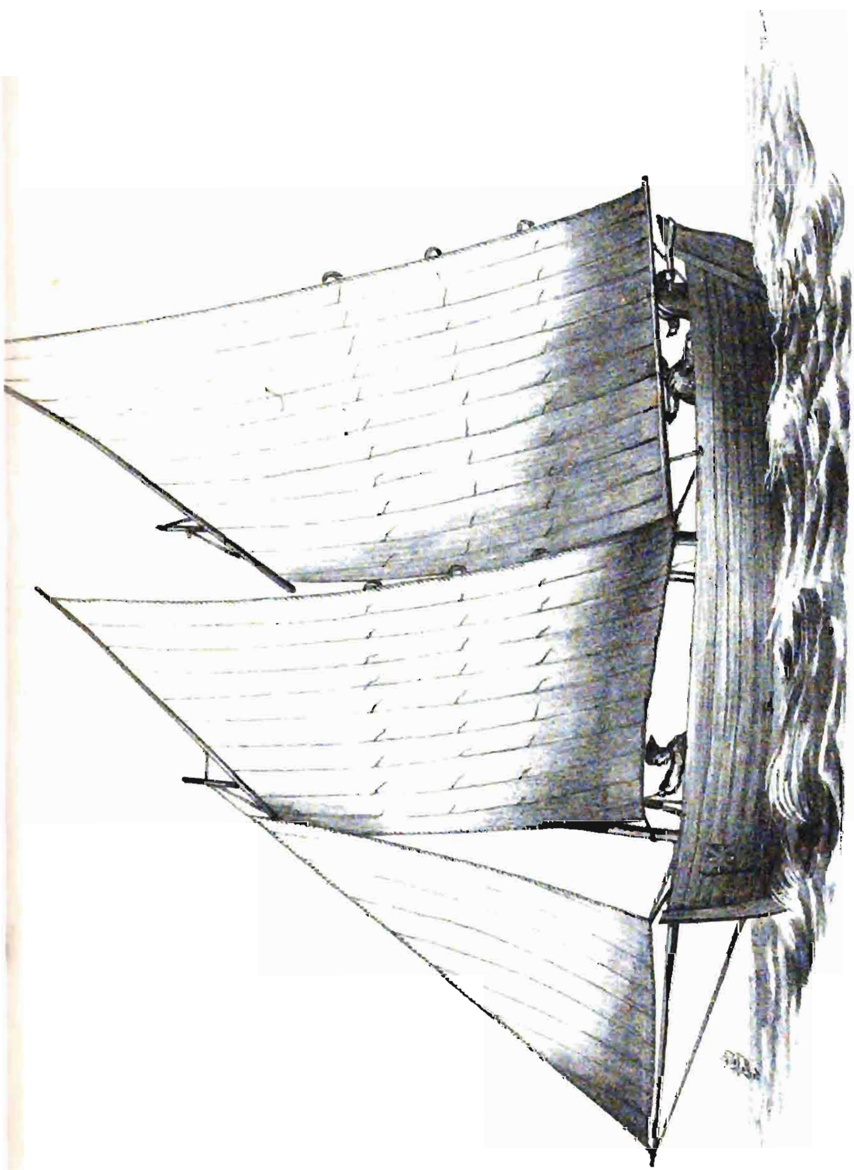
Fish and Fisheries, p. **334.**

PLATE I.



Old Mould and Rig about 150 years ago.





Stroma Pilot Boat, also in use for fishing; lateen rig, boom mainsail, 17 ft. keel.
Exact counterpart of discarded Orkney herring fishing yawl, 20 to 30 feet keel.

T.&A.Constable, Printers to Her Majesty. Edin.

the weather earing is attached to this ring. A slender line also at the weather-earing reeves "fore and aft" through the mast-head, serving for a halyard, which is loosely hitched round the mast within reach of the hand, and simply is *slid* up or down as the reefs are taken in or let out. The tack is tied to a small staple in the mast. It has a copper hook for reefing. To set this sail—step the mast, and the sail is at the mast-head, cast loose the few turns of the sheet around the sail, grasp the peak, insert the sprit, up with it, insert the lower end of sprit in a sling sliding on the mast, and it is set. To reef it—slide up the halyard, slide down the sprit-sling, hook in the cringles, set up again the reef-points, tie reef-points at leisure. To stow it—jerk out the lower end of the sprit, down it comes, lay it inboard, twirl the sail together at the mast and secure it so with the sheet. In setting, reefing, or stowing, the process is almost instantaneous.

In larger boats of this class, from 15 ft. to 18 ft. or 20 ft., used in going considerable distances from the land, piloting the sprit is deemed cumbrous and unhandy. Recourse is again had to the "lateen:"—two sails and a jib, mainsail in general a little the larger.

Under this rig these boats work admirably. Under certain conditions they are considered to answer their purpose well and to be generally seaworthy and "sure."

Their qualities are swiftness, they carry a good cargo, scud well, and are fairly weatherly under double reefs. Close reefed in a head sea, they are "watery," and require skilful seamanship to bring them through. In them we have gained considerably towards the end in view, yet still we are some distance from it. My object in drawing attention to these smaller boats is to bring under notice their qualities, and because they are the origin of the larger herring fishing-boat peculiar to the Orkneys.

The boats employed in the Orkney herring-fishing fifty years ago were the exact counterpart of the pilot-boat previously mentioned, a trifle fuller built in some instances, with more depth of hold, but almost identical in mould and rig. One or two smack-rigged might have been seen among the fleet, but they were not general by any means. The length of keel ranged from 20 ft. to 30 ft. This mould and rig continued in use until about the time that the herrings rose in price, which gave a stimulus to have what was considered a boat of greater cargo capacity, and which would be able to go to sea in rougher weather. At first only a few of the "firthy" mould with a dipping lug made their appearance. At present scarce one of the old yawls remains, being almost if not entirely supplanted by the firthy and the smack rig. It may be remarked that the yawl rig never came into general use on the Caithness coast, not so much for inferiority in sea-going qualities as from their more slender construction, and the protruding bowsprit and boom which came to grief in the crush and pack of the harbour. If one did put in an appearance, it was at a cove where there was no crush.

In Orkney, where there are good natural harbours, the yawl was exceedingly handy and the rig was well adapted to the narrows; but it is superseded, and I now proceed to contrast it with the firthy. We shall find something good in both, and also something which is capable of improvement.

In moderate weather, off the wind, the yawl is not inferior to the firthy in sailing, and is rather its superior in speed, working to windward in the narrows greatly better than it. The firthy, again, in a gale and a long stretch on one tack, shows itself the better boat. It is generally considered among fishermen the more powerful and comfortable craft of the two, while, at the same time being more weatherly, it has not attained the same reputation as the yawl in scudding.

Neither of the two is defective in speed. The firthy is superior in going to windward, of greater burden, but is considered worse at scudding in a gale with a deep sea running. If the firthy can be improved in scudding and retain its other qualities, then, with improved rig, we have as near as possible attained what we wish.

The yawl's superiority in scudding is accounted for in its having more curve in the floor, being sharper under water, fore and aft, than the firthy. It is easily seen that a rush of water under a curved surface tends to raise the object, therefore we see the yawl has this good point in common with the kayak of the Greenlander. The firthy, on the other hand, being fuller built, of more wedge-like configuration fore and aft, it follows that, in running before a heavy sea, there is a tendency to suck downward, especially if there is more cargo than ordinary ballast. I had this account of it from one who had to run Wick bar on the occasion of the great loss of life there. "She ran that hard before a sea till her gunwales came to the water, and it stood in a heap fore and aft." That helmsman required a steady nerve and a good grasp of the tiller.

The weatherly quality of the firthy is accounted for by her greater length of keel, flat standing-sail, and her not "striking" so hard.

We must have a boat, then, with the good qualities of both; and how is this possible? The firthy is nearly a perfect boat, but not altogether; we must keep to it and improve it.

In regard to model, we have noticed the good points and the defective qualities in both large herring-boats, and find that, taken separately, neither comes up to the mark, but both combined answer our expectation. The plain inference then is, retain the better mould and improve it.

The improvement necessary is to give the firthy bottom or floor more curve, that is, make it sharper fore and under water, and that will improve the scudding, retain the length of keel which gives it the weatherly quality; and obtain a sail which will set as flat and plain as the dipping lug, and I cannot conceive a more perfect boat. I shall speak of the sail in its place. The bottom must be a graduated curve, so that it may act when the vessel is running fair on her bottom. When she runs on her bilge there is little fear of her "sucking down." On inspection of Plate III. it will be seen that this model is not so wedge-shaped fore and aft as many of the firthies. The bottom is not sharpened to increase speed, as in some racing yachts, but, for the purpose of additional speed, there is added a little to the length. Fishermen set great store by a "sure" boat; that means the opposite of crank, and I have retained the bottom which is found to insure that, so that, on the whole, my mould or model will be found weatherly, sure, swift, with capacity for cargo, and will scud along, keeping sea in a gale. There is much against our fishers keeping sea in a gale. Being near the coast, and coming ashore daily, has tended to induce the habit of not keeping sea in a gale. Want of sufficient provisions or accommodation aboard has been another reason. Safety and shelter at the shore is another strong inducement not to do it.

The simple fact is, they used to have more prospect of saving their lives and property by running for the harbour, just because the craft they were in were not calculated to live in a gale at sea. They were open boats.

It is only lately that part-decks and full-decks were introduced into our herring-fishing craft. A boat that will live in and weather a gale at sea must be full-decked fore and aft, with suitable hatches, well secured, for working the gear; water and provisions for at least a week kept aboard, with a portable binnacle and charts. When the fisherman finds an article under his feet that he can trust to in a gale, be assured he is quite alive to the danger of running inshore with a gale of wind blowing direct on it, especially if it is dark and he has no lights.

I am assured, from my own experience of boats, that the main cause of the fishing disasters is filling over the gunwale, and turning over, that is, upsetting.

It is, indeed, surprising, considering some things, that many more accidents don't occur, and nothing averts it but, under the providence of God, consummate seamanship.

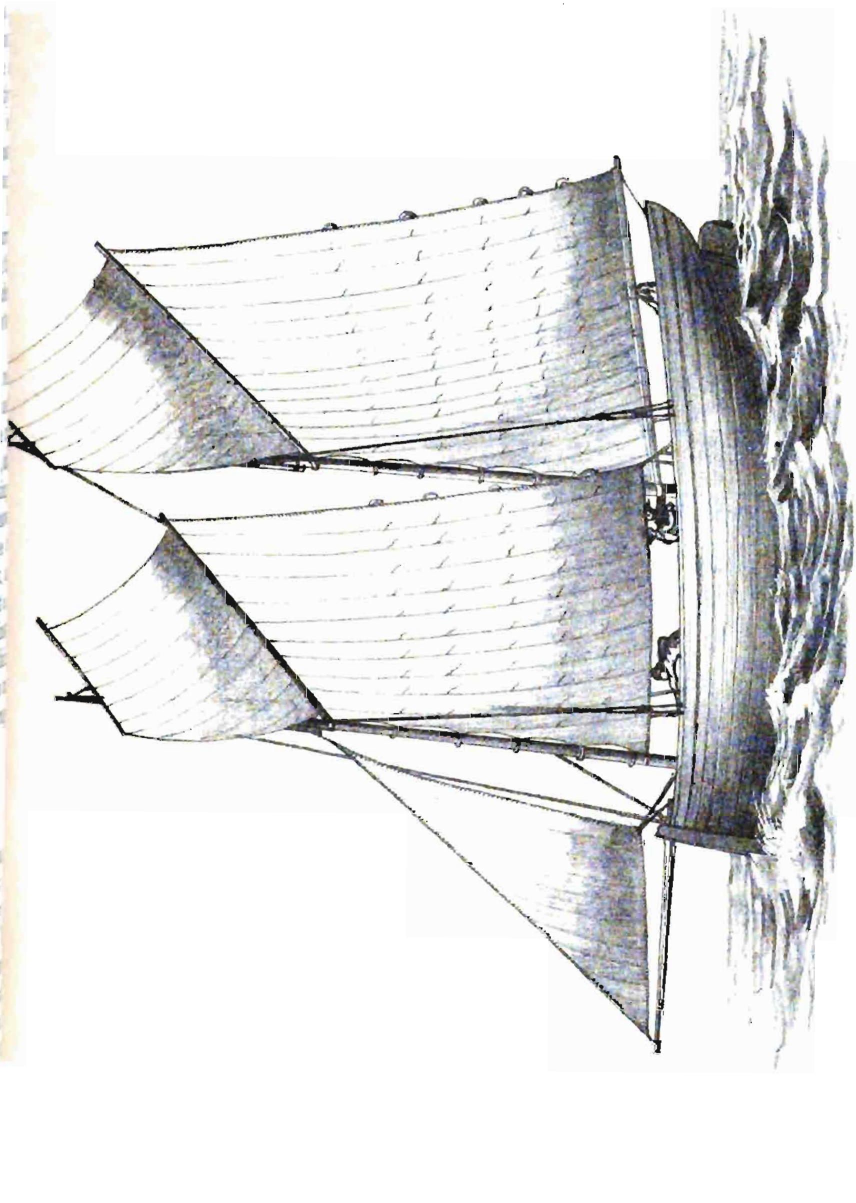
All in general go to sea at the herring-fishing with too little ballast, and why? There are two principal reasons. In shallow harbours, such as Wick, they carry as little ballast as possible, in order that the boat may draw little water, and thus get first into the quay on the tide making. Against the often delusive expectation of obtaining a good haul, ballast is frequently thrown over to make room for fish. A wiser course would be to get assistance from a less fortunate companion. These boats sit on the water almost as buoyant as an egg-shell, and if caught side on in a storm and heavy sea no wonder they turn over. Depend upon it, the herring-boat must be full-decked and carry more ballast. Even with the mould at present employed on the east coast, or be the model what it may, common sense teaches that if you don't want your boat to fill, deck her. If she is to keep her bottom, ballast her.

I have made my model yacht stern, and for three reasons, viz.:—A heavy sea on is a great danger in shipping and unshipping a heavy rudder; I have intended that the rudder remain shipped, the stern giving it sufficient protection, and the protruding part of the keel below, and also preventing the fouling when sailing among and over drifts and hawsers; secondly, it affords facility in reefing the mainsail, the boom being within easy reach; thirdly, a more roomy deck, and a more sightly appearance in general. I may remark that a man is often knocked from the helm by a sea breaking against the part of the rudder above water. However, if fishers think it necessary, it may be shipped and unshipped without so much trouble as at present. My arguments and suggestions regarding the model, I think, are exhausted.

The Rig.

If we employ the one-mast rig, the consequence is that, in order to secure a sufficient spread of canvas, both mast and sail must of necessity be large. This is the reason why we discard the smack-rig in herring fishing-boats especially. The smacks do well enough in a wind with such a sail in moderate weather, and some in a gale, as the Gravesend fishing-smacks, but in general they don't scud well. The long heavy boom is objectionable, and so much "after" sail causes her to be set too much by the stern, and the herring-fisher takes in his cargo there, and generally hauls stern forward. It is a heavy mast, sail, and boom, and in running before a gale is altogether too one-sided, and makes steering difficult. Yawing it is impossible to avoid with such a spread of canvas stretching out so far from the centre of motion.

Should we employ too many masts, then there is unnecessary



The most handy rig to supersede the dipping lug, proposed to be applied to the boats now in use on the East Coast of Scotland.

T. & A. Constable, Printers to Her Majesty Edinr

gear, and a multiplicity of sails, and the working becomes needlessly troublesome. We therefore avoid the one mast and the three masts, and confine ourselves to *two*, and consider the purpose served much better.

The two masts give a more uniform spread of sails, are proportionable, more sightly, and the craft will work and steer better than with a very large sail or a multiplicity of small sails.

The discarded Orkney herring-yawl wrought under a rig similar to this, but with one halyard attached a third from the weather earing, bringing the yard to lee on one tack and to weather of the mast on the other, and the sail did not stand so plain, but in choosing between it and the dipping lug, I prefer the former, especially if laced to the mast from where the weather-bolt rope comes into it.

The dipping lug has proved itself to be unhandy in the narrows, and literally murderous to work in short tacks, and—one main fault in going about in a gale—it leaves the vessel for a time in a dangerous position,—broadside on to the sea. Also in lowering to reef, or taking the sail in, its bellying out to leeward is a great fault.

The modified dipping lug is certainly no great improvement. The foresail is too huge and unmanageable; in a gale it can't be kept well in hand, and when such a mass is rolled up in reefing and full of water, it is most objectionable, and intolerably unhandy.

I have adopted three proportionable sails, as a working rig, of the fore-and-aft schooner plan. A racing yacht rig, discarding the stay foresail, I recommend as the safest, handiest, and most effective rig for a fishing-boat. Experience has taught us that the old yawl did well under three sails such as this boat has. The smaller boats in Orkney and the Pentland Firth work admirably under it. It is picturesque and sightly, well distributed over the hull, and consequently the boat must steer better.

In reefing, the sail is held to the mast, does not bag out to leeward, does not extend beyond the vessel, requires no dipping, and stands equally well on either tack, and if carefully made, it will stand "like a board," as fishermen say, and can be snugly tucked to the mast in harbour. It can be set to the mast-head before leaving the quay, and snugged to the mast by a peak line or brail, so that on getting outside the pier-head, the sails are set by simply raising the peak. If the rudder remains shipped, and the sail easy set, many an awkward bump and grumble will be avoided. No better "lying to" sail is required than this mainsail reefed, or even the peak raised, the rest lashed to the boom. If that is not deemed good enough a small trysail may be made specially on purpose, and a second jib. Boats of this rig work under the foresail alone, and much better under jib and mainsail.

If the bowsprit and boom are objected to, I answer, the boom is about on a line with the stern, and cannot be in the way at sea. It is fitted with a goose neck, which can be unhooked, and the boom run on deck in harbour. The jib should be taken in on approaching the harbour, and the bowsprit run in, to facilitate which I recommend a roller to be fitted in the under side of the bowsprit hoop attached to the stem, and another one between the "bits," underneath the heel of the bowsprit. The "bits" should be a sort of frame to secure the inner end of the bowsprit from shifting; a simple tackle could easily "bowse" it out. The rollers are essential, as sticking or jambing must be by all means avoided.

I consider a handy and safe rig as one under which a boat works and steers well, and which can be manipulated with the most ease and least danger to crew and vessel, and such I have attempted to produce.

Herrings are being caught further from land, boats are getting too large for oars; therefore, that cargo may not deteriorate, speed is necessary; so, in light weather, two topmasts can be run up with this rig, and gaff-topsails set if thought necessary; two rings at the back of each mast-head for them to run through is most of the fittings necessary.

I cannot imagine anything better on purpose to supersede the "dipping lug" in fishing-boats sailing at present under the dipping lug, and, I think very little trouble and expense would transform them into a rig such as the present model, thus:— Shift the masts, placing the main-mast forward, or, if too short, get a new one, cut down the foresail a little, and add a little to the mainsail to supply the place of the foresail, which bring aft and get a new jib.

The craft, under this rig, will require to be a trifle more set by the heel than under the single dipping lug, but what of that? In moderate weather the nets can come in aft as usual, and in bad weather bring her bow to it.

Ballasting.

No matter how exquisite the mould or model of the craft, how sure she may be,—if there is to be a gale weathered at sea, the safety of a boat lies in her keeping her bottom, that is, she must be like a good wrestler, very difficult to knock off her feet. If we are to attain to this in the greatest perfection, it must be gained by a judicious placing of the ballast.

Fishermen are too careless, it is to be feared, in this respect, and to give security, even ordinary security, it should be placed directly on the keel between the bulkheads, and under the "bottom boards" or "platforms," which should be secured down, and the ballast prevented from shifting when there is a heavy lurch to leeward.

I would specially draw attention to the most efficient ballast imaginable. I think all new fishing-boats should be built on a keel of wrought-iron, and this would be the strongest of keels; and that is but the least of it,—it would prove the most efficient of ballasts; indeed, a boat so constructed could scarcely be upset, and if full-decked, I don't think a more safe and seaworthy boat need be sought.

The leverage would then be at the utmost counteracting point, and if it is objected to because of being extra heavy, a few extra hands to those that are drawn up all winter would overcome the difficulty, and in the case of those sailing all the year, it would be the greatest possible safety.

I beg to submit that the mould and rig I have the honour to introduce and recommend (Plate III.), are, from my own experience and that of others, better calculated for the safe and successful prosecution of the herring-fishing than those now in use. I have given, I hope, sufficient reasons to show that the mould or shape of the boat is safe, and any one can see that the rig is safe, sightly, and handy. I am quite sure if this model is introduced full-decked, and the ballast properly secured, it will be found an efficient sea-boat in a gale.

The Drag.

I shall now describe a "drag" to assist boats in lying-to. Have some boards—thin ones, weighted at one edge—arranged as the shelves for books suspended by ropes at the four corners, but at a distance between 2 or 3 fathoms, for if close the "backwater" of one will "bring home" the other. If such a drag was paid out in a gale, it would do much to keep a vessel head-on to the sea.

An oil-bag attached to the drag would allow the oil to spread to windward of the vessel, and then she could ride in unbroken water, and such could serve more boats than one if they could manage to remain in the smooth water. There is no doubt regarding the efficacy of oil on the water. The oil from the limpets, used as bait by the sillock-fishers, induces a long stripe of smooth water. One way oil could not be utilised is in running free before a gale and crossing a "roost." In such a case the speed is greater, and the oil would be outstripped, but a little dripping from the stern might be tried.

In conclusion I shall suggest some improvement in the small fishing-boats, used in Orkney and the Shetlands, for inshore cod, ling, and haddock fishing; tide-fishers, as it were, coming home generally at the turn of the tide, when the "slack" is over, daily with the fresh fish. These are often exposed to severe gales, and in open boats, the quality of which as before remarked, is best off the wind and scudding.

If it comes to close reefs, and on a wind in a pitch of sea, it is most dangerous navigation; every pitch her side goes gunwale under, water is shipped over the lee, and even when she is eased on the sheets, often the hands are kept at incessant baling to keep her afloat. Fishermen are tenacious of old customs and tools, and unwilling to yield until disaster compels them.

I would recommend a model on the same principles as I have advocated, with these modifications: the usual boat stern, scarcely so deep in the hold, and more beam than I have given, and the sides a trifle more laid out. This, partly decked, would be very much better. I would deck about one-third of the beam on each side, leaving space amidships for the men to stand, and hatch the rest, to be put on in extremity.

The Shetland sixern is certainly not the thing. On a wind in a hard gale leewater is shipped, and in a storm her fate is sealed. Get a good beam powerful to carry sail, straight stem for holding to windward, deck or partly deck; pay attention to to have the ballast well placed, and I can imagine little more remains to be done. A low boat, shallow and narrow in the beam, is good only off the wind and scudding. Bring such to the wind and she ships water over the lee side every pitch. If a part of the side were covered she could slash into it gunwale under, and no danger unless in sailing her over.

INDEX.

ERRATUM.

P. 65, line 8 of Essay—
for During the ten years which followed
read During the eight years which followed.

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