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EIGHTH
ANNUAL REPORT

OF THE

FISHERY BOARD FOR SCOTLAND,

Being for the Year 1889

IN THREE PARTS.

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.
PART III.—SCIENTIFIC INVESTIGATIONS.

PART I.—GENERAL REPORT.

Presented to both Houses of Parliament in pursuance of
Act 45 and 46 Vict., cap. 78.

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TO THE MOST HONOURABLE

THE MARQUIS OF LOTHIAN, K.T.,

Her Majesty's Secretary for Scotland.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 1*st May* 1890.

MY LORD MARQUIS,

We, the Members of the Fishery Board for Scotland, have the honour to submit the Board's Eighth Annual Report, being for the year 1889.

The subject matter of the Report has been arranged, as was done last year, in three parts, under the following titles:—

Part I.—General Report.
Part II.—Report on Salmon Fisheries.
Part III.—Scientific Investigations.

We have the honour to be,

MY LORD MARQUIS,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEO. H. M. THOMS.
ALEXR. FORBES IRVINE.
J. R. G. MAITLAND.
J. COSSAR EWART.
JAMES JOHNSTON.
WILLIAM BOYD.
W. ANDERSON SMITH.

PART I.—GENERAL REPORT.

THE SEA FISHERIES OF SCOTLAND.

General Statement.

Commencement of herring fishing. **Closed first week in September.** **Number of boats engaged greater than in 1888.** **Prices of herrings.** **Five-hundred and seventy-one boats left on beach.**

The herring fishing of 1889 commenced at Stornoway and Barra on the 15th of May, and practically ended at both places about the middle of July. Although the catch was considerably below that of 1888, about £10,000 more was realised, owing to the higher prices obtained. On the East Coast it began about ten days earlier than usual,—at Wick on the 2nd of May, Shetland 15th June, and Orkney 20th June. The date of commencement at the other stations varied from the 1st to the 16th of July. The fishing was regularly prosecuted till the first week of September, when it practically ceased, although a few boats continued to fish two or three weeks longer. The fleet employed at the East Coast stations, including Orkney and Shetland, numbered 3993 boats, being an increase over the preceding year of 236 boats. Of this fleet, 1234 boats were engaged to curers at fixed rates of from 10s. to 16s. a cran. The remainder sold their catches daily at the current prices, which ranged from 2s. to 30s. a cran, the average for the season being about 13s. 9d. Last year 571 good seaworthy boats were left on the beach,—188 on the East Coast, and 383 on the West Coast. £14,463, 16s. was sanctioned during the year for loans to crofter fishermen to buy boats and gear. Few boats have been built otherwise as compared with previous years.

Produce of inshore grounds. **General fishing ground.**

The inshore waters on the East Coast were not quite so productive as during the preceding three or four years, excepting that portion lying between the Pentland Firth and the Cromarty Firth. Within these limits,—from two to six miles offshore,—there was a very abundant fishing during the early part of the season, a number of large takes of from 90 to 150 crans being landed. The general fishing ground lay from 2 to 40 miles offshore, the best individual takes being got from 6 to 12 miles distant, these ranging from 80 to 150 crans.

East Coast catch much greater than in 1888.

The aggregate catch upon the East Coast showed a considerable increase as compared with 1888, amounting to 311,243$\frac{3}{4}$ barrels cured, and 9724 crans in the quantity consumed fresh. The increases were chiefly in the following districts, viz., Fraserburgh 137,521 barrels; Peterhead, 100,362 barrels; Wick, 37,567 barrels; and Aberdeen, 31,091 barrels. Shetland again showed a great

Continued falling off in the fishing in Shetland.

falling off, amounting to 52,215¼ barrels cured, and 6700 crans consumed fresh, under the previous year. After the end of June the fishing in this district was almost a complete failure, which was attributed by the fishermen to the presence on the coast, shortly after the fishing commenced, of large shoals of dog-fish.

Rise and fall there during past ten years.

The rise and fall in the fishing of Shetland district during the last ten years has been most striking. In 1878 the number of barrels of herrings cured was 8458; in 1880, it was 48,552; in 1882, 134,187; in 1884, 300,117; reaching a climax in 1885, with 370,238 barrels cured. After that year it has as rapidly declined, the number of barrels cured in 1886 amounting to 198,051, in 1887 to 125,989, in 1888 to 99,221, and last year to 47,006.

Decrease on West Coast, compared with 1888, but increase in totals for both coasts.

There was a decrease on the West Coast of 32,609 barrels cured, and an increase in the quantity consumed fresh of 3436 crans, as compared with 1888. Stornoway showed the large decrease of 50,283 barrels cured, and 1042 crans in the quantity used fresh. The totals for both coasts gave an increase of 278,634¾ barrels cured, and 13,160 crans consumed fresh, over those for the preceding year.

Quality of herrings.

A striking feature of the fishing of 1889 was the large proportion of small immature herrings in the catch. The 'Full' fish were of average quality, but the 'Maties' were, as a rule, very inferior.

Number of fish-curing establishments on East Coast.

There were 653 fish-curing establishments engaged in the herring industry upon the East Coast last season, being 41 more than in 1888.

Herrings landed on West Coast.

With the exception of Stornoway district, the West Coast herring fishing is generally carried on in the sea lochs, and narrow waters. In one or other of the districts herrings were landed during every month of the year, but owing to the deficiency in Stornoway, the gross catch showed a decrease as compared with the preceding year. The superior quality of the herrings usually taken in the districts of Inveraray, Campbeltown, and Loch Carron and Skye has been well maintained during the past year. The takes in the two former districts were nearly all sent to the home markets for use fresh, where they are much esteemed for their rich flavour.

Takes generally used fresh.

Rich flavour.

Decrease in winter fishing, as compared with 1888.

The winter herring fishing yielded 75,407 crans, being a decrease of 4,349 crans as compared with 1888. During the last two years the shoals seemed to be very much scattered, and were not found in such abundance upon the same grounds as formerly.

Quantity of herrings branded.

Amount of brand fees.

The gross quantity of herrings branded during the year was 455,285½ barrels, being an increase of 71,305 barrels over 1888. The brand fee of 4d. a barrel realised £7588, 1s. 10d.,—an increase of £1188, 8s. 4d. over the previous year.

Cured herrings exported.

The total quantity of herrings exported was 970,175¾ barrels. Of these, 931,923¾ barrels were sent to Germany and other places on the Continent; 32,653 barrels to Ireland; and 5599 barrels to places out of Europe—the largest portion of which went to America, mostly repacked in small casks or kegs, and shipped from Greenock, Leith, and Aberdeen.

Quantity of herrings landed on both coasts.

The total catch of herrings in 1889, on both the East and West Coasts, was 1,062,430 crans, for which the fishermen received £716,445. Of this quantity, it is estimated 350,531 crans, valued at £280,424, 16s., were consumed in Great Britain and Ireland, 32,653 barrels being cured and exported to Ireland, and about 20,000 barrels cured and disposed of in Great Britain, valued at £31,225, 9s., which gives the total value of herrings consumed in the United Kingdom as £311,650, 3s. 937,523 barrels of cured herrings were exported to foreign countries. The 350,531 crans consumed in the United Kingdom were of the following description, viz., fresh, 137,196 crans; kippers, 74,600 crans; bloaters and lightly smoked reds, 8948 crans; preserved in tins, 16,923 crans; slightly salted and in bulk, 104,421 crans (a large proportion of which were made into kippers and bloaters in other parts of the Kingdom); and red herrings for use at home and abroad, 8443 crans. A considerable increase is observed yearly in the quantity of herrings kippered and preserved in tins. The best fish were generally used for making into fresh kippers, &c., and realised about 16s. per cran, while the best cured, which were valued at 13s. per barrel, besides the cost of cure, were sent to Ireland, where they are in demand. Most of the small herrings are sent to the Continent, being largely consumed in Poland, Russia, and Austria.

Quantity and value of same consumed in the United Kingdom.

Quantity of cured herrings exported.

Different kinds of herrings consumed.

Increase in quantity kippered and preserved in tins.

Small herrings sent to Continent.

The Board have had under consideration the question of introducing new crown brands during the season of 1890, in the hope that the standard quality of Scottish branded herrings may be raised.

New crown brands under consideration.

Of the total quantity of cod, ling, and hake landed last year, 145,661 cwts. were cured dried, and 6920 barrels pickled, showing an increase, as compared with the previous year, of 8445 cwts. dried, but a decrease of 132 barrels in the quantity pickled. The quantity of dried cod exported was 108,698 cwts., being an increase of 20,598 cwts. over 1888. No pickled cod was exported last year.

Returns of cod, ling, and hake fisheries in 1889, as compared with 1888.

The total quantity of white fish landed and used in a fresh state amounted to 1,977,357 cwts., against 1,901,439 cwts. in 1888, showing an increase of 75,918 cwts. The returns of white fish continue to increase, those of last year being higher than any of the preceding five years during which returns have been collected. The greatest increase was in cod, herrings, eels, and lemon soles. The total value of white fish landed and sold for consumption fresh was £744,351, being an increase over the previous year of £27,294. The total value of shell-fish landed was £63,201—a decrease of £8527 under 1888. Thus the total value of both white fish used fresh and shell-fish was £807,552,—an aggregate increase of £18,767 over 1888.

Total quantity of white fish used in a fresh state.

Aggregate value thereof, and of shell fish.

When the weather permitted, the white fishing was regularly prosecuted throughout the year, generally with satisfactory results. Haddocks were taken in large quantities, from $1\frac{1}{2}$ to 6 miles off the shore, during a period of about seven weeks, after which they began to spawn. No large shoals seem to have entered the Firth of Forth. The improvement in the quality of haddocks (referred to in the Report for 1888) was still more marked last year, particularly in those taken along the Berwick and Aberdeen coasts, the fish being large, and of superior quality. The demand for fresh fish was fairly good throughout the year, although prices were slightly lower than in recent years.

White fishing successful.

During the great summer and autumn herring fishery the weather was generally mild and suitable for fishing, there being no violent gales, and very few interruptions on account of storms. Throughout the remainder of the year the weather was generally favourable. Notwithstanding this, however, 72 lives were unfortunately lost in connection with the fisheries, being 13 more than in the preceding year. Thirty-six boats were totally wrecked, and 218 sustained damage—the aggregate loss being estimated at £7798. In addition, there was a loss of nets and other fishing material amounting to £38,662. During the last six years, 556 fishermen were drowned, or lost their lives in connection with the Scottish fisheries, 275 boats were totally wrecked, and 940 damaged, the total loss in boats and fishing material being estimated at £288,399.

State of weather.

Seventy-two lives lost.

Boats wrecked and damaged; and loss of fishing gear.

The number of fishermen and boys employed in connection with the Scottish sea fisheries of last year was 47,943. In addition, 63,915 persons were employed during a portion of the year, chiefly in connection with the summer herring fishery. The number of boats and vessels engaged was 14,714, being 190 less than in the previous year; and the capital invested in boats and vessels, nets and lines, was estimated at £1,603,307, being £40,173 less than in that year.

Persons employed.

Boats and capital invested.

HERRING FISHERY.

Cured Fish.

Herrings cured in each of the last seven years.

The following is a statement of the total quantity of herrings cured in each of the last seven years:—

Years.	Barrels Cured.
1883,	1,269,412½
1884,	1,697,077¼
1885,	1,572,952¼
1886,	1,312,223¼
1887,	1,303,424¼
1888,	1,118,872¼
1889,	1,397,507

Increase in 1889 over 1888.

These returns show that the quantity of herrings cured in 1889 was 278,634¾ barrels more than in the previous year, being an increase of 24·9 per cent., and an increase over the average of the preceding six years of 1·34 per cent. There was an increase on the East Coast in 1889, as against 1888, of 311,243¾ barrels; but on the West Coast, a decrease of 32,609 barrels; the net increase, therefore, being 278,634¾ barrels, as stated above.

Results of 1888 and 1889 compared.

The particulars of the results of the fishing of last year, when compared with those of 1888, in the herrings cured, branded, and exported and in the amount of brand fees received, show an increase in all the items, viz.:—

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees Received.
1888,	1,118,872¼	383,980½	774,193	6,399 13 6
1889,	1,397,507	455,285½	970,175¾	£7,588 1 10
Increase in 1889,	278,634¾	71,305	195,982¾	£1,188 8 4

A comparison of the results of 1889, with the average of the preceding ten years, shows a large increase in the quantity of herrings cured and exported, but a decrease in the quantity branded, and in the amount of brand fees received, viz. :—

Comparison of the results of 1889, with the average of the preceding ten years.

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees Received.
Average of ten years, 1879–1888,	1,298,348½	519,512	891,071	£8,658 10 8
Year 1889,	1,397,507	455,285½	970,175¾	7,588 1 10
Increase in 1889,	99,158½	...	79,104¾	...
Decrease in 1889,	...	64,226½	...	£1,070 8 10

SUMMARY OF HERRING FISHING.

Cured Fish.

I. East Coast.

The returns of the herrings cured on the East Coast of Scotland for 1889 show a collective increase in twelve districts, as compared with the quantity cured in 1888, of 383,462 barrels, and a collective decrease in five districts of 72,218¼ barrels, resulting in a net increase of 311,243¾ barrels in 1889, over 1888. The districts which mainly contributed to the increase were, Fraserburgh, Peterhead, Wick, Aberdeen, Buckie, Montrose, and Eyemouth. Those which exhibit the largest decreases were Shetland, Stonehaven, and Helmsdale.

Twelve districts show an increase and five a decrease

Net increase in 1889 over 1888.

The returns of herrings cured on the whole of the East Coast of Scotland in the fifty years preceding last year, on the average of each period of ten years, show a continuous large increase, with the exception of the period 1859–68.

East Coast fishing of preceding fifty years.

The particulars are as follow :—

Yearly average of barrels cured in periods of ten years.

Periods of Ten Years.	Yearly Average of Barrels Cured.
1839 to 1848 inclusive,	460,496¾
1849 „ 1858 „	521,206¾
1859 „ 1868 „	497,000½
1869 „ 1878 „	691,618¼
1879 „ 1888 „	1,063,796¾

Barrels cured in 1889, 1,183,857.

Increase in 1889 over 1888, and over preceding fifty years.

The quantity of herrings cured in 1889, when compared with 1888, shows an increase of 35·66 per cent.; when compared with the average of the preceding ten years, an increase of 11·28 per cent.; of twenty-five years, 48·41 per cent.; and of fifty years, 83·02 per cent.

II. West Coast.

Total decrease in herrings cured.

Three districts show an increase and five a decrease.

General view of fishing.

The returns of the herring fishing on the West Coast of Scotland show that the total quantity of herrings cured in 1889 was 213,650 barrels, as compared with 246,259 barrels in the previous year, being a decrease of 32,609 barrels. The three districts of Inveraray, Loch Carron and Skye, and Loch Broom show a collective increase of 23,592 barrels over the preceding year, of which Inveraray contributed nearly one half. On the other hand, the districts of Stornoway, Campbeltown, Ballantrae, Rothesay, and Fort-William exhibit a collective decrease of 56,201 barrels, the largest falling off, amounting to 50,283 barrels, being in Stornoway. Herrings have not been cured in Greenock district during the last four years, the whole of those landed having been used in a fresh state. Last year shoals were found in greatest abundance on the West Coast, in the districts of Loch Carron and Skye, Inveraray, and Campbeltown. Loch Fyne and Kilbrannan Sound, as in the previous year, yielded large catches of excellent herrings. An abundant fishing was also got in Lochindail, Lochghriunard in Islay, Loch Hourn, and the Sound of Sleat.

West Coast fishing of preceding fifty years.

The returns of herrings cured on the whole of the West Coast of Scotland in the fifty years preceding last year, on the average of each period of ten years, exhibit, with the exception of the period from 1869 to 1878, a continuous large increase. The catch for 1889, however, is 8·9 per cent. below the average for the last decade.

The following statement shows the particulars:—

Yearly average of herrings cured in periods of ten years.

Periods of Ten Years.	Yearly Average of Barrels Cured.
1839 to 1848 inclusive,	72,014¼
1849 „ 1858 „	92,615½
1859 „ 1868 „	147,949¼
1869 „ 1878 „	142,591
1879 „ 1888 „	234,551¾

Barrels cured in 1889, 213,650.

Decrease in 1889 under 1888, but increase over preceding fifty years.

The quantity of herrings cured in 1889, when compared with 1888, shows a decrease of 13·24 per cent.; when compared with the average of the preceding ten years, it shows a decrease of 8·91 per cent.; but on twenty-five years, an increase of 14·06 per cent.; and of fifty years, 54·88 per cent.

III. Both Coasts.

Herrings cured in each Fishery District in 1888 and 1889, and respective increases or decreases.

The following tabular statement gives the total quantities of all the herrings cured in 1888 and 1889, in each of the twenty-six districts embracing the whole coasts of Scotland, and shows the respective increases or decreases in 1889:—

The Twenty-Six Fishery Districts.	Year 1888, Barrels Cured.	Year 1889, Barrels Cured.	Increase in 1889.	Decrease in 1889.
Eyemouth,	44,573	56,305	11,732	...
Leith,	5,316	2,498	...	2,818
Anstruther,	9,942	9,261	...	681
Montrose,	34,670	50,580	15,910	...
Stonehaven,	22,624	13,410	...	9,214
Aberdeen,	101,877	132,968	31,091	...
Peterhead,	128,571	228,933	100,362	...
Fraserburgh,	170,600	308,121	137,521	...
Banff,	24,426	33,612	9,186	...
Buckie,	31,040	47,922	16,882	...
Findhorn,	22,592	30,205	7,613	...
Cromarty,	3,187	4,949	1,762	...
Helmsdale,	30,248	22,958	...	7,290
Lybster,	7,428	13,939	6,511	...
Wick,	113,706	151,273	37,567	...
Orkney Isles,	22,592	29,917	7,325	...
Shetland Isles,	99,221¼	47,006	...	52,215¼
Stornoway,	131,803	81,520	...	50,283
Loch Broom,	1,413	5,321	3,908	...
Loch Carron and Skye,	30,757	40,427	9,670	...
Fort-William,	986	969	...	17
Campbeltown,	49,232	45,883	...	3,349
Inveraray,	21,134	31,148	10,014	...
Rothesay,	1,238	594	...	644
Greenock,	...	...	...	...
Ballantrae,	9,696	7,788	...	1,908
Totals,	1,118,872¼	1,397,507	407,054	128,419¼

Totals of increases or decreases.

These statistics show that the total quantity of herrings cured in 1889, on both the East and West Coasts, was greater than in 1888 by 278,634¾ barrels; and the returns for the fifty years preceding last year, on the average of each period of ten years, show a continuous large increase. The following statement gives the particulars of this increase:—

Net increase in 1889 over 1888, and increase during preceding fifty years.

Period of Ten Years.	Average Number of Barrels Cured Yearly in each Period.	Increase in Average Number of Barrels Cured Yearly in each Period.	Increase per cent. in Average Number of Barrels Cured Yearly in each Period.
1839 to 1848 inclusive,	532,512¼	...	...
1849 ,, 1858 ,,	612,922½	80,410¼	15·06
1859 ,, 1868 ,,	644,949¾	32,027¼	5·22
1869 ,, 1878 ,,	834,209¾	189,260	29·34
1879 ,, 1888 ,,	1,298,348½	464,138¾	55·63
Barrels Cured in 1889,		1,397,507	

Yearly average increase in periods of ten years.

A general view may be formed of the immense importance and value of the herring fishery to not only those engaged in this industry but to the people generally, from an examination of the above statement. The total quantity of herrings cured in 1889, when compared with the average of the preceding ten years, shows

Value of herring fishery to people of Scotland.

Increase per cent. of 1889 over average of preceding ten, twenty-five, and fifty years. Great development of fishery since 1809.

an increase of 7·63 per cent.; when compared with the average of the preceding twenty-five years, an increase of 41·88 per cent.; and of the preceding fifty years, 78·11 per cent. The great yield of this fishery appears even more remarkable than is shown by these returns, when the fact is borne in mind that, in the year 1809, when the returns were first compiled by the former Fishery Board, the whole number of barrels cured was only 90,185½; while the number cured last year, as shown above, was 1,397,507.

Details regarding herring fishery.

No. I. Appendix A, gives some details taken from the reports of the inspectors and district officers regarding the herring fishery of 1889 in each of the twenty-six districts into which the coasts of Scotland are divided for fishery purposes.

HERRINGS CURED ON BOARD OF VESSELS AND ON SHORE.

Herrings cured on board of vessels.

No. II. Appendix A, shows the number of vessels fitted out in Scotland last year for the herring fishery; the districts from which they were fitted out; their tonnage, and the number of men; the quantity of netting, salt, and empty barrels shipped; and the total number of barrels of white herrings cured on board; distinguishing those cured gutted from those cured ungutted.

This branch of industry declining.

This branch of the herring fishing industry has been carried on chiefly among the sea lochs on the West Coast of Scotland, but for a number of years past it has been gradually declining. During recent years, however, strenuous efforts have been made to revive it on the East Coast, but, so far, it has proved unremunerative, partly owing to the herring shoals being found in greatest abundance upon the inshore grounds. Only one vessel was fitted out on the East Coast for this industry in 1889, and 58 on the West Coast. They made 66 voyages in all, and cured on board 29,558 barrels of herrings. Fifty-four vessels cured 16,568 barrels in 1888. The number of vessels some years ago varied from 90 to upwards of 300.

Total quantity of herrings cured in vessels and on shore.

No. III. Appendix A, shows the total number of barrels of white herrings cured or salted in Scotland last year, both on board of vessels and on shore, and the districts in which they were taken and cured, distinguishing the herrings cured gutted from those cured ungutted; and also the quantities of herrings cured as kippers, bloaters, or red herrings, or preserved in tins.

Herrings cured as kippers, bloaters, or red herrings, or preserved in tins.

The curing of herrings as kippers, bloaters, or red herrings, or preserved in tins, having now become an important and increasing branch of business in connection with the herring fishery of Scotland, the herrings treated in this way are distinguished in the appendix above referred to from those cured in the ordinary manner. Last year, 74,600 crans were kippered, 8948 crans were cured as bloaters or red herrings, and 16,923 crans were preserved in tins.

Further particulars thereof.

The kippering of herrings was most extensively carried on in the districts of Stornoway, Eyemouth, Aberdeen, Peterhead, Wick, and Fraserburgh. Of bloaters the largest quantity was prepared in the districts of Aberdeen and Anstruther, and the business of preserving herrings in tins was prosecuted chiefly in the districts of Aberdeen, Fraserburgh, and Peterhead.

BRANDING OF HERRINGS.

During the season of 1889, 475,566 barrels of herrings were presented to the Board's officers for the various official brands, and, after examination, 455,285½ barrels were branded, and 20,350½ barrels rejected as not being entitled to the brand. In 1888, out of 390,239½ barrels presented, 383,980½ barrels were branded, and only 6259 barrels rejected. These figures show an increase in the branding of 1889, over the preceding year, of 71,305 barrels. Quantity of herrings branded.

Of the number of barrels branded, 144,911 were branded 'Full,' 221,759 'Maties,' 63,440 'Spent,' and 25,175½ 'P,' or 'Mixed' brand. The amount of fees received by the Board on account of this service was £7588, 1s. 10d.

The herrings taken during 1889, were, on the whole, exceptionally poor in quality, especially the 'Maties,' the catch of which was unusually large. The 'Full' herrings, although fewer than in the previous year, were fully up to the average in quality. A considerable proportion of the 'Maties' were so immature that it was impossible to cure them up to the standard required for the brand. Were it not for this circumstance a much larger number of barrels would have received the brand. Quality of herrings.

It is almost unnecessary again to mention that the Board deem the branding of herrings one of the most important branches of the service, and that the herrings presented for the Government brands should, in every respect, conform to the requirements of the Fishery Acts and the regulations of the Board. Branding of herrings important branch of service. It was stated in the Board's last Report that it appeared, much to their surprise, that from the recent reports of Her Majesty's Diplomatic and Consular officers abroad, grave allegations had been made on the Continent as to the trustworthiness of the Government brand; and that, in view of these reports, the Board had been inquiring into the whole matter with the object of, as far as possible, restoring the prestige of the Scottish cured herrings in the Continental markets. Reports thereon by H.M. Diplomatic and Consular officers abroad. During the course of that enquiry, several complaints were received from the Continent of the bad condition of crown branded herrings which had been sent there, and a quantity of these herrings having been returned to this country for the purpose of being examined, an examination of them was carefully made by Mr James Johnston, a member of the Board, and their general and assistant inspectors. In the circumstances of the case, the Board appointed a deputation consisting of Mr James Johnston and Mr William Anderson Smith, two of their number, to be accompanied by one of the fishery officers, to visit certain places on the Continent to enquire into the complaints against branded herrings, and also to make enquiry on the subject, generally, with a view of enabling the Board to deal with certain proposals which had been made for altering the classification of cured herrings for the government brand, and of raising its character. Deputation from Board appointed to visit Continent. The deputation presented to the Board a full report on the whole matter, with a number of recommendations, which has been receiving their most careful consideration with the intention of taking such steps as will attain the desired object.

Particulars of herrings branded.

No. IV. Appendix A, shows the total number of barrels of white herrings which were branded in Scotland last year, and of the brandings in each district. This Appendix also shows the respective numbers of barrels which were branded 'Full,' 'Maties,' 'Spent, and 'P,' or 'Mixed,' and the amount of brand fees collected.

Comparison of brandings with 1888.

It will be seen from that Table that in the year 1889, as compared with 1888, there was a decrease of 42,235 barrels in the quantity of herrings branded 'Full,' although the number of barrels cured was much greater than in the latter year, which shows that the herrings of last year were of an inferior quality. The quantity branded 'Maties' shows the very large increase of 133,733 barrels, the quantity branded 'Spent,' a decrease of 22,850 barrels, and the quantity branded 'P,' or 'Mixed,' an increase of 2657½ barrels.

HERRINGS EXPORTED.

Quantity of cured herrings exported.

The total quantity of cured herrings exported from Scotland in 1889 amounted to 970,175¾ barrels, against 774,193 barrels in 1888, being an increase of 195,982¾ barrels.

Places to which exported.

It will be seen from the subjoined Table that Germany and other places on the Continent imported 196,693¼ barrels more than in the previous year, and that the demand from Ireland was less by 1385½ barrels. Places out of Europe took 675 barrels more than in 1888, a great proportion of which went to America, chiefly in barrels, half-barrels, quarter-barrels, eighth-barrels, and sixteenth-barrels. A number of the barrels and half-barrels were branded 'Crown Full.' All the smaller sizes, however, consisted of repacked herrings, and amounted to about one half of the total export to America. The chief ports from which these herrings were shipped were, Greenock, Leith, and Aberdeen. Besides these, which form only a small portion of the Scottish herrings that enter the American market, a large quantity which had been exported to Hamburg were repacked there into small kegs, and reshipped to America. Stettin, being the principal herring market of Germany, took the largest portion of the quantity exported to that country, amounting to 319,170¾ barrels.

Exports in 1888 and 1889 compared.

The following table shows the number of barrels of cured herrings exported from Scotland in the years 1888 and 1889:—

Years.	To Ireland.	To the Continent.	To Places out of Europe.	Total Number of Barrels Exported.
1888, ...	34,038½	735,230½	4,924	774,193
1889, ...	32,653	931,923¾	5,599	970,175¾
Increase in 1889, . .	...	196,693¼	675	195,982¾
Decrease in 1889, . .	1,385½	...	...	...

Particulars of barrels exported.

No. V. Appendix A, shows the total number of barrels of white herrings exported from Scotland last year; and the districts from which they were exported; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and distinguishing also herrings crown branded from herrings unbranded, and giving the quantity of herrings repacked. To this Table is appended a supplementary note, showing the ports or places to which the herrings exported to the Continent were shipped, and the total quantity exported to the Continent.

Herrings cured, branded, and exported, 1875 to 1889.

No. VI. Appendix A, gives an abstract of the total quantity of white herrings cured, branded, and exported, year by year, *in so far as brought under the cognizance of the fishery officers* from 1st January 1875 to 31st December 1889; distinguishing the export to Ireland, to the Continent, and to places out of Europe.

WINTER HERRING FISHERY.

Winter herring fishing not so successful as in preceding three years.

The Scottish winter herring fishing of 1889 was not so successful as in the preceding three years. The total quantity landed amounted to 75,407 crans, against 79,756 crans in 1888, and 162,900 crans in 1887. Of last year's catch, 51,614 crans were landed at eleven districts on the East Coast, and 23,793 crans at six districts on the West Coast. The districts which show the largest returns are, Anstruther, Wick, Leith, and Peterhead on the East Coast; and Ballantrae, Campbeltown, and Stornoway on the West Coast. Fluctuations are usually of more frequent occurrence in the winter than in the summer herring fishing. This, in a great measure, can be attributed during the winter of 1889 to the stormy state of the weather, which has an important bearing upon all the sea fisheries, and especially upon the herring fishery. The winter herrings of 1889 were generally larger than those of former years—from 700 to 780, on an average, filling the cran. They had a remarkably bright colour, but, as usual, they were not so rich in flavour as the summer herrings. Prices ranged from 3s. to 30s. per cran, the average being about 12s. Comparatively few of the herrings landed in the winter of 1889 were cured for exportation, nearly the whole of them being used in this country either in a fresh state, lightly salted, or made into kippers or bloaters.

Districts where prosecuted.

Fluctuations in the fishing.

Quality and prices of herrings.

How disposed of.

Daylight and Sunday Fishing prohibited on West Coast.

Regulations as to close time for herrings on West Coast.

By the fifth section of the Herring Fishery (Scotland) Act, 1889, it is enacted that it shall not be lawful to set or shoot any herring net on any day between sunrise and one hour before sunset on any day between the first day of June and the first day of October, nor between sunrise on Saturday morning and one hour before sunset on Monday evening, on the West Coasts of Scotland between the Points of Ardnamurchan on the north and the Mull of Galloway on the south.

It is further enacted that any person contravening the above section shall be liable, on conviction under the Summary Jurisdiction (Scotland) Acts, to a fine not exceeding for the first offence five pounds, and for the second or any subsequent offence twenty pounds; and that every net set, or attempted to be set, in contravention of this section shall be forfeited, and may be seized and destroyed or otherwise disposed of by any superintendent of the herring fishery or other officer employed in the execution of the Herring Fishery (Scotland) Acts.

Illegal-Sized Herring Barrels.

Large number of undersized herring barrels made.

The Board regret to state that, notwithstanding the several warnings issued against the use of barrels, with a less capacity than the legal standard of $26\frac{2}{3}$ imperial gallons, for packing cured white herrings, they had reason to believe that a large number of such barrels had been made and were intended to be used during last year's summer herring fishery.

Seizure of barrels under legal size.

In these circumstances the Board were under the necessity of issuing instructions to their officers to seize all undersized barrels which might be found filled with cured white herrings, and seizures were accordingly made at Leith, Stornoway, Castle Bay, and Shetland. These seizures were prosecuted in terms of the Statute, and in every case the barrels and herrings were condemned and forfeited, and thereafter sold for behoof of the Crown. In one of the cases an appeal was made to a higher Court from the decision of the sheriff; but his judgment was confirmed.

Their condemnation and sale for behoof of Crown.

Good Results.

The proceedings of the Board have had a very salutory effect in checking the use of undersized barrels. The fishery officers report that all barrels now being made are of the legal size, and that in numerous instances where small barrels were in store they have been enlarged to the capacity required by the Act.

Expression of opinion elicited from fishcurers as to existing law regarding barrels.

The Board were desirous of getting an expression of opinion from the Scottish fish-curing trade on the question of barrels and half-barrels for the packing, shipping, or exporting of cured white herrings, with the view of ascertaining what changes, if any, should be made in the existing law. With that object they prepared a list of queries (see Appendix A. No. VII.) which were sent to the trade generally, asking that they would be good enough to make replies thereto, and thereafter return the list to the Board. These queries were forwarded to 859 persons and firms, of whom 592 sent replies.

Board concluded that barrels and half-barrels should be stamped by them before being used.

The Board gave very full consideration to the expression of opinion thus elicited, and they came to the conclusion that, in order to secure to the public a guarantee that the barrels and half-barrels were of the statutory size, it should be enacted that cured white herrings should only be packed in barrels or half-barrels which bore an official stamp of the Board, certifying that they were of the legal capacity; and that the Board should charge a fee of one halfpenny each for every barrel or half-barrel for this service—such payment to be afterwards deducted from the brand fee.

This conclusion was communicated to your Lordship, and the Board trust that it will receive such consideration as the importance of the subject merits.

Hooping of Herring Barrels.

New regulations made as to hooping of herring barrels.

Four years have now elapsed since an alteration was made in the regulations for hooping white herring barrels, at the request of a number of fishcurers at some of the principal stations in Scotland, under statutory powers subsequently acquired by the Board. Previously, it was only lawful to hoop such barrels with wooden hoops; but under the new regulations either wooden or iron hoops may be used. The reasons for the change were fully given in a previous Report; but it may be here repeated that there was often a difficulty in procuring, at a moderate price, a sufficient quantity of wooden hoops to meet the requirements of the trade; while an unlimited supply of iron hoops could be obtained at any time; and also that iron hooped barrels could be made stronger and more easily tightened than those hooped with wood.

Reasons for change.

The new regulations have given general satisfaction. During the past year, 848,984 white herring barrels were made in Scotland, and of these 543,037 barrels, or 63·9 per cent., were hooped more or less with iron hoops; 305,947 barrels with wooden hoops; and 1000 with iron hoops entirely. The method most approved of seems to be hooping partly with iron and partly with wooden hoops, as it is being adopted to a greater extent each year.

Results satisfactory.

Standard Measures for Fresh Herrings.

As stated in a former report, representations have been frequently made to the Board, by large numbers of fishermen at different parts of the coasts, that the mode adopted for the measurement of fresh herrings, as between buyer and seller, was of a very unsatisfactory character, and they asked that the Board would take steps to put matters on a better footing, and especially that they would frame a regulation for making quarter-cran measures of basket work, and legalise their use. Fishermen and also numerous fishcurers complained that, in the delivery of herrings, baskets were frequently used for measuring them, which, while being represented as of the capacity of a quarter cran, were of larger size; and that there was, therefore, a great lack of uniformity in this respect.

Fishermen desire that a quarter-cran Measure be legalised.

Reasons therefor.

Powers have been conferred upon the Board by the Herring Fishery (Scotland) Act, 1889, and under that Act they are authorized to make regulations for the construction and branding of a quarter-cran measure which may be used for buying, selling, delivering, or receiving fresh herring in the Scottish Herring Fishery, being a measure of such capacity that four times its content, when filled with herrings, shall be equal to one cran.

Board authorised to make regulations for constructing and branding quarter-cran measure.

Acting under these powers, the Board have made and established regulations for the construction and branding of such a measure which shall take one of the two following forms:—

Regulations made.

I. Basket Measure.—A basket of a circular form, well bound, and composed of willows, pieces of hoopwood, hardwood, and cane, all of fresh quality, and of suitable size and strength, which shall, for convenience in use, have two cane handles, and shall have a crown brand on each side.

Quarter-cran basket measure.

II. Box Measure.—An oblong box, constructed of properly seasoned fir or other suitable wood, well bound with iron hoops secured by nails, all of suitable size and strength, which shall, for convenience in use, have two rope handles, and shall also be crown branded.

Quarter-cran box measure.

Regulations printed and circulated.

The regulations have been printed and circulated for the information of the fishing trade. A copy of them forms Appendix A, No. VIII. to this Report and they may be had on application to any of the Board's fishery officers. A basket and a box measure made and crown branded according thereto may be seen at the assistant inspector's office in Leith, or at any of the district fishery offices of the Board, and measures may be presented for the purpose of being crown branded at such time and place as may be arranged by the fishery officer of the district.

Cran and quarter-cran only legal measures for sale or delivery of fresh herrings.

The measure known as the cran may also be used for buying selling, delivering, or receiving fresh herrings; but any person using any measure other than this, or the basket or box measure aforesaid, shall be liable, on conviction under the Summary Jurisdiction (Scotland) Acts, to a fine not exceeding five pounds for the first offence, and not exceeding twenty pounds for the second or any subsequent offence; and also to the forfeiture of the measure or measures, which may be seized and destroyed or otherwise disposed of by any superintendent of the herring fishery or other officer employed in the execution of the Herring Fishery (Scotland) Acts; provided always that nothing shall prevent the sale of herrings by weight or number or in bulk.

These measures now in general use, and giving satisfaction.

The basket and box quarter cran measures, made and branded under the regulations, are now in general use along the coasts of Scotland; and the Board are much gratified to learn that they have given great satisfaction to the fishermen and to a majority of fish-curers, and remedied a very great grievance.

COD, LING, AND HAKE FISHERY.

Cured Fish.

Cod, ling, and hake fishery successfully prosecuted.

The cod, ling, and hake fishery of Scotland was prosecuted during the past year with better success than in the preceding eight years. Of the gross catch, the districts of Shetland, Orkney, Stornoway, and Anstruther show the largest quantities cured.

Quantity of fish cured in each of the last six years

The following is a statement of the total quantity of cod, ling, and hake cured in each of the last six years:—

Years.	Cured Dried. Cwts.	Cured in Pickle. Cwts.
1884,	124,506½	5,907½
1885,	125,352½	7,100
1886,	121,078	6,700
1887,	122,832	7,538
1888,	137,216	7,052
1889,	145,661	6,920

The particulars of the results of the fishing of last year, when compared with those of 1888, in the cod, ling, and hake cured dried, and in pickle, and exported, are as follows:—

Cod, ling, and hake cured and exported in 1888 and 1889.

Years.	Total Quantity Cured.		Total Quantity Cured Dried, and in Pickle, Exported.					
	Dried.	In Pickle.	To Ireland.		To the Continent.		To Places out of Europe. Dried.	Total Quantity Exported.
			Dried.	Pickled.	Dried.	Pickled.		
	Cwts.	Barrels.	Cwts.	Barrels.	Cwts.	Barrels.	Cwts.	Cwts.
1888,	137,216	7,052	51,082	224	29,156	...	7,862	88,660
1889,	145,661	6,920	65,023	...	32,685	...	10,990	108,698
Increase in 1889,	8,445	...	13,941	...	3,529	...	3,128	20,038
Decrease in 1889,	...	132	...	224	...	...	...	...

The above returns show a considerable increase against 1888 in the quantity of these fish cured dried, as well as in the quantity exported to Ireland, the Continent, and places out of Europe. There is, however, a small decrease in the quantity pickled. The demand from the Spanish markets exhibited some improvement as compared with 1888. The exports to that country in dried fish have recently been greatly restricted owing to the differential duties charged there. — Increase in 1889 over 1888.

No. I. Appendix B, gives some details taken from the reports of the inspectors and district officers, regarding the cod, ling, and hake fishery of 1889. — Details regarding cod, ling, and hake fishery.

No. II. Appendix B, shows the number of vessels fitted out in Scotland last year for the cod and ling fishery; the districts from which they were fitted out; the tonnage of the vessels; and the number of men; also the quantity of cod, ling, and hake cured on board; distinguishing whether cured dried or cured in pickle. — Cod, ling, and hake cured on board of vessels.

No. III. Appendix B, shows the total quantity of cod, ling, and hake taken at the cod and ling fishery in Scotland last year by boats and vessels, and cured on shore, distinguishing the fish cured dried and the fish cured in pickle; and distinguishing also the districts in which they were cured. — Cod, ling, and hake cured on shore.

No. IV. Appendix B, shows the total quantity of cod, ling, and hake taken, both by vessels and boats, at the cod and ling fishery in Scotland, and cured last year; and the districts in which they were cured; distinguishing the fish cured dried and the fish cured in pickle. — Total of cod, ling, and hake cured in vessels and on shore.

No. V. Appendix B, shows the total quantity of cod, ling, and hake exported from Scotland last year; and the districts from which they were exported; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and also whether cured dried or cured in pickle. — Cod, ling, and hake exported.

No. VI. Appendix B, gives an abstract of the total quantity of cod, ling, and hake cured and exported, *in so far as brought under the cognizance of the fishery officers*, from 1st January 1875 to 31st December 1889. — Cod, ling, and hake cured and exported, 1875 to 1889.

TOTAL QUANTITY OF FISH LANDED.

In Appendix C, No. I., will be found a statement of the total quantity and value of the different kinds of white and shell-fish — Quantity and value of white and shell-fish landed.

landed in Scotland, in the year 1889, as compared with 1888, distinguishing the respective quantities and values landed in each of the twenty-six districts into which the coasts of Scotland are divided for fishery purposes.

White and shell-fish landed in the last two years.

The total quantity and value of white fish landed last year was 5,589,239 cwts. and £1,454,175 respectively, and the value of shell fish landed was £63,201,—making the value of both white and shell fish £1,517,376. In 1888 the quantity of white fish landed was 4,633,556½ cwts., valued at £1,332,760, and the value of shell fish was £71,728,—making the value of both £1,404,488. This shows an increase of white fish in 1889 over 1888 of 955,682½ cwts., and of £121,415, but a decrease in the value of shell-fish of £8,527,—the net increase in value being £112,888.

Quantity and value of fish landed by beam trawlers.

Appendix C, No. II., is a statement of the total quantity and value of the different kinds of white fish taken by beam trawl vessels, and landed in Scotland in 1889, and showing the quantities landed in different districts.

It will be seen by this statement that the total quantity and value of all kinds of white fish landed last year by beam trawl vessels was 252,524¼ cwts., valued at £158,306,—being 4·51 per cent. of the total quantity landed, and 10·88 per cent. of its value; but, excluding herrings and sprats, the quantity landed by these vessels was 13·53 per cent. in weight, and 21·46 per cent. in value.

Returns collected by Board's officers.

These statistics have been compiled from returns collected by the Board's officers in the twenty-six districts, assisted by a number of correspondents resident at different harbours and creeks.

Published monthly.

As early in each month as possible, a statement was published of the total quantity and value of the different kinds of white and shell-fish landed during the preceding month, distinguishing the respective quantities landed in each district, and the values thereof; and a copy of this statement was regularly sent to the Board of Trade and published in their Monthly Journal.

Fish Sold for use in a Fresh State.

Fish sold for use in a fresh state.

The following statement shows the total quantity and value of white fish landed in Scotland and sold for use in a fresh state, during the last six years. It also shows the value of shell-fish landed for the same period.

Details thereof for last six years.

Years.	Total Quantity of White Fish used Fresh.	Total Value of White Fish used Fresh.	Total Value of Shell Fish.	Gross Total Value.
	Cwts.	£	£	£
1884, ...	1,494,042	716,295	80,939	797,234
1885, ...	1,725,459	737,824	89,193	827,017
1886, ...	1,714,453	685,973	73,287	759,260
1887, ...	1,877,998	694,091	67,315	761,406
1888, ...	1,901,439	717,057	71,728	788,785
1889, ...	1,977,357	744,351	63,201	807,552
Totals, ...	10,690,748	4,295,591	445,663	4,741,254

Comparison of 1889 with preceding five years.

It will be seen from the above statement that although the total quantity of white fish consumed fresh has considerably increased since these returns were first collected six years ago, there has not been a corresponding increase in the total value. The total weight of last year's catch, when compared with the average of the preceding five years, shows an increase of 13·46 per cent., while the increase in value is only 4·23 per cent. The value of shell-fish landed last year, when compared with the average of the preceding five years, shows a decrease of 17·37 per cent., while the value of both white and shell fish shows the small increase of 2·64 per cent.

Prices.

The prices of white fish sold for consumption fresh were fairly well maintained throughout the past year. The average was 7s. 6¼d. per cwt.—about the same rate as in 1888,—being the amount received by the fishermen for their catches.

Causes of reduction in same.

Since 1884, when returns of the above nature were first compiled, there has been a decline in prices of about 2s. per cwt. This is partly due to the large quantity of fish landed, and partly to the competition of foreign fish in some of the principal markets.

Details regarding fish used fresh.

Appendix C, No. III., gives some details, taken from the reports of the inspectors and fishery officers, of the total quantity and value of the different kinds of white and shell fish landed in Scotland last year.

OYSTERS.

Supply falling off rapidly.

The statistics for the past year show an improvement in the supply of oysters compared with the previous year, but the quantity is not one-half of what it was only a few years ago,—and altogether insignificant, when contrasted with the abundance of fine oysters for which the Firth of Forth and other Scottish waters were at one time famous. The following are returns for the last seven years, during which the present Board has been in existence:—

Year	Hundreds	Value
1883	6456	£3406
1884	5176	2174
1885	2202	809
1886	2956	1295
1887	2130	965
1888	1527	742
1889	3119	1453

Of the above quantity nearly nine-tenths belong to the West Coast, where the chief seats of the industry now appear to be Inveraray and Ballantrae. On the East Coast, Leith is the only port where oysters are landed, and there the trade has dwindled down to 315 hundreds,—returned as of the value of £175, and which therefore must have cost the consumer over 11s. a hundred. It is melancholy to think that a once considerable industry has fallen so low. About the beginning of the century the scalps of the Firth of Forth were so productive that 6000 oysters were frequently dragged by one boat in a single day, and after supplying the local demand at 1s. 3d. a hundred, were shipped in great quantities to Newcastle, or carted to Glasgow. Sir John Sinclair, in his Statistical Account of Scotland, published about the year 1800, mentions the case of a merchant at Leith who for ten years paid £2500 sterling per annum for oysters (vol. xvii. page 69). But already the destructive effects of over fishing were beginning to be felt. At Cramond the fishermen sold their oysters to the Dutch for 4s. the herring barrel, with the result that instead of making 30s. a day as they used to do, less than half the usual number of boats were able to find profitable employment, and that only occasionally. Burntisland also had its oyster beds—belonging partly to the burgh and partly to the Earl of Morton. In the parish of Tranent, 4000 to 7000 a day was some years previously a good fishing for a single boat, although a boat would sometimes drag 9000 in a day, which at 5d., 6d., 7d. a hundred, afforded a good income to a crew of five. But 'latterly (says Sir John), oysters 'have become scarce, and at present 700 or 800 are reckoned a good 'day's work.' The parish of Prestonpans appears to have lived off its oysters, the oyster boats belonging to the parish being 10 in number, each requiring a crew of five men; and three or four times in a season a boat sailed to Newcastle, with a cargo of oysters to the number of 30,000, sometimes 40,000. Among the enemies of the oyster found among the oyster beds, Sir John Sinclair mentions 'buckies, clams, sea-urchins, star-fish, and corse-fish'—and to these, along with over-fishing and the throwing of refuse into the river, we may attribute the decay of the once famous oyster beds of the Firth of Forth.

Having regard to the above facts in the history of this industry, and the progressive and almost continuous decline in the supply of oysters, both in quantity and value during the last few years, we do not see how its complete extinction can be averted unless some decided steps for its revival are immediately taken. Without this, oysters are likely to become scarcer and dearer; and this is not to be wondered at. It is only another proof that the country which trusts exclusively to its natural oyster beds, without making proper provision for their protection and systematic culture, is doing itself a grave injury. The experience of almost every other country has been the same. The districts around the Isle d'Oleron, on the west coast of France, which yielded 10,000,000 oysters in 1853–54, and 15,000,000 in 1854–55, yielded less than half a million in 1863–64; and the produce of the rich beds of the Bay of Cancale, on the coast of Normandy, gradually fell from 71,000,000 of oysters in 1847 to 1,000,000 in 1865–66.

Protection and cultivation necessary.

Experience of other Countries.

France.

In 1851, under the direction of Professor Coste, the distinguished embryologist of the College de France, the French Government introduced the system of strewing oyster shells on the sea-bottom, as cultch, to which the fry diffused throughout the water could attach themselves. In later years artificial oyster culture was further developed both in France and Holland on a very extensive scale with astonishing success. In particular, the supply was increased manyfold at Arcachon, the number of oysters exported from that basin alone having risen from 4,897,500 in 1871 to 195,477,357 in 1880.

Supply increased in France and Holland.

America.

Natural Beds fished out.

In America, although in earlier times oysters were found in large quantities on the coast of New England, the natural growth beds north of the Chesapeake are now said to be practically worthless (save as nurseries for seed). Those on Rhode Island and Connecticut are reported extinct; and even the great beds of Maryland and Virginia are, it appears, becoming rapidly exhausted.

About ten years ago the marked decrease in the supply of oysters in the United States attracted the attention of the State Legislatures to the subject; and there is now in operation in Long Island Sound a system of artificial beds, which are held as private property by individual fishermen for a small annual payment to the State, and are cultivated by them like an oyster farm. The first experiments in this direction were made, it is said, near the city of New York about the beginning of the century, but it had apparently fallen into disrepute, until it was again taken up by Mr H. C. Rowe of Newhaven, in Connecticut, who about the year 1874 began sowing shells in deep water. The success of the system in Long Island Sound has been so great that Mr Rowe now sows as many as 100,000 bushels of shells annually upon what is now the most colossal oyster farm in the world, embracing an area of 15,000 acres of the bottom of the sea. The example of Mr Rowe has been followed by others engaged in the oyster industry in the State of New York, and under the fostering care and judicious guidance of the Commission appointed by the State, and presided over by Mr Eugene G. Blackford, Commissioner of Fisheries, it has become a very important industry. The success of the system is sufficiently indicated by the fact, that while in 1860 the vast majority of the oysters sold in the New York market came from natural beds of oysters of natural growth, to-day 60 per cent. of the annual supply is from planted beds, and the oyster industry is rapidly passing from the hands of the fishermen to those of the planter and oyster-culturist.

State interference.

Oyster Farms held as private property.

Sixty per cent. of supplies is from planted beds.

It is well known that the artificial propagation of the oyster is as easy as any other kind of fish hatching. The sexes are distinct in the American oyster, and the removal and artificial fertilisation of the eggs is not difficult; but, as the matter was explained to one of our number * during a recent visit to the City of Washington by Colonel Marshall M'Donald, of the United States Fish Commission, although it is possible to produce a set of spat in this way, it has not yet been accomplished to an extent sufficient to be of much value. 'The failure,' said Colonel Marshall M'Donald, 'is due to 'imperfect trials, but we have full confidence in being able to 'obtain some methods of artificial culture of the oyster which can 'be carried on by private individuals.' In the United States the point appears to have been of less importance, from the abundant supply of seed oysters which is obtainable from certain parts of the coast, at a cost of 40 cents to a dollar per bushel, according to quality and size. It has accordingly been unnecessary to do more than make arrangements for their being planted under proper conditions, and carefully preserved against their natural enemies until they come to maturity.

Artificial Propagation of the Oyst[illegible].

An oyster bed is a kind of community, having many wants in common, and finding their food in the minute forms of animal and plant life floating in the adjoining waters. It is a community, however, with few friends and many enemies, such as the starfish,

* The Deputy-Chairman.

Enemies of the Oyster.

Chief causes of depletion are over-fishing, river pollution, and deposits of mud.

the whelk, and a small univalve mollusc called the "drill" (*Urosalpinx cinerea*); but it is found that the damage done by the predatory attacks of these animals is small compared with excessive fishing, river pollution, and the deposition of mud killing the infant brood. These facts indicate clearly enough the direction in which our efforts for the multiplication of the oyster and the revival of our oyster beds ought to proceed.

The system of collecting the Spat.

In France.

Both in France and America the plan which has been followed is, not to produce oysters artificially, but to try to collect the spat as it comes by natural means upon 'collectors.' The method used at Arcachon is during the spawning season to suspend tiles in the water coated with plaster, to which the young oysters readily adhere. When they have set upon the tiles the latter are taken up, the plaster is sheared off with the adhering oysters, and the tile is planted again. The plaster holding the spat is then planted out like a plant taken from a seed bed, and allowed to grow up to maturity under conditions adapted to its proper preservation.

In America.

In America the method followed is in principle the same, but carried out in a very different manner. It is found unnecessary to have recourse to the troublesome and expensive method which is followed in France of collecting the spat. Refuse oyster shells, tiles, slates, a lot of dead bushes weighted with stones and heaved overboard—anything, in fact, to which the young oyster can cling is laid down in some inland basin over which the tide ebbs and flows. In this manner there is formed an artificial bottom, which is planted and replanted, so that the spat is carried over them. It takes from three to four years for the spat to grow to maturity in some places, although in others they are ready for market in the second or third year. It thus becomes necessary for the oyster planter to have three or four separate plots of ground, to be yearly seeded in succession, so as to give him a crop for each year.

Security of Tenure necessary.

Where so much depends upon the planter himself, it is obviously proper that he should have a direct personal interest in the work in which he is engaged. No one could be expected to cultivate the oyster land scientifically, and at considerable expense, unless he is made reasonably certain that he will be allowed to reap the fruit, and it is only by guaranteeing security of tenure that the State can prevent the reckless and excessive dredging which has been the ruin of natural beds, and stimulate the fisherman to take the measures necessary for the protection of his oysters from their natural enemies.

A perpetual Franchise to the ground granted,

which is the only practical solution of the Oyster question.

With this view, an Act was passed by the State of Connecticut (since made the model of similar legislation in several of the neighbouring States), under which, in consideration of a certain payment, and a small annual tax, the fisherman obtains from the State a perpetual franchise of the ground under the sea, which he occupies and holds. Under the operation of this Act, many thousand acres in Long Island Sound have been taken up by the planters, and are now being cultivated with remarkable success. The system has been cordially accepted by the fishermen. It is approved by all the leading oyster experts in America; 'and there 'can be no doubt,' says Mr Blackford, 'that this is the only prac- 'ticable solution of the oyster question.' In 1889 the Commissioners of Fisheries of the State of New York reported to the Legislature that 'the security of tenure afforded by the Act of '1887, known as the Oyster Franchise Law, bids fair to make this 'State one of the greatest oyster-producing States on this continent. 'Already it is estimated that ten times the amount of land is being 'cultivated that was occupied ten years ago, and the rapidly in-'creasing demand warrants the belief that the growth of the 'business will be even greater during the next ten years. In fact, 'there can be no doubt that the depletion and exhaustion of the 'great natural oyster beds of Chesapeake Bay will ultimately 'compel the artificial cultivation of every available acre of land 'under water in New York State.' In 1887 the Commissioners fixed the price of the land already in cultivation at 50 cents the acre, and decided that new land should be sold by auction at not less than a dollar per acre. The annual tax is 6 cents an acre. As regards the area which may be embraced in a single lease, the limit allowed by law is 250 acres; but many applicants are content with an allotment of from one to three acres, from which it is found that a single fisherman can make a very decent living.

The results in New York State.

Professor Ryder, who was formerly connected with the Fish Commission, and is now Professor of Embryology in the University of Pennsylvania, and who has been working on the oyster question for about ten years, recently published a pamphlet embodying the results of his experiments. 'The practical man,' he says, 'has no time to waste upon the anatomy or development of 'the animal. What he wants to know is not how the egg of the 'oyster segments and develops, but what the habits of the minute 'creature are when it is first let loose in what must seem to it, if 'conscious, a truly vast universe of water. Moving about in its 'element with the help of the fine cilia encircling its velum, it 'swims until it finally meets with a nidus to which it can glue itself 'fast with the margin of the left lobe of its tiny mantle. Once 'fixed, its wandering existence is for ever at an end. It is now ready, 'by slow stages of growth, to become more and more like its 'parent.' What is needed is a study of the habits of the animal, and then to create the necessary favourable conditions by artificial means for its growth towards maturity.' In his view the method adopted at Long Island Sound might be greatly improved by a more scientific method of providing the spatting surface than is obtained by scattering the cultch, such as tiles and slates, at the bottom of the sea, and allowing the embryos to become diffused through an enormous body of water.

The Method proposed by Professor Ryder.

He proposes to place, in a pond or other enclosed area, say 40 feet square, 100 bushels of spawning oysters, which at the rate of 50 females per bushel, a very low estimate, ought to yield 100 to 200 billions of fry. From the pond the water flows into the sea by a series of zig-zag canals 3¼ feet wide, in which a system of collectors is suspended, 400 in number, consisting essentially of flat baskets having the bottoms and ends formed of galvanised iron netting, with a mesh of 1 inch to 1½ inches, filled with clean oyster or clam shells as cultch for the spat. During the rise and fall of the tide the water will have to pass through them four times a day, and as the water is thoroughly charged with embryos the greatest possible opportunity is afforded for the young fry to fix themselves. Careful provision is made against the accumulation of sediment, for he says it must be considered a cardinal principle in practical oyster culture that the cultch, in order to be available, or to afford an eligible surface for the existence of the adhering fry, must be clean. 'If the cultch becomes thickly coated with 'vegetable life, such as filamentous algæ or diatoms, or with 'incrusting animal life, such as boyozoa, barnacles, and ascidians, 'ooze or sediment, the chances for the survival of the adherent fry, 'and its capability of growing into spat, is greatly diminished or 'rendered quite impossible. Diatoms will very often increase on 'such surfaces with prodigious rapidity, and form a thick coating 'which will greatly interfere with the life of the very first adherent 'stages of the oyster. In fact, the latter are asphyxiated in pro-'digious numbers from such causes.' The cultch may be allowed to remain in the suspended receptacles in the canals until the first or the middle of October, when it should be taken out and spread upon the bottom in the planting beds, where the fry has to grow larger. One advantage of this method is, that it puts it in the power of the culturist to obtain his own seed for planting, and while his main source of supply will be the natural yield thrown off by the adult oysters, he will be able in addition to call in the aid of artificial fertilisation to supplement the supply of fry yielded naturally.

The importance of clean cultch.

Colonel M'Donald's opinion.

The opinion expressed by Colonel Marshall M'Donald, on the occasion above mentioned, is that the Long Island system, subject to the remarks and suggestions made by Professor Ryder, was well worthy the consideration of this Board, as the most practical and efficient method of increasing the supply of oysters which has yet been discovered. This opinion was concurred in by Dr Richard Rathbun, who is employed by the Fish Commission as the assistant in charge of the scientific inquiries, and the other assistant, Captain J. W. Collins, both of whom were of opinion that, by the adoption of some such system in Scotland, the culture of oysters might be made an industry of commercial importance, while the benefit which would be gained by the public in having an abundant supply of cheap oysters is beyond question. Considering that America is so far before us on this subject, we believe that, instead of trying experiments of our own, and seeking to solve questions of purely scientific interest, we cannot do better, for at least some years to come, than follow in the wake of American experience, and it is satisfactory to know that this Board, having had transferred to them, by the 11th section of the Sea Fisheries (Scotland) Amendment Act, 1885, all the powers of the Board of Trade under the Sea Fisheries Acts as to oyster and mussel fisheries, is in a position to grant a lease of oyster ground, similar to the American franchise, to any person or persons who may be desirous of embarking in the business of planting and cultivating oysters.

Present condition of Scottish oyster beds.

As to the subject of oysters in Scotland, we must first of all understand the present condition of those beds which, once famous for their abundance of good oysters, are now ruined and desolate. Almost every known oyster bed in Scotland might be put under this category. Two localities which perhaps might be excepted are

Loch Ryan, where the banks yield a small return, and are let out in lots to several oystermen, and West Loch Tarbert, Argyleshire, where a system of oyster farming somewhat on American lines has been started and is apparently doing well.

In all the other cases, where indiscriminate fishing is carried on, and where no system of supervision exists so as to protect the oysters during spawning time, or from their enemies, the beds are reduced to such a condition that, even if now protected, it is almost certain they would be unable to recover themselves without the planting of new seed or some artificial assistance. On the West Coast, however, there are still several localities where, either from the oysters being considered private property, or from the position being far distant from market, natural beds do still exist, and where the native oysters are in sufficient numbers to form the nuclei of extensive oyster farms, from which the over-fished oyster beds of other localities might be restocked. On the West Coast, the configuration of the land varies so much, that different methods of oyster culture would have to be resorted to in different localities, or combinations in a great many different ways arranged.

It has been suggested that, by way of inducing others to take up the cultivation of oysters commercially, a start should be made by taking in hand some one of those beds in the Western Highlands already referred to. That the ground should be dredged over thoroughly, and cleaned of all enemies to the oyster; that some method of spat collecting be fixed upon (to be determined upon by the nature of the locality), provided that it is so inexpensive as to be practicable if taken up by others for commercial purposes; and that the cultch or collectors being in position before the spawning season, a fair trial of oyster culture may be made. At the same time, if possible, the trial of another method of spat collecting might be made in a different locality, for the purpose of comparison.

The mere planting of new oysters on old beds has been shown by the failure of several individuals to be useless. As a rule, the old beds, through want of supervision, have become the home of all manner of animals which prey upon the oyster. The planting of new oysters is therefore nothing but a method of feeding those animals. Foreign impure matter in the water would, of course, also cause destruction.

ARTIFICIAL PROPAGATION OF COD AND OTHER FOOD FISHES.

Now carried on in United States, Newfoundland, and elsewhere.

The artificial propagation of cod and other marine fishes is now carried on in the United States, Norway, and in other countries with remarkable success. It appears to be a law ruling all fish life, and to which it is impossible to believe the cod forms any exception, that when the young fish have come to maturity they return to their birthplace in order to spawn, and never fail to do so during the whole term of their existence. The late Professor Baird, whose knowledge of the subject was unequalled, states the law as follows:—'In regard to the sea fisheries, one important

Fish return to the place at which they were spawned.

'principle should be carefully borne in mind, and that is that every 'fish that spawns on or near the shore has a definite relationship 'to the particular area of sea-bottom; or, in other words, that, as far 'as we can judge from experiment and observation, every fish 'returns, as nearly as possible, to its own birthplace, to exercise the 'function of reproduction, and continues to do so, year after year, 'during the whole period of its existence. A second law, equally 'positive, with a great variety of fish, is, that they pass from their 'spawning grounds to the sea by the shortest route that will take 'them out into the deeper waters, where they spend the winter, and 'that coming and going to and from a given locality they follow a 'determinate and definite line of migration.'

Results of Cod-hatching.

These principles have been fully confirmed by the astonishing results which have attended the artificial hatching which was resorted to as a means of restoring the cod fishery to its former productiveness, both in Norway and the United States. In Norway this system was initiated under Professor Sars; in New England it was introduced as an experiment in 1878–79. After an experience of several years the cod fishery at Flödevig has been doubled; and at the station at Gloucester, Mass., a hatchery is now in operation capable of producing many millions of cod in a season.

Millions of young fish on the fishing grounds.

From the latest Annual Report of the U.S. Fish Commission we learn that 60,000,000 of cod fry have been placed in the water in the vicinity of Gloucester; that 500,000 young cod had been forwarded to Hampton Roads, in the hope of forming a cod colony in Chesapeake Bay; and that a similar shipment had been made to the Gulf of Mexico, in order to determine whether cod can be successfully transferred to southern waters. Colonel M'Donald stated that the results of these efforts were very encouraging. They were, he said, now catching small cod inshore, which is unusual in the history of the fishery, and indicates that the fish had been successfully planted there. The Boston Fish Bureau, in its Report for 1890, confirms this statement. During the past two years, it says, many millions of cod, haddock, and pollack have been produced and planted in New England waters, with the result that 'millions of these species of one and two years growth 'are reported as being on the fishing grounds near the coast, 'while young cod have been taken in traps and otherwise 'where the oldest fishermen have no recollection of seeing them 'before.'

Newfoundland has established a Hatchery for Cod and Lobsters.

Description of the Apparatus used.

In 1888 a Fisheries Commission was appointed by the Colony of Newfoundland, and they appointed a Norwegian expert, Mr A. Nielsen, as its superintendent. One of the first steps taken was to establish an efficiently equipped hatchery for cod and other marine fish and lobsters at Dildo Island, Trinity Bay. The apparatus used is in the improved form, which is due to the inventive genius of Colonel M'Donald, and which is described in the Second Report of the Commission, dated March 1890. The Macdonald apparatus is placed on one side of the hatching room. It consists of four boxes, each 13 feet long, 4 feet wide, and 1 foot high. Each box is divided into twelve water-tight compartments, into which the incubator (a box, the bottom of which is covered with cheese cloth, and furnished with gateways and aerators) is fitted. Each compartment is again divided into three—the incubator, the inlet, and the outlet compartments. In the outlet compartment a siphon is placed which draws the water, working automatically, and causing the water to rise and fall. The advantage of this apparatus is that the ova can be transferred from one incubator to another through the gateways, without taking the incubator up, so that they can be cleansed with less trouble. In the middle of the hatching room are placed three large tanks of wood, in which spawning fish can be kept alive. From these boxes the fish are taken and stripped for their ova, according as they ripen. After the ripe quantity is taken from them they are put back into the tanks, and the process is repeated till all the ova are taken from the fish. At Flödevig, in Norway, an improved method is now adopted of keeping the live ripe cod in a very large tank, allowing them to spawn naturally, and skimming off the fertilised ova which collects on the surface of the water. In the hatching room at Dildo Island, a Chester apparatus, similar in construction, is kept on the other side of the room, and the hatchery is capable of producing 200,000,000 cod fry in one season.

Method in Norway.

In Newfoundland these active measures have been accelerated by the marked and continuous decline which for some years has been observed in the cod fishery, and the necessity of doing something to restore the depleted grounds. As the Commissioners properly observe, 'it is useless for mere theorists to tell us that fish are so 'prolific that they cannot be exterminated; that from some unknown causes fish come in plentifully in certain years, then 'become scarce, and after years of absence return in abundance; 'that we cannot calculate their erratic pelagic movements; that 'man cannot exhaust the great ocean. These specious but utterly 'baseless theories are confuted by the undeniable fact, that in all 'our great bays the supply of cod has been steadily diminishing, 'never increasing; and that several of them are almost depleted, so 'that the fishermen are driven to other distant places in search of 'fish. For such a decline there must be causes. It is our part to 'search out and remove these causes and use remedial measures.'

Decrease in the Cod-fishing in Newfoundland.

Fish can be exterminated by over-fishing.

LOBSTER-CULTURE.

Of special interest to us in Scotland are the efforts which are being made in Newfoundland to hatch lobsters artificially. Newfoundland is the home of the lobster, and it is proposed to establish at least one lobster hatchery in each bay, whereby the stock of lobsters may be not only maintained but greatly increased. This was also the advice given by Colonel Marshall M'Donald to the member of this Board whose privilege it was to confer with him on the subject in April last. 'Select,' he said, 'certain areas where the ground is 'suitable for breeding lobsters, prohibit all fishing on this ground, 'and they will serve as central points of supply, and so multiply 'that the fishery along the coast will be replenished. I do not 'think any special measures for the preservation of the lobster 'when hatched are necessary. The lobster occupies rocky ground;

It is proposed to establish several Lobster Hatcheries in Newfoundland.

'he gets under the rocks, and when he is old enough a lobster is 'not an easy thing to tackle.'

The importance of this Fishery in Newfoundland.

The importance of this fishery in Newfoundland is sufficiently indicated by the fact that in Placentia Bay alone there are forty factories in operation, representing a capital of about 100,000 dollars, and giving employment to 1200 men and women. The catch of lobsters amounts to 5,000,000 annually, equal to 180,000 dollars when canned. The total value of the lobsters exported in 1888 from Newfoundland was 385,077 dollars. The establishment of lobster hatcheries has been suggested by the fact that at these factories large supplies of eggs, now subject to destruction, would be easily obtained, whereas at present the industry is prosecuted in such a reckless way as will probably end in its extermination. There is no close season to protect lobsters when spawning and shelling; factories can be erected anywhere without restriction, and independent of all public regulation. No fishery ground, say the Commissioners, can stand such destructive draughts for any length of time, if nothing is done for their replenishment, and the result is seen in the steady diminution of the stock of fish. It appears in fact that the decrease is far more possible with this species than with the true fishes, from the habits of the lobster. Lobsters, says Mr Nielsen, are of a voracious nature, and pass a great part of their time in shallow water and within limited bounds. For these reasons they are more easily captured than the other denizens of the ocean, and in all countries vigorous efforts have had to be made to preserve this fishery from ruin. These facts correspond with what has occurred in Scotland, where lobsters have been gradually declining both in numbers, and especially in size; in some places the fishermen have been forced to abandon this fishery altogether.

Decline of Lobsters in Newfoundland.

Decline in Scotland.

Decline in Canada.

A similar decline has been found in Canada, where protective measures of a stringent character have failed to arrest it, or restore it to its former condition. Although the price has recently advanced 25 per cent., the value of the Canadian lobster fishery in 1888 was only 1,483,388 dollars, as compared with 2,638,394 in 1886, and 2,613,731 in 1885. Prince Edward's Island has also to lament a similar diminution, particularly in the size of the lobsters. In 1880, three and a half to four lobsters filled a 1 lb. can; in 1888 fully seven lobsters were needed to make up this quantity. The lobster being a local fish, in the strictest sense of the term, never migrates far from its deep-water haunt, but comes in annually to pretty nearly the same place on the shore.

How depletion of a ground is produced.

Hence by over-fishing, or by taking immature fish that have never spawned, any given locality may be speedily depleted and ruined as a lobster ground. The keeping up of the stock by ratificial breeding and stringent protective measures is, in the opinion of the Commissioners, of paramount importance, if the lobster fishery is to be saved from destruction. With this view Mr Nielsen has constructed floating hatching boxes, which, he says, if properly managed, will hatch out lobsters when the eggs have once reached a due stage of ripeness.

Mode of hatching.

The work of the Fishery Board.

The Fishery Board for Scotland have also had constructed a similar apparatus, which has been used at Dunbar, where some forty or fifty years ago the lobster fishery was one of very great importance. In that district now, however, the supply of lobsters has greatly fallen off, and the number of 'berried hens,' or females carrying ova, obtained is very small. The Board are therefore making arrangements for the establishment of a lobster-hatching enclosure at Brodick, Arran, on the West Coast, which will enable them to obtain an abundant supply of ova for the replenishment of the exhausted grounds on the East Coast, while at the same time permitting of the restocking of grounds on the West Coast.

Lobster-Hatching Enclosure at Brodick, Arran.

At the Dildo hatchery 4,039,000 lobsters' eggs were hatched last year, and the young set free; and it is calculated that if 25 per cent. of these survived and reached maturity, the value of the whole would be 27,768 dollars.

Importance of the study of the life-history of the Lobster.

The importance of a thorough study of the life history of the lobster is shown by the fact that Mr Nielsen has discovered that in Newfoundland waters the lobster has two distinct periods of spawning; this fact, as Mr Nielsen, points out, has a very important bearing on the legislative enactments which may be found necessary for the protection of the lobster fishery. In Newfoundland lobsters carrying ova are seldom found below the size of eight inches; more frequently they are rather over than below ten inches, and Mr Nielsen therefore proposes that the Legislature should prohibit the capture of lobsters under a certain size before they have had time to exercise the function of reproduction, and also to establish a close time from July to September. The standard size, he says, should be fixed at nine inches in length in certain parts of the island, and at ten inches in other parts, reckoning from the tip of the rostrum to the end of the tail. Any lobsters caught by fishermen below this size should be put back into the water without injuring them.

The value of the application of Scientific Principles in Fisheries.

The value of the practical application of scientific principles to the development of our fisheries is very distinctly shown by certain facts which were mentioned by Colonel Marshall M'Donald, in connection with the artificial hatching of the shad in the Delaware, Susquehanna, and Potomac. The U.S. Fish Commission turns out from 100,000,000 to 150,000,000 of shad per year. The work was experimental up to 1880, but since then it has been continued on a large scale and on a definite plan. The statistics which have been collected since 1885 show year after year a progressive increase in the catch. In 1889 the number of fish taken was 84 per cent. over the estimated quantity in 1880, equal to upwards of 700,000 dollars in money—nearly three times the entire appropriasion which the department receives from the Government for all their work of every description and in every direction. Another striking fact may be mentioned. Formerly the shad on the west coast of America was practically unknown. In 1880 the Commission placed 500,000 of shad in a single river in California. These have since multiplied in such numbers that the shad is now a common fish on the Pacific coast, being found in the rivers of California, Oregon, Washington, British Columbia, and even as far north as the Sitka in Alaska.

The hatching of Shad.

The success of Shad hatching.

WEATHER AND DISASTERS AT SEA.

State of weather during summer and winter herring fishing, and generally throughout 1889.

During the period that the great summer herring fishery was in operation, the weather was exceptionally good, there being only an occasional strong gale. Boats were at sea, in greater or lesser numbers, every fishing night during the season. Unfortunately, the fishermen frequently experienced violent storms during the prosecution of the winter herring and line fishing,—serious loss of life and property being sustained on several occasions. Loss of life was greatest in Stornoway district, where sixteen persons were drowned, twelve by the capsizing of two boats during a heavy gale on 19th March. One or more fishermen were drowned in each of fourteen other districts, while in eleven districts no lives were lost. The loss in damage to boats and fishing material was greatest in Aberdeen district, the amount being £9255—Fraserburgh, Wick, Leith, and Anstruther also suffering considerably. The total number of lives lost was 72,—50 on the East Coast, and 22 on the West Coast, against 59 in 1888, an increase of 13; but a decrease of 24 as compared with the average of the preceding five years. Thirty-six boats were totally wrecked, and 218 were damaged. A great quantity of netting was also lost, but not to the same extent as in the preceding two years, through the fouling and weight of fish meshed when the shoals were dense, especially at Fraserburgh and Wick. The total loss sustained last year in boats and fishing material amounted to £46,460.

Seventy-two persons drowned.

Loss in boats and fishing year.

The following Table shows the number of lives lost, and the manner in which those casualties happened; also the number of boats totally wrecked, and the number damaged, with the amount of loss sustained in boats and fishing material in each of the past six years, during which period such statistics have been collected:—

Lives lost, boats wrecked and damaged, and total loss in boats and fishing material in last six years.

Years.	Lives Lost by Wrecks or other Casualties.							Boats totally wrecked.	Boats damaged.	Total Loss in Boats and Fishing Material.
	Founderings.	Wrecks in taking Harbours.	Collisions.	Washed overboard.	Fell overboard.	Knocked overboard, or killed by Sails, &c.	Total.			
1884,	42	...	...	8	18	5	73	39	112	£29,506
1885,	84	12	...	5	20	5	126	51	112	59,825
1886,	38	6	2	8	10	6	70	40	132	51,201
1887,	85	13	8	19	17	14	156	51	187	51,581
1888,	16	7	2	8	17	9	59	58	179	49,826
1889,	37	2	...	8	12	13	72	36	218	46,460
Totals,	302	40	12	56	94	52	556	275	940	288,399

Similar return by districts.

Table VI., Appendix D., is a return, by districts, of the number of lives lost in connection with the sea fisheries of Scotland, and the manner in which the casualties happened; the number of boats totally wrecked, and the value thereof; the number of boats and the amount of damage; and the loss on nets and other fishing material lost or damaged last year.

MARINE POLICE AND FISHERY SUPERINTENDENCE.

This superintendence was conducted in the same manner as in former years, and the regulations in regard to the lettering and numbering of fishing boats have been generally well observed by the fishermen. The returns show that the number of boats and vessels detained during the year for non-observance of these regulations was 598, being an increase of 284 over the former year. Number of boats detained.

The proceedings in connection with the registration of fishing boats during last year were as follow :—The number of applications made to the fishery officers for certificates of registry was 526, the number of registers issued was 536, and the number of registers examined and indorsed was 5400. Registration of boats. Certificates issued, examined, and endorsed.

In Appendix D, Table VII., will be found particulars, classified by districts, of these applications to register; of the registers issued, examined, and indorsed; and of the boats detained for non-compliance with the Fishery Acts, by the fishery officers and cruisers under the Board. Detailed particulars thereof.

The vessels employed in carrying on the superintendence of the fisheries during last year were H.M.S. 'Jackal,' commanded by Lieut. A. M. Farquhar, who was succeeded in the command by Lieut. Augustus L. K. Knapton; the Board's cruiser 'Vigilant,' commanded by Mr Alexander M'Donald; and H.M. cutter 'Daisy,' commanded by Mr George Hogg, who was succeeded by Mr Clement Roach. These vessels were supplemented, during the great summer herring fishery on the East Coast, by H.M. gun-boat 'Firm,' Lieut. W. H. Somerset in command, and by H.M. cutter 'Eagle,' Mr J. F. Tremayne in command, which were placed at the disposal of the Board by the Admiral Superintendent of Naval Reserves. The services of these vessels during the year were as follow :— Vessels employed in protecting the fisheries.

H.M.S. 'Jackal' was engaged in the early part of the year upon the East Coast—her head-quarters being at Granton—in the general superintendence of the fisheries, and in protecting the closed territorial waters against the encroachments of beam trawlers. She then proceeded, after her annual refit at Devonport, to Barra in the Hebrides, for fishery superintendence there. She afterwards proceeded to Oban, where the Chairman of the Board, Professor Ewart and Mr Anderson Smith, two other of its members, joined her and accompanied your Lordship and party in the 'Enchantress,' to the North West Coast of Scotland, with the view of your Lordship personally inspecting the harbour works in operation, the sites suggested for new harbours, and of considering the whole question of communications,—railway, telegraphic, and otherwise in the interest of the fisheries. The 'Jackal' thereafter returned to the East Coast for the great summer herring fishery, taking up station at Wick, and carrying on the superintendence from Rattray Head on the south, including the whole of the Moray Firth, to and including the southern part of the Orkney Islands. At the close of the fishing she returned to Granton for general superintendence on the East Coast. Her principal duty there consisted in protecting the territorial waters from the encroachments of beam trawlers. Services of 'Jackal.'

Services of 'Vigilant.'

The 'Vigilant' cruiser was employed from January to May in the superintendence of the fisheries in the Clyde estuary, and at Ballantrae, on the Ayrshire coast, where, besides the usual fleet of herring boats, there were 18 Scottish steam beam trawlers, 13 Scottish and from 8 to 20 English sailing trawlers engaged in fishing. She then proceeded to the Hebrides, and, until the arrival of the 'Jackal,' had charge of the Coast and Islands between the Butt of Lewis and Barra Head. While there the commander was successful in assisting several boats in distress, and in settling many cases of collision and damage to nets. The 'Vigilant' then proceeded to the East Coast for the great summer herring fishery, making her head-quarters Aberdeen, and extending her superintendence over the coast to Berwick-upon-Tweed on the south. At the close of this fishing she returned to the West Coast, and resumed her superintendence there. Besides her duty in fishery superintendence, the 'Vigilant' was also engaged, as in previous years, in taking a series of continuous physical observations in connection with the scientific work of the Board. During the year 1210 boat registers were examined by the commander; 189 boats were detained for non-observance of the Fishery regulations; and 134 boats were communicated with, and the law regarding carrying proper lights explained and its observance enforced. It is gratifying to report that the active and energetic, and at the same time judicious, manner in which Mr M'Donald, her commander, carried out the whole of these duties was highly satisfactory.

Services of 'Daisy.'

Services of 'Firm.'

Services of 'Eagle.'

H.M. cutter 'Daisy' was employed during the year in the superintendence of the fisheries in Loch Fyne and on the West Coast. H.M. gun-boat 'Firm' was employed in the protection of the fisheries around the Shetland Islands and the northern portion of the Orkney Islands; and H.M. cutter 'Eagle' was employed around the Orkney Islands on similar duty.

Arrangements for superintending fisheries and protecting closed waters against trawlers most unsatisfactory.

The Board have again to express their regret that the arrangements for the general superintendence of the fisheries, and more especially for protecting the territorial waters closed against beam trawling, are so unsatisfactory and inadequate. By the Herring Fishery (Scotland) Act, 1889, nearly the whole of the territorial waters round the Scottish coasts are closed against this mode of fishing, and the cruisers under the Board are wholly inadequate to see that the law is enforced. Complaints are constantly being received that trawlers are fishing within the proscribed waters, and much dissatisfaction prevails amongst the fishermen in consequence. Except during the great summer herring fishing the Board have only H.M. gun-boat 'Jackal' at their disposal for service on the East Coast, and she is wholly unable to protect such a long stretch of coast against the evil complained of.

Injuries done by Trawlers or other Fishing Boats to the Boats or Gear of Fishermen.

Return of complaints investigated and eported on.

In Appendix E, No. I., will be found a return, by districts, for last year, of complaints made to officers of the Board, and investigated and reported on by them, of injuries done by trawlers or other fishing boats to the boats, nets, lines, or gear of fishermen, and showing the results in each case.

From this return it will seen that, although the complaints investigated and reported on by the Board's fishery officers and commanders of fishery cruisers, were not so numerous as in the preceding year—numbering only 79 as against 128 in 1888—they were spread over as wide an area, and were of as varied a character. Twenty-five complaints against trawlers and 11 against fishing boats, for damaging lines of other fishing boats were investigated and reported on, 20 being satisfactorily settled (based on the officers' reports), and 7 not proven, while in the remaining cases the defenders declined to accept the decision of the officers. Of 18 complaints against fishing boats for damage to nets, and 4 for the same offence against trawlers, 9 were satisfactorily settled, 2 are still pending, 4 were allowed to drop, and the remainder not proven. One complaint was made against the owners of crab creels for damage to nets, and 4 against steamers for the same offence, 3 being settled, and 2 departed from. There were 12 cases of collision and consequent damage to boats, 7 being satisfactorily settled, 3 allowed to drop, and 2 not proven.

Damaging lines.

Damage to nets by fishing boats and trawlers.

Collisions.

Fifty of the total number of complaints arose from damage sustained outside the territorial waters, while 29 occurred inside these waters. Of these, the Board's fishery officers investigated 70, the commander of the 'Vigilant' cruiser 5, and the commander of H.M.S. 'Jackal' 4.

Damage sustained inside and outside the territorial waters.

It is satisfactory to note that in only two cases was it necessary to have recourse to legal proceedings, and that in both cases the finding of the Sheriff virtually confirmed the decision given by the officer. A great deal of expense was thus saved to the fishermen through the instrumentality of the Board's officers. Damages, amounting to upwards of £350, were awarded by them—£257 being given against trawlers.

Results satisfactory.

The Board would here repeat the recommendation which they made in the last Report, that any fisherman whose boats, nets, lines, or fishing gear are damaged by any trawler or other fishing boat, should immediately make his complaint known to the fishery officer of the district, or to any of the commanders of the superintending cruisers, who will, in terms of the Act of Parliament, inquire into the circumstances of the complaint, and furnish a report setting forth the particulars thereof, stating the amount of damage done, and who is in fault. In the event of both parties being satisfied with the report, the matter may be settled in terms thereof; but if an arrangement is not made, then the party who has sustained damage may take the case into court, and have the question tried and decided by the Sheriff, the officer's report being part of the evidence.

Fishermen sustaining damage should make complaint to officers.

This recommendation is all the more pressed upon fishermen, as by such inquiries and reports which are mentioned above they are usually enabled to get a settlement of the damage they sustain without having recourse to legal preceedings, or incurring any expense; and, indeed, it would appear that the cases already decided have had the effect of making trawlers and other fishing boats more careful than hitherto in avoiding doing injury to each other.

Great importance of this matter to fishermen.

TERRITORIAL WATERS CLOSED AGAINST BEAM TRAWLING.

Bye-laws of Board closing certain waters against trawling satisfactory to fishermen.

As formerly reported, the Board, under the powers conferred upon them by the Sea Fisheries (Scotland) Amendment Act, 1885, made bye-laws, from time to time, which were confirmed by the Secretary for Scotland, closing different parts of the territorial waters on the East Coast of Scotland against beam trawling. This action of the Board gave great satisfaction to the line and drift-net fishermen specially interested in the areas so closed, but those fishermen who prosecuted their calling in other territorial waters were greatly dissatisfied that those waters had not been dealt with in like manner, and they expressed a very strong desire that beam trawling should be prohibited in them also, and indeed in the whole of the territorial waters round the Scottish coasts.

Act passed closing all territorial waters round the coasts of Scotland.

The Board deemed it desirable, in the interest of the fisheries, that, with certain exceptions, this should be done, but they had no power to make a bye-law giving effect to it. Thereafter, however, the Herring Fishery (Scotland) Act, 1889, was passed. Besides other provisions, it enacts—sec. 6 (1)—that it shall not be lawful to use the method of fishing known as beam trawling or otter trawling within three miles of low-water mark of any part of the coast of Scotland, nor within the waters specified in the schedule thereto annexed (which schedule includes the bye laws of this Board) save only between such points on the coast or within such other defined areas as may from time to time be permitted by the Board's bye-laws, if confirmed by the Secretary for Scotland, and subject to any conditions or regulations made by those bye-laws: Provided that this section shall not apply to the Solway Firth or to the Pentland Firth. This statute further enacts—sec. 6 (3)—that any person who uses any method of fishing in contravention of this enactment or of any bye-law of this Board, shall be liable, on conviction under the Summary Jurisdiction (Scotland) Act, to a fine not exceeding five pounds for the first offence, and not exceeding twenty pounds for the second or any subsequent offence; and every net set, or attempted to be set, in contravention of this section shall be forfeited, and may be seized and destroyed or otherwise disposed of by any superintendent of the herring fishery or other officers employed in the execution of the Herring Fishery (Scotland) Acts.

Two bye-laws made.

Last year, after this Act was passed, the Board, under the powers it conferred upon them, made two bye-laws, both of which were duly confirmed by your Lordship. One of these is in the following terms :—

Bye-law (No. 6) made by the Fishery Board for Scotland, under the powers conferred on the Board by the Sea Fisheries (Scotland) Amendment Act, 1885, and the Herring Fishery (Scotland) Act, 1889.

I. This bye-law shall extend and apply to the waters inside of a line drawn from Garroch Head, Island of Bute, to Gull Point, Little Cumbrae, and thence to Portincross Castle on the Ayrshire coast, and a line drawn from Colintraive Hotel, Argyleshire, to a point due south (magnetic) on the Island of Bute.

II. From and after the date when this bye-law shall come into force until the 30th April 1890 inclusive, and thereafter from the 1st of August to the 30th of April, both inclusive, annually, it shall be lawful, within the said limits, to fish by means of a beam trawl, provided the boat from which the same is used is a sailing vessel of not more than eight tons burthen.

III. This bye-law shall come into force from the date of its confirmation by the Secretary for Scotland.

Reasons for one of them being made.

This bye-law was passed by the Board in consequence of fishermen at Greenock and Rothesay having requested that they might be allowed to continue as heretofore fishing from small sailing vessels by means of a beam trawl in certain waters in the Clyde, by which mode of fishing they and their families mainly got their livelihood. Some opposition was offered to the re-introduction of beam trawling in the Clyde as being injurious to the fishing industry; but the Board were satisfied that in this case little if any such injury could arise, as the permission asked for was to be restricted to sailing vessels not exceeding eight tons burthen, and the area to which it applied was of limited extent, while the operations of these trawlers were usually carried on in daylight, and in waters where net or line fishing was not prosecuted.

Other bye-law made.

The other bye-law passed by the Board was in the following terms:—

Bye-law (No. 7) made by the Fishery Board for Scotland, under the powers conferred on the Board by the Sea Fisheries (Scotland) Amendment Act, 1885, and the Herring Fishery (Scotland) Act, 1889.

I. Whereas by the Act 52 and 53, Vict. cap. 23, sec. 6, beam and otter trawling have been prohibited within certain limits therein specified, save only between such points on the coast or within such other defined areas as may from time to time be permitted by bye-laws of the Fishery Board for Scotland, and subject to any conditions or regulations made by those bye-laws, but it is provided that the said section (6) shall not apply to the Solway Firth nor to the Pentland Firth; and whereas it is expedient that the experiments and observations heretofore conducted by the Fishery Board for Scotland should be continued, therefore it is hereby declared that any person in the service or possessing the written authority of the said Fishery Board, under the hand of the Secretary thereof, may lawfully use, and is hereby permitted to use, when employed in connection with the experiments and observations aforesaid, or other scientific purposes, the method of fishing known as beam trawling or otter trawling within three miles of low-water mark of any part of the coast of Scotland to which the said section (6) of the said Act applies, and within the waters specified in the schedule annexed to the said Act.

II. This bye-law shall come into force from and after the date of its confirmation by the Secretary for Scotland.

Reasons for passing it.

The Herring Fishery Scotland Act, 1889, closed certain waters specified therein against beam and otter trawling, in which experiments and observations had previously been carried on by the Board, in order to ascertain the influence of beam trawling on the fish supply of the territorial waters; and as it was expedient that these should be continued, this bye-law was passed. Detailed particulars of this work will be found under Scientific Investigations, forming Part III. of this Report.

Complaints against trawlers for fishing in proscribed waters.

During last year a number of complaints were made to the Board of contravention of the bye-laws passed in former years closing territorial waters against beam trawling, by trawlers fishing within the proscribed areas, and also of infringements by trawlers of that part of the Herring Fishery (Scotland) Act, 1889, closing other waters against beam and otter trawling. Each of these complaints was fully considered by the Board, and whenever it appeared to them that the evidence in support of a complaint was well founded, the case was reported to the Procurator Fiscal of the county where the offence was committed, informing him at the same time that the Board were of opinion that, in the interest of the fisheries, the alleged offenders should be prosecuted.

Return of prosecutions against alleged offenders.

From Appendix E, No. II., which is a return of prosecutions against beam trawl vessels last year for alleged infringement of the bye-laws of the Board, or the provisions of the Herring Fishery (Scotland) Act, 1889, prohibiting beam trawling within certain waters round the coasts of Scotland, it will be seen that twenty-four trawlers were tried for contravention of the bye-laws and Act referred to. Sixteen of these were found guilty, and were fined sums varying from £2 to £10. In one case the conviction was quashed on appeal to the Justiciary Appeal Court, and in the remaining eight cases the charge was found not proven. Two trawlers were twice charged with violating the law in regard to trawling, but in each case the master was only once found guilty. The total amount of the fines was £106.

Fishermen urged to get evidence.

The Board would strongly recommend fishermen, when they see a trawler fishing within the proscribed waters, to endeavour to get such evidence of the fact as would lead to the conviction of the offender, and communicate the particulars of the case to one of the Board's officers or commanders of superintending cruisers, who will at once report the case to the Board.

HARBOURS.

The state of the Harbour Works in progress with which the Board are connected, during the year 1889, is as follows:—

Harbour constructed at Portknockie.

PORTKNOCKIE HARBOUR, BANFFSHIRE.—The works at this harbour have been prosecuted by the contractors, Messrs Morrison & Son, who have now practically finished their contract; but it has been decided to expend the balance of the sum voted for the harbour in reducing the heights of some rocks near the entrance, and in the erection of a quay on the south side of the harbour, and these works are now in progress.

Broadford harbour.

BROADFORD HARBOUR, ISLE OF SKYE.—The works at Broadford were let to Mr John Best, Leith, who began operations in February last year. The concrete portion of the pier has been extended from the outer end of the old pier for a distance of 144 feet. The founding of the pier is necessarily a slow operation; but the contractor has now plant on the ground which will enable the works to proceed with greater dispatch during the season of this year. The works of excavation have also been proceeded with and 1800 cubic yards have been removed.

Progress of works.

Balintore harbour. Provisional Order obtained.

BALINTORE HARBOUR, ROSS-SHIRE.—The Provisional Order referred to in the Board's last Report for this harbour was obtained in July 1889, authorising the construction of a harbour at Balintore, which lies midway between the fishing villages of Shandwick and Hilton, and the appointment of a body of trustees, with power to levy rates for the management and maintenance of the harbour. The works, which are to consist of a pier 760 feet in length, and a breakwater to the west of it, will enclose an area of 4½ acres. They are estimated to cost £7600, of which the trustees are to contribute £1900, and the Board an amount not exceeding £5700. Working plans and specifications were prepared, and tenders invited for the execution of the works, and the tender made by Mr G. Pirie, contractor, Aberdeen, has been accepted. Cost of works. Tender accepted.

NESS HARBOUR, ISLAND OF LEWIS.—The Provisional Order referred to in last Report was obtained in June 1889 for enlarging this harbour, and the formation of a new entrance, the estimated cost of the works being £6000, of which the locality is to contribute £1500, and the Board an amount not exceeding £4500. By the Provisional Order, a body of trustees is appointed, with power to levy rates for the management and maintenance of the harbour. The working drawings and specifications have been prepared, and it is expected the works will shortly be begun. Ness harbour Provisional Order obtained. Estimated cost.

COLDINGHAM HARBOUR, BERWICKSHIRE.—The works at Coldingham were prosecuted continuously by the contractors during last year. The sum of £10,000, which was generously placed at the disposal of the fishermen by Mr Usher, has now been expended, and the £3000, voted by the Board as their contribution to this important harbour, is being drawn upon. The concrete work is well advanced towards completion, and the deepening operations are also in progress. It is expected that the harbour will be completed in the summer of this year. Coldingham harbour. Progress of works.

AUCHMITHIE HARBOUR, FORFARSHIRE.—The Provisional Order referred to in the Board's last Report for the construction of this harbour was obtained in the course of 1889, and it constituted a body of trustees, with power to levy dues for the management and maintenance of the harbour. These trustees thereafter unanimously adopted a plan for the work prepared by Mr James Barron, C.E., Wick, the estimated cost of carrying out which, was £4428, and appointed him engineer, subject to the approval of the Board. Mr Barron was at the same time directed by the trustees to prepare working plans and specifications, and to invite tenders for the works. The Board approved of the said plan, appointed Mr Barron engineer, and, on condition that the trustees should first expend £1050 towards the construction of the harbour, agreed to pay towards its completion a sum not exceeding £3150. The works are now being proceeded with under a contract with Mr John Malcolm, Dunnet, Caithness, and are expected to be completed in October of this year. Auchmithie harbour. Provisional Order obtained. Estimated cost. Operations commenced.

PORTNACON PIER, LOCH ERIBOLL, SUTHERLANDSHIRE.—The works referred to in the Board's last Report in connection with this pier were completed during the course of 1889, under the direction of Mr Barron, C.E., the engineer, in accordance with the plan and specifications, and at a cost of £1200, the sum voted for the work, £900 of which was contributed by the Board, and the remaining £300 by His Grace the Duke of Sutherland. The pier has been substantially built, and, with attention in the way of keeping the timber work coated with tar and pitch oil, will be a durable structure. There is a depth of from 9 to 11 feet of water along- Portnacon Pier. Works completed. Description thereof.

side the pier at time of low water ordinary spring tides, which will admit of steamers trading in the district approaching at all times of tide, and it is anticipated that this will be of great benefit to the fishermen by enabling them to get their fish quickly dispatched to market. It may be added, that the bottom or ground alongside the pier is perfectly clean, free from stones, and soft.

TELEGRAPHIC EXTENSION TO REMOTE FISHERY DISTRICTS.

Extension of telegraph to remote places completed.

The following are the names of the places to which telegraphic communication has been extended under agreements entered into between the Postmaster-General and the Board, by which the Board guarantee to make good any loss which may arise from the extensions, from funds placed at their disposal for the purpose, viz. :—

List of places above referred to.

Loch Ranza and Pirnmill, Arran.	Achiltiebuie, Sutherlandshire.
Loch Buie, Mull.	Durness, Sutherlandshire.
Islands of Tiree and Coll.	Hillswick, Shetland.
Arisaig, Inverness-shire.	Burravoe, Shetland.
Portnaguran and Gress, Lewis.	Brae, Shetland.
Barvas and Garrabost, Lewis.	Ollaberry, Shetland.
Ness, Lewis.	North Roe, Shetland.

Of these extensions, the most recent are to Barvas and Garrabost, in the island of Lewis, which will be of great benefit to the community generally. The distance from Stornoway to Ness, between which Barvas and Garrabost are situated, is very considerable, and there is a large population in their respective districts.

The Board continue to receive reports from their officers of the benefits arising from the different extensions which have been carried out, some of which may be narrated.

Great benefit of telegraphic extension as an aid to improvement of fisheries. Illustrations thereof. Stornoway District.

Regarding the Stornoway district, the officer reports that the telegraph extensions to Ness, Gress, and Portnaguran, which have now been fully a year in operation, are of incalculable value in promoting the welfare of the people generally. As regards the advantages accruing to the fishing industry, he mentions that the crofter fishermen view the telegraphic facilities now provided with much satisfaction, more especially in the locality of Ness. The fish-buyers are in daily communication with the southern markets, and realise higher prices for the large quantities of halibut and turbot landed there in the spring than they could otherwise have done. As is well known, large numbers of the Lewis fishermen annually go to the East Coast of Scotland, and take part in the herring fishery there as hired men, and the extension of the telegraph has materially aided them in effecting engagements and facilitating arrangements in connection therewith. During the absence of the fishermen, in time of storm, the telegraph has been the means of bringing news of safety to their families and friends. This was especially illustrated by the fact that, during a severe gale on the east coast on August last, no fewer than 60 telegrams passed through the Ness office in one day, making inquiry regarding absent fishermen, or bringing intelligence of their safety. Upon another occasion, information was telegraphed to Stornoway that three small fishing boats belonging to Ness had been caught in a gale and were missing. With commendable promptitude, a steamer was immediately dispatched from Stornoway in search of these boats, and in a short time they were found at sea, and safely towed into Ness harbour,—thus, in all probability, averting loss of life and property. Through the medium of the telegraphic wire, meteorological storm warnings are regularly transmitted to the Butt of Lewis, and from thence, by means of the signal system, fishermen and mariners are forewarned when danger is approaching—an inestimable benefit on that exposed and stormy coast. By means of the wire between Portnaguran and Stornoway, arrangements have been in operation whereby curers and others get early information as to the position of the fishing boats; and during the calms which prevailed while the herring fishing of last season was going on, despatch steamers were sent to becalmed boats, and towed them into harbour. Thus fishing operations were facilitated, and many valuable cargoes of herrings were landed in a fresh state, which otherwise would have been worthless.

Island of Barra. In the Island of Barra the telegraph has been in operation several years. It has afforded valuable aid in the promotion of all departments of the fishing industry, and is now looked upon as an indispensable adjunct towards promoting the success and well-being of that island.

Shetland Islands. In the Shetland Islands, the officer reports that the telegraph extension is of great and increasing benefit to the fishing trade; and he gives many instances where heavy takes of herrings having been landed in some islands, and the news communicated by telegram to the fishermen in other islands where fish were not being found, they at once proceeded to the former places, and met with gratifying success. On the 18th, 19th, and 20th of June, a very heavy fishing of herrings was landed at Walls, the curing of which exhausted the whole stock of salt and barrels, and, but for the telegraph enabling curers to get a new supply at once from other stations, a great loss would have been sustained. It appears also that at Hillswick, North Roe and Ollaberry, the haddock fishing has been more extensively prosecuted than formerly, and that the number of decked boats engaged therein has increased, and is likely still further to do so.

Orkney Islands. In the Orkney Islands, the officer reports that whenever a shoal of herrings is discovered at any point in the district, the fact is immediately communicated to the different stations; and that fishermen there frequently proceed to the place where the herrings have been found. One day last year, when large takes of herrings were landed at Stronsay, for the curing of which there were not enough of barrels nor a sufficient number of coopers, gutters, and packers, what was wanted was got from Wick on the following morning, whereas, had there been no telegraph, this could not have been done. Curers and their agents consider the telegraph of the greatest importance, being enabled thereby to transmit urgent communications to their correspondents during the herring fishing season.

Wick district.

The officer at Wick reports, that since the telegraph was extended from Tongue to Durness, the business has been gradually growing larger. Not only fishermen and others connected with the fisheries, but the people generally, avail themselves of it; and there is every indication that it will be increasingly used as time goes on. At Wick, Scrabster, and Portskerry also curers and fishermen use it largely. Consignments of fresh fish to the southern markets, as well as shipments of cured herrings by steamers to Continental ports, are advised to consignees by telegraph. Fishermen very often use the wire to ascertain where fishings are being carried on. During last year, by its means Wick fishermen, hearing of a successful fishing at Scrabster, proceeded there at once, and obtained good success; and in the same way on another occasion, those fishing at Scrabster went to Wick, and shared in the success of the early herring fishing which was being prosecuted there. During stormy weather at sea, when fishermen often cannot reach their own ports, causing much anxiety to their friends and others at home, telegraphic communication is constantly resorted to, and often, in the course of an hour or two, intelligence is received from ports at a distance of the safe arrival of boats inquired after.

Fort William district.

The officer at Oban reports, that the telegraphic stations opened at Tiree, Coll, Dervaig and Arisaig have, taken as a whole, proved beneficial to the districts in general. At Tiree and Coll, the fishermen have found the wire of great advantage in ascertaining the daily price in the south and the markets to which they should send their fish, either cured or fresh. Last season was the first in which fresh fish were sent to the southern market from Tiree, and without doubt the telegraph wire was to a considerable extent the cause of this change. It has also induced more fishermen from the east coast to prosecute the cod and ling fishing at Coll. The extension of the telegraph to Arisaig has proved of great service to fishermen and buyers, but it is believed to be too far from the fishing grounds.

Extensions to Arran.

The Rothesay officer reports, that telegraphic extension to the fishing townships of Loch Ranza and Pirnmill contributes in a considerable degree to the prosperity of the inhabitants and benefits those employed in the fishing industry on the north coast of the Island of Arran. The telegraph was again this season greatly taken advantage of, particularly as the fish landed are all despatched to market for use in a fresh state. Almost in every case, those forwarded were advised by telegraph to the fish factors or agents in Glasgow; and several instances occurred of hundreds of boxes of herrings being sold when in course of transit. The success or non-success of the daily catches of the fleet is reported by telegraph, and buyers at telegraph stations are re-advised as to the state of the markets, and the prices are fixed accordingly on the coast. The telegraph has also proved of advantage during the season when an additional supply of empty boxes were urgently required for carrying the fish to market; and masters of vessels in passing the station of Pirnmill with cargoes of herrings from Mackrie Bay, generally wire the number of packages on board to the agents at the port of destination, thus facilitating arrangements for a quick delivery of fish, and the return of the vessel to the fishing grounds.

These cases above mentioned are sufficient evidence of the great value of telegraphic extension to remote fishery districts, in promoting the development of the fishing industry, as well as being of service to the general community.

In Appendix F, No. II., will be found a statement of the expenditure for telegraphic extension during last year.

Expenditure for telegraphic extension.

Boats and Vessels, and Persons, employed in connection with the Sea Fisheries.

Table I. Appendix D, gives an account of the number of boats, decked and undecked, *irrespective* of the places to which they belong, employed in the herring fishery in Scotland, in the season of last year, in a selected week for each district; with the number of fishermen and boys by whom they were manned; of coopers, gutters, packers, and labourers employed at the said fishery in the week so selected; and the total number of such fishermen and other persons so employed.

Fishing boats employed in herring fishery in a selected week.

The following table shows the number of boats, decked and undecked, and beam trawl vessels employed in the sea fisheries of Scotland; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed, in the years 1888 and 1889:—

Boats and vessels, fishermen, and other persons employed in 1888 and 1889.

Years.	Fishing Boats and Beam Trawl Vessels.	Fishermen and Boys.	Fish-curers.	Coopers.	Other Persons (estimated).
1888, ...	14,904	48,618	1,047	2,410	45,806
1889, ...	14,714	47,943	1,071	2,665	48,178
Increase in 1889, .	...	...	24	255	2,372
Decrease in 1889, .	190	675	...	...	...

The amount of capital embarked last year in boats, beam trawl vessels, and nets, fell short of that of 1888, and of the preceding three years. The amount expended on lines, however, has been gradually increasing since 1884, which shows that fishermen are paying greater attention to line fishing than formerly.

The particulars of this increase and of the decreases are given in the following table:—

Capital employed in 1888 and 1889.

Years.	Value (estimated).			
	Boats and Beam Trawl Vessels.	Nets.	Lines.	Total.
1888, ...	£837,718	£679,290	£126,472	£1,643,480
1889, ...	828,728	647,879	126,700	1,603,307
Increase in 1889, .	...	...	£228	...
Decrease in 1889, .	£8,990	£31,411	...	£40,173

The falling off during the last few years in the amount of capital invested in boats, vessels, and nets, is mainly accounted for by depreciation, loss of boats, and material, and by very few boats having been built, or nets manufactured, since 1884.

Details of boats, vessels, &c., and capital employed.

Table II. Appendix D, shows the number and tonnage of boats, decked and undecked, and beam trawl vessels, employed in the herring and other sea fisheries of Scotland last year, with the districts to which they belong; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed; with the estimated value of boats, beam trawl vessels, nets, and lines.

Details of beam trawl vessels.

Table III., Appendix D, shows the number and tonnage of beam trawl vessels and boats employed in the sea fisheries of Scotland last year; with the districts to which they belong; the number of fishermen and boys by whom manned; distinguishing steam trawlers from sailing trawlers; with the estimated value of the vessels, nets, and fishing material.

Tonnage of shipping and number of seamen engaged.

Table IV. Appendix D, shows the tonnage of shipping, and of the number of seamen engaged in the trade of the herring and cod and ling fisheries of Scotland, last year—distinguishing those employed in importing stave wood, hoops, and salt; in carrying herrings or cod-fish coastwise, or exporting them abroad; and distinguishing British from foreign tonnage and men.

The following table shows the total tonnage of boats and vessels, and the number of persons employed in the herring, cod, and ling, and other sea fisheries of Scotland in 1889, as compared with 1888:—

Tonnage of boats and vessels, and number of persons employed.

ABSTRACT.	Total Tonnage of Boats and Vessels, and Number of Persons employed.			
	British.		Foreign.	
Years.	Tons.	Persons.	Tons.	Persons.
1888, ...	276,322½	107,639	29,345	1,498
1889, ...	279 369½	109,757	43,113	2,101
Increase in 1889, . .	3,047	2,118	13,768	603

Abstract returns of tonnage and persons employed.

Table V. Appendix D, gives abstract return of the tonnage of vessels and number of men; the tonnage of boats and number of fishermen and boys; and the number of other persons employed in the herring, cod, and ling, and other sea fisheries of Scotland last year.

Number of boats and beam trawl vessels and resident fishermen in Scotland.

Table VIII. Appendix D, is a return, by fishing villages or creeks, for the coasts of Scotland, of the number of first, second, and third class fishing boats, beam trawl vessels, and resident fishermen and boys, in the year 1889. It will be seen that in Table II. of Appendix D, the fishermen and boys returned are 7558 more than the above-mentioned number. This is, however, in consequence of that additional number, who were non-resident, having been employed in the herring fishery at the various stations, when the return was made up.

LOANS TO FISHERMEN TO PURCHASE BOATS AND GEAR.

By the 32nd section of the Crofters Holdings (Scotland) Act, 1886, the Lords of the Treasury are empowered to advance to this Board such sums as may from time to time be placed at their disposal by Parliament, for the purpose of enabling them to make advances, by way of loan, to persons engaged in the prosecution of the fishing industry in crofting parishes abutting upon the sea in certain counties to which the Act applies. The purposes to which such loans may be applied include the building, purchase, or repair of vessels, boats, and gear for fishing purposes, and any other purpose of the like nature, for the benefit or encouragement of the fishing industry, within the localities referred to, which may be sanctioned by the Board, with consent of the Secretary for Scotland. The loans are to be made upon such terms as to repayment, security, rate, and payment of interest and otherwise, as the Secretary for Scotland, with the consent of the Treasury, shall determine. Under the Sea Fishing Boats (Scotland) Act, 1886, further provision is made for the registration and mortgage of fishing boats, so that they may become a valid security for loans; and under the authority of that Act, an Order in Council was issued for carrying out these provisions. Rules were made by the Secretary for Scotland, with the consent of the Treasury, as to the terms on which the Board might make loans; and forms of proposals, with instructions for filling them up, are sent to those fishermen who apply for money.

Treasury to advance Money to Board for Loans to Fishermen to buy Boats and Gear.

Secretary for Scotland, with consent of Treasury, to settle terms on which loans are to be made.

Rules made accordingly.

The parishes which have been defined by the Commissioners under the Crofters Act to be crofting parishes are situated in the following counties, viz., Argyle, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney, and Shetland.

Parishes to which Act applies.

During the past year 134 applications for loans were received from crofting parishes, the applicants numbering 504, and the amount asked £21,069, 15s. By far the largest number of applications were received from the districts of Stornoway and Wick.

Applications received, applicants, and amount asked.

Full inquiry was made into each case, and of the applications received, the Board, after the fullest consideration, decided to grant 106, the sum sanctioned amounting to £14,463, 16s. Eighty-two loans were completed, the amount paid over being £9114, 8s., while the remainder are either in course of being carried out, or are awaiting the completion of the building of new boats.

Number and amount of loans granted and completed.

Since the Crofters Act was passed in 1886, 795 applications have been received from 2888 persons; the amount asked being £93,347, 15s. Of these, 321 have been sanctioned, amounting to £36,750, 16s., and 197 carried out, the sum paid over being £20,926, 6s. 7d.

Particulars of loans since Crofters Act was passed.

The details in regard to the granting of loans to fishermen, in the districts situated within the counties defined by the Crofters Commission, as containing crofting parishes, are as follow:—

Details regarding loans, by districts.

Findhorn District.*

Findhorn district.

No applications were received in this district for loans during last year, nor were there any received in previous years

Cromarty District.

Cromarty district.

Three applications were received last year from 14 persons for loans amounting to £465, and one for £284 was sanctioned. Two loans, sanctioned in previous years for the purchase of boats were completed, £303, 10s. being the amount lent, made up of £65 and £238, 10s. These are the only loans completed since the Crofters Act was passed.

Instalments—principal and interest—amounting to £25, 1s. 2d. have fallen due, of which £17, 8s. 5d. has been paid, and £7, 12s. 9d. is in arrear.

Helmsdale District.

Helmsdale district.

Eight applications were received last year from 25 persons for loans amounting to £1692. Three loans were sanctioned, to the amount of £653, and three completed, the sum paid over—£653—being made up of £66, £275, and £312.

Since the Crofters Act was passed in 1886, nine loans have been made, all of which were for the purchase of boats, the amount issued being £1269.

Instalments—principal and interest—amounting to £167, 4s. 4d. have fallen due, £101, 12s. 6d. of which has been paid, and £65, 11s. 10d. is in arrear. £21, 1s. 2d. was received, which was not due till 1890.

Lybster District.

Lybster district.

Four applications were received last year from 7 persons for loans amounting to £281, all of which were sanctioned as well as one for £112 applied for previously. Five loans granted in this and previous years were carried out, the sum paid over being £595. The loans ranged from £56 to £312.

Since the Crofters Act was passed in 1886, six loans have been completed, four for the purchase of boats, and two for gear, the amount advanced being £907.

Instalments—consisting of principal and interest—amounting to £115, 14s. 8d. have fallen due, £95, 3s. 2d. of which has been paid, and £20, 11s. 6d. is in arrear.

Wick District.

Wick district.

Thirty-three applications were received last year from 114 persons for loans amounting to £6304, and 25 loans were sanctioned

* The boundaries of each fishery district will be found on pp. 5–23 of Appendix.

to the amount of £4168, 10s. Sixteen loans were completed, the sum lent being £1953, 10s. 0d., the loans ranging from £43 to £274.

Since the Crofters Act was passed in 1886, 59 loans have been carried out, 55 for the purchase of boats and 4 for fishing gear, the amount issued being £7096, 1s. 6d.

Instalments—principal and interest—amounting to £1276, 1s. 11d. have fallen due, £1003, 7s. 0d. of which has been paid, and £272, 14s. 11d. is in arrear. The sum of £104, 6s. 4d., which was received from the Insurance Company for two boats being totally wrecked during the year, is included in the above amount. £19, 16s. 10d. was received which was not due till 1890.

Orkney District.

Orkney district.

Seven applications were received last year from 11 persons for loans amounting to £861. Four loans were sanctioned to the amount of £435, and three completed, the sum paid over, £415, being made up of £90, £136, and £189.

Since the Crofters Act was passed in 1886, six loans have been advanced, all for the purchase of boats, the amount issued being £635.

Instalments—principal and interest—amounting to £94, 6s. 8d. have fallen due, the whole of which has been paid, and £7, 17s. 10d. was received which was not due till 1890.

Shetland District.

Shetland district.

Eleven applications for loans were received last year from 23 persons, the amount asked being £1632. Ten loans were sanctioned amounting to £844, and 11, which had been sanctioned in that and previous years, were advanced, the sum lent being £943, 18s. The loans ranged from £40 to £252.

Since the Crofters Act, 1886, was passed, eighteen loans have been completed, 16 for purchase of boats, and 3 for gear, the amount advanced being £1816, 18s.

Instalments—principal and interest—amounting to £313, 17s. 6d. have fallen due, of which £181, 2s. 3d. has been paid, and £132, 15s. 3d. is in arrear.

Stornoway District.

Stornoway district.

Stornoway section.

I. Stornoway Section.—During last year 45 applications were received from 237 persons, the amount asked being £7368. Forty-five applications were sanctioned to the extent of £6625, and 34 carried out, the amount issued being £3488, 1s. 0d. The loans ranged from £18 to £284.

Since the Crofters Act was passed in 1886, 73 loans have been completed, 66 for the purchase of boats, and 7 for gear, the sum advanced being £6526, 11s. 9d.

Instalments—principal and interest—amounting to £983, 1s. 9d. have fallen due, of which £730, 18s. 4d. has been paid, and £252, 3s. 5d. is in arrear. £28, 10s. 5d. of the amount received was insurance money for a boat wrecked in March last. In addition, £7, 14s. 8d. was received which was not due till 1890.

Barra section.

II. BARRA SECTION.—During last year 8 applications for loans were received from 29 persons, the amount asked being £539, 10s. Nine loans were sanctioned, amounting to £722, 6s., and six were advanced, the sum lent being £642. The loans ranged from £41 to £225.

Since 1886, when the Crofters Act was passed, 16 loans have been completed, all for the purchase of boats, the sum advanced being £1604, 16s. 4d.

Instalments—principal and interest—amounting to £287, 14s. 2d. have fallen due, of which £172, 15s. 1d. has been paid and £114, 19s. 1d. is in arrear.

LOCH BROOM DISTRICT.

Loch Broom district.

Eleven applications were received last year from 38 persons for loans amounting to £1801, 15s. Three loans were sanctioned, to the amount of £305, and 2 completed, the sums paid over being £57, 9s. and £63 respectively, making together £120, 9s.

Since the Crofters Act was passed in 1886, 8 loans have been carried out, 6 for the purchase of boats, and 2 for gear, the amount issued being £767, 9s.

Instalments—principal and interest—amounting to £157, 0s. 8d. have fallen due, £85 12s. 9d. of which has been paid, and £71, 7s. 11d. is in arrear.

LOCH CARRON DISTRICT.

Loch Carron district.

During last year 1 application from 3 persons was received, the amount asked being £15, but it was not granted. No loans have been carried out in the district since the Crofters Act was passed.

FORT-WILLIAM DISTRICT.

Fort William district.

Two applications for loans from 2 persons, were received last year, the amount asked being £79. One of these loans, amounting to £34, was sanctioned, but no loans were carried out.

No loans have been advanced in this district since the Crofters Act was passed in 1886, although 28 applications have been received, the majority of these being for open boats, over which policies of insurance could not be effected with an insurance company.

CAMPBELTOWN DISTRICT.

Campbeltown district.

During last year one application from one person was received for a loan of £31, 10s., which was declined.

Since 1886, when the Crofters Act was passed, no loans have been granted in this district.

Appendix G. is a return showing the number of loans carried out in each Crofting Fishery District, the amount paid over, and the total repayments since the Crofters Holdings (Scotland) Act, 1886, was passed, to 31st December 1889, together with the number and amount of loans in arrear.

Number and amount of loans completed, total repayments, and number and amount of arrears.

From this return it will be seen that of instalments amounting to £3420, 2s. 10d. which have fallen due, £2482, 6s. 2d. has been paid and £937, 16s. 8d. is in arrear. In addition £56, 10s. 8d. was received, which was not due till 1890.

Instalments due and paid.

The Board greatly regret that there is such a large amount of arrears to be reported. While part of them are no doubt due to the poor fishing in certain districts last year, in some cases the Board had reason to believe that the borrowers were in a position to pay the instalments as they fell due, but did not do so. Consequently the Board deemed it their duty, after fully inquiring into the circumstances of the defaulters, to take proceedings, although with much regret, against some of the persons in arrear for recovery of the amounts due.

Observations thereon.

Proceedings taken against defaulters.

PRODUCE AND VALUE OF THE SEA FISHERIES OF SCOTLAND, EXCLUSIVE OF SALMON.

The following is a statement of the total quantity and value of the different kinds of white and shell-fish landed in Scotland in the year 1889, compared with 1888.

Total quantity and value of fish landed.

Total quantities and values of White Fish landed—

White fish landed.

Herrings, .	3,718,505 cwts.,	£716,445	0	0	
Sprats, .	4,371 „	263	0	0	
Mackerel, .	664 „	380	0	0	
Cod, . .	503,663 „	172,100	0	0	
Ling, . .	134,481 „	46,493	0	0	
Torsk (Tusk),	11,483 „	1,725	0	0	
Saithe (Coal Fish),	84,472 „	11,987	0	0	
Haddocks, .	792,130 „	331,215	0	0	
Whitings, .	69,694½ „	23,786	0	0	
Turbot, .	6,338½ „	20,472	0	0	
Halibut, .	21,094¼ „	18,496	0	0	
Soles (Lemon Soles), .	14,391¼ „	21,925	0	0	
Flounders, Plaice, and Brill,	74,270½ „	53,072	0	0	
Eels, . .	16,230 „	8,552	0	0	
Skate, .	50,087 „	10,875	0	0	
Other kinds of White Fish,	87,363½ „	16,389	0	0	
	5,589,238½ cwts.,				
Gross total value of White Fish landed carried forward, ...					£1,454,175 0 0

Gross total value of White Fish landed brought forward,		£1,454,175 0 0

Shell fish landed.

Total values of Shell Fish landed—

Oysters,	£1,453 0 0	
Mussels,	11,677 0 0	
Clams,	2,564 0 0	
Lobsters,	24,449 0 0	
Crabs,	13,397 0 0	
Other kinds of Shell Fish,	9,661 0 0	
Gross total value of Shell Fish landed,		63,201 0 0

Total value of Sea fisheries.

GROSS TOTAL Value of the Sea Fisheries of Scotland, exclusive of Salmon, for the year 1889,	£1,517,376 0 0
Ditto for the year 1888,	1,404,488 0 0
Increase in year 1889 over 1888,	£112,888 0 0

Note.—An estimate of the value of the Salmon taken last year will be found in Part II. of this Report. It amounts to £221,560, making the grand total value of the Sea and Salmon Fisheries of Scotland for the year 1889, £1,738,936, 0s. 0d. It should also be explained that there is spent in Scotland £400,000 in connection with the gross total value of the sea fisheries in curing fish,—that is, on wood, hoops, coopers' and women's wages, salt, &c. Hitherto this sum has been included in the total estimate of the fish landed.

Quantity of fish cured.

Of the total quantity of herrings landed, as shown in the above statement, 1,397,507 barrels were cured. Of the total catch of cod, 229,622 cwts. were cured dried, and in pickle; of ling, 93,474 cwts. were cured dried; of torsk, 9131 cwts.; and of saithe, 41,335½ cwts.

Visit of Secretary for Scotland to North West Coast.

In concluding this Report, the Board desire to put on record that your Lordship having resolved to visit the North-West Coast of Scotland in the course of last summer, with the view of personally inspecting the harbour works in operation, the sites for new harbours, and of considering the whole question of communications, railway, telegraphic, and otherwise, in the interest of the fisheries, directed that the Chairman of the Board and some of the other members should accompany you.

Representatives of Board on that occasion.

The Board, at a special meeting held for the purpose, arranged that Professor Ewart and Mr Anderson Smith, two of their number, should go along with the Chairman to represent them on the occasion. Your Lordship having arranged to get H.M.S. 'Enchantress,' whose accommodation was limited, to take yourself and party to the different places on the coast which you intended to inspect, proposed that the members of the Board should take the cruiser H.M.S. 'Jackal' for their accommodation. This proposal was adopted, and they joined that vessel at Oban on 7th June, and accompanied the 'Enchantress' with your Lordship and party to the different places visited; and it was gratifying to them to give you such information in the course of the inspection as their knowledge of the fisheries and the wants of the fishermen enabled them to do.

APPENDICES.

APPENDIX A.

HERRING FISHERY. PAGE

APPENDIX B.

COD AND LING FISHERY.

APPENDIX C.

TOTAL QUANTITY OF FISH LANDED.

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FISHERY STATISTICS.

APPENDIX E.

RETURN OF COMPLAINTS OF INJURIES DONE TO FISHING BOATS, AND OF PROSECUTIONS AGAINST TRAWLERS.

APPENDIX F.

HARBOUR WORKS AND TELEGRAPHIC EXTENSION.

APPENDIX G.

LOANS TO FISHERMEN.

APPENDIX A.—No. I.

HERRING FISHERY.—Details, taken from the reports of the inspectors and district officers, regarding the herring fishery of 1889, in each of the twenty-six districts into which the coasts of Scotland are divided for fishery purposes, beginning at the south with the seventeen on the East Coast. These are—Eyemouth, Leith, Anstruther, Montrose, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, Wick, Orkney Isles, and Shetland Isles.

I. EAST COAST HERRING FISHERY.

Eyemouth District.

From Amble, in the county of Northumberland, to the east side of St Abb's Head, both inclusive, with Coquet Island, Holy Island, and the Farne Islands.

District Fishery Office—Berwick-on-Tweed.

Comparing the total catch of herrings in the district for 1889 with that of the preceding year, there is exhibited an increase of 11,732 barrels on the quantity cured, and 4500 crans on the quantity consumed fresh, and contrasted with the average catch of the previous ten years the quantities cured are almost identically the same, but a decrease of 8600 crans is presented on the quantity consumed fresh, which shows that the year's catch, though fair, is under the average of that of the previous ten years.

At Eyemouth and Berwick the early herring fishing began in the middle of May. 28 boats were employed, and landed large quantities of herrings, their average catch being 106 crans. The bulk of the fish, however, were small and immature, and occasionally they sold as low as from 2s. to 8s. per cran, the average price being 14s. Several takes of very inferior quality were sold for manure. The general herring fishing did not begin until the last week in July, and it finally closed on 24th September. The 312 boats employed averaged 173 crans, as against 141 crans for 278 boats in the preceding year. Forty boats of the fleet came from Cornwall, and a number from Firth of Forth ports. There were 234 herring boats belonging to the district, 195 of which were engaged in the fishing, while 39 were not launched, as their owners preferred to join with other crews, or follow the line or crab fisheries. A good general fishing was obtained almost weekly until near the end of August, when the shoals of herrings left the coast, and only an insignificant quantity was thereafter captured. The week ended 17th August produced the heaviest yield,—an average catch of 47½ crans per boat being landed. The highest gross catch for any boat was 550 crans, and the lowest 30 crans. There were a number of heavy takes, from 70 to 112 crans, brought ashore, whilst an exceedingly large one of 145 crans was landed at Eyemouth on 15th August, and another of 127 crans on the following day.

The most productive stations were Berwick, Eyemouth, Craster, and North Sunderland, where the average catch per boat for the season was 250, 204, 183, and 134 crans respectively. At the other five stations in the district the average varied from 93 to 116 crans per boat. During the early fishing, herrings were found everywhere on the inshore and distant fishing grounds on the coast between St Abb's Head and Holy Island. Thereafter the most productive grounds were about 20 miles off Berwick, and from 5 to 12 miles off the Farne Islands, where also the best quality of herrings was obtained. One half of the catch consisted of full herrings of exceptionally large size and superior quality, the finest caught in the district for many years past. The other half of the catch was, to a large extent, matie herrings of inferior quality. About 500 crans of inferior maties and torn bellies were sold in the district for manure. Prices varied from 2s. to 25s. per cran; the average price for the district being 12s. per cran, as compared with 10s. 6d. in 1888, and 9s. 6d. in 1887. Whilst a number of crews had an unremunerative season, a large number did fairly well. Although the boats were kept ashore on several nights by bad weather, the season on the whole was favourable for prosecuting the fishing, and it is gratifying to note that no lives were lost, and but little damage was sustained by any of the boats. About 1000 nets, worth fully £1900, were lost, or irreparably damaged, chiefly by weight of herrings. Four steam tugs were employed part of the season towing boats to and from the fishing ground, against 5 in 1888, and 8 in 1887.

Leith District.

From the west side of St Abb's Head, inclusive, westwards, and including all the south side of the Firth of Forth; and its north side to Buckhaven exclusive.

District Fishery Office—Newhaven.

There is both a summer and a winter herring fishing in Leith district. The summer fishing began on 8th July, and was prosecuted more or less steadily till the 7th September. The fishermen, having no arrangement with curers or buyers for delivery of their catches, readily removed from port to port, as indications of herrings were reported. The number of boats employed, therefore, varied from ten up to fifty, while the average number was forty. The total produce of this fishing was only 2955 crans, compared with 8410 crans for the previous year. The average weekly catches per boat, beginning with the week ended 13th July, were, 7, 18¼, 11¼, 19¼, 16¼, 20¼, 2¼, and 4 crans respectively; and the average catch per boat for the season was 73¾ crans, compared with 120¼ crans in 1888. An unusually heavy take of 105¾ crans was landed at Dunbar on 9th August. The fishing grounds extended from to 2 to 40 miles off the coast, herrings being scarce on all the grounds throughout the season. The bulk of the catch was disposed of for consumption in a fresh state, only a small quantity being cured. The principal fishing stations were Dunbar and Newhaven. Besides the boats employed in the district, a much larger number belonging to it prosecuted the herring fishing off the Irish coasts, on the west and east coasts of Scotland, and on the east coast of England.

The winter and spring herring fishing was prosecuted during the months of January, February, and March, and November and December. It was followed with fair success by about 100 boats, the total catch amounting to 7023 crans. The most successful months were January, February, and

March—the herrings being caught chiefly between Queensferry and westward of Inchkeith, and between Dunbar and May Island. No fish appeared in the vicinity of torpedo minefield, west of Inchkeith, which is marked off permanently by buoys.

The gross total catch of both the summer and winter fishings amounted to 9944 crans, as compared with 17,160 crans in 1888. The method of fishing followed was almost wholly that of drift nets. During the year two fishermen were drowned by falling overboard at sea.

Anstruther District.

From Buckhaven to the south side of Tay, both inclusive.

District Fishery Office—Anstruther.

There is both a summer and winter herring fishing in Anstruther district. The summer fishing opened early in July and closed in the first week in September. The average number of boats employed was 26, and the total catch amounted to 3328 crans, being an average of 128 crans per boat. The most productive week was that ended 27th July—the quality of the fish being also best at that period. During the remainder of the season, maties and spent fish were most abundant. Prices varied from 4s. to 28s. per cran, averaging 11s., being equal to the average of the previous three years. The principal fishing grounds lay from 20 to 40 miles eastward of the May Island, but some fair takes were landed towards the end of the season, at the entrance to the Firth of Forth, and off Dunbar. There were 438 boats fitted out for the summer herring fishing in the district, of which about 100 fished from Shields, and the remainder from the district and other east coast ports.

The winter herring fishing is the most important in this district, being prosecuted by 169 boats. From 1st January till 31st March the catch amounted to 19,758 crans, and in December to 311 crans, making a total of 20,069 crans for the season, being 6208 crans less than in 1888. Prices being low, many crews combined the great line fishing with the herring fishing, but confined their attention chiefly to the former. The quality of the herrings was equal to previous years. The general prices obtained ranged from 6s. to 15s. per cran, the average being 11s. per cran, the same as for the summer herrings. Part of the catch was cured ungutted and sent to Ireland, 216 crans were kippered, 2568 crans bloated, and the remainder sent to market fresh or lightly salted. The fishing ground was principally at the entrance to the Firth of Forth, the heaviest takes coming from the spawning ground lying between the May Island and Fifeness. The fishing was frequently interrupted by stormy weather, and there was a good deal of damage to netting.

Montrose District.

From the north side of Tay to Bervie, both inclusive.

District Fishery Office—Montrose.

The summer herring fishing was begun by a few boats during the weeks ended 6th and 13th July, but it did not become general until the week ended 20th July. It was brought to a close on 7th September, after which date only 33 crans were landed in the district. The fishing was more successful than in 1888, but the quality of the herrings was inferior, the proportion of maties or small fish being greater, and the proportion of large full fish less than in that year, while the quantity of spent herrings was not so great. A fleet of 156 boats were employed during the season, as compared with 126 in 1888, of which 150 belonged to the district, 4 to Anstruther, and 2 to Leith, and of these 39 fished from Gourdon, 13 from Johnshaven, 83 from Montrose, 19 from Arbroath, and 2 from Broughty Ferry and Dundee. The whole fleet, excepting 6 boats, were engaged to curers, the average price per cran for the season being about 13s. 6d., as against 12s. 8d. in 1888. The herrings were caught chiefly on the fishing grounds between Arbroath and Gourdon, and at distances of from 10 to 38 miles from land. During 7 nights of the season most of the boats were prevented from going to sea by rough weather. The total catch of herrings was 37,452 crans, and the average per boat 240 crans, as compared with 24,065 and 190¾ crans respectively in 1888. The average gross takes per boat landed at the several stations were:—Gourdon, 155 crans; Johnshaven, 149; Montrose, 248; Arbroath, 218¾; and Broughty Ferry and Dundee, 166½ crans. The average weekly catch, per boat, for the nine weeks the fishing was in operation, beginning 13th July, was 7, 31½, 35, 39½, 31¼, 48¼, 2½, 9½, and 5½ crans respectively. The heaviest fishing was landed in the week ended 17th August, when the average was 48½ crans per boat. During that week there were many takes ranging from 70 to 90 crans,—the largest individual takes being landed on the 15th and 16th August, one of 116 crans at Montrose, and the other at Arbroath of 106 crans. The most successful boat caught 360 crans for the season, and the least successful 47 crans.

The winter and spring herring fishing of the district was attended with little better success than in 1888; the total catch being only 713 crans, or an increase of 171 crans, compared with 1888. The prices varied greatly, ranging from 2s. to 30s. per cran. The total catch of herrings for 1889 was 38,165 crans against 24,607 crans for 1888.

Stonehaven District.

From Bervie, exclusive, to Skateraw, inclusive.

District Fishery Office—Stonehaven.

In Stonehaven district the summer herring fishing opened on 1st July—a fortnight earlier than in the previous year—and closed on 6th September. Until the 9th of July, it was prosecuted only to a limited extent, as the herrings landed before that date were of a very inferior quality, for which there was little demand. Thereafter, till 17th August, it was carried on with fair success, the weekly averages per boat for the six weeks embraced in that period being 20, 32⅓, 15, 35, 22⅓, and 24 crans respectively. During the remainder of the season the results generally were unsatisfactory, only 1495 crans being landed, 807 crans of which were captured on 3rd September. Nearly all that day's catch, however, consisted of spent fish. The most productive week was that ended 3rd August. The aggregate catch for the season amounted to 14,736 crans, against 16,050 crans in 1888. There were 68 boats employed, being 2 less than in the preceding year. The highest total take of any boat was about 340 crans, and the lowest 50 crans. The largest single take was 70 crans, and the highest total daily take, amounting to 816 crans, was landed on 19th July. The fishing grounds extended from 3 miles to 41 miles offshore, but very few herrings were caught beyond 30 miles. The most productive grounds lay from 3 to 12 miles distant, between Stonehaven and Bervie. From 24th July to 3rd August the herrings were of good quality, but during the rest of the season the takes consisted largely of maties. The full and spent fish were good, but a considerable proportion of the maties were small inferior fish. Nineteen boats were engaged to deliver their fish to curers at fixed prices, the herrings caught by the remainder of the boats being sold by auction, at prices ranging from 3s. 3d. to 23s. 6d. per cran. The average price realised over the whole fleet was about 12s. per cran. The weather, on the whole, was favourable, and the boats were at sea 44 nights. Seven nights were stormy, or threatening, and all the boats remained in harbour.

The winter and spring fishing was attended with average success. It yielded a total of 1143 crans, as compared with 965 crans in 1888. These herrings were nearly all sent to market for consumption fresh, prices ranging from 6s. 6d. to 60s. per cran. One fisherman was unfortunately drowned on 27th April. Boats, nets, and lines of the value of £429 were lost and damaged during the year. There were 64 herring boats belonging to the district, as compared with 62 in the previous year.

Aberdeen District.

From Skateraw, exclusive, to Aberdeen, inclusive.

District Fishery Office—Aberdeen.

The summer herring fishing of the Aberdeen district began in the first week of July, being earlier than usual, and closed on 7th September. The fleet numbered 408 boats, comprising 400 Scottish and 8 English, against 389 Scottish, 33 English, and 8 Isle of Man, in 1888, showing a decrease of 22 boats for the year. The chief fishing grounds lay from 5 to 60 miles offshore, extending S.S.E. to E.N.E. from Aberdeen, but the most productive lay inshore, distant 5 to 20 miles from land. Herrings were abundant, and the fishing was general. The total quantity landed was the highest on record, amounting to 105,745 crans, against 71,205 crans in 1888. The average per boat was 259 crans, against 165½ crans in 1888. July yielded 43,596 crans, August 43,576 crans, and September 5170 crans. The most productive week was that ended 27th July, with a catch of 16,557 crans, as against 18,724 crans for the best week of 1888, which ended 28th July. The highest single take was 146¾ crans, and the most successful boat of the season landed fully 700 crans. It being mainly an inshore fishing, the herrings were generally landed in good condition. The quality of the fulls was excellent, of the spents good, and of the maties inferior. Sixteen crews were engaged to curers at from 15s. to 16s. per cran for a complement of 200 crans, while unengaged boats sold their herrings daily, chiefly by auction. The average price obtained in July was 9s. 5½d., in August 13s., in September 13s. 1¼d., and for the season 11s. 4d. per cran, as compared with 15s. in 1888, and 13s. in 1887. The total quantity of herrings cured was 132,968 barrels, showing an increase of 31,091 barrels over 1888. The weather was favourable for the regular prosecution of fishing. One fisherman was unfortunately drowned in the harbour at night by falling overboard. No boats were wrecked, and the damage sustained was slight. By a severe gale which came on suddenly from the N.W. on the night of 20th August, nets valued at about £1200 were lost and damaged, but, apart from this, the loss sustained amounted to about £246.

The winter, spring, and early herring fishing only yielded 1666 crans,—making the total catch of the year 107,411 crans.

Peterhead District.

From Aberdeen to Rattray Head, both exclusive.

District Fishery Office—Peterhead.

The summer fishing of 1889 was commenced at an earlier date than usual. Towards the end of June from 60 to 70 boats were engaged in the prosecution of this fishing, and on the last days of the month curing for the Continental markets had begun. Fully one half of the season's catch was landed by the end of July. There were 506 boats employed, of which 2 fished from Port Erroll, 54 from Boddam, and 450 from Peterhead. Of these, 264 belonged to the district. For the number of boats employed, the catch was the highest on record. At Port Erroll the average catch for each boat during the season was 270, Boddam 158½, and Peterhead 285 crans, or an average of 271½ crans for each boat. The most successful boat landed upwards of 700 crans, and a number from 200 to 500, but there were some that did not reach 100. The largest single take was 146½ crans, but takes of from 100 to 126 were frequently landed during the season. The highest ascertainable earnings of one boat amounted to £416, a number had from £200 to £300, but there were some that barely earned as much as would pay expenses. The weeks ended 13th July and 17th August were the most successful of the season, the catch landed giving an average of fully 48 crans over the whole fleet for each of these weeks. The highest daily average was reached on 12th July, when 266 boats had an average of about 32 crans each, but the largest catch was landed on the 23rd July, when 380 boats had an average of 25 crans. Almost the whole of the season's catch was got on the inshore grounds at a distance of from 1 to 25 miles from land. A large proportion of the fish consisted of small immature herrings, which was largely owing to the early commencement of the fishing. The price per cran ranged from 3s. 9d. to 23s., according to the quality and the quantity landed. The weather during the season was remarkably good, there being only one night on which the whole fleet remained in harbour. On the 25th of July a hired man belonging to Lochinver, Sutherlandshire, fell overboard, and was drowned, being the only loss of life during the year. A considerable quantity of netting was lost by sinking with weight of fish, and fouling on the inshore grounds. Several boats sustained damage. One vessel was employed in the deep-sea fishing, and succeeded fairly well.

From 20 to 30 boats were engaged in the winter herring fishing, and landed during the months of January and February close on 2000 crans, the most of which were prepared as kippers. The total quantity of herrings cured during the year amounted to 228,933 barrels, against 128,571 in 1888.

Fraserburgh District.

From Rattray Head, inclusive, to Troup Head, exclusive.

District Fishery Office—Fraserburgh.

The herring fishing of 1889 commenced on 25th June, but did not become general before the 10th July. It was regularly prosecuted till 7th September when it practically closed, although a few boats continued to fish for a week longer. The fleet numbered 750 boats, of which 258 belonged to this district—7 boats fishing from Rosehearty, 20 from Pittulie, and 723 from Fraserburgh—showing an increase of 48 over the preceding year. Thirteen boats were engaged to curers at 12s. per cran for 100 crans after 20th July, and 14s. after completion of that contract. With this exception the herrings were disposed of privately or by auction. Prices varied from 7s. to 24s. per cran, according to quality and time of delivery. At Rosehearty the average catch for each boat during the season was 190 crans, at Pittulie 195, and at Fraserburgh 240, which gave a total catch of 203,421 crans, or an average of 271 crans per boat. The most successful boat landed about 700 crans, 301 of which were delivered in three consecutive takes. The lowest aggregate catch was 94, but a large number of boats secured from 300 to 500 crans. The price per cran averaged about 14s. The largest single take was 115½ crans, but takes of 80 to 110 crans were often brought ashore. The weeks ended 13th and 20th July, 3rd and 17th August, and 7th September were the most productive,—the averages being 50¼, 28, 25, 46, and 55 crans respectively. Early in the season the fishing was prosecuted from 20 to 40 miles N.E. of Fraserburgh, but the bulk of the catch was taken within 18 miles of the land. The proportion of 'fulls' was under that of last year, but the quality proved much superior, the fish being unusually large and well developed, varying in size from 610 to 749 to the barrel. Spents were equal to former years, but in many cases maties were inferior, particularly those of 27th August and 3rd September. The loss of netting sustained by fouling, weight of fish meshed, and stress of weather was estimated at £4110. The total quantity of herrings cured was 308,121 barrels, of which 294,558 were cured gutted, 1719 crans were sent fresh or lightly salted to market, 11,452 crans were kippered or preserved in tins, and 255 made into reds; 6750 crans were also disposed of for consumption fresh in the district, and 7252 crans sent to other places. These figures exhibit a total increase of 137,521 barrels cured, and 6238 crans consumed fresh over that of 1888.

The winter and spring fishing was unsuccessful, and yielded only 851 crans, part of which was used for baiting long lines, the remainder being made into kippers or sent fresh to market. Prices greatly varied, ranging from 12s. to 40s. per cran, showing an average of about 22s. per cran. One fishing smack was totally wrecked, and 35 boats sustained damage amounting to £420. Fortunately there was no loss of life in connection with the fishing this season, and only 7 fishing nights were lost by stormy weather.

Banff District.

From Troup Head, inclusive, to Cullen, exclusive.

District Fishery Office—Macduff.

The summer herring fishing in Banff district for 1889, unlike the short season of 1888, extended over a period of eight weeks. It began on 8th

July, and closed on 3rd September, with a total catch of 22,730 crans, or an average of $181\frac{3}{4}$ crans to each of 125 boats employed. The total catch in 1888 was 17,027 crans, showing an increase in favour of the present year of 5703 crans, and of $45\frac{1}{2}$ crans in the average per boat. The fishing was much more regular than in the previous year,—the takes being more equally distributed over the fleet and a larger number of boats having an aggregate catch of 200 crans and upwards. The most successful boat landed a total of 430 crans, and the least successful 90 crans. The number of first class herring boats belonging to the district was 243, being 7 less than in the previous year, and of these 4 were disposed of to fishermen in other districts, and 3 not used, as unseaworthy. The most successful week was that ended 3rd August, when an average catch of 38 crans per boat was landed. The fishing ground extended over an area of from 2 to 20 miles from land along the coast of the district, but the majority of the takes landed were got at a distance of from 7 to 12 miles offshore. Very little was done on the inshore grounds—so productive in former years. The quality of the herrings was decidedly inferior to that of any previous year since 1884. Besides an unusual proportion of maties landed, there were also taken, towards the close of the season, quantities of soft tender fish, which are so liable to burst during the process of cure. One peculiarity of the season was the large quantity of small immature herrings landed. Stormy weather prevented the boats from getting to sea on 8 nights of the season. Three fishermen were drowned, and 7 boats were partially damaged; but owing to the absence of an inshore fishing, there was no crowding on the fishing ground, and the damage to netting was extremely small. The price of herrings varied from 2s. to 20s. 6d. per cran, the average price being 10s. 6d. per cran, against 15s. per cran in 1888.

The winter herring fishing was a complete failure. The early fishing yielded a total of 2827 crans, being an increase over that of last year of 897 crans, and with the exception of a few crans kippered daily, the whole of these were sold for consumption in a fresh or lightly salted condition.

Buckie District.

From Cullen to east side of Spey, both inclusive.

District Fishery Office—Buckie.

Buckie had 724 boats in 1889, being 35 fewer than in the previous year. Of these, 143 first class boats prosecuted the summer herring fishing in the district—25 from Cullen, 2 from Portknockie, 30 from Findochty, 80 from Buckie, and 6 from Portgordon,—being an increase of 43 boats over 1888. The season opened on 10th July and closed on 7th September. Very few herrings were caught on the inshore grounds, the chief fishing ground being from 15 to 35 miles north east of Buckie, while the average quality of the herrings was much below the previous season. The most successful week was that ended on the 3rd of August, which yielded an average of 44 crans per boat,—the weekly average thereafter ranging from 11 to 27 crans. The highest average catch per boat, 244 crans, was obtained at Buckie, and the lowest, 110 crans, at Portgordon,—the average for the whole fleet being 212 crans, against 214 in 1888. The average price obtained per cran was about 8s., which was considerably under that of the previous year. Of the herrings landed from January to

December, both inclusive, 40,130 barrels were cured for exportation, and 7792 barrels cured ungutted, or as kippers and bloaters,—the total numbering 47,922 barrels,—or an increase of 16,882 barrels over 1888. The weather was fairly good, with the exception of the week ended 24th August, when the boats were only able to go to sea on one night.

The winter fishing commenced on 3rd January and closed at the end of February, the total catch being 3661 crans,—an increase of 1091 crans over 1888. The chief fishing ground was off Troup Head, but several takes were brought from Orkney. Prices ranged from 14s. to 42s. per cran, the average obtained being about 18s. The herrings were cured as kippers and bloaters, or roused, for the English markets. In the course of the year 6 fishermen lost their lives at sea; 3 boats were totally wrecked, and 6 damaged,—the loss together, with that on nets and lines, amounting to £2109

Findhorn District.

From west side of Spey to south side of Kessock Ferry, both inclusive.

District Fishery Office—Burghead.

The summer herring fishing which commenced on 9th July and closed on 31st August was prosecuted by 104 boats, 46 of which fished from Lossiemouth, 20 from Hopeman, and 38 from Burghead. The average catch per boat was 198 crans, against 140 crans in 1888. The most productive week of the season was that ended 20th July which yielded 3985 crans. The largest single take was 78 crans, and the highest aggregate catch of any one boat 320 crans. The general fishing ground was from 5 to 7 miles south-east of Tarbetness. The herrings were of very inferior quality all through the season, only a small portion being full fish. None of the boats were engaged to curers, the fishermen selling their fish daily. Prices ranged from 5s. to 14s. per cran, the average price being 8s. 6d. The total quantity of herrings cured was 30,205 barrels, being 7613 barrels more than in 1888. The weather was remarkably fine throughout the season, the boats getting regularly to sea.

The winter herring fishing yielded 1411 crans, as compared with 1361 crans in 1888. Prices ranged from 5s. to 25s. per cran,—413 crans being prepared as bloaters, and the remainder sent to market fresh. The number of boats belonging to the district is 398, being a decrease of 15 as compared with the preceding year. No lives were lost in connection with the fisheries, but 2 boats were totally wrecked, and 10 damaged. The total loss on boats, nets, and lines was £1601.

Cromarty District.

From north side of Kessock Ferry to south side of Meikle Ferry, both inclusive.

District Fishery Office—Cromarty.

In Cromarty district there are 189 herring boats, but of these only 44 were employed in the district, viz., 40 at Portmahomack, 2 at Cromarty, and 2 at other stations, the remainder having removed to other places on the east coast during the fishing season. At Portmahomack—the only station in the district where herrings were cured last year—the fishing commenced on 16th July and ended on 31st August. The most productive weeks of the season were those ended 27th July, 3rd, 10th, and 17th August. The principal fishing ground was in the vicinity and a few miles south-east of Tarbatness, and the average catch for the 40 boats employed was 121 crans, against 83 crans in 1888,—the total catch for the season being 4854 crans, as compared with 2984 crans in 1888. The quality of the fish for curing purposes was very disappointing during the whole season, not much over one-seventh of the total catch being full fish, and the remainder chiefly maties. The Portmahomack boats were almost all engaged at 12s. to 13s. per cran, and the total catch would average about 12s. per cran. There were about 400 crans landed at Cromarty during the season, but these were all used in a fresh state. The weather was very favourable for fishing.

The winter herring fishing was prosecuted to a limited extent at Portmahomack and Cromarty during the months of January, February, and March, and again in November and December, principally for the purpose of getting bait for long lines—the total catch only amounting to 372 crans, valued at £191.

Helmsdale District.

From north side of Meikle Ferry to Dunbeath, both inclusive.

District Fishery Office—Helmsdale.

The summer herring fishing of 1889 was prosecuted by 122 boats, of which 113 fished from Helmsdale and 9 from Dunbeath,—being an increase of 24 boats over the previous year. Ninety-three of these belonged to the district and 29 to adjacent districts, viz., Wick, Banff, and Inverness. The season opened very favourably on the 10th of July, but was not in full operation until the 22nd, the low prices offered keeping the fishermen from the fishing until the 18th July, when the Helmsdale boats were engaged to curers at prices ranging from 11s. 6d. to 14s. per cran, for a complement of 200 crans, or for a period of seven weeks. Having regard to the prices paid before the 18th of July, which ranged from 2s. to 8s. per cran, and to those paid unengaged boats belonging to other districts, which varied from 5s. to 17s. 6d. per cran, the average price was 12s. per cran. The bulk of the season's catch was taken from 2 to 5 miles offshore, the average for the first 3 days being, 18, 14, and 20 crans respectively. The fishing throughout was very regular and productive, there being no blanks until the 3rd of August, when the average for the district was 111 crans. The most successful week was that ended 3rd August. The largest single take was 93½ crans, the highest gross catch 320 crans, and the lowest 40 crans. From the 3rd till the 16th of August, when the season closed, the fishing was very irregular, and the quality of the fish inferior. With the exception of one night, the weather was favourable for fishing. The total quantity of herrings cured was 30,248 barrels, against 22,958 in the previous year. There was no loss of life nor damage to boats, and the loss of nets, caused chiefly by fouling, amounted to only about £150.

The winter and spring fishing, which was carried on between 1st January and the end of April, was prosecuted by 12 boats,—the same number as in 1888. The season was more productive than the previous one, 630 crans being landed, against 282 crans in 1888. Forty-two crans were made up as bloaters, and the remainder sent to market in a fresh state.

Lybster District.

From Dunbeath, exclusive, to East Clyth, inclusive.

District Fishery Office—Lybster.

The summer herring fishing of 1889 commenced on the 2nd of July, but did not become general until the 16th of that month, and was continued until the end of August. Seventy boats were employed in the district, 43 of which were engaged to curers at fixed rates per cran, and the others sold their fish daily at current prices. The average price for the season was about 11s. 6d. per cran for all the fish landed. The total catch for the season was 11,625 crans, of which 7270 crans were landed in July, and 4355 crans in August. The average catch per boat was 166 crans, being the highest average catch on record in this district. The most successful period of the season was the week ending the 20th of July when 4253 crans were landed by 46 boats employed. On the 17th and 18th July several single takes of 80 to 100 crans were landed, and one boat had 150 crans of fine large herrings at one take. The highest total catch by any boat was 360 crans for the season. Others had from 250 to 350 crans, while one boat landed only 35 crans during the season. The quality of the fish in July was fairly good, but in August a very large proportion of the catch were the smallest in size, and the poorest in quality ever landed here. About one-fourth of the catch were fine large full fish, and rich in flavour. Spent fish were observed as early as the 17th of July, and more or less of them were landed up to the close of the season. The quantity of herrings cured gutted was 13,939 barrels, the quantity exported 13,152½ barrels, and branded 3929 barrels,—being an increase over last year of 6511 barrels cured, and of 5968 barrels exported, but a decrease of 521½ barrels branded.

The winter herring season had a fair degree of success in January when 349 crans of herrings were landed. Prices opened at 40s. a cran, but rapidly fell to 12s., and afterwards to 5s. 6d. The weather was stormy in February and March. Few herrings were then to be found on the coast, and the season closed with March having yielded a catch of 500 crans of herrings valued at £425. Of the 500 crans caught, 120 barrels were cured gutted and shipped to the Continent *viâ* Wick.

There was no loss of life in this district during the year, but 2 boats at Latheronwheel were damaged to the extent of £10, and the loss and damage to nets and lines during the year was £790.

Wick District.

From East Clyth, exclusive, to Cape Wrath, inclusive, including the Island of Stroma in the Pentland Firth.

District Fishery Office—Wick.

The summer herring fishing of 1889 was prosecuted by 442 boats, of which 402 fished at Wick, 17 at Ramsgoe, Boathaven, Elzie, and Staxigoe, 11 at Keiss, and 12 at Scrabster, being an increase of 12 boats as compared with the number fishing in 1888. Of these boats, 345 belonged to the district, as compared with 348 in 1888. The fishing commenced at

Scrabster on 2nd May, where it was continued till 26th July, the large catch of 16,000 crans having been landed there during that time by a fleet varying from 40 to 100 boats. Two-thirds of the catch was cured and shipped to the Continent, and the average price to fishermen was 14s. per cran. The fishing commenced at Wick on 25th June, and was continued till 5th September, the total catch of herrings in that time being 76,412 crans, giving a gross catch for the district of 92,412 crans, being an average of 172¾ crans for the 442 boats employed, against 197½ crans for 432 boats in the previous year. The boats were 53 nights at sea, and only on one night were they obliged to remain ashore by reason of stormy weather. During the middle of August a limited number of the boats went to the offshore fishing ground, from 25 to 30 miles distant, and from which they landed fair takes of herrings, but the great bulk of the season's catch was got on the inshore ground at from 2 to 8 miles off the shore. In July the herrings were of good quality, from one-third to one-half of the catch being full fish, but during the remainder of the season they were very inferior,—nine-tenths of the catch being small and spent fish. The proportion of full herrings for the season was not more than a sixth of the gross catch. The highest single take was 130 crans, but takes varying from 100 to 129 crans were frequently landed. The largest gross catch for the season by any one boat was 600 crans; a number of other boats landed from 400 to 500 crans each, and a large proportion from 200 to 300 crans, but a number did not take 100 crans, and a few were as low as from 30 to 40 crans. The total quantity of herrings cured was 151,273 barrels, being an increase of 37,567 barrels over the total for 1888. About 160 boats were engaged to curers at from 10s. to 15s. per cran. The herrings caught by the remainder of the boats were sold by auction at prices varying from 6s. to 18s. per cran. The average price realised over the whole fleet was about 12s. per cran. Nine lives were lost,—eight through a boat being swamped, and 1 by being knocked overboard by a sail. Five boats were totally lost, and 12 were damaged, causing a total loss of £694. The loss sustained through the sinking of nets by the weight of herrings meshed, and by accidental fouling, was large, amounting to £2880.

The winter herring fishing of 1889 was attended with average success, the total catch being 6667 crans,—an increase of 2071 crans over the winter catch of 1888. The average price paid to the fishermen was 12s. per cran,—making the total value £4000. The bulk of the catch was kippered, a small quantity cured gutted, and the remainder sent to market in a lightly salted state.

Orkney District.

The Orkney Islands; and Swona in the Pentland Firth.

District Fishery Office—Kirkwall.

The early herring fishing began at Stromness on 20th June, and closed on 20th July,—74 boats being employed, of which 72 were engaged to curers at 12s. per cran. The average catch was 80 crans, largest gross take 190½ crans, and lowest 25. The quality of the fish was good,—47 marks per barrel being obtained for the first consignments of the best selection and cure. Towards the middle of July prices lowered considerably, owing to large quantities being sent at that time to the Continent from other districts.

The general herring fishing began on the 23rd July, and terminated on the 31st August, 131 boats being employed, of which 5 fished from St Margaret's Hope, 10 from Cara, 20 from Burray, 33 from Holm, and 63 from Stronsay, being an increase of 5 over the fleet of 1888. With the exception of 6, they were all engaged to curers at 14s. per cran for a complement of 150 crans, and in some cases 14s. per cran for 100, and 12s. for 50 crans. The average catch was 124 crans per boat,—Stronsay being the most productive station with a general average of 132 crans. The highest individual catch was $100\frac{1}{2}$ crans landed by the steam fishing boat 'Alice' of Leith. The largest gross catch was 260 crans, and the smallest 40 crans. The quality of the herrings was poor throughout, a large proportion being maties and spents. Nets, valued at £947, had to be abandoned on 28th August, through weight of fish meshed, which was the heaviest loss ever sustained in Orkney in one season. Two first class boats were totally wrecked during the year, and 3 lives were lost in connection with the fisheries. The number of boats belonging to the district was 631, of which 168 were first class, 32 second class, and 431 third class, and the estimated value of which was £16,541.

Shetland District.

Comprising the Shetland Isles, Fair Isle, and Foula Island.

District Fishery Office—Lerwick.

The herring fishing of Shetland district, which developed so rapidly during the years 1880 to 1885, has recently greatly fallen off, and during the past year, considering the number of boats employed, it was little better than a complete failure. Extensive preparations were made for the early fishing, which began about the 20th June, all the available stations being occupied, and a few new ones erected. 771 boats, an increase of 371 over 1888, were engaged by 72 curers, and of these, 568 boats fished in the Unst section, and 203 on the west side of the district. In the first few days of the fishing a fair average catch was landed, but towards the end of June, dog-fish appeared on the fishing grounds and frightened the herrings away, all fishing operations being suspended. The early fishing closed in the second week of July, with an estimated catch of 27,822 crans, which realised an average of 15s. per cran.

The late fishing began at Lerwick and other stations on the east side of the district towards the end of July, 400 boats being engaged. It proved a complete failure, the total catch only amounting to about 800 crans, nearly a half of which quantity was landed at the station of Symbister. A large proportion of the boats did not take a single herring during the season. One take of 37 crans was landed at Lerwick, and another of 50 crans at Symbister. Of the 400 boats employed, 320 belonged to the district, and the remainder chiefly to the Isle of Man. The total quantity of herrings cured was 47,006 barrels, being a decrease of $52,215\frac{1}{4}$ barrels under the quantity cured in 1888, and a decrease of no less than 171,717 barrels under the average for the previous five years. The average price obtained was 16s. per cran. The fishing was continued by a few crews up to the middle of September, but with no better success, dog-fish being as numerous at that time as in the month of July. There were no lives lost in connection with the fishing. The estimated damage to nets amounted to £530, and the damage to boats to £155.

II. WEST COAST HERRING FISHERY.

The nine fishery districts on the West Coast of Scotland are:—Stornoway, Loch Broom, Loch Carron and Skye, Fort William, Campbeltown, Inveraray, Rothesay, Greenock, and Ballantrae.

Stornoway District.

The Islands of Lewis, Harris, North Uist, Benbecula, South Uist, Barra, and the smaller Islands within this range ; also St Kilda.

District Fishery Office—Stornoway.

Herring fishing began at Stornoway early in January, and continued thereafter with fair success until 14th April, when the fishermen agreed to observe a close time, and fishing was accordingly suspended. On expiry of the close time on 15th May, what is termed the summer fishing began, at which a fleet of 1,121 boats were employed, 188 of these being boats belonging to the district, 550 fishing in the Stornoway section, and 571 in Barra section, the industry being prosecuted from 9 stations. The average take per boat in Stornoway section was 106 crans, and in Barra section 18 crans. The total quantity of herrings cured in both sections was 81,520 barrels, being 50,283 barrels less than the preceding year. Of the total quantity cured, Stornoway section contributed 68,901 barrels, and Barra section 12,619 barrels ; the former section thus showing a decrease of 41,491 barrels under the preceding year, and the latter a decrease of 8792 barrels. 19,797 crans were kippered, and 4940 crans were sold for consumption fresh or lightly salted, these being all disposed of in the home markets, and amounting to only about half the quantity so used in the preceding year.

The decrease in the catch of this year was no doubt due to the unfavourable weather which prevailed during the summer. Calms were almost incessant, and the boats could therefore neither reach the best fishing ground nor return therefrom when herrings had been got. To meet this difficulty 3 or 4 large steamers were employed almost daily picking up successful boats at sea and bringing them to Stornoway.

During the summer the most productive fishing ground was, as formerly, in the vicinity of the Butt of Lewis, but during winter and spring most of the herrings were found quite close to shore. The herrings taken were of a fair quality. During the week ended 25th May, 12,833 crans were landed at Stornoway, that being the best week's catch of the season. The largest single take, the result of a night's fishing, was 104 crans. At Barra the fishing was irregular, and while some boats landed 100 crans for the season, others did not land as many herrings. The best fishing was obtained at Barra during the week ended 15th June, when 3039 crans were landed. It was estimated that the fishermen at Stornoway realised, on an average, 22s. per cran for their season's catch, but in consequence of the engagements which were generally made at Barra the herrings landed there cost the curers 50s. per cran. Based on these calculations the produce of the herring fishing of the district was valued at £87,354, and though the catch was a third less than the previous year, the value was greater by £10,200.

39,802½ barrels of herrings were sent direct from the district to Continental ports ; and of that number 33,117 were shipped for St Petersburg. The number exported was, therefore, 15,087½ barrels less than in the preceding year. In proportion to the catch landed, a larger quantity of herrings were sent to Continental markets than in the previous year. The fine flavour of the herrings of this district is much esteemed in foreign markets. Barra herrings being scarce, and of excellent quality, occasionally realised in Hamburg and St Petersburg prices equal to £8 per barrel. The trade in Stornoway kippers is still important, and it is believed that the kippers cured there are the finest in the country, and usually command high prices in the home markets. Seven large steamers were specially employed while the fishing was going on in carrying herrings to Scottish and English ports for distribution throughout the United Kingdom.

During the year, 16 fishermen were drowned, and the loss in boats and fishing material was estimated at £1654.

Loch Broom District.

From Cape Wrath to Diebeg, both exclusive ; including the lochs and islands within this range of coast.

District Fishery Office—Ullapool.

The principal herring fishing was carried on in this district from June till November, herrings appearing in all the large lochs during the season. Towards the middle of July a superior quality of fish was landed. When herrings were most plentiful, however, the first class boats belonging to the district were either fishing at Stornoway or on the East Coast. Consequently the fishing was followed only by small undecked boats, possessed of indifferent netting. Owing to the want of railway communication, the demand for fresh herring was limited, prices being consequently low, ranging only from 5s. to 16s. per cran. A large portion of the catch was cured by crofters for their own use. The total quantity of herrings cured on shore was 4511 barrels, while 810 barrels were cured on board of 9 vessels, fitted out in the district for the fishing, making a total cure of 5321 barrels. In addition, 1121 crans were used in a fresh state. There were 638 boats belonging to the district, about 400 of which used herring nets. The remaining 238 were seldom used for fishing, being employed chiefly in carrying peats for fuel, and sea-weed for manure.

Loch Carron and Skye District.

From Diebeg, inclusive, to Loch Nevis, exclusive ; including the lochs and smaller islands within this range of coast ; also the islands of Skye, Scalpa, Raasay, Rona, and Croulin.

District Fishery Office—Broadford.

In Loch Carron and Skye district the early herring fishing was again a failure, the whole catch for the first six months of the year being only 803 crans. Notwithstanding this, the total catch for the year was the largest recorded in the district since 1881, and may be estimated at fully 36,882 crans, being about 4882 crans in excess of the previous year. Of the total catch, 40,427 barrels were cured, and 15,617 crans sent away fresh against 30,757 barrels cured, and 7173 crans used fresh in 1888. The best fishing grounds were Loch Hourn and Sound of Sleat, Loch Sligichan, and Sounds of Croulin, Rona, Raasay, and Scalpa. Owing to the large catch and the quality generally of the herrings, which, with the exception of those got in Sound of Sleat, were largely mixed with small fish, prices throughout the year ruled low, and may be quoted at from 3s. and 6s., up to 15s. and 23s. per cran. There were 973 boats belonging to the district, and the average number of boats fishing during the year was 265, while the greatest number employed at any one time was 634. Thirty-five curing vessels were fitted out in the district for the herring fishing, and 9 steamers were engaged carrying fresh herrings to Glasgow, Oban, Stromeferry, and Liverpool. Four fishermen were drowned during the year,—2 at Loch Hourn, and 2 at Loch Snizort.

Fort William District.

From Loch Nevis to Oban, both inclusive; including the lochs within this range of coast; also the islands of Canna, Rum, Eig, Muck, Coll, Tyree, Iona, Mull, Lismore, Kerrera, and the smaller islands.

District Fishery Office—Oban.

The herring fishing in the Fort-William district was as unsuccessful last year as it had been in the two previous seasons. The principal fishing grounds were the Sound of Sleat and Lochs Linnhe and Scriddan. In Loch Linnhe the fishing was carried on during July and August; in the Sound of Sleat from July to the middle of November; and in Loch Scriddan during August and part of September. A number of boats from the locality of Loch Nevis went to Loch Hourn during August, September, and October to prosecute the industry there. On one occasion 60 boats were employed in the fishing, but the average number was only 24. The total quantity of herrings cured amounted to 969 barrels, as compared with 986 in 1888. The quality of herrings was fair. Prices ranged from 2s. to 90s. per cran, the average price being 22s. 6d. Four curing vessels were fitted out during the season.

Campbeltown District.

From Tayinloan, inclusive, round the Mull of Cantyre to Skipness Point, inclusive; including the islands of Colonsay, Jura, Islay, Gigha, and Sanda.

District Fishery Office—Campbeltown.

The herring fishing in this district was prosecuted throughout the whole year, with the exception of the period from 15th March to 1st June, now recognised as a close time by the Fisherman's Association. There were 378 boats employed, 98 of whom used the drift-nets, and 280 the seine or circle-nets. The result of the year's fishing showed a decrease, as compared with 1888, but was above the average of the past 10 years. The total quantity of herrings cured in 1889 amounted to 45,883 barrels against 49,232 barrels in 1888. The fishing was successfully prosecuted in January and February, many of the crews securing large takes and fair remuneration, as the quality of the fish was excellent. The greater number of the boats went to the Ballantrae fishing at the end of February, and remained till the fishing closed there. On 1st June the regular summer season opened, and the industry was carried on with fair success by drift-net boats till the end of September. The seine or circle-net boats were not very successful during the summer, but in the closing months of the year they landed large quantities of herrings. As many as 5000 crans were caught in the week ended 23rd November. In Kilbrannan Sound the herring shoals were often dense, and hundreds of crans were frequently encircled by a seine-net, which, unfortunately, invariably burst, the greater portion of the fish being lost. The largest single take, amounting to 150 crans, was landed by a Carradale crew, and was sold at 15s. per cran. A double crew belonging Campbeltown, who carried on the same mode of fishing, earned £750 during the season, while others earned from £300 to £400. The fishermen using the drift-nets realised considerably less than the seine-net fishermen—the season being the most unremunerative they have had for many years. The quality of the herrings was superior, particularly so in summer and the closing months of the year. The principal fishing ground was in the Sound of Kilbrannan. The fishing was also very prosperous in Islay, and turned out remunerative. The herrings were got in Lochindaal on the east, and in Lochgrunard on the west side of the island, where they were found in large numbers for several months. In the early part of the year the prices ranged from 5s. to 15s. per cran, and afterwards from 2s. to 20s. The total value of the season's catch was estimated at £37,669. The herrings were forwarded to Glasgow by trading and chartered steamers. Besides the district boats engaged in the fishing, there were others from Loch Fyne, Arran, Bute, Ayr, Mull, Skye, and the Firth of Forth. A small quantity of herrings were kippered and cured gutted at Campbeltown, Carradale, and Islay.

Inveraray District.

From Oban to Tayinloan, both exclusive; including the lochs and islands within this range of coast, and from Skipness Point and Ardlamont Point, both exclusive, for both sides of Loch Fyne, to the head of the loch.

District Fishery Office—Ardrishaig.

The herring fishing in Inveraray district commenced early in June and closed on 30th November. There were 331 herring boats in the district, 258 of which were constantly employed during the season—about a third using drift-nets, and two-thirds using seine-nets. The total catch for the year amounted to 26,249 crans, which is the largest recorded for the last 5 years, and is an increase of 5455 crans as compared with 1888. The most successful months were July and October. In the early part of the season the industry was prosecuted all over Loch Fyne, and some good takes were landed in its upper reaches, near Inveraray, but the most successful fishing was procured in the lower parts of the loch. From June till the close of September the fishing was light. Several dense shoals of herrings were discovered in different parts of Lower Loch Fyne during the months of October and November. Takes ranging from 150 to 200 crans were frequently landed, and one crew had a single catch of 232 crans, and another landed over 400 crans in one week. Much larger quantities were often encircled, but the nets burst and the herrings escaped. The sums realized for the largest single takes ranged from £100 to £187. Crews of 2 boats using seine-nets and working together earned from £300 to £700 during the season, while a few of the most successful crews got from £900 to £1100. Others, however, only received from £100 to £200 for their aggregate catches. Drift-net crews of 2 and 3 men made sums varying from £130 to £200. The quality of the herrings was most superior, and the size generally very large. Prices varied from 10s. to 70s. a cran—the average price being 22s., as compared with 27s. a cran, for the last 5 years. The bulk of the season's catch was forwarded direct to Glasgow in steamers chartered by the Argyle and Bute Fishermen's Association.

Rothesay District.

From Ardlamont Point, inclusive, to Roseneath Point, exclusive; including the lochs within this range of coast; also Bute and Arran.

District Fishery Office—Rothesay.

The summer herring fishing opened in Rothesay district on 24th June and practically closed on 31st October. There were 259 boats belonging to the district, and a falling off in the number employed—the old boats not being replaced by new ones. The total amount of herrings landed was 8289 crans, being a slight decrease against the two previous years. In the early part of the season the herrings made their appearance in Lochs Strivan and Long, and fair catches were secured, but the shoals did not remain for any length of time. During August the fleet began to prosecute the fishing on the more extensive grounds off Ardlamont, Skipness, Cock of Arran, and Machree Bay, Arran. In one week of the season as many as 294 boats were employed—catches with the seine or circle-net being extremely irregular, but the drift-net fishing was more successful. The gross earnings of the most prosperous pair of skiffs, with a crew of 8 men using the seine-net, amounted to £200, and the most successful drift-net crew of 3 men earned £135. The average earnings of the drifters, which were the most numerous, amounted to £75. In size and quality the herrings caught in the lochs were excellent, and commanded a ready sale. In June and July there was a good demand, and prices were as high as 45s. per cran. The average price for the season, however, was about 26s. per cran, as compared with 21s. in the previous year. Nearly the whole of the catch was despatched to market for use fresh. Five curing vessels were fitted out in the North West Highlands, and all returned with full cargoes. The weather up to the end of October was exceptionally good. One fatal accident occurred during the season.

Greenock District.

From Glasgow, westwards, on the north side of the River Clyde, to Rosneath Point, both inclusive, including Gareloch; on the south and east side of the River and Firth of Clyde to Ayr, exclusive, including the Cumbraes.

District Fishery Office—Greenock.

The herring fishing in this district was commenced in the latter part of May and was prosecuted until the middle of September, when it was discontinued for the year. The weather was very favourable for fishing all through the season. There were 230 boats belonging to the district—110 herring boats, and 120 engaged in other branches of the fishing. Eighty-seven boats were at one time employed at the herring fishing—being 4 more than in the preceding year. The principal fishing grounds were on the Ayrshire coast and in Gareloch. Herrings were found in Gareloch in good quantities during June and July, and were of fair size and quality, but no large shoals appeared at any time on the Ayrshire coast. The takes were small but general. The total catch of herrings amounted to 1840 crans, valued at £4439, against 3185 crans, valued at £5008, in 1888, and 1827 crans, valued at £2306, in 1887. All the catch was taken by drift-nets. It was disposed of, chiefly to local merchants, for consumption fresh. The highest individual take was $10\frac{3}{4}$ crans. The bulk of the herrings were of rather a poor quality all through the season, but high prices were generally obtained—the average price per cran being 41s. 4d. as compared with 31s. in the previous year. Four curing vessels were fitted out, and 13,267 barrels of cured herrings were landed in the district from them and from other vessels curing in the North West Highlands. This was an increase of 3763 barrels over 1888, and was the largest quantity landed in this district for many years past.

Ballantrae District.

From Ayr to Sark River, Solway Firth, both inclusive.

District Fishery Office—Girvan.

The fishing of 1889 in this district presented few features of interest apart from recent years, and was, upon the whole, fairly successful. The weather is always an important element in the prosecution of the winter herring fishing—especially upon an exposed coast like that of the Firth of Clyde, and last winter, though herrings were abundant on the coast, they could not be reached owing to continuous gales of wind, and for days in each week the boats remained on shore in enforced idleness. The herring shoal appeared first upon the Ayrshire Coast between Turnberry and Dunure early in January, and gradually went southwards to the Ballantrae banks—keeping unusually near the shore in its migration, so that it could scarcely be reached by the drift-net.

There was a great variety in the catches both with the drift and seine-net, some boats having large herrings, others small or mixed, on the same nights. The first good catch was made in the week ended 23rd February. A favourable change in the weather had set in, the herrings had settled on the Ballantrae banks, and for the first time since the commencement of the season the whole fleet were at sea, and 2260 crans of herrings were landed from 121 boats. The fine weather continuing, there was a regular and good fishing in the following week, with both seine and trammel-nets—6426 crans being landed by 155 boats. During both weeks the herrings landed were of large size and good quality. Five hundred waggons with herrings were despatched from Girvan Railway Station during the week ended 1st March. In the following week the fishing terminated for the season with a catch of 8883 crans.

The summer herring fishing was only a moderate success. Commencing in May the fishing was continued until the end of August, and yielded a catch of 1483 crans—the highest number of boats fishing being 92. There was no loss of life in connection with the fisheries, and the damage sustained by boats and fishing material was only trifling.

APPENDIX A.—No. II.

HERRING FISHERY.—RETURN of the Number of Vessels fitted out in SCOTLAND for the HERRING FISHERY in the Year 1889; the Districts from which fitted out; the Tonnage, and Number of Men; the quantity of Netting, Salt, and Barrels Shipped; and the number of Barrels of White Herrings Cured on Board.

DISTRICTS.	Vessels.	Tonnage.	Men.	Netting.	Salt.	Barrels.	Herrings Cured on Board.				Total Cured on Board of Vessels.
							Gutted.		Ungutted.		
							Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but *not* within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	Number.	*Tons.*	*Number.*	*Sq. Yards.*	*Bushels.*	*Number.*	*Barrels.*	*Barrels.*	*Number.*	*Number.*	*Barrels.*
Peterhead,	1	53	10	44,000	580	346	346	...	...	163	509
Loch Broom,	9	198	57	70,000	1,010	800	790	...	...	20	810
Loch Carron and Skye,	35	1,017½	115	202,000	29,810	14,226	8,473	...	93	718	9,284
Fort-William,	4	66	16	15,000	1,578	789	789	...	...	...	789
Campbeltown,	1	31	5	...	800	230	2,895	...	1,404	...	4,299
Rothesay,	5	71	15	...	2,072	1,035	580	...	...	20	600
Greenock,	4	127	16	...	2,420	1,183	12,887	...	380	...	13,267
Total,	59	1,563½	234	331,000	38,270	18,609	26,760	...	1,877	921	29,558

Note.—The above 59 Vessels made 66 Voyages.

APPENDIX A.—No. III.

HERRING FISHERY.—RETURN of the Total Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND, on Board of Vessels and on Shore, in the Year 1889; and the Districts in which they were Taken and Cured, distinguishing the Herrings Cured Gutted from those Cured Ungutted; showing also the quantities of Herrings cured as Kippers, Bloaters, or Red Herrings, or Preserved in Tins.

DISTRICTS.	Barrels of Herrings Cured on Shore.								Total Barrels of Herrings Cured on Board of Vessels.	Grand Total of Herrings Cured on Board of Vessels and on Shore.
	Gutted and Packed within 24 hours after being caught.	Gutted and Packed but *not* within 24 hours after being caught.	Herrings Cured Ungutted.					Total Barrels of Herrings Cured on Shore.		
			Barrels.	Barrels or Crans of Bulk.	Barrels or Crans Kippered.	Barrels or Crans Cured as Bloaters or Red Herrings.	Barrels or Crans preserved in Tins.			
	Barrels.	*Barrels.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Barrels.*
Eyemouth,	38,041	1,321	2,703	...	14,027	113	100	56,305	...	56,305
Leith,	798	10	122	...	1,549	19	...	2,498	...	2,498
Anstruther,	2,259	11	2,832	1,375	216	2,568	...	9,261	...	9,261
Montrose,	35,844	13,226	166	48	312	984	...	50,580	...	50,580
Stonehaven,	9,432	...	262	1,924	1,588	204	...	13,410	...	13,410
Aberdeen,	102,248	3,586	1,278	1,871	9,906	3,407	10,672	132,968	...	132,968
Peterhead,	217,431	243	451	224	8,820	488	767	228,424	509	228,933
Fraserburgh,	292,264	2,294	137	1,719	6,208	255	5,244	308,121	...	308,121
Banff,	32,564	...	...	...	973	75	...	33,612	...	33,612
Buckie,	38,051	2,079	664	4,964	2,008	156	...	47,922	...	47,922
Findhorn,	27,549	1,433	102	708	...	413	...	30,205	...	30,205
Cromarty,	4,620	329	...	...	...	...	...	4,949	...	4,949
Helmsdale,	22,300	616	...	...	...	42	...	22,958	...	22,958
Lybster,	12,673	967	...	...	261	38	...	13,939	...	13,939
Wick,	130,085	3,122	2,976	8,305	6,654	131	...	151,273	...	151,273
Orkney,	27,469	2,410	...	38	...	...	...	29,917	...	29,917
Shetland,	45,965	100	...	121	820	...	...	47,006	...	47,006
Stornoway,	56,643	...	...	4,940	19,797	...	140	81,520	...	81,520
Loch Broom,	3,311	1,200	...	...	...	...	...	4,511	810	5,321
Loch Carron and Skye,	10,385	1,472	874	142	...	...	...	12,873	27,554	40,427
Fort-William,	730	...	...	...	...	...	...	730	239	969
Campbeltown,	3,270	...	147	42,359	95	12	...	45,883	...	45,883
Inveraray,	437	...	...	30,218	47	...	...	30,702	446	31,148
Rothesay,	294	...	...	...	290	10	...	594	...	594
Ballantrae,	1,261	...	...	5,465	1,029	33	...	7,788	...	7,788
Total,	1,115,924	34,419	12,714	104,421	74,600	8,948	16,923	1,367,949	29,558	1,397,507

APPENDIX A.—No. IV.

HERRING FISHERY.—RETURN of the Total Number of Barrels of WHITE HERRINGS Branded in SCOTLAND, in the Year 1889; and of the Brandings in each District; distinguishing the number of Barrels Branded Crown Full, Maties, Spent, and P. or Mixed, and the amount of Brand Fees Collected.

DISTRICTS.	Number of Barrels of Herrings Branded.					Brand Fees Collected.		
	Full.	Mat.	Spt.	P.	Total.	£.	s.	d.
Eyemouth,	2,676½	1,377	1,387	534	5,974½	99	11	6
Anstruther,	35½	122	172	21	350½	5	16	10
Montrose,	3,324½	1,930	2,392½	46	7,693	128	4	4
Stonehaven,	1,909½	2,501	828	64	5,302½	88	7	6
Aberdeen,	17,423½	40,821½	5,824½	975½	65,045	1,084	1	8
Peterhead,	43,388½	53,080	21,817½	8,303½	126,589½	2,109	16	6
Fraserburgh,	37,551	64,615½	19,044½	3,164½	124,375½	2,072	18	6
Banff,	5,009	10,278½	2,253	2,822½	20,363	339	7	8
Buckie,	4,093	13,995½	1,392½	1,729	21,210	353	10	0
Findhorn,	2,752	11,200	557	689½	15,198½	253	6	2
Cromarty,	350½	2,044½	...	124½	2,519½	41	19	10
Helmsdale,	5,532	7,304½	928	1,067	14,831½	247	3	10
Lybster,	3,009	346	433	141	3,929	65	9	8
Wick,	14,782	8,828½	4,391½	3,520	31,522	525	7	4
Orkney,	2,623	3,271	1,679	1,938½	9,511½	158	10	6
Shetland,	451½	43½	340	35	870	14	10	0
Total,	144,911	221,759	63,440	25,175½	455,285½	£7,588	1	10

APPENDIX A.—No. V.

HERRING FISHERY.—RETURN of the Total Number of Barrels of White Herrings Exported from Scotland in the Year 1889; and the Districts from which Exported, distinguishing the Export to Ireland, to the Continent, and to places out of Europe; Herrings Crown Branded from Herrings Unbranded, and giving quantity of Herrings Repacked.

DISTRICTS.	BARRELS OF HERRINGS EXPORTED.																		
	To Ireland.							To the Continent.							To Places out of Europe.				Gross Total Exported.
	Branded.				Total Branded.	Total Unbranded.	Total to Ireland.	Branded.				Total Branded.	Total Unbranded.	Total to the Continent.	Branded. Full.	Unbranded.	Repacked.	Total.	
	Full.	Maties.	Spent.	Mixed.				Full.	Maties.	Spent.	Mixed.								
Eyemouth,	50	50	21	28	149	5,361	5,510	2,267½	1,169	629	247	4,312½	10,141½	14,454	...	...	...	...	19,964
Leith,	...	...	...	...	...	...	...	953	951	312	...	2,216	50,865½	53,081½	...	501½	...	501½	53,583
Montrose,	...	...	...	...	...	...	...	3,283½	1,930	2,392½	46	7,652	31,964½	39,616½	560	49	...	609	40,225½
Stonehaven,	...	...	...	...	...	...	...	740	1,931	785	58	3,514	573½	4,087½	...	...	...	...	4,087½
Aberdeen,	20	70	...	...	90	367	457	16,643½	39,626	5,940½	969½	63,179½	32,931½	96,111	25	10	10	45	96,613
Peterhead,	...	...	...	...	...	...	...	42,384	52,830	22,054½	8,227	125,495½	51,828	177,323½	...	...	...	...	177,323½
Fraserburgh,	...	...	...	...	...	...	...	36,929½	58.933½	19,420½	3,625	118,908½	112,619	231,527½	...	...	...	...	231,527½
Banff,	...	...	...	...	...	...	...	4,956½	9,606	2,491½	3,092½	20,146½	5,545	25,691½	...	...	...	...	25,691½
Buckie,	...	...	...	...	...	1,073	1,073	3,790½	13,446½	1,499	1,567	20,303	8,652½	28,955½	...	...	...	...	30,028½
Findhorn,	...	...	...	...	...	...	...	2,411½	10,992	745	641½	14,790	5,482½	20,272½	...	...	...	...	20,272½
Cromarty,	...	...	...	...	...	...	...	279	1,792½	...	124½	2,196	1,209½	3,405½	...	...	...	...	3,405½
Helmsdale,	...	...	...	...	...	...	...	5,461½	7,257½	936	1,065	14,720	4,573½	19,293½	...	...	...	...	19,293½
Lybster,	...	...	...	...	...	...	...	2,802	277	271	127	3,477	9,675½	13,152½	...	...	...	...	13,152½
Wick,	285	...	20	...	305	5,452	5,757	16,247½	8,286½	6,238	4,521	35,293	68,609	103,902	...	...	...	...	109,659
Orkney,	...	...	...	...	...	3,074	3,074	2,483½	3,097	1,641½	1,996	9,218	12,951½	22,169½	...	...	...	...	25,243½
Shetland,	...	...	...	...	...	...	...	258	33½	276	35	602½	37,474¾	38,077¼	...	...	...	...	38,077¼
Stornoway,	...	...	...	...	...	...	...	...	...	...	...	...	39,802½	39,802½	...	...	...	...	39,802½
Loch Broom,	...	...	...	...	...	217	217	...	...	...	...	...	1,000	1,000	...	...	...	...	1,217
Greenock,	...	...	...	...	...	16,179	16,179	...	...	...	...	...	...	...	...	1,381	3,062½	4,443½	20,622½
Ballantrae,	...	...	...	...	...	386	386	...	...	...	...	...	...	...	...	...	...	...	386
Total,	355	120	41	28	544	32,109	32,653	141,891	212,159	65,632	26,342	446,024	485,899¾	931,923¾	585	1,941½	3,072½	5,599	970,175¾

SUPPLEMENTARY NOTE, showing the Ports or Places to which the Herrings Exported to the Continent were Shipped.

DISTRICTS.	BARRELS OF HERRINGS EXPORTED.												Total Exported to the Continent.
	Russia.					Germany.						Holland.	
	Odessa.	St Petersburg.	Revel.	Riga.	Libau.	Memel.	Königsberg.	Danzig.	Stettin.	Hamburg.	Bremen.	Rotterdam.	
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Eyemouth,	...	...	...	...	...	...	1,420	2,621	5,512	4,901	...	...	14,454
Leith,	...	3,158½	92	25	...	...	2,600½	...	16,321½	30,227	...	657	53,081½
Montrose,	...	...	...	1,000	2,262	...	4,551	12,129½	19,674	...	...	...	39,616½
Stonehaven,	...	...	...	...	...	970½	...	690	2,427	...	...	...	4,087½
Aberdeen,	50	...	...	1,439	13,385	...	26,731	21,571½	21,001½	11,933	...	...	96,111
Peterhead,	...	...	...	...	45,241½	800	48,242½	10,631½	32,646½	39,761½	...	...	177,323½
Fraserburgh,	...	...	2,570	8,164	50,269	2,687	47,215	18,650½	68,353½	33,618½	...	...	231,527½
Banff,	...	...	...	...	594	...	2,370½	9,237	13,490	...	...	...	25,691½
Buckie	...	...	...	913	800	...	7,234	7,032½	12,976	...	...	...	28,955½
Findhorn,	...	...	...	...	1,502	...	6,048½	5,382	6,848½	491½	...	...	20,272½
Cromarty,	...	...	...	...	...	...	...	...	3,405½	...	...	...	3,405½
Helmsdale,	...	...	...	...	...	...	694	1,585	16,114½	900	...	...	19,293½
Lybster,	...	...	...	...	...	...	...	8,591	2,972	1,135½	454	...	13,152½
Wick,	...	...	...	835	4,204	971	7,852	27,968½	53,796	7,943½	33	...	103,902
Orkney,	...	150	...	...	...	...	4,933	6,108½	9,118	1,860	...	...	22,169½
Shetland,	...	...	...	...	...	...	3,349½	860	27,516¾	6,351	...	...	38,077¼
Stornoway,	...	33,117	...	...	...	...	688	...	5,997½	...	...	...	39,802½
Loch Broom,	...	...	...	...	...	...	...	...	1,000	...	...	...	1,000
Total,	50	36,425½	2,662	12,376	118,257½	5,428½	163,929½	133,058½	319,170¾	139,122½	786	657	931,923¾

APPENDIX A.—No. VI.

HERRING FISHERY.—ABSTRACT showing the Total Quantity of WHITE HERRINGS Cured, Branded, and Exported, year by year, *in so far as brought under cognizance of Fishery Officers*, from 1st January 1875 to 31st December 1889; distinguishing the Export to Ireland, to the Continent, and to places out of Europe

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Year ended 31st December 1875, for Scotland only,	834,822½	108,157½	942,980	523 789½	33,434	624,137½	3,399	660,970½
Year ended 31st December 1876, for do.	486,238½	111,959	598,197½	252,979½	20,333	378,740	1,350½	400,423½
Year ended 31st December 1877, for do.	716,871¼	130,847½	847,718¾	397,795	16,085½	543,908¼	1,992	561,985¾
Year ended 31st December 1878, for do.	771,556	134,212	905,768	456,708	17,445¾	608,969¼	2,519	628,934
Year ended 31st December 1879, for do.	655,991	185,805	841,796	342,323	8,857½	536,380½	755½	545,993½
Year ended 31st December 1880, for do.	1,224,198½	249,401¾	1,473,600¼	689,286	32,482½	976,300½	1,028½	1,009,811½
Year ended 31st December 1881, for do.	915,098	196,057¼	1,111,155¼	494,182½	33,459¼	711,448	972½	745,879¾
Year ended 31st December 1882, for do.	980,755½	302,218	1,282,973½	462,612½	40,377	782,576¼	3,029½	825,982¾
Year ended 31st December 1883, for do.	1,033,087	236,325½	1,269,412½	470,995½	25,870	863,644½	1,246	890,760½
Year ended 31st December 1884, for do.	1,452,213	244,864¼	1,697,077¼	653,425	35,299½	1,148,956½	964½	1,185,220½
Year ended 31st December 1885, for do.	1,352,449	220,503¼	1,572,952¼	689,325	22,711	1,104,705½	1,173	1,128,589½
Year ended 31st December 1886, for do.	1,093,363	218,860¼	1,312,223¼	518,994½	27,538½	908,896½	1,934½	938,369½
Year ended 31st December 1887, for do.	1,064,053¾	239,370½	1,303,424¼	489,998½	35,982¼	826,920¾	3,008¼	865,911¼
Year ended 31st December 1888, for do.	907,000	211,872¼	1,118,872¼	383,980½	34,038½	735 230½	4,924	774,193
Year ended 31st December 1889, for do.	1,179,901	217,606	1,397,507	455,285½	32,653	931,923¾	5,599	970,175¾

APPENDIX A.—No. VII.

STANDARD BARRELS FOR CURED WHITE HERRINGS. —List of Queries issued by the Fishery Board for Scotland, to the Scottish Fishcuring Trade, in regard to Standard Barrels and Half-Barrels for Packing, Shipping, or Exporting Cured White Herrings.

LIST OF QUERIES.

1. Do you approve of a standard size of barrel or half-barrel?

2. Are the standard sizes of $26\frac{2}{3}$ gallons Imperial measure for a barrel, and $13\frac{1}{3}$ gallons Imperial measure for a half-barrel, suitable?

3. If not, what capacity in gallons, Imperial measure, would be more suitable for barrels or half-barrels?

4. Should a fourth, or any other fractional, part of a barrel, be required to fulfil a certain standard size?

5. If so, what capacity in gallons, Imperial measure, should it be?

6. Are any special sizes for barrels, half-barrels, or other fractional parts of barrels, desirable for export to the United States, or elsewhere?

7. If so, what should their respective capacities in gallons, Imperial measure, be?

8. Do you consider it desirable to amend the present rules regarding any of the three permissible forms of hooping?

9. If so, state in what way you think the amendation should be made?
   (*a*) Hooping entirely with wooden hoops.
   (*b*) Hooping entirely with iron hoops.
   (*c*) Hooping partly with wooden hoops and partly with iron hoops.

10. Would you approve of the officers being empowered to measure and stamp barrels before being used, on payment of $\frac{1}{2}$d. to 1d. per barrel, to be deducted from the branding fee?

11. Please express your opinion on any point relating to barrels or half-barrels or other measure for cured white herrings which is not dealt with in any of the foregoing queries.

APPENDIX A.—No. VIII.

STANDARD MEASURES FOR FRESH HERRINGS.—Regulations made and established by the Fishery Board for Scotland, under the Provisions of the Herring Fishery (Scotland) Act, 1889, for the Construction and Branding of Measures for Buying, Selling, Delivering, or Receiving Fresh Herrings in the Scotch Herring Fishery.

In virtue of the powers conferred on them by the Herring Fishery (Scotland) Act, 1889 (52 and 53 Vict., cap. 23), sec. 4, the Fishery Board for Scotland hereby give notice, that from and after the 1st day of January, 1890, a quarter-cran measure which may be used for buying, selling, delivering, or receiving fresh herrings in the Scotch Herring Fishery, being a measure of such capacity that four times its contents, when filled with herrings, shall be equal to one cran, shall take one of the two following forms:—

I. Basket Measure.

A basket of a circular form, well bound, and composed of willows, pieces of hoopwood, hardwood, and cane, all of fresh quality, and of suitable size and strength, which shall, for convenience in use, have two cane handles. A sample basket may be seen at every Fishery Office.

Such Basket shall be of the following Dimensions:—

Interior diameter at bottom, $14\frac{1}{2}$ inches;
Interior diameter at mouth, $17\frac{1}{2}$ inches;
Diagonal measurement from inside the bottom to the inner side of the mouth, $21\frac{1}{2}$ inches;
Height inside, $14\frac{1}{2}$ inches;
Rise in the bottom, $1\frac{1}{2}$ inches.

The Materials of which the Basket shall be constructed shall be conform to the following Specification:—

Willows.

6 long lays in the bottom and side;
6 short sticks in the bottom;
20 stakes in the bottom and side;
18 bye sticks in the side.

Hoopwood and Hardwood Uprights.

6 pieces of hoopwood, each 1 inch broad, to be placed in the side at equal distances from each other and with their bark sides outermost; and 2 uprights of suitable hardwood, one of which shall be placed in the side in the centre of each of the spaces between the two ends of the handles, to be flat and smooth on outside to receive the official brand, notched at top and middle, and bevelled to inside of basket, each to be $1\frac{1}{2}$ inches broad from the top to the middle notch, and thence tapering to bottom. The said pieces of hoopwood and uprights shall be straight.

Binding.

The basket shall be well bound, and shall have strong and suitable binding and waling at the mouth and bottom, and a fitching of cane at each of the following places, viz. :—

The lower edge of the bottom binding; the centre; and the lower edge of the mouth binding.

II. Box Measure.

An oblong box, constructed of properly seasoned fir or other suitable wood, well bound with iron hoops secured by nails, all of suitable size and strength, which shall, for convenience in use, have two rope handles. A sample box may be seen at every Fishery Office.

Such Box shall be of the following Dimensions:—

Length inside, 31 inches;
Depth inside, 7 inches;
Breadth inside, $14\frac{3}{4}$ inches;
Sides and top, $\frac{5}{8}$ inch thick;
Ends, $\frac{3}{4}$ inch thick;
Bottom, $\frac{1}{2}$ inch thick;
Cross bottom openings not to exceed $\frac{1}{2}$ inch in width.

The Materials of which the Box shall be constructed shall be conform to the following Specification:—

Blocks.

Corner blocks inside, 7 inches long by $2\frac{1}{2}$ inches square, with 1 inch bevelled off inside corners, and similarly bevelled on both the clear sides of the top, of those in front.

Wooden Straps.

Two bottom straps, $\frac{3}{4}$ inch thick, and $2\frac{1}{2}$ inches broad; one middle strap, $\frac{1}{2}$ inch thick and 4 inches broad.

Lid.

To be in two pieces: one a fixture 5 inches broad; the other movable, fastened with two strong hinges, screw fastenings at neck, and nailed; with suitable clamps.

Binding.

The box shall be strongly nailed, and bound with 14 straps of iron hooping 1 inch wide, each fastened with four nails—4 straps being on the sides, 4 on front corners, 2 on back corners, and 4 on fixed portion of the top.

Handles.

Handles to be of $\frac{7}{8}$ inch rope, with a double crown knot inside; the fag strands not to exceed 2 inches in length.

It shall be lawful for the General or Assistant Inspector, or any of the Fishery Officers of the Fishery Board of Scotland, to authorise any basket or box measure fulfilling the before-mentioned conditions, intended for the purchase, sale, delivery, or receipt of fresh herrings in the Scotch herring fishery, to be branded in his presence with a hot iron having the figure of a crown, with the initial letters of his name, and the year of branding thereon; the brand on the basket to be stamped once on each of the two uprights of hardwood placed in the side of the measure, and that on the box to be stamped once on the centre of the right end of the measure.

In the event of a basket or box which has been branded as aforesaid, being found on subsequent inspection by the General or Assistant Inspector or any of the Fishery Officers of the Fishery Board for Scotland, to be disconform in any respect to the foregoing specification, such Inspector or Fishery Officer shall cause the brand thereon to be defaced.

The Regulations made on the 25th November last are hereby revoked.

Excerpt from the Herring Fishery (Scotland) Act, 1889.

4. Any person buying, selling, delivering, or receiving fresh herrings in the Scotch herring fishery shall be entitled to use for the purpose thereof the measure known as the cran, or a quarter-cran measure, being a measure of such capacity that four times its content, when filled with herrings, shall be equal to one cran; and such measure shall be made of wood, or of such other material as the Fishery Board for Scotland shall direct, and shall be made and branded or otherwise marked in accordance with any regulations for the time being in force of the Fishery Board for Scotland, which regulations that Board are hereby authorised to make, and from time to time to alter and revoke as they see fit.

These measures made, branded, or otherwise marked in all respects in conformity with the regulations for the time being in force of the said Board, shall be the only legal measures for use in buying, selling, delivering, or receiving fresh herrings in the Scotch herring fishery; and any person using any box, basket, or other measure not so made, branded or otherwise marked, shall be liable, on conviction under the Summary Jurisdiction (Scotland) Acts, to a fine not exceeding five pounds for the first offence, and not exceeding twenty pounds for the second or any subsequent offence; and also to the forfeiture of the measure or measures, which may be seized and destroyed or otherwise disposed of by any superintendent of the herring fishery or other officer employed in the execution of the Herring Fishery (Scotland) Acts: provided always, that nothing in this Act contained shall prevent the sale of herrings by weight or number or in bulk.

*** *A basket and a box measure made and branded according to the foregoing regulations may be seen at the Assistant Inspector's Office in Leith, or at any of the District Fishery Offices of the Fishery Board for Scotland; and measures may be presented for the purpose of being branded at such time and place as may be arranged by the Fishery Officer of the District.*

DUGALD GRAHAM, *Secretary.*

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

APPENDIX B.—No. I.

COD AND LING FISHERY.—Details, taken from the reports of the inspectors and district fishery officers, regarding the cod ling, and hake fishery of 1889.

This fishery was unusually successful during the past year,—the gross catch being considerably higher than that of 1888, or any of the preceding seven years. Of the total quantity of fish landed, 145,661 cwts. were cured dried, and 6920 barrels cured in pickle, against 137,216 cwts. dried, and 7052 barrels pickled in 1888—being an increase of 8445 cwts. dried, and a decrease of 132 barrels pickled. There was also an increase over 1888, in the quantity sold for use in a fresh state, of no less than 37,731 cwts.

Of the quantity cured dried, 16,834 cwts. were cured on board of 53 vessels and boats fitted out for this fishery. The total number of fish landed and cured last year amounted to 4,131,105, as compared with 3,910,283 in the preceding year, being an increase of 220,822 fish. Twenty-seven vessels fished from Shetland, 16 from Orkney, 9 from Fraserburgh, and one from Campbeltown, while 10 or 12 Swedish vessels fished during the summer months off the Shetland coast—usually 40 to 100 miles N.W. of Unst, and in from 100 to 200 fathoms of water. Swedish vessels have, for several years, prosecuted this fishing in the same vicinity, and have usually been remarkably successful. Last season, however, very few of their catches were landed at Balta Sound as formerly, owing to the low prices offered by local curers. Consequently they took the greatest proportion of their catches home for sale in the Swedish markets. Twenty-one of the Shetland vessels fished at Farœ and Rockall during the early spring, but finding the fishing unsuccessful they returned home. On proceeding to the same vicinity a second time, they found no improvement, and went to Iceland, where they met with better success, most of them securing full cargoes. The smaller vessels and boats prosecuted the fishing off the Shetland coast, and found the fish unusually abundant, and were generally very successful—a number of boats landing from 50 to 54 tons each of fish in eight weeks—perhaps the largest catches ever taken in Shetland by individual boats. Although prices were low, many of the boats' crews realised £300 each for their catches. Some of these boats, belonging to other districts and to English stations, took part in the fishing for only a short period. It was most unfortunate that so many of the native boats should have been absent during such a remunerative season. Swarms of dogfish appeared on the grounds early in July, and put a complete stop to the fishing for the season.

Shetland continues to be the chief centre for the prosecution of this industry. The quantity of fish cured dried there last year was 61,065 cwts., or 72·18 per cent. of the whole quantity cured dried in Scotland. Orkney and Stornoway come next, but last year fish were not quite so plentiful in these districts as in 1888. Sixteen English smacks prosecuted the fishing at the Farœ Isles at the beginning of summer, and landed 164,130 fish at Orkney. Although the fishing grounds around the Orkney Isles are productive, the native fishermen have never adopted the use of great-lines at the cod and ling fishery, but adhere to the antiquated and less successful hand-lines. Were the former method used, this important industry might undoubtedly be considerably developed. The water surrounding the islands of Orkney, Shetland, and the Outer Hebrides, and also the Pentland Firth, round by Cape Wrath to the Island of Tiree, abound with excellent cod and ling, but are only partially fished.

APPENDIX B.—No. II.

COD AND LING FISHERY.—RETURN of the Number of Vessels fitted out in SCOTLAND for the COD and LING Fishery, in the Year 1889; the Districts from which fitted out; the Tonnage of the Vessels, and the Number of Men; and the Quantity of COD, LING, and HAKE Cured on board; distinguishing whether Cured Dried, or Cured in Pickle.

DISTRICTS.	Vessels.	Tonnage.	Men.	Total Quantity of Cod, Ling, and Hake Cured on board of Vessels.	
				Number of Fish.	Cured Dried.
	Number.	*Tons.*	*Number.*	*Number.*	*Cwts.*
Fraserburgh, . . .	9	188	54	42,174	1,687
Orkney, . . .	16	1,021	166	164,130	3,871
Shetland, . . .	27	1,301	302	437,871	11,272
Campbelton, . . .	1	22	9	130	4
Total, . .	53	2,532	531	644,305	16,834

APPENDIX B.—No. III.

COD AND LING FISHERY.—RETURN of the Total Quantity of COD, LING, and HAKE taken at the Cod and Ling Fishery in SCOTLAND, by Boats and Vessels, and Cured on Shore, in the Year 1889; and the Districts in which Cured; distinguishing the Fish Cured Dried, and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling, and Hake Cured on Shore.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	Number.	*Cwts.*	*Barrels.*
Leith, ...	19,040	680	...
Anstruther, ...	199,360	9,346	41
Montrose, ...	46,175	1,500	...
Stonehaven, ...	22,340	817	...
Aberdeen, ...	90,426	3,726	16
Peterhead, ...	63,783	2,740	244
Fraserburgh, ...	88,240	3,332	...
Banff, ...	75,725	2,994	35
Buckie, ...	38,043	972	1,340
Findhorn, ...	14,572	138	521
Helmsdale, ...	2,560	72	16
Lybster, ...	16,990	...	678
Wick, ...	186,208	3,843	3,564
Orkney, ...	604,534	21,445	136
Shetland, ...	1,304,437	49,793	...
Stornoway, ...	494,748	18,393	244
Loch Broom, ...	63,000	2,170	85
Loch Carron and Skye, . . .	69,348	2,694	...
Fort-William, ...	44,655	1,880	...
Campbeltown, ...	42,616	1,792	...
Total, . .	3,486,800	128,827	6,920

APPENDIX B.—No. IV.

COD AND LING FISHERY.—RETURN of the Total Quantity of COD, LING, and HAKE taken, both by Vessels and Boats, at the Cod and Ling Fishery in SCOTLAND, and Cured, in the Year 1889; and the Districts in which Cured; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling, and Hake Cured.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	Number.	*Cwts.*	*Barrels.*
Leith,	19,040	680	...
Anstruther,	199,360	9,346	41
Montrose,	46,175	1,500	...
Stonehaven,	22 340	817	...
Aberdeen,	90,426	3,726	16
Peterhead,	63,783	2,740	244
Fraserburgh,	130,414	5,019	...
Banff,	75,725	2,994	35
Buckie,	38,043	972	1,340
Findhorn,	14,572	138	521
Helmsdale,	2,560	72	16
Lybster,	16,990	...	678
Wick,	186,208	3,843	3,564
Orkney,	768,664	25,316	136
Shetland,	1,742,308	61,065	...
Stornoway,	494,748	18,893	244
Loch Broom,	63,000	2,170	85
Loch Carron and Skye,	69,348	2,694	...
Fort-William,	44,655	1,880	...
Campbeltown,	42,746	1,796	...
Total,	4,131,105	145,661	6,920

APPENDIX B.—No. V.

COD AND LING FISHERY.—RETURN of the Total Quantity of COD, LING, and HAKE Exported from SCOTLAND, in the Year 1889; with the Districts from which Exported; distinguishing the Export to Ireland, to the Continent, and to places out of Europe; also whether Cured Dried, or Cured in Pickle.

DISTRICTS.	Cod, Ling, and Hake Exported.						
	To Ireland.		To the Continent.		To Places out of Europe.	Total Exported.	
	Cured Dried.	Cured in Pickle.	Cured Dried.	Cured in Pickle.	Cured Dried.	Cured Dried.	Cured in Pickle.
	Cwts.	*Barrels.*	*Cwts.*	*Barrels.*	*Cwts.*	*Cwts.*	*Barrels.*
Leith,	16,137	...	15,711	...	7,065	38,913	...
Aberdeen,	...	...	...	...	1,438	1,438	...
Orkney,	6,206	...	2,000	...	200	8,406	...
Shetland,	21,510	...	14,974	...	...	36,484	...
Stornoway,	2,989	...	...	...	...	2,989	...
Loch Broom,	596	...	...	...	...	596	...
Campbeltown,	1,553	...	...	...	...	1,553	...
Greenock,	16,032	...	...	...	2,287	18,319	...
Total,	65,023	...	32,685	...	10,990	108,698	...

APPENDIX B.—No. VI.

COD AND LING FISHERY.—ABSTRACT, showing the Total Quantity of COD, LING, and HAKE Cured and Exported year by year, *in so far as brought under cognizance of Fishery Officers,* from 1st January 1875 to 31st December 1889.

PERIODS.	Total Quantity of Cod, Ling, and Hake Cured.		Total Quantity of Cod, Ling, and Hake Exported.		
	Cured Dried.	Cured in Pickle.	Cured Dried.		Cured in Pickle.
	Cwts.	*Barrels.*	*Cwts.*	*qrs.*	*Barrels.*
Year ended 31st December 1875, for Scotland only, .	187,788½	8,503½	81,880	2	...
Year ended 31st December 1876, for do. .	111,457	6,109	59,886	„	...
Year ended 31st December 1877, for do. .	187,200½	8,619½	73,368	2	...
Year ended 31st December 1878, for do. .	183,809¼	9,219	94,969	2	...
Year ended 31st December 1879, for do. .	162,365	8,737	78,868	2	...
Year ended 31st December 1880, for do. .	155,745¼	7,794½	79,946	„	...
Year ended 31st December 1881, for do. .	115,513½	4,075½	61,426	„	...
Year ended 31st December 1882, for do. .	121,337	7,737	56,497	„	2
Year ended 31st December 1883, for do. .	120,335¾	7,310	56,525	2	...
Year ended 31st December 1884, for do. .	124,509½	5,907½	56,716	1	...
Year ended 31st December 1885, for do. .	125,352½	7,100	47,241	„	...
Year ended 31st December 1886, for do. .	121,078	6,700	56,372	„	71
Year ended 31st December 1887, for do. .	122,832	7,538	87,549	„	276½
Year ended 31st December 1888, for do. .	137,216	7,052	88,100	„	224
Year ended 31st December 1889, for do. .	145,661	6,920	108,698	„	...

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

DUGALD GRAHAM, *Secretary.*

APPENDIX C.—No. I.

TOTAL QUANTITY OF FISH LANDED.—STATEMENT, by Districts, of the Total Quantity and Value of the different kinds of White and Shell Fish landed in SCOTLAND, in the Year 1889, compared with 1888.

DISTRICTS.	Herring.		Sprat.		Mackerel.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coal Fish).	
	Crans.	Value.	Crans.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.
EAST COAST.		£		£		£		£		£		£		£
Eyemouth,	51,794	27,192	...	...	...	...	3,565	1,028	19	8	...	...	266	41
Leith,	9,944	9,505	317	14	6	9	51,495	28,656	2,472	1,756	4	4	2,370	372
Anstruther,	20,069	12,709	267	28	...	...	48,290	16,047	3,109	1,055	20	5	3,930	445
Montrose,	38,165	22,051	70	6	7	9	14,732	5,366	772	288	...	...	919	120
Stonehaven,	14,736	7,467	...	...	...	...	10,224	3,033	555	249	...	...	659	73
Aberdeen,	107,411	53,430	...	...	...	...	27,564	15,712	4,170	2,449	49	9	4,711	877
Peterhead,	167,705	92,522	...	...	...	...	27,952	8,476	4,993	2,471	254	40	4,574	388
Fraserburgh,	204,272	123,709	...	...	...	...	13,450	5,238	6,823	3,147	190	26	2,860	387
Banff,	22,730	15,498	...	...	20	10	13,626	4,015	2,235	802	31	8	2,013	368
Buckie,	28,345	15,668	...	...	...	...	22,450	8,243	2,419	878	5	1	867	83
Findhorn,	19,714	10,763	550	211	...	...	18,453	5,994	1,430	435	4	1	395	75
Cromarty,	5,227	2,734	...	...	...	...	3,817	1,119	42	9	...	...	90	19
Helmsdale,	14,538	9,958	...	...	...	...	5,805	1,907	53	22	...	...	215	29
Lybster,	10,821	7,254	...	...	...	...	5,049	1,398	10	3	...	...	327	42
Wick,	99,079	75,079	...	...	...	...	43,001	15,313	4,206	1,636	154	44	6,918	943
East Coast Totals carried down,	814,550	485,539	1,204	259	33	28	309,473	121,545	33,308	15,208	711	138	31,114	4,262
Orkney and Shetland.														
Orkney,	25,547	15,036	...	...	...	...	46,474	12,820	7,473	2,614	1,044	190	9,104	1,174
Shetland,	28,622	24,808	...	...	180	30	86,582	17,611	45,641	11,857	8,658	1,164	18,773	1,670
Orkney and Shetland Totals carried down,	54,169	39,844	...	...	180	30	133,056	30,431	53,114	14,471	9,702	1,354	27,877	2,844
WEST COAST.														
Stornoway,	69,480	66,907	45	4	23	5	26,484	5,440	40,989	14,080	974	206	6,055	668
Loch Broom,	5,460	2,537	...	...	19	4	11,498	2,881	2,394	671	85	21	3,956	532
Loch Carron and Skye,	36,882	15,276	...	...	...	...	1,682	425	593	191	...	...	2,823	286
Fort William,	1,170	1,555	...	...	106	34	5,564	2,420	2,443	865	5	3	2,689	597
Campbeltown,	33,975	37,669	...	...	46	56	3,924	1,656	477	239	...	...	4,149	943
Inveraray,	26,249	41,847	...	...	46	40	468	267	38	32	...	...	2,464	651
Rothesay,	8,289	12,561	...	...	26	20	1,844	1,274	318	196	...	...	1,270	484
Greenock,	1,840	4,439	...	...	109	99	1,559	1,278	55	32	...	...	627	295
Ballantrae,	10,366	8,271	...	...	76	64	8,111	4,483	752	508	6	3	1,448	425
West Coast Totals carried down,	193,711	191,062	45	4	451	322	61,134	20,124	48,059	16,814	1,070	233	25,481	4,881
Totals brought down.														
East Coast—Totals,	814,550	485,539	1,204	259	33	28	309,473	121,545	33,308	15,208	711	138	31,114	4,262
Orkney and Shetland—Totals,	54,169	39,844	..	...	180	30	133,056	30,431	53,114	14,471	9,702	1,354	27,877	2,844
West Coast—Totals,	193,711	191,062	45	4	451	322	61,134	20,124	48,059	16,814	1,070	233	25,481	4,881
Grand Totals in Year 1889,	1,062,430	716,445	1,249	263	664	380	503,663	172,100	134,481	46,493	11,483	1,725	84,472	11,987
Grand Totals in Year 1888,	783,249	551,026	4,310	807	598	397	469,453	205,794	99,722	49,083	8,727	3,478	105,573	19,064
Increases in Year 1889,	279,181	165,419	...	...	66	...	34,210	...	34,759	...	2,756	...	...	...
Decreases in Year 1889,	...	...	3,061	544	...	17	...	33,694	...	2,590	...	1,753	21,101	7,077

DISTRICTS.	Haddock.		Whiting.		Turbot.		Halibut.		Sole (Lemon Sole).		Flounder, Plaice, Brill.		Eel.		Skate.		Other kinds of White Fish.		Total Value of White Fish.
	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Value.
EAST COAST.		£		£		£		£		£		£		£		£		£	£
Eyemouth,	42,341	18,044	4,045	1,897	1½	6	5½	9	...	...	175	52	...	...	9	2	218	48	48,327
Leith,	94,651	44,654	6,930	2,643	1,067½	2,441	929¾	1,806	2,274	3,159	8,751	5,890	220	120	3,083	1,408	13,432	2,913	105,350
Anstruther,	31,904	14,594	3,617	1,487	208	302	555	892	...	...	3,305	1,487	112	126	2,297	454	583½	495	50,126
Montrose,	102,755	45,754	8,662	2,391	342½	1,067	79	101	1,049	1,129	8,830	4,952	132	92	1,019	234	11,663	2,589	86,149
Stonehaven,	26,106	10,896	4,257	818	19	47	156	284	...	...	375	145	134	74	407	70	585	125	23,281
Aberdeen,	114,225	52,042	12,990	4,080	3,827	15,018	2,223	3,261	9,750	15,431	28,855	27,120	78	57	4,144	852	16,581	1,577	191,915
Peterhead,	47,709	19,089	4,070	837	69	174	1,391½	2,080	13¼	39	540	288	478	228	5,837	1,158	1,014	212	128,002
Fraserburgh,	41,400	19,024	1,380	315	100	269	590½	869	33	50	561	366	871	578	3,300	560	4,304	728	155,266
Banff,	80,337	31,736	6,657	1,683	¾	2	127	145	...	...	236	118	238	150	822	176	175	58	54,769
Buckie,	60,988	25,204	1,549	335	26	32	366	457	...	...	82	85	303	131	2,577	339	4,423	935	52,341
Findhorn,	50,763	19,037	4,897	1,319	43¾	116	54¼	75	...	...	2,636	1,163	120	51	1,078	277	1,267	329	39,846
Cromarty,	10,298	4,371	622	190	3	5	6	6	...	...	585	315	357	105	98	29	2,021	660	9,562
Helmsdale,	4,143	1,347	338	94	½	1	14½	16	...	...	761	344	...	...	165	59	1,530	516	14,293
Lybster,	2,359	635	257	59	...	...	22	19	...	...	14	4	30	6	30	6	62	13	9,439
Wick,	15,367	4,635	729	177	56	141	985	1,460	8	12	2,632	1,103	773	504	5,333	1,756	7,925	2,238	105,041
East Coast Totals carried down,	725,346	311,062	61,000	18,325	5,764½	19,621	7,504¾	11,480	13,127¼	19,820	58,338	43,382	3,846	2,222	30,199	7,380	65,783½	13,436	1,073,707
Orkney and Shetland.																			
Orkney,	10,885	2,709	87	20	5	3	2,689	1,893	...	...	1,116	422	...	...	4,427	1,079	5,589	224	38,184
Shetland,	24,595	5,524	44	9	...	...	7,216	3,126	...	...	5	1	64	19	1,723	163	8,105	723	66,705
Orkney and Shetland Totals carried down,	35,480	8,233	131	29	5	3	9,905	5,019	...	...	1,121	423	64	19	6,150	1,242	13,694	947	104,889
WEST COAST.																			
Stornoway,	15,518	4,218	131	23	102	89	3,330	1,693	...	...	2,480	696	4,159	1,948	8,706	1,025	2,585	226	97,228
Loch Broom,	5,853	1,344	832	179	117	64	182	102	...	...	316	76	753	284	781	133	126	23	8,851
Loch Carron and Skye,	432	100	107	24	43	28	54	24	9	4	128	56	799	356	133	18	857	189	16,977
Fort William,	172	140	239½	229	18	28	2	3	...	...	1,787	554	3,728½	2,134	407	110	122	62	8,734
Campbeltown,	1,607	1,258	1,573	1,412	102½	158	114	167	290	448	2,469	2,217	1,052½	544	1,070	285	1,272	340	47,392
Inveraray,	210	147	239	153	...	...	...	...	...	...	72	43	201	157	222	44	199	99	43,480
Rothesay,	1,379	1,121	1,727	1,376	...	...	...	...	21	31	299	270	249	125	434	131	20	8	17,597
Greenock,	1,193	985	978	764	36	99	...	...	40	56	1,363½	1,004	439	259	455	192	489	124	9,626
Ballantrae,	4,940	2,607	2,737	1,272	150½	382	2½	8	904	1,566	5,897	4,351	939	504	1,530	315	2,216	935	25,694
West Coast Totals carried down,	31,304	11,920	8,563½	5,432	569	848	3,684½	1,997	1,264	2,105	14,811½	9,267	12,320	6,311	13,738	2,253	7,886	2,006	275,579
Totals brought down.																			
East Coast—Totals,	725,346	311,062	61,000	18,325	5,764½	19,621	7,504¾	11,480	13,127¼	19,820	58,338	43,382	3,846	2,222	30,199	7,380	65,783½	13,436	1,073,707
Orkney and Shetland—Totals,	35,480	8,233	131	29	5	3	9,905	5,019	...	...	1,121	423	64	19	6,150	1,242	13,694	947	104,889
West Coast—Totals,	31,304	11,920	8,563½	5,432	569	848	3,684½	1,997	1,264	2,105	14,811½	9,267	12,320	6,311	13,738	2,253	7,886	2,006	275,579
Grand Totals in Year 1889,	792,130	331,215	69,694½	23,786	6,338½	20,472	21,094½	18,496	14,391¼	21,925	74,270⅓	53,072	16,230	8,552	50,087	10,875	87,363⅓	16,389	1,454,175
Grand Totals in Year 1888,	820,498	333,134	76,755	25,637	5,424	16,310	20,197	19,721	12,669	16,512	87,184	55,918	6,797	3,689	59,089	12,014	104,414	20,176	1,332,760
Increases in Year 1889,	...	...	...	...	914½	4,162	897	...	1,722¼	5,413	...	...	9,433	4,863	...	...	...	...	121,415
Decreases in Year 1889,	28,368	1,919	7,060½	1,851	...	...	...	1,225	...	...	12,913½	2,846	...	...	9,002	1,139	17,050½	3,787	...

DISTRICTS.	Oysters.		Mussels.		Clams.		Lobsters.		Crabs.		Other kinds of Shell Fish.		Total Value of Shell Fish.	Gross Total Value.
	Hundreds.	Value.	Cwts.	Value.	Cwts.	Value.	Hundreds.	Value.	Hundreds.	Value.	Cwts.	Value.		
EAST COAST.		£		£		£		£		£		£	£	£
Eyemouth,	...	...	...	...	...	...	28·11	144	2,720½	1,258	686	103	1,505	49,832
Leith,	315	175	24,765	1,342	21,545	2,280	36·59	163	6,445½	3,776	1,748	319	8,055	113,405
Anstruther,	...	...	33,638	2,650	2,266	283	89·10	379	5,186½	2,061	864	97	5,470	55,596
Montrose,	...	...	75,267	4,401	...	...	57·61	235	4,933	2,456	1,558	265	7,357	93,506
Stonehaven,	...	...	...	...	...	...	11·75	36	1,463	780	542	82	898	24,179
Aberdeen,	...	...	...	...	...	...	7·	37	194⅓	159	..	...	196	192,111
Peterhead,	...	...	11,250	283	...	...	12·33	59	101	44	249	76	462	128,464
Fraserburgh,	...	...	25	2	...	...	51·	203	2,148	891	905	100	1,196	156,462
Banff,	...	...	...	...	...	...	58·30	251	963	547	...	...	798	55,567
Buckie,	..	...	...	...	...	...	4·04	20	478	78	132	11	109	52,450
Findhorn,	...	...	8,356	561	...	...	8·45	39	170	67	224	42	709	40,555
Cromarty,	...	...	12,921	950	...	...	19·75	84	239¼	171	1,822	210	1,415	10,977
Helmsdale,	...	...	2,352	206	...	...	17·50	106	95	77	904	118	507	14,800
Lybster,	...	...	...	...	...	...	6·50	37	29	18	...	...	55	9,494
Wick,	...	...	331	37	...	...	414·75	2,364	924	387	4,379	718	3,506	108,547
East Coast Totals carried down,	315	175	168,905	10,432	23,811	2,563	822·78	4,157	26,090¼	12,770	14,013	2,141	32,238	1,105,945
Orkney and Shetland.														
Orkney,	...	...	...	...	...	...	828·50	4,574	70	24	8,127	1,525	6,123	44,307
Shetland,	...	...	3,410	280	...	...	...	...	...	...	3,320	336	616	67,321
Orkney and Shetland Totals carried down,	...	...	3,410	280	...	...	828·50	4,574	70	24	11,447	1,861	6,739	111,628
WEST COAST.														
Stornoway,	130	20	757	67	2	...	2,237·	7,890	245	117	6,952	930	9,024	106,252
Loch Broom,	...	...	1,033	105	...	...	381·50	1,672	221	35	3,471	477	2,289	11,140
Loch Carron and Skye,	...	...	...	...	...	...	259·	1,213	417	124	3,184	469	1,806	18,783
Fort William,	...	...	72	6	...	...	408·75	1,672	...	...	4,160	739	2,417	11,151
Campbeltown,	34·35	20	723	68	...	...	338·95	1,391	49⅔	56	4,582	1,152	2,687	50,079
Inveraray,	1,402	701	1,174	115	4	1	98·	466	31	31	3,011	601	1,915	45,395
Rothesay,	...	...	6,415	321	...	...	72·	303	6	3	1,116	243	870	18,467
Greenock,	...	...	4,765	192	...	...	136·	550	...	...	252	51	793	10,419
Ballantrae,	1,238	537	1,580	91	...	...	182·	561	613	237	1,443	997	2,423	28,117
West Coast Totals carried down,	2,804⅓	1,278	16,519	965	6	1	4,113·20	15,718	1,582¾	603	28,171	5,659	24,224	299,803
Totals brought down.														
East Coast—Totals,	315	175	168,905	10,432	23,811	2,563	822·78	4,157	26,090¼	12,770	14,013	2,141	32,238	1,105,945
Orkney and Shetland—Totals,	...	...	3,410	280	...	...	828·50	4,574	70	24	11,447	1,861	6,739	111,628
West Coast—Totals,	2,804⅓	1,278	16,519	965	6	1	4,113·20	15,718	1,582¾	603	28,171	5,659	24,224	299,803
Grand Totals in Year 1889,	3,119⅓	1,453	188,834	11,677	23,817	2,564	5,764·48	24,449	27,743	13,397	53,631	9,661	63,201	1,517,376
Grand Totals in Year 1888,	1,527	742	249,627	15,366	20,674	2,918	6,781·75	28,093	30,817¾	14,717	55,578	9,892	71,728	1,404,488
Increases in Year 1889,	1,592⅓	711	...	...	3,143	...	...	...	...	...	...	...	...	112,888
Decreases in Year 1889,	...	...	60,793	3,689	...	354	1,017·27	3,644	3,074¾	1,320	1,947	231	8,527	...

Note.—The total quantity of Herrings landed in Scotland in 1889, as above stated in crans, is equal to 3,718,505 cwts. Of this quantity, 1,397,507 barrels were cured, chiefly for exportation, and 137,196 crans, or 480,182 cwts., sold for consumption fresh. Of the total catch of Cod, 229,622 cwts. were cured dried, and in pickle; of Ling, 93,474 cwts. were cured dried; of Torsk, 9131 cwts., and of Saithe, 41,335½ cwts.; the remainder of these Fish being disposed of for consumption fresh.

APPENDIX C.—No. II.

FISH LANDED BY BEAM TRAWL VESSELS.—STATEMENT, by Districts, of the Total Quantity and Value of the different kinds of White Fish taken by Beam Trawl Vessels, and landed in SCOTLAND, in the Year 1889.

DISTRICTS.	Cod.		Ling.		Saithe (Coal Fish).		Haddock.		Whiting.		Turbot.		Halibut.		Sole (Lemon Sole).		Flounder, Plaice, Brill.		Eel.		Skate.		Other kinds of White Fish.		Total Value.
	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	
		£		£		£		£		£		£		£		£		£		£		£		£	£
Leith, . .	10,304	5,323	429	310	200	83	39,739	17,769	2,988	1,099	888	2,033	26¼	66	2,239	3,047	5,359	4,041	27	14	1,361	343	8,631	1,741	35,869
Montrose, .	1,673	753	96	47	86	19	11,732	5,502	405	95	300½	976	11	16	1,039	1,129	5,856	3,788	2	1	348	79	2,460	554	12,959
Aberdeen, .	7,946	6,370	247	172	1,118	484	69,253	32,755	477	171	3,760	14,775	23	40	9,750	15,431	28,676	27,010	17	11	920	100	15,006	1,333	98,652
Fraserburgh,	97	40	11	6	...	...	688	263	20	5	5½	20	...	...	25	35	410½	279	...	...	16	4	34	9	661
Wick, . .	...	...	...	...	...	...	201	71	...	...	24	67	...	...	...	...	575	280	...	...	...	...	...	...	418
Orkney, .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	500	250	...	...	...	...	...	...	250
Campbeltown,	42	22	15	8	31	8	4	4	2	2	23	35	24	36	48	92	144	144	41	25	52	13	34	9	398
Rothesay, .	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19	28	115	103	...	...	...	...	...	...	131
Greenock, .	605	328	37	16	237	53	312	121	253	71	26	83	...	...	40	56	869½	584	...	...	56	15	431	82	1,409
Ballantrae, .	3,010	1,505	220	120	640	192	1,320	660	890	445	50	100	...	...	904	1,566	3,824	2,294	196	117	430	86	1,580	474	7,559
Total, .	23,677	14,341	1,055	679	2,312	839	123249	57,145	5,035	1,888	5,077	18,089	84¼	158	14,064	21,384	46,329	38,773	283	168	3,183	640	28,176	4,202	158,306

APPENDIX C.—No. III.

TOTAL QUANTITY OF FISH LANDED.—Details, taken from the reports of the inspectors and district fishery officers, of the total quantity and value of the different kinds of white and shell fish landed in Scotland, in the year 1889.

I. Different Kinds of White Fish.

The white fisheries of Scotland are most productive on the East Coast, owing, in a large measure, to the greater facilities there for despatching fish to market for use fresh, and to the fact that the fishermen on that coast devote the whole of their time to the prosecution of the fishing industry.

Beam-trawling continues to be prosecuted with much energy in the Scottish fisheries. The number of vessels engaged in that mode of fishing last year belonging to Scotland was 110, or an increase of 3 over 1888. These were valued at £111,174, and the trawl-nets at £6204, giving £117,378 as the total amount invested in vessels and material. They fished principally from the districts of Leith, Montrose, and Aberdeen on the East Coast, and Campbeltown, Rothesay, Greenock, and Ballantrae on the West Coast. Besides the Scottish vessels, there was a large fleet of English trawlers fishing off both the East and West Coasts. Exceptionally large quantities of flounders and other flat-fish were taken off the Orkney Islands, and in the Pentland Firth. The gross quantity of all kinds of trawled fish landed in Scotland during 1889 was 252,524¼ cwts., valued at £158,306. They consisted of cod, ling, saithe, haddock, whiting, turbot, halibut, sole, flounder, plaice, brill, eel, skate, and other varieties of white fish.

A statement, by districts, of the total quantity and value of the different kinds of white fish taken by beam-trawl vessels, and landed in Scotland, will be found in Appendix C, No. II.

The total quantity of all the different kinds of white fish landed in Scotland in 1889, amounted to 5,589,239 cwts., valued at £1,454,175, and the value of shell fish, £63,201, giving £1,517,376 as the gross value of both white and shell fish. Of the catch of white fish 4,200,687 cwts. were landed on the East Coast, 480,070½ cwts. in Orkney and Shetland, and 908,481½ cwts. on the West Coast. The total catch of white fish in 1888 was 4,633,556½ cwts., valued at £1,332,760, and the shell fish landed was valued at £71,728, giving a gross value of both fisheries as £1,404,488, or an increase of 955,682½ cwts. in quantity, and £121,415 in value of white fish, but a decrease in the value of shell fish to the extent of £8527. There was thus a net increase in value of fish landed in 1889, of £112,888.

Some particulars follow of the total quantity and value (to the fishermen) of the principal kinds of white fish landed.

Herring.—The total quantity of herrings landed in Scotland last year, was 1,062,430 crans, valued at £716,445, or an increase of 279,181 crans, and £165,419 over 1888. The average price obtained was 13s. 6d. per cran, or 3s. 10d. per cwt., against 14s. 1d. and 4s. respectively in 1888. The East Coast yielded 814,550 crans, Orkney and Shetland 54,169 crans, and the West Coast 193,711 crans. Of the gross catch landed, 137,196 crans were sold for use in a fresh state, and 925,234 crans cured, chiefly for exportation to the Continent. The most successful districts were Fraserburgh with 204,272 crans, Peterhead 167,705 crans, Aberdeen 107,411 crans, Wick 99,079 crans, and Stornoway 69,480 crans.

SPRAT.—The sprat fishing of 1889 was a failure, the quantity taken amounting to only 1,249 crans, valued at £263, being 3061 crans and £544 respectively, less than the preceding year, and no less than 31,751 crans and £5308 under 1887. The fluctuation in this fishing is more striking than in any of the other fisheries. Sprats are seldom taken except in the months of January, February, November, and December, and are usually got in the upper reaches of the Firths of Forth and Tay, and the Moray Firth. Occasionally a few are taken in the Stornoway and Fort William districts. This variety of fish is of comparatively little value, and when abundant a large portion of the catch is disposed of, at a very low figure, for manure. The average price obtained last year was 1s. 2¼d. per cwt., that of 1888 being 1s. 3d.

MACKEREL.—The quantity of mackerel landed last year was 664 cwts., valued at £380, or an increase of 66 cwts., but a decrease of £17, in value as compared with 1888. The East Coast only yielded 33 cwts., Orkney and Shetland 180 cwts., and the West Coast 451 cwts.,—Shetland, Greenock, and Fort William districts showing the largest quantities. This fishing has never been a distinct one in Scotland, as most of the fish landed were caught in nets set for herrings. The average price obtained last year was 11s. 5¼d. per cwt. while in the previous year it was 13s. 3¼d. per cwt.

COD.—Last year's catch amounted to 503,663 cwts., valued at £172,100, being an increase over 1888 of 34,210 cwts., but a decrease in value to the extent of £33,694. This large decrease was, in a great measure, due to the low prices obtained at many of the stations during the season. The average price obtained by the fishermen for their catches was 6s. 10d. per cwt., or 1s. 8d. below that of 1888. The most successful districts were Shetland, Leith, Anstruther, Orkney, Wick, Peterhead, Aberdeen, and Stornoway. The East Coast yielded the largest quantity, amounting to 309,473 cwts., Orkney and Shetland 133,056 cwts., and the West Coast 61,134 cwts.

Of the total quantity landed beam-trawl vessels accounted for 23,677 cwts., valued at £14,341, or an average of 12s. 1d. per cwt. Most of their catches being landed in the districts of Leith, Aberdeen, and Ballantrae—the best fresh fish markets in Scotland—they commanded a higher average price than the general rate.

LING.—The total quantity of ling landed last year was, like the cod, in excess of the previous year, and the value less, the figures for 1889 being 134,481 cwts., and £46,493, an increase in quantity of 34,759 cwts., but a decrease of £2590 in value. The average price obtained was 6s. 10¾d. per cwt., against 9s. 7d. in 1888. The districts which showed the largest returns were Shetland, Stornoway, Orkney, Fraserburgh, Peterhead, Aberdeen, and Wick. The East Coast yielded 33,308 cwts., Orkney and Shetland 53,114 cwts., and the West Coast 48,059 cwts. Swedish luggers prosecuted this fishery off Shetland with their usual success; but owing to the very low prices offered by local curers, they went home with their catches.

Of the above catch, beam-trawl vessels landed 1055 cwts., valued at £679, the average price obtained being 12s. 10d. per cwt.

Torsk (Tusk).—The torsk, unlike the cod and ling, is only found in a few localities. The total quantity landed last year was 11,483 cwts., valued at £1725, being an increase in quantity over 1888 of 2756 cwts., but a decrease of £1753 in value. The average price obtained was only 3s. per cwt., or 1s. 7d. less than in 1888. The bulk of the catch was landed at Orkney and Shetland, Stornoway coming next. Some years ago this variety of fish realised high prices but of late it has not been in such demand and has consequently fallen in value. No torsk are reported as having been landed by beam-trawlers.

Saithe (Coal Fish).—Saithe are more or less abundant at every fishing station in Scotland, but are particularly so in Orkney, Shetland, Wick, Stornoway, Aberdeen, and Peterhead. The total quantity landed last year amounted to 84,472 cwts., valued at £11,987, being a decrease under 1888 of 21,101 cwts. and £7077 respectively. These fish are not much relished as an article of food, and usually sell at low prices—the average price last year being 2s. 10d. per cwt., against 3s. 2d. in the preceding year.

Of the total catch, 2312 cwts., valued at £839, were landed by beam-trawlers, the average price obtained being 7s. 3d. per cwt.

Haddock.—The total quantity of haddocks landed last year amounted to 792,130 cwts., valued at £331,215 or a decrease under 1888 of 28,368 cwts., and £1919; but an increase of 146,412 cwts. over the average for the preceding five years. The average price obtained was 8s. 4d. per cwt., or 3d. more than in 1888. Next to the herring, the haddock continues to be the most abundant and the most valuable of all the white fish taken in Scotland, and every district contributed, more or less, to the aggregate catch. The East Coast yielded last year 725,346 cwts.—more than nine-tenths of the gross catch—Orkney and Shetland 35,480 cwts., and the West Coast 31,304 cwts. The districts which produced the largest quantities were Aberdeen 114,225 cwts., Montrose 102,755 cwts., Leith 94,651 cwts., Banff 80,337 cwts., and Buckie 60,988 cwts. During the last few years, the Shetland haddock fishery has been gradually developing, but in 1889, the catch was 3461 cwts. below that of 1888. A considerable proportion of the total catch was smoked and cured as Findon haddocks.

Of the gross catch for 1889, beam-trawlers landed 123,249 cwts., valued £57,145—the average price obtained being 9s. 3d. per cwt.

Whiting.—The total quantity landed last year was 69,694 cwts., valued at £23,786—a decrease under 1888 of 7060½ cwts. and £1851, respectively. The average price obtained was 6s. 9d. per cwt. against 6s. 8d. in 1888. The East Coast contributed 61,000 cwts., Orkney and Shetland 131 cwts., and the West Coast 8563½ cwts. Whitings were taken, more or less, in every district in Scotland—the districts which yielded most being Aberdeen, Montrose, Leith, Banff, and Buckie.

Of the gross catch, 5035 cwts., valued at £1888 were landed by beam-trawlers.

TURBOT.—Last year's catch of turbot showed an increase over 1888 of 914½ cwts. and £4162 respectively, the total quantity landed being 6338½ cwts., valued at £20,472. The average price was £3, 4s. 7d. per cwt., or 4s. 7d. more than in 1888. Turbot are always in good demand and usually command high prices as compared with other sea fish, but are never found in great abundance on any part of the Scottish coasts. The districts which yielded the largest quantities were Aberdeen, Leith, Montrose, Anstruther, and Ballantrae, while Lybster, Shetland, Inveraray, and Rothesay did not contribute any.

Of the gross quantity landed, 5077 cwts., or 80 per cent., were taken by beam-trawlers, and sold at an average of £3, 11s. 3d. per cwt. Aberdeen contributed 60 per cent. of the whole catch, and Leith ·16 per cent., nearly all of which was landed by beam-trawl vessels.

HALIBUT.—The total quantity of halibut landed last year was 21,094¼ cwts., valued at £18,496—an increase of 897½ cwts. in quantity, but a decrease of £1225 in value, as compared with 1888. The average price was about 17s. 6d. per cwt., against 19s. 6d. in the previous year. The districts which yielded most were Shetland, Stornoway, Orkney, and Aberdeen—the lowest prices being obtained in the three first-mentioned districts.

Of the gross catch, beam-trawlers only landed 84¼ cwts., valued at £158, or an average price of 37s. 6d. per cwt. It is noteworthy that although trawlers caught 80 per cent. of the turbot taken last year, they only landed ·39 per cent. of the total catch of halibut, the latter fish being seldom taken by this mode of fishing.

SOLE (LEMON SOLE).—There was an increase in the soles landed last year over 1888 of 1722¼ cwts. and £5413 respectively—the quantity landed being 14,391¼ cwts., valued at £21,925. The average price obtained was 30s. 5d. per cwt. This variety of fish is highly prized, and usually commands a ready sale and good prices. Aberdeen has all along been the best district for these fish. The quantity landed there last year was 9750 cwts. or 67 per cent. of the total catch. Fair quantities were landed at Leith, Montrose, and Ballantrae, but fifteen districts did not land any.

Nearly the whole catch was taken by beam trawlers—14,064 cwts., valued at £21,384, being landed by them. The average price was 30s. 4d. per cwt., against 26s. in 1888.

FLOUNDER, PLAICE, and BRILL.—The total quantity of these fish landed last year, was 74,270½ cwts., valued £53,072—a decrease under 1888 of 12,913½ cwts., and £2846 respectively. The average price was 14s. 3d. per cwt. or 1s. 6d. more than in the preceding year. The districts which contributed most to the catch were Aberdeen, Montrose, Leith, and Ballantrae.

The trawlers landed 46,329 cwts., or 62 per cent. of the gross catch—Aberdeen contributing 28,676 cwts., Montrose, 5856 cwts., and Leith 5359 cwts—the average price obtained being 16s. 8d. per cwt.

CONGER EEL.—This fish, a few years ago, was considered of very little value, but recently it has commanded a ready sale at higher prices than any of the other round fish. The quanity landed last year was 16,230 cwts., valued at £8,552—an increase over 1888 of 9433 cwts. and £4863 respectively. In 1886, the catch only amounted to 1308 cwts. The average price obtained was 10s. 6d. per cwt., or 4d. less than in 1888. The East Coast yielded 3846 cwts., Shetland 64 cwts., and the West Coast 12,320 cwts.

Of the gross catch, beam-trawlers only landed 293 cwts.

SKATE.—The total quantity landed last year amounted to 50,087 cwts., valued at £10,875, or a decrease under 1888 of 9002 cwts., and £1139 respectively. The average price was 4s. 4d. per cwt., or 4d. more than in the preceding year. Skate were more or less plentiful in every district, but particularly so in Stornoway, Peterhead, Wick, Aberdeen, and Orkney.

Of the gross catch, beam-trawlers landed 3183 cwts., valued at £640, the average price obtained being 4s. per cwt.

OTHER KINDS OF WHITE FISH.—The fish included under this heading embrace a great many varieties—the most important however being hake, bream, gurnard, cat-fish, and sillock. The total quantity landed amounted to 87,363½ cwts., valued at £16,389—a falling off under 1888 of 17,050½ cwts. and £3,787 respectively. A large proportion of the fish taken were of comparatively little value, the average price being only 3s. 9d. per cwt., against 3s. 10d. in 1888. The districts which gave the largest returns were Aberdeen, Leith, Montrose, Shetland, Wick, Orkney, Buckie, and Fraserburgh.

Of the gross catch, 28,176 cwts., valued at £4202 were landed by beam-trawlers, and sold at an average price of 2s. 11d. per cwt.

II. DIFFERENT KINDS OF SHELL FISH.

The total value of all the shell fish landed in Scotland last year was £63,201, against £71,728 in 1888—a falling of to the extent of £8527. Every variety exhibits a decrease, with the exception of oysters, which show a small increase over the preceding year.

Some particulars follow as to the total quantity and value of each of the different kinds of shell fish landed.

OYSTER.—Last year's returns of this fishery show an improvement as compared with 1888, the total number of oysters landed being 3119⅓ hundreds, valued at £1453, or an increase over the preceding year of 1592⅓ hundreds, and £711 respectively. The average price obtained was 9s. 3d. a hundred, or 5d. less than in 1888. They were only landed in one district—that of Leith—on the East Coast, and in four districts on the West Coast. Inveraray yielded 1402 hundreds or 44·9 per cent., and Ballantrae 1238 hundreds or 39·6 per cent. of the total quantity landed.

MUSSEL.—The total quantity landed last year was 188,834 cwts., valued at £11,677, against 249,627 cwts., valued at £15,366 in 1888. The average price obtained was the same as in the preceding year—1s. 2¾d. per cwt. The most productive beds upon the East Coast are situated in the upper reaches of the Firths of Forth and Tay, the mouth of the Eden, Moray Firth, and the district of Montrose. On the West Coast the largest mussel bed is in the Firth of Clyde, off Port Glasgow, but mussels are found, in more or less abundance, in a large number of the West Coast lochs, and afford the local fishermen a plentiful supply of bait. The districts which showed the largest returns were Montrose 75,267 cwts., Anstruther 33,638 cwts., Leith 24,765 cwts., Cromarty 12,921 cwts., and Peterhead 11,250 cwts. Occasionally the East Coast fishermen get large consignments of mussels from the north of Ireland.

CLAM.—Last year 23,817 cwts. of these shell fish were landed, valued at £2564, being an increase of 3143 cwts. in quantity, but a decrease of £354 in value, as compared with 1888. The average price was 2s. 1½d. per cwt. or 8d. less than in the previous year. Clams are chiefly found in the Firth of Forth, on extensive beds lying off Prestonpans and Cockenzie. Leith district contributed 21,545 cwts., and Anstruther district 2266 cwts. A few were also landed in Stornoway and Inveraray districts.

LOBSTER.—The number landed last year amounted to 576,448, valued at £24,449, being a decrease under 1888 of 101,727, and £3644 respectively. The average price obtained was 10d. each, against 9¾d. in the previous year. Stornoway district gave the largest return, the number landed there being 223,700 or one-third of the total catch, while Orkney accounted for 82,850, Wick 41,475, Loch Broom 38,150, and Campbeltown 33,895. With the exception of Shetland, a few hundred lobsters were landed at each of the other districts. It is very remarkable that, while lobsters are very numerous in the Orkney Isles, none are found in the neighbouring Shetland Isles.

CRAB.—Fewer crabs were taken last year than in 1888, the number landed being 2,774,300, valued at £13,397, or a decrease of 307,470 and £1320 respectively. The average price was 1s. 11d. a score, against 2s. in 1888. The most productive districts were Leith, Anstruther, Montrose, Eyemouth, and Fraserburgh. A few were landed in Orkney, but none in Shetland, Fort William, or Greenock. The quality of those found on the West Coast is not considered as good as of those found on the East Coast, and consequently the former are not in such demand as the latter, and if forwarded to the southern markets would scarcely realize sufficient to cover carriage and other expenses.

OTHER KINDS OF SHELL FISH.—The varieties which come under this head are chiefly, the cockle, whelk, limpet, and razor-fish. The total quantity landed was 53,631 cwts., valued at £9661, a decrease under 1888 of 1947 cwts., and £231 respectively. The average price obtained was 3s. 7d. per cwt., against 3s. 6½d. in 1888. The districts which contributed the largest quantities were Orkney, Stornoway, Wick, Campbeltown, Fort William, Loch Broom, Shetland, Loch Carron and Skye, and Inveraray. Cockles have always been found in great abundance on the West Coast, and have been largely used by the natives as an article of food, and occasionally as bait. The richest beds are in the Outer Hebrides, particularly at the north end of Barra, where large quantities have been regularly gathered for many years and despatched to the southern markets. During the last five years the Barra cockle beds have yielded 29,233 cwts, valued at £3281. The quantity taken last year amounted to 4880 cwts, against 2149 cwts. in 1888, and 3719 cwts. in 1887.

Whelks are plentiful both on the East and West Coasts, and are regularly forwarded to the southern markets—where both whelks and cockles find a ready sale.

Limpets are found attached to the rocks all round the coast, and are largely used as bait, and occasionally, in some districts, as food.

Razor-fish are not generally found in large quantities in Scotland, except on some of the sands on the West Coast during low tides, the most productive locality being Broad Bay, in the Island of Lewis. Immense quantities are occasionally procured in this bay, and, being much esteemed as an article of food, are despatched to the southern markets.

The aggregate value of all kinds of fish, including shell fish, landed in Scotland during 1889 was, as previously stated, £1,517,376—an increase over the preceding year of £112,888.

DUGALD GRAHAM, *Secretary.*

Fishery Board for Scotland,
Edinburgh, 1st May 1890

APPENDIX D.—TABLE I.

FISHERY STATISTICS.—RETURN of the Number of Boats, Decked and Un-decked, *irrespective* of the places to which they belong, employed in the Herring Fishery in SCOTLAND, in the Season of 1889, in a selected Week for each District, with the Number of Fishermen aud Boys by whom manned; of Coopers, Gutters, Packers, and Labourers employed at the said Fishery in the Week so selected; and the Total Number of such Fishermen and other persons so employed.

Districts where the Boats were employed at the Herring Fishery.	Boats.	Fishermen and Boys.	Coopers.	Gutters and Packers.	Labourers.	Total Persons Employed.
Eyemouth, . .	312	1,799	158	1,146	319	3,422
Leith, . . .	115	460	48	235	215	958
Anstruther, . .	169	1,183	47	155	54	1,439
Montrose, . .	156	1,044	103	698	105	1,950
Stonehaven, . .	68	476	28	210	26	740
Aberdeen, . .	409	2,659	175	1,886	398	5,118
Peterhead, . .	506	3,012	321	2,283	240	5,856
Fraserburgh, . .	750	5,052	420	2,970	502	8,944
Banff, . . .	148	974	64	410	44	1,492
Buckie, . . .	160	976	76	576	49	1,677
Findhorn, . .	104	636	57	496	42	1,231
Cromarty, . .	48	244	10	120	10	384
Helmsdale, . .	122	736	67	462	34	1,299
Lybster, . . .	70	422	37	268	30	757
Wick, . . .	442	2,920	307	2,047	197	5,471
Orkney, . . .	131	786	42	333	11	1,172
Shetland, . . .	400	2,583	133	1,249	26	3,991
Stornoway, . .	1,121	6,721	377	3,007	385	10,490
Loch Broom, . .	90	400	4	100	4	508
Loch Carron and Skye,	634	2,201	74	486	27	2,788
Fort-William, . .	60	132	3	51	3	189
Campbeltown, . .	378	1,417	13	129	62	1,621
Inveraray, . .	258	936	4	...	57	997
Rothesay, . . .	294	882	4	30	11	927
Greenock, . .	87	262	40	390	107	799
Ballantrae, . .	155	620	34	90	91	835

APPENDIX D.—TABLE II.

FISHERY STATISTICS.—RETURN of the Number and Tonnage of Boats, Decked and Undecked, and Beam Trawl Vessels, employed in the Herring and other Sea Fisheries of SCOTLAND, in the year 1889, with the District to which they belong; the Number of Fishermen and Boys by whom manned; the Number of Fish-Curers, Coopers, and other Persons employed; with the estimated Value of Boats, Beam Trawl Vessels, Nets, and Lines.

DISTRICTS.	FISHING BOATS.						Beam Trawl Vessels.		Total.		Fishermen and Boys.	Fish-curers.	Coopers.	Other Persons (*Estimated*).	Total Persons employed.	Value (*Estimated*) of—			
	First Class, 30 feet keel and upwards.		Second Class, from 18 to 30 feet keel.		Third Class, under 18 feet keel.											Boats and Bm. Trawl Vessels.	Nets.	Lines.	Total.
	Number.	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	£	£	£	£
Eyemouth,	236	4,063	187	1,122	99	198	...	...	522	5,383	1,276	55	159	2,488	3,978	26,589	26,748	6,676	60,013
Leith,	186	4,178	301	1,559	41	123	18	606	546	6,466	1,916	22	48	2,616	4,602	93,849	34,038	6,452	134,339
Anstruther,	538	10,207	232	969	105	210	2	136	877	11,522	3,562	49	61	2,078	5,750	68,836	83,964	12,906	165,706
Montrose,	211	3,527	238	1,059	199	247	3	330	651	5,163	1,327	18	103	2,458	3,906	48,242	20,182	8,872	77,296
Stonehaven,	111	1,652	41	164	57	114	...	...	209	1,930	531	23	29	688	1,271	13,573	8,985	4,013	73,867
Aberdeen,	103	1,648	116	696	50	100	13	1,729	282	4,173	878	41	175	4,141	5,235	56,576	13,171	4,120	26,571
Peterhead,	318	5,997	145	686	86	170	...	...	549	6,853	1,937	115	322	3,440	5,814	56,779	39,220	8,634	104,633
Fraserburgh,	270	5,400	112	672	278	834	...	...	660	6,906	1,945	89	420	3,479	5,933	42,936	44,354	7,450	94,740
Banff,	243	4,860	96	576	214	642	...	...	553	6,078	1,600	27	64	1,064	2,755	39,314	22,245	5,300	66,859
Buckie,	552	11,040	53	265	119	357	...	...	724	11,662	3,522	24	83	3,546	7,175	91,420	88,370	17,252	197,042
Findhorn,	268	5,234	108	688	22	77	...	...	398	5,999	2,053	28	82	2,602	4,765	49,570	42,087	6,526	98,183
Cromarty,	129	1,955	112	527	83	210	...	...	324	2,692	1,074	5	15	1,346	2,440	11,953	23,580	3,349	38,882
Helmsdale,	93	1,469	48	222	44	99	...	...	185	1,790	619	14	68	570	1,271	7,377	6,278	1,875	15,530
Lybster,	104	2,009	22	120	27	54	...	...	153	2,183	620	10	37	355	1,022	6,007	6,010	384	12,401
Wick,	345	6,682	63	501	375	1,125	...	...	783	8,308	3,197	114	310	3,626	7,247	48,509	40,900	4,040	93,449
Orkney,	168	2,663	32	165	431	862	...	...	631	3,690	2,197	30	55	877	3,159	16,541	9,442	1,246	27,229
Shetland,	321	5,004	110	220	467	467	...	...	898	5,691	3,028	84	370	3,570	7,052	33,795	25,680	7,120	66,595
Stornoway,	231	3,681	485	3,143	783	2,349	...	...	1,499	9,173	5,645	55	73	3,681	9,454	40,566	31,926	9,994	82,486
Loch Broom,	74	1,110	68	346	496	1,488	...	...	638	2,944	1,896	24	8	941	2,869	8,633	12,720	1,883	23,236
Loch Carron and Skye,	31	561	318	1,360	624	1,260	...	...	973	3,181	2,944	73	74	948	4,039	7,616	23,046	3,489	34,151
Fort-William,	15	263	150	516	339	659	...	...	504	1,438	1,188	19	3	442	1,652	5,566	2,813	803	9,182
Campbeltown,	38	663	369	1,974	208	416	10	180	625	3,233	2,061	50	24	751	2,886	17,978	13,148	1,012	32,138
Inveraray,	5	86	326	1,892	139	278	...	...	470	2,256	1,097	18	4	303	1,422	15,559	11,722	1,184	28,465
Rothesay,	7	105	151	703	96	192	5	55	259	1,055	450	12	4	199	665	4,377	6,335	320	11,032
Greenock,	2	24	138	533	116	116	14	250	270	923	427	32	41	1,135	1,635	7,438	4,409	654	12,501
Ballantrae,	5	46	218	887	263	298	45	322	531	1,553	953	40	33	834	1,860	9,129	6,506	1,146	16,781
Totals,	4,604	84,127	4,239	21,565	5,761	12,945	110	3,608	14,714	122,245	47,943	1,071	2,665	48,178	99,857	828,728	647,879	126,700	1,603,307

APPENDIX D.—TABLE III.

FISHERY STATISTICS.—RETURN of the Number and Tonnage of Beam Trawl Vessels and Boats, employed in the Sea Fisheries of SCOTLAND, in the year 1889, with the Districts to which they belong; the Number of Fishermen and Boys by whom manned; distinguishing Steam Trawlers from Sailing Trawlers; with the estimated Value of the Vessels, Nets, and Fishing Material.

DISTRICTS.	BEAM TRAWL VESSELS AND BOATS.														
	Steam Trawlers.					Sailing Trawlers.					Total.				
	Number.	Tons.	Men.	Value of Vessels.	Value of Nets, &c.	Number.	Tons.	Men.	Value of Vessels.	Value of Nets, &c.	Number.	Tons.	Men.	Value of Vessels.	Value of Nets, &c.
				£	£				£	£				£	£
Leith,	18	1,980	128	45,900	2,160	...	...	...	...	...	18	1,980	128	45,900	2,160
Anstruther,	2	136	15	3,400	260	...	...	...	...	...	2	136	15	3,400	260
Montrose,	3	330	22	9,600	00	...	...	...	...	...	3	330	22	9,600	300
Aberdeen,	13	1,729	93	43,706	1,800	...	...	...	...	...	13	1,729	93	43,706	1,800
Campbeltown,	...	...	...	...	...	10	180	50	2,000	300	10	180	50	2,000	300
Rothesay,	...	...	...	...	...	5	55	16	150	50	5	55	16	150	50
Greenock,	1	136	11	3,800	240	13	114	46	358	252	14	250	57	4,158	492
Ballantrae,	1	58	7	500	50	44	264	90	1,760	792	45	322	97	2,260	842
Total,	38	4,369	276	106,906	4,810	72	613	202	4,268	1,394	110	4,982	478	111,174	6,204

APPENDIX D.—TABLE IV.

FISHERY STATISTICS.—RETURN, by Districts, of the Tonnage of Shipping, and of the Number of Seamen engaged in the Trade of the Herring and Cod and Ling Fisheries of SCOTLAND, in the year 1889; distinguishing those employed in Importing Stave Wood, Hoops, and Salt; in Carrying Herrings or Cod Fish Coastwise; or Exporting them abroad; and distinguishing British from Foreign Tonnage and Men.

DISTRICTS.	TONNAGE AND MEN.																			
	Importing Stave Wood and Hoops for the Fisheries.				Importing Salt for the Fisheries.				Carrying Herrings or Cod Fish Coastwise.				Exporting Herrings or Cod Fish.				Total.			
	British.		Foreign.		British.		Foreign.		British.		Foreign.		British.		Foreign.		British.		Foreign.	
	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.
Eyemouth,	...	...	174	10	1,390	80	...	...	1,004	64	...	...	1,239	74	683	39	3,633	218	857	49
Leith,	166	8	440	20	170	9	...	...	700	50	...	...	8,796	627	...	...	9,832	694	440	20
Anstruther,	186	12	252	13	280	19	...	...	...	...	...	...	...	...	...	...	466	31	252	13
Montrose,	50	5	268	17	1,443	86	120	6	40	4	...	...	2,129	115	2,055	94	3,662	210	2,443	117
Stonehaven,	...	...	...	...	382	23	...	...	110	9	...	...	163	11	258	17	655	43	258	17
Aberdeen,	3,905	224	192	11	2,689	162	...	...	1,725	110	...	...	5,806	213	2,715	101	14,125	709	2,907	112
Peterhead,	988	58	379	24	2,678	171	257	11	494	32	...	...	7,920	383	9,661	408	12,030	644	10,297	443
Fraserburgh,	866	53	183	14	3,170	239	...	...	630	54	...	...	12,517	600	10,380	510	17,183	946	10,563	524
Banff,	...	...	...	...	1,404	84	...	...	280	57	...	...	1,585	97	882	44	3,269	238	882	44
Buckie,	70	5	...	...	1,076	57	...	...	...	...	...	...	11,984	112	1,112	53	3,130	174	1,112	53
Findhorn,	...	...	...	...	655	33	...	...	...	...	...	...	1,175	64	595	29	1,830	97	595	29
Cromarty,	110	6	...	...	240	15	...	...	460	84	...	...	159	10	197	10	969	115	197	10
Helmsdale,	188	10	183	9	1,000	63	...	...	84	7	...	...	1,423	87	465	26	2,695	167	648	35
Lybster,	...	...	...	...	282	20	...	...	80	12	...	...	933	54	387	19	1,295	86	387	19
Wick,	3,296	218	1,869	129	5,499	314	394	19	2,348	140	...	...	6,321	325	4,388	238	17,464	997	6,651	386
Orkney,	...	...	87	6	2,138	124	...	...	1,682	166	...	...	2,712	164	277	15	6,532	454	364	21
Shetland,	260	14	84	5	3,332	153	442	12	5,500	275	...	...	3,782	199	1,578	78	12,874	641	2.104	95
Stornoway,	1,653	107	200	16	3,672	200	317	12	12,205	780	...	...	2,710	145	1,639	86	20,240	1,232	2,156	114
Loch Broom,	60	6	...	...	520	70	...	...	1,062	167	...	...	167	13	...	...	1,809	256	...	...
Loch Carron and Skye,	...	...	..	...	1,682	109	...	...	2,458	163	...	...	...	...	...	..	4,140	272	...	...
Fort-William,	...	...	...	...	368	25	...	...	535	47	...	...	...	...	...	...	903	72	...	...
Campbeltown,	...	...	...	...	156	14	...	...	6,316	303	...	...	150	40	...	...	6,622	357	...	...
Inveraray,	...	...	...	...	179	10	...	...	700	70	...	...	...	...	...	...	879	80	...	...
Rothesay,	...	...	...	...	80	5	...	...	389	36	...	...	...	...	...	...	469	41	...	...
Greenock,	75	5	...	...	1,100	55	...	...	987	54	...	...	3,862	227	...	...	6,024	341	...	...
Ballantrae,	...	...	...	...	173	12	...	...	38	4	...	...	38	4	...	...	249	20	...	...
Total,	11,873	731	4,311	274	35,758	2,152	1,530	60	39,827	2,688	...	...	65,571	3,564	37,272	1,767	153,029	9.135	43,113	2,101

APPENDIX D.—TABLE V.

FISHERY STATISTICS.—ABSTRACT RETURN, showing the Tonnage of Vessels and Number of Men; the Tonnage of Boats and Number of Fishermen and Boys; and the Number of other Persons employed in the Herring, Cod and Ling and other Sea Fisheries of SCOTLAND, in the Year 1889.

ABSTRACT.	Tonnage of Vessels and Number of Men.				Tonnage of Boats and Number of Fishermen and Boys.		Number of other Persons employed.	Total Tonnage and Persons employed.			
	British.		Foreign.					British.		Foreign.	
	Tons.	Men.	Tons.	Men.	Tons.	Fishermen and Boys.		Tons.	Persons.	Tons.	Persons.
Total of Herring Fishery Account, Appendix A—Table I.,	1,563½	234	...	...	...	...	...	1,563½	234	...	...
Total of Cod and Ling Fishery Account, Appendix B—Table I.,	2,532	531	...	...	...	...	...	2,532	531	...	...
Total of Fishery Statistics Account, Appendix D—Table II.,	...	...	...	...	122,245	47,943	51,914	122,245	99,857	43,113	...
Total of Fishery Statistics Account, Appendix D—Table III.,	153,029	9,135	43,113	2,101	...	...	...	153,029	9,135	...	2,101
Total,	157,124½	9,900	43,113	2,101	122,245	47,943	51,914	279,369½	109,757	43,113	2,101

APPENDIX D.—TABLE VI.

FISHERY STATISTICS.—RETURN, by Districts, of the Number of Lives Lost in connection with the Sea Fisheries of SCOTLAND, and the manner in which the Casualties happened; the Number of Boats totally wrecked, and Value thereof; the Number of Boats damaged, and Amount of Damage; and the Loss on Nets and other Fishing Material lost or damaged, in the Year 1889.

DISTRICTS.	Lives Lost.							Boats Totally Wrecked, and Value thereof.		Boats Damaged, and Amount of Damage.		Gross Loss on Boats Totally Wrecked or Damaged.	Loss on Nets and other Fishing Material, lost or damaged.	Gross Total Loss on Boats, Nets, &c., Lost or Damaged.
	Foundering at Sea.	Taking Harbour.	Collisions.	Washed Overboard.	Fell Overboard.	Knocked Overboard or Killed by Sail, &c.	Total Lives Lost.	Number.	Value.	Number.	Amount of Damage.			
									£		£	£	£	£
Eyemouth,	3	2	...	...	...	2	7	2	27	7	123	150	2,718	2,868
Leith,	...	...	...	...	2	...	2	1	20	7	225	245	2,875	3,120
Anstruther,	...	...	...	2	3	1	6	2	350	11	227	577	2,483	3,060
Montrose,	...	...	...	...	...	...	...	1	40	20	116	156	1,790	1,946
Stonehaven,	...	...	...	...	...	1	1	1	50	1	25	75	354	429
Aberdeen,	...	...	...	...	5	...	5	...	...	13	1,767	1,767	7,488	9,255
Peterhead,	...	...	...	...	1	...	1	...	...	13	79	79	1,818	1,897
Fraserburgh,	...	...	...	...	...	...	...	1	200	41	232	432	6,128	6,560
Banff,	2	...	...	...	...	1	3	...	...	9	115	115	255	370
Buckie,	...	...	...	1	1	4	6	3	1,100	6	115	1,215	894	2,109
Findhorn,	...	...	...	...	...	...	...	2	400	10	112	512	1,089	1,601
Cromarty,	...	...	...	...	...	...	...	...	...	...	...	...	873	873
Helmsdale,	...	...	...	...	...	...	...	1	250	1	58	308	274	582
Lybster,	...	...	...	...	...	...	...	...	...	2	10	10	790	800
Wick,	8	...	...	1	...	...	9	5	610	12	84	694	2,880	3,574
Orkney,	...	...	...	...	...	3	3	2	400	1	40	440	947	1,387
Shetland,	7	...	...	...	...	...	7	2	155	...	...	155	530	685
Stornoway,	12	...	...	3	...	1	16	10	360	20	234	594	1,060	1,654
Loch Broom,	...	...	...	1	...	...	1	...	...	4	24	24	550	574
Loch Carron and Skye,	4	...	...	...	...	...	4	1	10	7	59	69	716	785
Fort-William,	...	...	...	...	...	...	...	...	...	2	6	6	320	326
Campbeltown,	...	...	...	...	...	...	...	...	...	27	100	100	538	638
Inveraray,	...	...	...	...	...	...	...	...	...	3	25	25	774	799
Rothesay,	1	...	...	...	...	...	1	1	12	1	8	20	217	237
Greenock,	...	...	...	...	...	...	...	...	...	...	...	...	102	102
Ballantrae,	...	...	...	...	...	...	...	1	30	...	...	30	199	229
Total,	37	2	...	8	12	13	72	36	4,014	218	3,784	7,798	38,662	46,460

APPENDIX D.—TABLE VII.

REGISTRATION OF FISHING BOATS.—ABSTRACT RETURNS of Proceedings in SCOTLAND in the Year 1889, under Sea Fisheries Acts of 1868 and 1883, and Sea Fisheries (Scotland) Amendment Act of 1885, and showing the Districts in which these proceedings took place.

DISTRICTS.	FISHING BOATS.															
	Applications to Register.				Registers Issued.				Registers Examined and Endorsed.				Boats Detained.			
	First Class.	Second Class.	Third Class.	Total.	First Class.	Second Class.	Third Class.	Total.	First Class.	Second Class.	Third Class.	Total.	First Class.	Second Class.	Third Class.	Total.
Eyemouth,	...	...	...	...	...	...	...	...	...	...	...	...	39	52	...	91
Leith,	1	2	...	3	1	2	...	3	22	76	...	98	5	...	...	5
Anstruther,	28	8	...	36	28	8	...	36	257	151	...	408	1	...	...	1
Montrose,	...	...	...	...	...	...	...	...	1	...	...	1	6	10	...	16
Aberdeen,	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	4
Peterhead,	...	...	...	...	...	...	...	...	250	171	73	494	...	...	...	...
Fraserburgh,	19	31	11	61	19	31	11	61	244	80	252	576	2	...	...	2
Banff,	4	32	...	36	4	32	...	36	200	254	...	454	...	4	...	4
Buckie,	21	5	...	26	21	5	...	26	254	101	...	355	18	...	...	18
Findhorn,	3	1	...	4	3	2	...	5	4	7	3	14	1	1	...	2
Cromarty,	5	3	...	8	5	3	...	8	14	29	23	66	...	...	...	...
Helmsdale,	13	6	...	19	13	6	...	19	42	28	...	70	...	...	...	...
Lybster,	15	...	...	15	15	...	...	15	65	49	...	114	...	...	...	...
Wick,	51	10	4	65	50	10	4	64	313	48	78	439	4	...	...	4
Orkney,	15	11	...	26	15	11	...	26	44	84	...	128	...	...	...	...
Stornoway,	6	13	2	21	6	13	2	21	5	24	31	60	...	...	...	...
Loch Broom,	3	11	3	17	3	11	3	17	52	99	74	225	...	...	8	8
Loch Carron & Skye,	2	40	25	67	2	40	25	67	16	246	375	637	...	...	...	...
Fort-William,	...	10	8	18	...	10	8	18	4	80	94	178	...	...	...	...
Campbeltown,	3	20	...	23	3	20	...	23	44	288	...	332	...	1	...	1
Inveraray,	...	67	...	67	...	67	...	67	8	267	2	277	...	11	...	11
Rothesay,	...	15	1	16	...	15	1	16	4	208	22	234	...	4	...	4
Greenock,	...	1	...	1	...	1	...	1	...	37	...	37	...	1	...	1
Ballantrae,	1	6	...	7	1	6	...	7	3	210	...	213	...	...	...	...
'Vigilant' Cruiser,	...	...	...	...	...	...	...	...	...	...	...	1,210	...	...	...	189
H.M.S. 'Jackal,'	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	50
Fishery Superintendents,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11
Total,	190	292	54	536	189	293	54	536	1,846	2,537	1,027	6,620	80	84	8	422

APPENDIX D.—TABLE VIII.

FISHERY STATISTICS.—RETURN, by Fishing Villages or Creeks, for the Coasts of SCOTLAND, of the Number of Boats, Beam Trawl Vessels, and Resident Fishermen and Boys, in the Year 1889.

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Eyemouth District.						
Amble,	6	2	3	...	11	26
Alnmouth,	1	10	4	...	15	20
Boulmer,	8	24	3	...	35	49
Craster,	17	26	6	...	49	70
Newton,	12	14	2	...	28	33
Beadnell,	13	17	4	...	34	44
North Sunderland,	21	18	8	...	47	66
Holy Island,	12	19	12	...	43	80
Spittal,	7	14	3	...	24	65
Berwick,	20	25	4	...	49	100
Burnmouth,	20	3	20	...	43	112
Eyemouth,	77	8	12	...	97	305
Coldingham,	22	7	18	...	47	84
Total,	236	187	99	...	522	1,054
Leith District.						
Cove,	...	16	...	...	16	24
Dunbar,	9	37	...	...	46	146
North Berwick,	7	17	...	...	24	70
Port Seton and Cockenzie,	64	43	...	...	107	415
Prestonpans,	8	6	...	...	14	90
Fisherrow,	29	17	...	...	46	280
Leith,	10	...	...	4	14	100
Newhaven,	26	120	...	...	146	360
Granton,	6	...	...	13	19	127
Queensferry,	...	8	...	...	8	30
Bo'ness,	...	1	...	...	1	4
Alloa,	22	...	...	1	23	72
Kincardine,	3	3	...	...	6	12
Limekilns,	...	4	2	...	6	14
Inverkeithing,	...	6	...	...	6	18
Aberdour,	...	3	...	...	3	9
Burntisland,	2	7	3	...	12	20
Kinghorn,	...	6	11	...	17	20
Kirkcaldy,	...	...	22	...	22	22
Dysart,	...	6	3	...	9	24
Wemyss,	...	1	...	...	1	4
Total,	186	301	41	18	546	1,861
Anstruther District.						
Buckhaven,	108	71	4	...	183	370
Methil and Leven,	...	1	4	...	5	12
Largo,	13	13	5	...	31	80
Elie and Earlsferry,	...	6	7	...	13	18
St Monance,	95	22	...	...	117	390
Pittenweem,	62	19	3	...	84	270
Anstruther and Cellardyke,	189	19	10	...	218	640
Crail,	2	19	21	...	42	75
Kingsbarns and Boarhills,	...	3	4	...	7	20
St Andrews,	34	19	5	2	60	170
Tayport,	1	40	8	...	49	125
Newburgh,	34	...	34	...	68	105
Total,	538	232	105	2	877	2,275

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Montrose District.						
Dundee,	...	...	...	...	...	...
Broughty Ferry,	29	34	65	...	128	218
Westhaven,	...	6	9	...	15	26
Easthaven,	...	6	7	...	13	22
Arbroath,	49	27	7	...	83	182
Auchmithie,	8	20	4	...	32	61
Usan,	1	8	2	...	11	28
Ferryden,	65	42	60	...	167	302
Montrose,	...	...	14	3	17	45
Milton,	...	...	3	...	3	5
Johnshaven,	16	30	15	...	61	119
Gourdon,	43	65	13	...	121	270
Total,	211	238	199	3	651	1,278
Stonehaven District.						
Shieldhill,	...	3	3	...	6	8
Catterline,	8	5	15	...	28	37
Crawton,	1	3	6	...	10	13
Stonehaven,	76	22	14	...	112	327
Cowie,	5	6	6	...	17	36
Stranathra,	...	...	1	...	1	2
Skateraw,	21	2	12	...	35	66
Total,	111	41	57	...	209	489
Aberdeen District.						
Downies,	4	4	10	...	18	35
Portlethen,	14	14	14	...	42	94
Findon,	4	3	4	...	11	30
Cove,	6	10	7	...	23	80
Burnbank,	1	1	1	...	3	6
Torry,	38	50	8	...	96	255
Aberdeen,	36	34	6	13	89	273
Total,	103	116	50	13	282	773
Peterhead District.						
Newburgh,	...	3	2	...	5	17
Collieston,	18	30	2	...	50	108
Old Castle,	3	11	...	...	14	30
Whinnyfold,	9	9	4	...	22	37
Port Erroll,	23	16	8	...	47	86
Bullers of Buchan,	3	2	3	...	8	15
Boddam,	90	19	4	...	113	198
Burnhaven,	7	7	10	...	24	28
Peterhead,	112	32	36	...	180	360
Buchanhaven,	53	16	17	...	86	176
Total,	318	145	86	...	549	1,050

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes.			Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
	1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.			
Fraserburgh District.						
St Combs,	43	6	69	...	118	157
Charlestown,	5	3	5	...	13	26
Inverallochy,	53	15	60	...	128	212
Cairnbulg,	30	12	34	...	76	141
Fraserburgh,	73	40	50	...	163	388
Pittulie,	16	12	12	...	40	82
Rosehearty,	39	17	32	...	88	170
Pennan,	11	7	16	...	34	64
Total,	270	112	278	...	660	1,240
Banff District.						
Crovie,	20	8	18	...	46	112
Gardenstown,	48	16	38	...	102	180
Macduff,	56	24	60	...	140	256
Banff,	41	3	10	...	54	148
Whitehills,	31	34	42	...	107	210
Portsoy,	32	7	22	...	61	138
Sandend,	15	4	24	...	43	88
Total,	243	96	214	...	553	1,132
Buckie District.						
Cullen,	67	6	13	...	86	268
Portknockie,	70	7	32	...	109	300
Findochty,	68	8	31	...	107	260
Portessie,	89	4	21	...	114	340
Buckie,	196	20	16	...	232	784
Portgordon,	62	8	6	...	76	250
Total,	552	53	119	...	724	2,202
Findhorn District.						
Lossiemouth,	125	18	5	...	148	480
Hopeman,	58	21	2	...	81	285
Burghead,	37	12	6	...	55	196
Findhorn,	3	7	1	...	11	48
Nairn,	35	36	3	...	74	226
Campbeltown,	8	8	...	...	16	48
Petty,	2	2	2	...	6	15
Inverness,	...	4	3	...	7	20
Total,	268	108	22	...	398	1,318
Cromarty District.						
Craigton and Kilmuir,	...	6	...	...	6	30
Avoch,	36	41	6	...	83	220
Fortrose and Rosemarkie,	...	...	4	...	4	16
Cromarty,	17	18	36	...	71	190
Invergordon, &c.,	...	...	6	...	6	24
Balintrad,	...	...	2	...	2	8
Nigg,	1	...	10	...	11	36
Shandwick,	6	6	...	...	12	30
Balintore,	16	10	2	...	28	87
Hilton,	11	9	9	...	29	80
Rockfield,	9	9	...	...	18	54
Portmahomack,	18	5	4	...	27	100
Inver,	15	8	4	...	27	84
Total,	129	112	83	...	324	959

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Helmsdale District.						
Embo, - - - - -	25	14	3	...	42	90
Golspie, - - - - -	14	12	2	...	28	58
Brora, - - - - -	14	12	3	...	29	64
Portgower, - - - -	5	4	2	...	11	21
Helmsdale, - - - -	15	6	11	...	32	56
Navidale, - - - - -	...	...	2	...	2	8
Berriedale, - - - -	...	...	4	...	4	16
Dunbeath, - - - -	20	...	17	...	37	85
Total, - -	93	48	44	...	185	398
Lybster District.						
Latheronwheel, - - -	11	3	11	...	25	64
Forse, - - - - -	11	6	2	...	19	40
Lybster, - - - - -	74	7	8	...	89	280
Clyth, - - - - -	8	6	6	...	20	95
Total, - -	104	22	27	...	153	479
Wick District.						
Whaligoe, - - - - -	6	2	7	...	15	48
Sarclet, - - - - -	9	...	5	...	14	50
Wick and Pulteney, - -	227	16	44	...	287	781
Boathaven to Elzie, - -	8	3	9	...	20	43
Staxigoe, - - - -	7	5	7	...	19	38
Ackergill, - - - - -	3	3	4	...	10	22
Keiss, - - - - -	20	2	18	...	40	120
Nybster, - - - - -	2	...	13	...	15	42
Freswick, - - - - -	3	...	15	...	18	60
Duncansbay and Huna, -	5	...	24	...	29	88
Stroma, - - - - -	11	3	44	...	58	130
Gills and Mey, - - -	9	...	20	...	29	80
Scarfskerry and Ham, -	1	...	13	...	14	50
Brough and Dunnet, - -	...	...	12	...	12	48
Castlehill and Murkle, -	...	...	10	...	10	32
Thurso and Scrabster, -	9	17	10	...	36	80
Crosskirk and Brims, - -	1	1	9	...	11	28
Sandside, - - - - -	1	1	6	...	8	32
Portskerra, - - - -	9	6	9	...	24	106
Strathypoint, - - - -	1	...	7	...	8	27
Armadale, - - - - -	3	1	5	...	9	38
Kirtomy and Farr, - -	3	...	9	...	12	62
Island Roan, Skerry, &c., -	3	1	24	...	28	125
Coldibacky and Scullomy, -	...	...	5	...	5	20
Talmine and Portvasgo, -	3	2	17	...	22	80
Erriboll, Rispond and Smoo,	1	...	29	...	30	86
Total, - -	345	63	375	...	783	2,316

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Orkney District.						
Burwick,	3	1	11	...	15	56
Grimness,	13	1	15	...	29	125
St Margarets Hope,	18	2	18	...	38	160
Herston,	4	1	6	...	11	38
Swona,	...	...	6	...	6	14
Walls,	10	1	14	...	25	93
Flotta,	7	1	12	...	20	76
Fara, South,	1	...	2	...	3	12
Cava,	...	...	2	...	2	7
Hoy,	4	...	6	...	10	40
Graemsay,	...	...	5	...	5	19
Stromness,	6	2	12	...	20	76
Orphir and Scapa,	1	4	12	...	17	60
Holm,	13	...	7	...	20	70
Burray,	22	1	15	...	38	100
Deerness,	6	...	10	...	16	60
Tankerness,	2	...	4	...	6	23
Kirkwall,	11	2	21	...	34	160
Eviea nd Birsay,	4	...	16	...	20	70
Rousay,	...	...	24	...	24	45
Weir,	...	...	1	...	1	3
Egilshay,	...	...	4	...	4	12
Shapinshay,	5	...	15	...	20	75
Stronsay,	13	1	17	...	31	100
Eday,	4	1	19	...	24	95
Fara, North,	...	...	2	...	2	8
Westray and Papa Westray,	8	13	130	...	151	460
Sanday,	3	1	15	...	19	60
North Ronaldshay,	10	...	10	...	20	80
Total,	168	32	431	...	631	2,197
Shetland District.						
Dunrossness,	1	10	29	...	40	153
Levenwick,	4	6	6	...	16	70
Hoswick,	5	5	8	...	18	68
Sandsair,	16	6	7	...	29	138
Aithsvoe,	22	4	9	...	35	176
Bressay,	6	...	7	...	13	39
Lerwick,	55	3	30	...	88	355
Nesting,	8	...	4	...	12	56
Whalsay,	24	2	25	...	51	156
Skerries,	3	3	6	...	12	42
Vidlin,	8	3	...	...	11	66
Dalesvoe,	7	...	5	...	12	42
Mossbank,	6	...	7	...	13	38
Burravoe,	3	...	4	...	7	18
Gussaburgh,	...	...	3	...	3	12
Midyell,	8	...	15	...	23	56
Gutcher,	5	...	6	...	11	30
Cullivoe,	7	4	12	...	23	66
Fetlar,	1	3	6	...	10	24
Uyasound,	17	2	24	...	43	114
Baltasound,	6	...	5	...	11	40
Haroldswick,	...	6	11	...	17	36
Carry forward,	212	57	229	...	498	1,795

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes.			Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
	1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.			
Brought forward, -	212	57	229	...	498	1,795
Shetland District—continued.						
Norwick, - - - -	...	4	5	...	9	24
Burrafirth, - - -	...	7	9	...	16	42
West Sandwick, - -	8	...	8	...	16	48
Fethaland, - - -	...	10	14	...	24	60
Ollaberry, - - - -	...	...	18	...	18	36
Sandvoe, - - - -	...	3	...	...	3	18
Ronasvoe, - - - -	4	4	3	...	11	52
Stennis, - - - -	...	17	...	...	17	102
Hillswick, - - -	8	...	20	...	28	50
Papa Stour, - - -	4	1	12	...	17	45
Sandness, - - - -	4	2	10	...	16	50
Vaila Sound, - - -	12	...	12	...	24	72
Skeld, - - - -	2	...	4	...	6	12
Raewick, - - - -	7	...	3	...	10	42
Sand, - - - -	9	...	4	...	13	60
Whiteness, - - -	8	...	10	...	18	54
Burwick, - - - -	3	...	3	...	6	18
Scalloway, - - -	10	...	54	...	64	113
Oxna, - - - -	3	...	4	...	7	18
Trondra, - - - -	5	...	3	...	8	30
Burra Isle, - - -	15	...	8	...	23	100
Havera, - - - -	...	...	6	...	6	24
Maywick, - - - -	...	...	8	...	8	32
Spiggie, - - - -	4	...	2	...	6	30
Queendale, - - -	...	...	9	...	9	27
Foula Isle, - - -	2	5	...	...	7	38
Fair Isle, - - - -	1	...	9	...	10	36
Total, - -	321	110	467	...	898	3,028
Stornoway District.						
Europia, - - - -	...	4	3	...	7	40
Stow, - - - -	...	7	3	...	10	40
Portness, - - - -	2	37	6	...	45	250
Skegersta, - - - -	1	7	4	...	12	35
Tolsta, - - - -	5	9	3	...	17	60
Glen, - - - -	1	1	1	...	3	14
Coll - - - -	...	8	6	...	14	120
Back, - - - -	5	11	2	...	18	130
Vatisker, - - - -	5	9	4	...	18	150
Tong, - - - -	8	9	5	...	22	95
Stenish, - - - -	...	...	4	...	4	10
Melbost, - - - -	2	5	5	...	12	60
Garrabost, - - - -	9	8	10	...	27	95
Shadder, - - - -	8	4	3	...	15	60
Portnagurin, - - -	12	12	6	...	30	170
Portvoller, - - -	4	5	6	...	15	85
Sheshader, - - -	7	6	2	...	15	70
Bayble, - - - -	23	25	16	...	64	260
Knock, - - - -	5	9	4	...	18	45
Swordle, - - - -	4	6	4	...	14	50
Holm, - - - -	...	3	4	...	7	18
Sandwick, - - - -	...	2	6	...	8	20
Stornoway, - - -	...	3	15	...	18	25
Grimshader, - - -	2	5	2	...	9	40
Ranish, - - - -	5	8	4	...	17	55
Carry forward, - -	108	203	128	...	439	1,997

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Brought forward, –	108	203	128	...	439	1,997
Stornoway District—continued.						
Crossbost, – – – –	9	10	6	...	25	60
Leurbost, – – – –	8	9	7	...	24	70
Keose, – – – –	3	...	4	...	7	20
Laxay, – – – –	2	...	3	...	5	20
Balallan, – – – –	1	...	4	...	5	50
Habost, – – – –	1	...	6	...	7	15
Kershader, – – –	1	...	2	...	3	12
Garryvard, – – –	1	...	5	...	6	18
Cromore, – – – –	3	8	6	...	17	50
Marvick, – – – –	6	6	8	...	20	70
Calbost, – – – –	6	6	3	...	15	50
Gravor, – – – –	7	10	8	...	25	55
Leumeriva, – – –	6	7	7	...	20	60
Loch Seaforth, – – –	...	...	5	...	5	40
Elennenibe, – – –	...	...	2	...	2	12
Quilis, – – – –	1	2	5	...	8	10
Scalpay Island, – – –	9	14	40	...	63	160
Plockerpool, – – –	...	13	6	...	19	50
Orrigo, – – – –	...	2	5	...	7	16
Derriclate, – – –	...	...	3	...	3	12
Maevig, – – – –	1	2	4	...	7	20
Drimishader, – – –	1	3	5	...	9	25
Scadabay, – – – –	1	3	7	...	11	20
Grozabay, – – – –	...	2	3	...	5	60
Cluer, – – – –	...	...	4	...	4	20
Stocknish, – – –	1	9	6	...	16	50
Lochalee, – – – –	...	...	6	...	6	30
Grocrass, – – – –	...	2	6	...	8	25
Manish, – – – –	...	...	4	...	4	20
Fladavay, – – – –	...	...	5	...	5	20
Quitinish, – – – –	...	...	4	...	4	25
Finnisbay, – – – –	...	11	8	...	19	70
Strond, – – – –	1	6	25	...	32	90
Tarrinsay, – – – –	...	2	6	...	8	30
Airdhasaig, – – –	...	...	7	...	7	24
Scarf Island, – – –	...	...	6	...	6	30
Borve, – – – –	...	2	2	...	4	40
Shader, – – – –	...	...	2	...	2	11
Barvas, – – – –	...	4	4	...	8	50
Arnol, – – – –	1	3	3	...	7	40
Bragor, – – – –	1	3	5	...	9	85
Shawlbost, – – –	2	6	5	...	13	60
Carloway, – – – –	15	11	6	...	32	150
Tolstachulish, – – –	4	5	10	...	19	50
Tobson, – – – –	1	8	6	...	15	60
Eneclate, – – – –	...	...	4	...	4	20
Breasclate, – – –	2	5	7	...	14	80
Geshader, – – – –	...	...	4	...	4	15
Kirkibost, – – – –	2	3	2	...	7	30
Carrishader, – – –	...	...	5	...	5	20
Crulivig, – – – –	...	...	3	...	3	20
Valtos, – – – –	4	12	8	...	24	120
Kneep, – – – –	...	5	4	...	9	30
Airduig, – – – –	...	4	3	...	7	30
Crowlista, – – – –	2	8	6	...	16	60
Carry forward, –	211	409	458	...	1,078	4,377

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Brought forward, -	211	409	458	...	1,078	4,377
Stornoway District—continued.						
Mangersta, - - - -	...	...	3	...	3	10
Islivig, - - - - -	1	4	6	...	11	25
Brenish, - - - - -	...	4	6	...	10	25
Valley, North Uist, - -	...	...	3	...	3	15
Lochmaddy, - - -	...	7	40	...	47	138
Locheport, - - -	...	4	27	...	31	71
Graemsay Island, - -	...	2	9	...	11	37
Heisker Island, - - -	...	...	9	...	9	27
Benbecula Island, - -	...	2	70	...	72	106
Loch Skipport, - - -	...	2	10	...	12	30
Loch Boisdale, - - -	...	14	73	...	87	219
Eriskay Island, - - -	...	4	12	...	16	160
Brurnish Barra, - -	2	2	5	...	9	54
Bualnabodach, - - -	1	2	8	...	11	36
Earsary, - - - -	2	2	9	...	13	56
Brevig, - - - - -	3	4	6	...	13	30
Castlebay, - - - -	11	18	22	...	51	176
Pabbay, - - - -	...	2	1	...	3	5
Minglay, - - - -	...	3	3	...	6	30
Barrahead, - - -	...	...	1	...	1	3
Borve, - - - -	...	...	2	...	2	15
Total, -	231	485	783	...	1,499	5,645
Loch Broom District.						
Poulin, - - - - -	1	...	7	...	8	25
Oldshorebeg and Oldshoremore, - - - - -	3	1	19	...	23	82
Kinlochbervie, - - -	2	...	7	...	9	28
Badcall (Inchard), and Achriskill, - - -	2	...	11	...	13	36
Ardomre and Portlovorchaidh, - - - -	...	...	5	...	5	15
Findlemore, and Fanagmore, - - - -	1	1	7	...	9	27
Tarbet and Scourie, - -	2	...	18	...	20	45
Badcaul (Scourie), - -	...	1	8	...	9	20
Glendhu and Unapool, -	...	...	7	...	7	22
Ardvar and Nedd, - -	1	...	8	...	9	24
Drumbeg, - - - -	...	...	6	...	6	15
Culkein (Drumbeg), - -	...	...	12	...	12	20
Clashnessie, - - -	2	...	6	...	8	24
Achnacarnin, - - -	...	...	4	...	4	12
Culkein (Stoer), - - -	...	...	5	...	5	16
Raffin and Balnacladich, -	1	...	8	...	9	24
Clachtoll, - - - -	6	...	17	...	23	68
Achmelvich, - - -	3	...	4	...	7	24
Lochinver and Strathan, -	...	...	9	...	9	16
Badnaban and Inverkirkaig,	1	...	12	...	13	30
Achnahaird and Reef, -	1	2	9	...	12	29
Carry forward, -	26	5	189	...	220	602

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Brought forward,	26	5	189	...	220	602
Loch Broom District—continued						
Altandhu,	2	3	11	...	16	36
Polbain and Tanera,	5	11	14	...	30	66
Achiltibuie and Badenscally,	...	5	20	...	25	58
Polglass and Culnacraig,	2	3	10	...	15	44
Isle Martin and Ardmair,	1	...	8	...	9	16
Rhue and Morefield,	2	...	12	...	14	35
Ullapool,	2	...	30	...	32	100
Leckmelm and Ardcharnish,	...	...	5	...	5	10
Letters, Ardindrean and Rheroy,	6	2	25	...	33	96
Achmore and Scoriag,	2	1	16	...	19	50
Charnoch and Badralloch,	1	2	13	...	16	45
Ardessie and Badcall,	...	...	9	...	9	25
Durnmuk and Badlurach,	...	...	22	...	22	75
First and Second Coast,	...	...	7	...	7	27
Sand and Laid,	3	...	10	...	13	60
Achgarve and Mellon Udrigle,	2	...	6	...	8	35
Opinin and Mellon Charles,	3	...	9	...	12	48
Ormiscraig and Bualnaluil,	1	...	9	...	10	40
Tenefelin and Aultbea,	1	...	8	...	9	38
Poolewe and Naast,	...	...	10	...	10	35
Inveresdale,	2	4	11	...	17	55
Cove,	...	...	10	...	10	25
Melvaig,	2	...	4	...	6	20
North Erradale,	1	1	2	...	4	18
Sand (Gairloch),	...	4	7	...	11	45
Strath,	1	9	4	...	14	60
Badachro,	4	11	4	...	19	52
Porthenderson,	3	5	5	...	13	38
South Erradale,	1	1	2	...	4	20
Charleston and Red Point,	1	1	4	...	6	22
Total,	74	68	496	...	638	1,896
Loch Carron and Skye District.						
Dibieg to Ardglass,	1	...	6	...	7	26
Loch Torridon,	3	3	7	...	13	42
Loch Shieldaig,	1	5	14	...	20	61
Ardheslaig to Kenmore,	1	6	4	...	11	35
Arinachrinachd to Lonebain,	...	3	7	...	10	31
Applecross to Ugas,	5	15	29	...	49	126
Kishorn to Kinistin,	1	6	25	...	32	87
Aird to Strome,	1	9	21	...	31	91
Loch Carron,	2	14	41	...	57	176
Plockton to Balmacara,	2	21	18	...	41	134
Lochs Duich and Long,	...	5	56	...	61	164
Loch Hourn and Glenelg,	...	6	37	...	43	118
Proternish,	...	19	5	...	24	66
Carry forward,	17	112	270	...	399	1,157

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Brought forward,	17	112	270	...	399	1,157
Loch Carron and Skye District—continued.						
Portree,	3	13	33	...	49	156
Balameanoch,	...	1	35	...	36	110
Sconser,	...	4	32	...	36	102
Luib to Strolomus,	1	11	49	...	61	184
Broadford to Lussay,	1	18	38	...	57	178
Kylea Kin,	2	10	8	...	20	64
Sleat,	1	31	52	...	84	253
Uig,	3	26	1	...	30	85
Snizort,	...	9	10	...	19	65
Lyndale,	...	17	9	...	26	78
Waternish,	...	12	...	...	12	43
Stein,	1	8	...	...	9	40
Dunvegan,	...	14	6	...	20	58
Glendale,	...	15	...	...	15	57
Lochs Bracadale and Brittle,	1	6	9	...	16	50
Straithaird,	...	4	16	...	20	60
Lochs Slapin and Eyeshort,	...	...	24	...	24	73
Rona, Raasay and Scalpa,	1	6	26	...	33	99
Croulin and Soay,	...	1	6	...	7	32
Total,	31	318	624	...	973	2,944
Fort-William District.						
Lochs Nevis and Moror,	2	14	41	...	57	110
Arisaig and Loch Aylort,	...	2	13	...	15	35
Sumisary to Ockle Point and Eilean Shona,	...	14	25	...	39	78
Ockle Point to Loch Sunart,	2	12	5	...	19	57
Loch Sunart and Aline,	...	2	11	...	13	22
Loch Eil and Fort-William,	...	4	49	...	53	95
Corran,	...	4	9	...	13	26
Loch Leven and Kintallen,	...	1	24	...	25	50
Cuil Port Appin and Loch Creran,	...	3	18	...	21	63
Loch Etive and Dunstaffnage,	...	...	9	...	9	18
Oban,	2	19	11	...	32	48
Lismore,	...	1	8	...	9	27
Tobermory,	2	10	17	...	29	72
Lochs Don, Spelve and Buie,	...	2	10	...	12	36
Carsaig to Kentra,	...	3	4	...	7	21
Lochs Laich and Scriddan,	...	2	14	...	16	32
Ulva, Loch-na-Kiel, and Tuadh,	...	3	6	...	9	27
Coll,	...	3	8	...	11	36
Tiree,	7	50	42	...	99	300
Iona,	...	...	7	...	7	14
Muck, Eigg, Rum and Canna,	...	1	8	...	9	21
Total,	15	150	339	...	504	1,188

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes. 1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.	Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
Campbeltown District.						
Skipness and Clonaig, -	1	18	6	...	25	92
Cour and Grogport, - -	...	5	4	...	9	32
Carradale and Torrisdale, -	1	57	6	...	64	223
Campbeltown, - - -	31	169	10	10	220	690
South end of Kintyre, -	...	4	4	...	8	28
Sanda Island, - - -	...	4	2	...	6	12
Machrihanish, - - -	...	4	2	...	6	16
Ballochantee and Musdale, -	...	4	5	...	9	27
Gigha Island, - - -	2	22	8	...	32	122
Jura Island, - - -	...	2	38	...	40	46
Colonsay Island, - -	...	6	14	...	20	35
Portnahaven, Islay, - -	3	24	52	...	79	219
Portwemyss, Islay, - -	...	18	30	...	48	96
Bowmore and Port Charlotte,	...	20	20	...	40	81
Portellen & Portaskaig, -	...	10	3	...	13	50
Lochgrunard, - - -	...	2	4	...	6	12
Total, - - -	38	369	208	10	625	1,781
Inveraray District.						
Loch Feochan, - - -	...	4	11	...	15	32
Luing, - - - -	...	3	21	...	24	46
Loch Melfort, - - -	...	...	9	...	9	10
Loch Craignish, - - -	...	1	4	...	5	8
Crinan, - - - -	...	...	4	...	4	6
Loch Sweyn, - - -	...	...	8	...	8	14
Loch Kylesport, - - -	...	...	5	...	5	7
Tarbert, - - - -	4	107	17	...	128	361
Ardrishaig, - - -	...	64	16	...	80	218
Lochgilphead, - - -	...	41	4	...	45	107
Castleton, - - - -	...	19	6	...	25	58
Lochgair, - - - -	1	12	5	...	18	36
Minard, - - - -	...	14	4	...	18	35
Crarae, - - - -	...	8	2	...	10	19
Furnace, - - - -	...	9	3	...	12	26
Kenmore, - - - -	...	4	2	...	6	11
Inveraray, - - - -	...	6	5	...	11	10
Dunderaw to Newton, -	...	15	6	...	21	30
Otter to Ardlamont, - -	...	19	7	...	26	63
Total, - -	5	326	139	...	470	1,097
Rothesay District.						
Rothesay, - - -	...	8	14	4	26	35
Port Bannatyne and North Bute, - - - -	2	13	7	...	22	26
Kyles of Bute, - - -	...	32	12	...	44	80
St Ninians, and West Side of Bute, - - - -	2	10	6	...	18	22
Kilchatten and Schoolac, -	...	5	7	...	12	15
Roseneath to Toward, -	...	26	30	...	56	86
Lochranza and Caticol, -	3	26	3	1	33	62
Pirnmill to Blackwater, -	...	20	4	...	24	45
Blackwater to Whiting Bay,	...	4	5	...	9	12
Whiting Bay to Lamlash, -	...	4	6	...	10	14
Brodick and Corrie, - -	...	3	2	...	5	8
Total, - -	7	151	96	5	259	405

APPENDIX D.—TABLE VIII.—*Continued.*

CREEKS.	Number of Boats in Classes.			Number of Beam Trawl Vessels.	Total Number of Boats and Beam Trawl Vessels.	Resident Fishermen and Boys.
	1st Class, 30 ft. Keel and upwards.	2nd Class, 18 ft. to 30 ft. Keel.	3rd Class, under 18 ft. Keel.			
Greenock District.						
Gareloch, - - - - -	...	6	10	...	16	30
Helensbro and Dumbarton, -	...	4	8	...	12	20
Glasgow and Paisley, - -	...	2	2	1	5	15
Port-Glasgow, - - -	...	12	9	...	21	22
Greenock, - - - -	...	8	13	10	31	50
Gourock, - - - -	...	2	7	2	11	14
Inverkip, - - - -	...	...	5	...	5	8
Largs, - - - - -	1	4	23	1	29	60
Fairlie, - - - -	...	...	5	...	5	8
Cumbraes, - - - -	...	5	11	...	16	23
Portincross, - - -	...	4	7	...	11	18
Ardrossan, - - - -	...	...	2	...	2	4
Saltcoats, - - - -	...	42	7	...	49	80
Irvine, - - - -	1	27	3	...	31	55
Troon, - - - -	...	22	4	...	26	20
Total, - -	2	138	116	14	270	427
Ballantrae District.						
Annan, - - - - -	...	...	10	44	54	90
Powfoot, &c., - - -	...	...	...	...	...	24
Carsethorn, - - -	...	...	5	...	5	12
Kirkcudbright, &c., - -	...	...	10	...	10	12
Garlieston, - - -	...	4	14	...	18	12
Whitehorn Isle, - - -	...	...	16	...	16	18
Port William, - - -	...	...	36	...	36	38
Glenluce, - - - -	...	4	9	...	13	24
Sandhead, - - - -	...	1	20	...	21	24
Drumore, - - - -	...	8	4	...	12	40
Portlogan, - - - -	...	...	9	...	9	15
Portpatrick, - - -	...	3	24	...	27	63
Stewarton, &c., - - -	...	1	12	...	13	24
Stranraer, - - - -	1	15	15	...	31	54
Cairnryan, - - - -	...	2	6	...	8	24
Ballantrae, - - -	...	30	10	...	40	88
Carleton, &c., - - -	2	12	4	...	17	48
Girvan, - - - -	1	62	8	1	72	164
Maidens, - - - -	...	18	18	...	36	55
Dunure, - - - -	...	40	15	...	55	70
Ayr, - - - - -	1	18	18	...	38	54
Total, - -	5	218	263	45	531	953

DUGALD GRAHAM, *Secretary.*

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

APPENDIX E.—TABLE I.

RETURN, by Districts, of COMPLAINTS made to Officers of the FISHERY BOARD, and Investigated and Reported on by them, of Injuries done by Beam-Trawl Vessels or other Fishing Boats to the Boats, Nets, Lines, or Gear of Fishermen, in the Year 1889; and showing the Results in each case.

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
	EYEMOUTH DISTRICT.				
1888. Dec. 19	Damage to great lines of steam fishing boat 'Effort' of Leith, L.H. 1083, by steam trawler 'Sarah Smart' of North Shields, S.S.S. 271.	18 miles E. of St Abb's Head.	Outside.	Officer investigated case, and assessed damage at £21, 16s.	After protracted efforts to settle case, Respondents offered £8 in full of all claims, which was accepted by complainer.
1889. Mar. 18	Damage to haddock lines of boat 'Britannia' of Eyemouth, B.K. 960, by boat 'Confidence' of same port, B.K. 1191.	2 miles S.E. of Eyemouth.	Outside.	Officer investigated case, and assessed damage at £3.	Respondent offered £1 in settlement of claim, which was accepted by complainers.
Apr. 25	Damage to boat 'Iona' of Eyemouth, B.K. 1029, by collision with boat 'Trio' of same port, B.K. 870.	In Eyemouth Bay.	Inside.	Officer investigated case, found that the 'Iona' was accidentally damaged by the 'Trio.' Suggested to Master of 'Trio' that he should pay 30s. half of damage, but got no reply.	Case departed from.
Aug. 24	Damage to herring nets by fouling and retention of three buoys thereof, belonging to boat 'Summer Cloud' of Burnmouth, B.K. 842, by boat 'Good Intent' of Newton, B.K. 681.	About ½ mile off Craster.	Inside.	Officer communicated with Master of the 'Good Intent.'	Respondent denied having done the damage or retained the buoys. Case departed from.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Nov. 1	Alleged damage to haddock lines of boat 'Mary Murray' of Coldingham, B.K. 1111, by boat 'Gleaner' of Eyemouth, L.H. 75.	Off St Abb's Head.	Outside.	Officer requested to be supplied with additional particulars.	Not having got the information thus wanted, officer abandoned case.
	LEITH DISTRICT.				
Mar. 7	Alleged damage to herring-nets of boat 'Maggie Brown' of Fisherrow, L.H. 1899, by steam-liner 'Restless Wave' of Granton, G.N. 26.	4 miles N.E. of Dunbar.	Outside.	Officer investigated case by correspondence, and examination of both parties.	Found respondent not culpable, he having sustained greater loss than the complainer, by his efforts to avoid damaging complainer's nets.
May 11	Destruction of buoy-lantern and flag of steam trawler 'Shamrock' of North Shields, S.N. 1433, by fishing boat 'Iona' of Eyemouth, B.K. 1029.	18 miles E. by S. from May Island.	Outside.	Officer investigated case by correspondence, and examination of both parties.	Respondent paid claim of 18s. 6d. to complainer, through officer.
May 15	Threatening to destroy nets, &c. at sea, of boat 'Eclipse' of Newhaven, L.H. 601, by boat 'Janet' of Prestonpans, L.H. 342.	1 mile off Prestonpans.	Inside.	Officer investigated case by correspondence.	Respondent cautioned.
June 5	Destruction of skate-nets of boat 'Annie' of Cockenzie, L.H. 1031, by Fishery Board's steamer, 'Garland.'	½ mile off Cockenzie.	Inside.	Officer investigated case, by correspondence, and examination of both parties.	Respondent paid £3, 4s. to complainer, as recommended by officer.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. May 10	Destruction of lines by boat 'Lady Elcho' of Dunbar, L.H. 970, by steam-trawler 'Douglas' of Granton, G.N. 14.	5 miles N.N.E. from Dunbar.	Outside.	Officer investigated case by correspondence, and examination of both parties.	Award of £6, to complainer, which Respondent refused to pay.
Oct. 21	Alleged fouling of lines of boat 'Mine & Thine' of Fisherrow, L.H. 868, by boat 'Maggie Ross' of Fisherrow, L.H. 931.	9 miles E.N.E. from May Island.	Outside.	Officer investigated case by correspondence, and examination of both parties.	Found respondent not culpable, and dismissed complaint.
	ANSTRUTHER DISTRICT.				
Feb. 4	Damage to herring-nets of boat 'May Queen' of St Monance, K.Y. 2055, by fouling with nets of boat 'Barbara Wilson,' K.Y. 382 of same place.	South end of the May Island.	Inside.	Officer investigated case, and estimated damage at £15.	Respondent put in a counter-claim, would not agree to arbitration, and case departed from.
Feb. 5	Damage to herring-nets of boat 'Express' of Cellardyke, K.Y. 2050, by lines of boat 'John and Agnes' of St Monance, K.Y. 235.	3 miles off Anstruther.	Inside.	Officer investigated the case.	Respondent paid £1, 10s. to compainer, as recommended by officer.
Feb. 14	Damage to herring-nets of boat 'Andrewina' of Pittenweem, K.Y. 1509, by foreign schooner said to be named 'Fremad.'	2 miles off Anstruther.	Inside.	Officer investigated the case, found damage to amount of 20s., and tried to find the vessel.	No trace of vessel could be got, and the case was departed from.
May 15	Damage to lines of boat 'Bon Accord' of St Monance' K.Y. 54, by boat 'Champion of Eyemouth,' B.K. 57.	35 miles E. of St Abb's Head.	Outside.	Officer investigated case by corpondence.	Found fouling unavoidable, damage trifling, and charge departed from.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Dec. 20	Damage to lines of boat 'Bonito' of Cellardyke, K.Y. 1871, by steam trawler 'Earl of Windsor,' North Shields, S.N. 34.	6 miles E. of Bell Rock.	Outside.	Officer investigated case, and assessed damage at £7, 10s.	Respondent offered £6 which complainer accepted. Money paid through officer.
	DISTRICT OF STONEHAVEN.				
Feb. 14	Damage by cutting, to fouled lines of boat 'Formidable' of Stonehaven, A. 634, by boat 'Proud Maid' of same place, A. 258.	4 miles E.S.E. from Stonehaven.	Outside.	Officer investigated case.	Complainer found in fault for setting lines foul.
Sept. 5	Alleged carrying away lines of boat 'Vine' of Stonehaven, A. 331, by steam-trawler 'Royal Saxon' of Aberdeen, A. 621.	4 miles off Dunotter Castle.	Outside.	Officer investigated case.	Found not proven.
Dec. 27	Alleged damage to lines of boat 'Isabella' of Stonehaven, A. 41, by boat 'Vigilant' of same place, A. 235.	2 miles S.E. of Stonehaven.	Inside.	Officer investigated case.	No proof of offence against respondent.
	ABERDEEN DISTRICT.				
Feb. 20	Refusal to give up lines lost at sea of boat 'Scarf' of Torry, A. 103, by boat 'Glad Tidings' of Collieston, A. 193.	5 to 6 miles off Collieston.	Outside.	Officer investigated case by correspondence.	Settled by lines being returned by rail to complainers.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. May 10	Carrying away lines of boat 'Onward' of Aberdeen, A. 47, by steam trawler 'Royal Saxon,' A. 361 of same place.	About 48 miles E.S.E. from Girdleness.	Outside.	Officer investigated case, and assessed damage at £6.	Settled by respondent paying the £6 awarded by officer.
May 10	Carrying lines of steam-fishing boat 'Young Donald' of Sunderland, S.D. 326, by steam trawlers 'William Dodds' of North Shields, S.N. 1493, the 'Victory' of same place, S.N. 1407, and the 'Royal Saxon' of Aberdeen, A. 361.	About 48 miles E.S.E. from Girdleness.	Outside.	Officer investigated case, and suggested an amicable arrangement between the parties.	Respondents mutually agree to pay £35, which complainers accepted.
May 22	Damage to fishing boat 'Pink' of Skateraw, A. 102, by S.S. 'Otto M'Combie' of Glasgow.	About 7 miles off Aberdeen.	Outside.	Officer wrote to owners of 'Otto M'Combie.'	Settled.
Oct. 17	Alleged carrying away buoy, buoy-rope, and part of line of boat 'Good Design' of Aberdeen, A. 312, by steam-line fishing boat 'Merlin' of Granton, G.N. 7.	About 6 miles off Aberdeen.	Outside.	Officer investigated case.	Found not proven.
Dec. 3.	Carrying away great-line of steam-fishing boat 'Puffin' of Granton, G.N. 15, by steam trawler 'William Findlay' of North Shields, S.N. 1459.	About 23 miles S.S.E. from Girdleness.	Outside.	Officer investigated case.	Settled by respondent supplying new line.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
	PETERHEAD DISTRICT.				
1889. July 31	Alleged damage to nets of boat 'Success' of Boddam, P.D. 62, by boat 'Express' of Collieston, P.D. 799.	About 5 miles S.S.E. from Buchanness.	Outside.	Officer investigated case.	Found not proven.
Aug. 14	Alleged damage to nets of boat 'Ruby' of Peterhead, P.D. 538, by boat 'Active' of Collieston, P.D. 386.	About 2½ miles from land, off Peterhead.	Inside.	Officer investigated case by hearing both parties.	Found not proven.
Aug. 20	Damage to boat 'Margaret Anderson' of St Andrews, D.E. 300, by boat 'Active' of Buchanhaven, P.D. 59.	Peterhead Harbour.	Inside.	Officer investigated case by hearing both parties.	Respondent paid £4, 19s. 6d. to complainer.
Aug. 27	Alleged damage to nets of boat 'Prince of Wales' of Peterhead, P.D. 616, by boat 'Young Helen' of Leith, L.H. 1035.	7 to 8 miles off Rattray Head.	Outside.	Officer investigated case by hearing both parties.	Nets about equally damaged, and damage by fouling unavoidable.
Oct. 15	Damage to lines of boat 'Palm Tree' of Peterhead, P.D. 187, by steam trawler 'Stephenson' of North Shields, S.N. 8.	About 5 miles off Bullers of Buchan.	Outside.	Investigated complaint, and corresponded with trawler. Assessed damage at £6.	Respondent offered £5 in full of claim, which was accepted by complainer.
Dec. 15	Alleged cutting of lines of boat 'Christina' of Boddam, P.D. 414, by boat 'Elspit' of Burnhaven, P.D. 1030.	A short distance off Boddam.	Inside.	Investigated complaint by hearing both parties.	Found not proven.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
	BANFF DISTRICT.				
1881. Mar. 18	Carrying away lines of boat 'Dewdrop' of Macduff, B.F. 94, by boat 'Stag' of Banff, B.F. 913.	15 miles N. of Banff.	Outside.	Officer investigated case, and assessed loss of fish at £1.	Respondent returned lines to complainers who accepted £1 awarded by officer.
Aug. 10	Damage to nets of boat 'Margarets' of Macduff, B.F. 246, by crab creels set on drift-net fishing ground by Macduff crab fishers.	$\frac{3}{4}$ of a mile N.E. of Macduff.	Inside.	Officer investigated case, and assessed damage at £3, 15s.	Complainers accepted nets in lieu of money.
Dec. 2	Carrying away buoy and lines of boat 'Rising Sun' of Banff, B.F. 769, by boat 'Anns' of Sandend, B.F. 367.	12 miles N.E. of Portsoy.	Outside.	Officer investigated case.	Respondent denies liability. Case still pending.
	BUCKIE DISTRICT.				
Jan. 29	Alleged damage to nets, buoys, &c., of boat 'Freedom' of Portessie, B.F. 663, by steam trawler 'Scottish Maid' of Aberdeen, A. 301.	$4\frac{1}{2}$ miles off Clyth Head.	Outside.	Officer investigated case, and assessed damage at £42, 16s.	Found not proven.
Feb. 14	Damage to lines, buoys, &c., of boat 'Burd' of Buckie, B.F. 242, by steam trawler 'Rosa' of Montrose, M.E., 660.	4 miles off Lybster.	Outside.	Officer investigated case, and assessed damage at £12, 10s.	Respondent offered £5, 10s. in full of claim, which was accepted by complainers.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Feb. 20	Damage to lines, buoys, &c., of boat 'Jessie Alice' of Findochty, B.F. 694, by the steam trawler 'Rosa' of Montrose, M.E. 660.	8 miles off Clythness.	Outside.	Officer investigated case, and assessed damage at £11, 10s.	Respondents offered £5 in full of claim, which was accepted by complainers.
Feb. 20	Damage to lines, buoy, &c., of boat 'Exhibition' B.F. 686 of Portknockie, by steam trawler 'Powerful' of Hull, H. 1361.	10 to 12 miles off Clyth Head.	Outside.	Officer investigated case, and assessed damage at £4, 10s.	'Powerful' having gone to England immediately, the case was departed from.
Feb. 20	Damage to lines, buoys, &c., of boat 'Maggie Sutherland' of Findochty, B.F. 721, by the steam trawler 'Frank Buckland' of Sunderland, S.D. 318.	10 to 12 miles off Clythness.	Outside.	Officer investigated case, and assessed damage at £9, 18s. 4d.	Respondents offered £5 in full of claim, which was accepted by complainers.
Mar. 13	Carrying away of flag, buoy and line of boat 'Branch' of Portessie, B.F. 684, by the steam trawler 'Rosa' of Montrose, M.E. 660.	3 to 4 miles off Lybster.	Outside.	Officer investigated case, and assessed damage at £1.	Respondents offered 10s. in full of claim, which was accepted by complainers.
Mar. 14	Damage to lines, buoys, &c., of boat 'Look Sharper' of Buckie, B.F. 170, by the steam trawler of Aberdeen, A. 393.	10 to 12 miles off Lybster.	Outside.	Officer investigated case, and assessed damage at £13, 15s.	Respondents offered £6 in full of claim, which was accepted by complainer.
Mar. 18	Damage to lines, buoy, &c., of boat 'Jessie Ann' of Buckie, B.F. 813, by the steam trawler 'Dalhousie' of Scarborough, S.H. 72.	37 miles N.E. from Buckie.	Outside.	Officer investigated case, and assessed damage at £3, 2s.	Respondents offered £2 in full of claim, which was accepted by complainers.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
	FINDHORN DISTRICT.				
1889. Jan. 12	Damage to nets of boat 'Cetewayo' of Lossiemouth, I.N.S. 358, by steam trawler 'Andrew Bain,' North Shields, S.N. 1496.	4 miles off Portskerra.	Outside.	Officer investigated case, and assessed damage at £25.	Case tried before sheriff in Elgin. Respondent fined £5, and complainer awarded £22 for damage.
Feb. 6	Damage to lines of boat 'Lilie' of Hopeman, I.N.S. 846, by steam trawler 'Bosphorus' of South Shields, S.S.S. 278.	4 miles off Dunbeath.	Outside.	Officer investigated case, and assessed damage at £6, 10s.	Respondent offered £4 in full of claim, which was accepted by complainers.
Feb. 8	Alleged damage to nets of boat 'Shannon' of Lossiemouth, I.N.S. 41, by boat 'Dexterous' of Burghhead, I.N.S. 2890.	6 miles off Ordness.	Outside.	Officer investigated case.	Damage unavoidable, and case departed from.
Feb. 20	Alleged damage to lines of boat 'Vintage' of Lossiemouth, I.N.S. 1892, by steam trawler 'Prince Consort' of North Shields, S.N. 37.	4 miles off Clyth Ness.	Outside.	Officer investigated case, and assessed damage at £4.	Respondent denied liability, and case departed from.
	HELMSDALE DISTRICT.				
Aug. 15	Damage to rudder of boat 'Caroline' of Golspie, W.K. 1311, by boat 'Isabella' of Embo, W.K. 1281.	Entrance to Helmsdale Harbour.	Inside.	Officer investigated case.	Respondent supplied wood for a new rudder.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Aug. 16	Alleged cutting of nets of boat 'Spartan' of Embo, W.K., 28, by boat 'Jean' of Embo, W.K. 1067.	6 miles off Helmsdale.	Outside.	Officer investigated case.	Found not proven.
Aug. 22	Alleged damage to nets of boat 'May Duchess of Sutherland' of Wick, W.K. 263, by boat 'Friendship' of Portgower, W.K. 1213.	4 miles E. of Helmsdale.	Outside.	Officer investigated case, and assessed damage at £2, 10s.	Case still pending.
	LYBSTER DISTRICT.				
Feb. 21	Damage to lines of boat 'Pride o' the Morning' of Forse, W.K. 1775, by steam trawler 'Bosphorus' of South Shields, S.S.S. 278.	6 miles or so off Clyth Head.	Outside.	Officer investigatd case, and assessed damage at £3.	Respondent offered £2 in full of claim, but finally £3, was recovered through Procurator-Fiscal, Wick, and remitted through officer to complainers.
Feb. 21.	Alleged damage to lines of boat 'Victory' of Lybster, W.K. 453, by steam trawler 'Lady Tredegar' of Newport, S.S.S. 278.	5 or 6 miles or so off Clyth Head.	Outside.	Officer investigated case, and assessed damage at £3.	Respondent denied liability, and complainers would not prosecute.
	WICK DISTRICT.				
Jan. 2	Carrying away three lines of boat 'Brothers of Thurso,' W.K. 1930, by steam trawler 'Mare' of Montrose, M.E. 650.	$2\frac{1}{2}$ miles off Sandside.	Inside.	Officer investigated case, and assessed damage at £3.	Respondent paid £3 to complainer, as recommended by officer.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Feb. 15	Damage to nets of boat 'Warsprite' of Wick, W.K. 958, by boat 'Farmers Boy' of Portessie, B.F. 599.	2 miles off Wick.	Inside.	Officer investigated case, and assessed damage at £14.	Respondent offered £10 in full of claim, which was accepted by complainer.
Feb. 20	Carrying away lines of boat 'Crusader' of Wick, W.K. 159, by boat 'Kate' of Staxigoe, W.K. 273.	3 miles off Wick.	Inside.	Officer investigated case, and assessed damage at £2.	Settled by respondent returning missing lines to complainer.
Feb. 20	Carrying away lines of boat 'Crusader' of Wick, W.K. 159, by boat 'Nellie Jane' of Bosthaven, W.K. 196.	3 miles off Wick.	Inside.	Officer investigated case, and assessed damage at £3.	Settled by respondent returning missing lines to complainer.
Mar. 1	Carrying away nets and swing rope of boat 'Princes of Thule,' W.K., 1353, by Schooner 'Redtail' of Runcurn.	8 miles off Strathy.	Outside.	Officer investigated case, and assessed damage at £13, 5s.	Respondent returned swing rope, but denied further liability, and case departed from.
Mar. 14	Carrying away lines and fish from boat 'Alice Christina' of Wick, W.K. 444, by steam trawler 'St Clement' of Aberdeen, A. 70.	6 miles off Wick.	Outside.	Officer investigated case, and assessed damage at £8, 10s.	Respondent offered £3 in full of claim, which was accepted by complainers.
Mar. 15	Damage to lines and buoys of boat 'Onward' of Wick, W.K. 920, by steam trawler 'Gannet' of Granton, G.N. 9.	7 miles off Wick.	Outside.	Officer investigated case, and assessed damage at £2, 10s.	Respondent denied liability, and case departed from.
Mar. 16	Damage to lines, &c. of boat 'Nicoline' of Wick, W.K. 946, by steam trawler 'Royal Saxon' of Aberdeen, A. 621.	10 miles off Wick.	Outside.	Officer investigated case, and assessed damage at £7, 10s.	Respondent denied liability, and case departed from.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Mar. 16	Damage to lines, &c., of boat 'Orient' of Wick, W.K. 1322, by steam trawler 'Maggie Walker' of Aberdeen, A. 259.	6 miles off Scarlet Head.	Outside.	Officer investigated case, and assessed damage at £10.	Respondent denied liability, case put into the hands of a solicitor, but no settlement come to.
July 25	Damage to boat 'Sunbeam' of Stornoway, S.Y. 633, by Schooner 'Lizzie' of Wick.	Wick Bay.	Inside.	Officer investigated case, and assessed damage at £1.	Respondent offered 15s. in full of claim, which was accepted by complainers.
July 27	Damage to boat 'Nancy' of Flotta, Orkney, K. 132, by schooner 'Margaretha' of Hanover.	Wick Bay.	Inside.	Officer investigated case, and assessed damage at £6, 15s.	Case put into the hands of the German Consul who failed to settle it.
Aug. 1	Damage to nets of boat 'Harriet and Helen' of Wick, W.K. 160, by boat 'Meg,' Nybster, W.K. 305.	4 miles off Nosshead.	Outside.	Officer investigated case, and estimated damage at 30s.	Found respondent liable for 15s., which sum was accepted by complainers.
Aug. 28	Damage to boat and nets of 'Victory' of Wick, W.K. 665, by boat 'Vigilant' of Wick, W.K. 853.	1 mile off Scarlet.	Inside.	Officer investigated case, and estimated damage at £18.	Found respondent liable for £6, one-third of damage, which sum was accepted by complainers.
	ORKNEY DISTRICT.				
July 31	Damage to nets and buoys of boat 'Cathrine' of Deerness, K. 246, by boat 'Jasper' of Stronsay, K. 299.	10 miles off Stronsay.	Outside.	Officer investigated case and assessed damage at 12s.	Respondents paid 12s. to complainer, as recommended by officer.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Aug. 28	Damage to nets of boat 'Emerald' of Deerness, K. 113, by boat 'Saxon' of St Margaret's Hope, K. 130.	6 miles off Stronsay.	Outside.	Officer investigated case, and assessed damage at £6.	Respondents paid £6 to complainer, as recommended by officer.
Oct. 11	Damage to fishing lines of boat 'Alice R.' of Kirkwall, by steam trawler 'Snowdrop' of Dundee, fishing from Aberdeen.	Within 3 miles off Deerness.	Inside.	Tried before Sheriff at Kirkwall.	Respondent fined £10 or 30 days imprisonment.
	ROTHESAY DISTRICT.				
June 14	Alleged damage to nets of boat 'Siren' of Rothesay, R. O. 31, by boat 'Sisters' of St Ninians, G. K. 4672.	3 miles off shore, between Bute and Arran.	Inside.	Parties brought together, and refused to agree to arbitration.	Case heard before Sheriff, and found not proven.
	BALLANTRAE DISTRICT.				
Aug. 2	Alleged damage to two trains of Turbot nets of boat 'Jane' of Girvan, left unattended on 2nd August, to be fished on 9th and 12th, by steam trawler 'Conquest' of Alloa.	$3\frac{1}{2}$ miles off Girvan.	Outside.	Officer investigated case, damage estimated at £10.	Respondent denied liability, and refused to pay damages. Case departed from.

APPENDIX E.—TABLE I.—*continued.*

Date of Offence.	Nature of Complaint.	Locality, and Distance from Shore.	Whether Inside or Outside Territorial Waters.	Steps taken.	Results.
1889. Aug. 2	Alleged damage to two trains of turbot nets of boat 'Margaret' of Girvan, A.R. 100, left unattended on 2nd August, to be fished on 9th and 12th, by steam trawler 'Conquest' of Alloa.	Between Girvan and Turnberry Point.	Outside.	Officer investigated case, damage estimated at £28.	Respondent denied liability and refused to pay damages. Case departed from.
	'VIGILANT' CRUISER.				
Jan. 14	Alleged cutting of nets, S.R. 24 v. A.D. 93.	Off Ballantrae.	Inside.	Commander investigated case.	Complaint unfounded.
June 16	Herring nets stolen from several boats.	Off Tiumpan Head.	Outside.	Commander investigated case at Stornoway, where nets supposed to have been taken.	No trace of nets.
June 22	Collision, S.Y. 297 v. B.F. 845.	Off Bayble Head.	Inside.	Commander investigated case.	Compensation paid to complainer.
June 27	Collision, W.K. 954 v. S.Y. 629.	Off Stornoway.	Inside.	Complainer's evidence taken.	Not known.
June 29	Collision, B.F. 879 v. S.S. 'Labua.'	Off Chicken Head.	Inside.	Commander communicated with master of steamer.	Master denied liability. Case unsettled when 'Vigilant' left that part of coast.
	H.M.S. 'JACKAL.'				
1888. June –	Damage to stem of boat I.N.S. 215, by boat B.F. 465.	Castlebay, Barra.	Inside.	Commander investigated case.	Complainer awarded 25s. damages.
1889. May 21	Damage to mizen-boom of boat I.N.S., 2868, by boat B.F. 1258.	Castlebay, Barra.	Inside.	Commander investigated case.	Complainer awarded 20s. damages or otherwise that respondent put a new boom in boat I.N.S. 2868.
Sept. 5	Collision, A. 9 v. I.N.S. 901.	Entering Aberdeen.	Inside.	Commander investigated case.	Decided in favour of boat I.N.S. 901.
Sept. 10	Alleged destruction of nets of boat A. 76, by boat A. 62.	10 miles off Aberdeen.	Outside.	Commander investigated case.	Found not proven.

APPENDIX E.—TABLE II.

RETURN OF PROSECUTIONS against BEAM TRAWL VESSELS in the Year 1889, for Alleged Infringement of the Bye-Laws of the Fishery Board, or the Provisions of the Herring Fishery (Scotland) Act, 1889, Prohibiting Beam Trawling within certain Waters round the Coasts of Scotland, and showing the Result in each Case.

Date of Alleged Offence.	Name of Accused, &c.	Nature of Alleged Offence, and where committed.	Place and Mode of Trial.	Result of Trial.
1889.				
Sept. 17	John Thomson, master of steam trawler No. 6 of Granton.	Beam trawling, in contravention of Herring Fishery (Scotland) Act, 1889, about a mile from shore, off Brander Point, Berwickshire.	At Duns, before Sheriff, summarily.	Found not proven.
Jan. 27	Olaf Stromborg, master of steam trawler 'Malta' of Granton, G. N. 17.	Beam trawling, in contravention of Bye-Law No. 3, in the Firth of Forth, 1300 yards to the west of a straight line drawn from Tantallon Castle to the Lighthouse on the Isle of May, and thence to Fifeness.	At Edinburgh, before Sheriff, summarily.	Found not proven.
May 2	Charles Peach, mate of steam trawler 'Black Prince,' South Shields.	Beam trawling, in contravention of Bye-Law No. 3, in St Andrews Bay.	At Cupar, before Sheriff, summarily.	Fined £10, or 60 days imprisonment.
Sept. 20	Frederick Holder, head fisherman steam trawler 'Kingfisher.'	Beam trawling, in contravention of Bye-Law No. 3, in St Andrews Bay.	At Cupar, before Sheriff, summarily.	Fined £10, or 60 days imprisonment.
Sept. 13	William Lewis, master of steam trawler 'Albatross' of Leith.	Beam trawling, in contravention of Bye-Law No. 3, in St Andrews Bay.	At Cupar, before Sheriff, summarily.	Fined £10, or 60 days imprisonment. Carried to the Justiciary Appeal Court on 6th March, conviction quashed, fine repaid, and Appellant awarded £7, 7s. expenses.

APPENDIX E.—TABLE II.—*continued.*

Date of Alleged Offence.	Name of Accused, &c.	Nature of Alleged Offence, and where committed.	Place and Mode of Trial.	Result of Trial.
1889. Sept. 26	Henry Rae, master of steam trawler 'Royal Norman,' C. F. 69.	Beam trawling, in contravention of Herring Fishery (Scotland) Act, 1889, about $1\frac{1}{2}$ mile S. E. from Scurdyness, Forfarshire.	At Forfar, before Sheriff, summarily.	Found not proven.
Sept. 26	Frederick Powderhall, master of Aberdeen steam trawler.	Beam trawling about 1 mile S. E. from Usan Village, Forfarshire.	At Forfar, before Sheriff, summarily.	Fined £5.
Sept. 27	Frederick Powderhall, master of Aberdeen steam trawler.	Beam trawling about $2\frac{1}{2}$ miles E. from Scurdyness, Forfarshire.	At Forfar, before Sheriff, summarily.	Found not proven.
July 8	Luke Fiddler, master of steam trawler 'Coast Guard.'	Beam trawling, in contravention of Bye-Laws, about $1\frac{1}{2}$ mile from shore, off Slains, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Fined £10, or 30 days imprisonment.
July 12	Luke Fiddler, master of steam trawler 'Coast Guard.'	Beam trawling about 2 miles from shore, off Belhelvie, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Fined £10, or 30 days imprisonment.
July 15	John G. Farrer, master of steam trawler 'Royal Saxon' of Aberdeen, A. 361.	Beam trawling about $1\frac{1}{2}$ mile from shore, off Donmouth, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Fined £10, or 30 days imprisonment.
July 18	Horace Girdlestone, master of the steam trawler 'Snowdrop' of Dundee.	Beam trawling about $1\frac{1}{2}$ mile from shore, off Belhelvie, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Found not proven.
July 22	Charles W. Black, master of the 'Stephenson,' S. N. 8.	Beam trawling about 2 miles from shore, off Belhelvie, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Found not proven.
Aug. 29	Robert Davidson, master of steam trawler 'Royal Saxon' of Aberdeen, A. 361.	Beam trawling about $1\frac{1}{2}$ mile from shore, off Dunnottar, Kincardineshire.	At Aberdeen, before Sheriff, summarily.	Fined £10, or 30 days imprisonment.
Sept. 12	Luke Fiddler, master of the steam trawler 'Coast Guard' of Aberdeen, A. 619.	Beam trawling about $\frac{1}{2}$ mile from shore, off Newburgh, Aberdeenshire.	At Aberdeen, before Sheriff, summarily.	Found not proven.
May 8	Alexander Main, master of steam trawler 'Bonito' of Aberdeen, No. 93.	Beam trawling, in contravention of Herring Fishery (Scotland) Act, 1889, within 3 miles from shore, off Findhorn.	At Elgin, before Sheriff, summarily.	Fined £10, or 21 days imprisonment.

APPENDIX E.—TABLE II.—*continued.*

Date of Alleged Offence.	Name of Accused, &c.	Nature of Alleged Offence, and where committed.	Place and Mode of Trial.	Result of Trial.
1889. May 14	William Potter, master of steam trawler 'Premier' of North Shields, No. 56.	Beam trawling within 3 miles from shore, to the west of mouth of the River Findhorn.	At Elgin, before Sheriff, summarily.	Fined £10, or 21 days imprisonment.
June 8	Albert Baldwin, master of steam trawler 'North Star' of Aberdeen, No. 393.	Beam trawling within 3 miles from shore, to the west of mouth of the River Findhorn.	At Elgin, before Sheriff, summarily.	Fined £10, or 21 days imprisonment.
Aug. 19	Horace Girdlestone, master of steam trawler 'Snowdrop' of Dundee.	Beam trawling within 3 miles from shore, in Deer Sound, Orkney.	At Kirkwall, before Sheriff, summarily.	Fined £2, or 14 days imprisonment.
Aug. 19	Thomas Bond, master of steam trawler 'Dewdrop' of Dundee.	Beam trawling within 3 miles from shore, in Deer Sound, Orkney.	At Kirkwall, before Sheriff, summarily.	Fined £2, or 14 days imprisonment.
Aug. 19	John Bond, master of steam trawler 'Gannet' of Granton.	Beam trawling within 3 miles from shore, in Deer Sound, Orkney.	At Kirkwall, before Sheriff, summarily.	Fined £2, or 14 days imprisonment.
Dec. 17	Wallis Warman, master of the steam trawler 'Scottish Queen' of Aberdeen, No. 384.	Beam trawling within 3 miles from shore, in Deer Sound, Orkney.	At Kirkwall, before Sheriff, summarily.	Found not proven.
Dec. 23	James Ross, master of steam trawler 'St Fontin,' 392, of Aberdeen.	Beam trawling in North Sound, between the Islands of Sanday and Papa Westray.	At Kirkwall, before Sheriff, summarily.	Fined £3, or 21 days imprisonment.
Aug. 7	John Moss, master of steam trawler 'Conquest' of Alloa.	Beam trawling in North Bay, off Girvan.	At Ayr, before Sheriff, summarily.	Fined £2, paid into Court.

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

DUGALD GRAHAM, *Secretary.*

APPENDIX F.

HARBOUR WORKS AND TELEGRAPHIC EXTENSION.—ACCOUNT of RECEIPT and EXPENDITURE by the Fishery Board for Scotland, for Building and Repairing PIERS and HARBOURS, and for TELEGRAPHIC EXTENSION to Remote Fishery Districts in Scotland in the year 1889.

Dr.

1888. Dec. 31.	To Balance			£25,034 1 11
1889.	**PARLIAMENTARY GRANTS.**			
Mar. 30.	To Parliamentary Grants for Piers or Quays (5 Geo. IV. cap. 64), year ending 31st March 1889,		£3000 0 0	
" "	" Parliamentary Grant for Piers or Quays and Telegraphic Extension (*ex* Herring Brand fees, 1887):—			
	For Piers or Quays,	£150 0 0		
	" Telegraphic Extension,	1500 0 0		
			1650 0 0	
				4650 0 0
	BANK INTEREST.			
May 31.	" Bank Interest on Piers or Quays Deposit Account at Exchequer, year ended 31st March 1889,			201 17 10
	PIERS AND HARBOURS.			
	Portnacon Pier, Loch Erriboll, Sutherlandshire.			
April 8.	" Contribution from His Grace the Duke of Sutherland, towards erection of a new Pier at Portnacon,			300 0 0
	Carried over			£30,185 19 9

Cr.

1889.	**PIERS AND HARBOURS.**			
	Portknockie Harbour, Banffshire.			
Dec. 31.	By Payments for the harbour works at Portknockie during the year ended this date viz.:—			
	Works,		£3523 0 0	
	Engineer's fees,		100 0 0	
	Inspector's wages,		164 6 6	
				£3787 6 6
	Broadford Harbour, Island of Skye.			
Jan. 28.	" Payment for Lord M'Donald's rights and interests in the Harbours of Broadford and Corry, and adjacent foreshores,		500 0 0	
Dec. 31.	" Payments for the Harbour Works at Broadford during the year ended this date, viz.:—			
	Works,	£700 0 0		
	Inspector's wages, &c.,	133 17 6		
			833 17 6	
				1333 17 6
	Coldingham Harbour, Berwickshire.			
" "	" Payments for the Harbour Works at Coldingham, during the year ended this date, viz.:—			
	Works,		740 0 0	
	Inspector's wages,		27 16 6	
				767 16 6
	Carried over			£5889 0 6

APPENDIX F.—*continued.*

	Brought over		30,185 19 9
	TELEGRAPHIC EXTENSION.		
1889.	*Lochbuie, Island of Mull.*		
May 20.	To Guarantee received from Maclaine of Lochbuie to meet his proportion of the deficit in receipts from inland messages forwarded during the yeai ended 1st May 1889, from the telegraph office established at Lochbuie, ...	£16 2 5	
	St Mary's (Holm), Burray, and St Margaret's Hope, Orkney.		
Aug. 22.	To Guarantee received from Mr J. Laughton, Blanster, St Margaret's Hope, to meet his proportion of the deficit in receipts from inland messages forwarded during the year ended 3rd August 1889, from the telegraph offices established at St Mary's, Burray, and St Margaret's Hope, .	69 17 1	£85 19 6
	Carried over		£30,271 19 3

	PIERS AND HARBOURS. Brought over .		£5889 0 6
1889.	*Portnacon Pier, Loch Erriboll, Sutherlandshire.*		
Dec. 31.	By Payments for the Pier Works at Portnacon during the year ended this date, viz.:—		
	Works, ...	1047 17 4	
	Engineer's charges and outlay, . . .	140 11 11	
	Miscellaneous, ...	11 10 9	
			1200 0 0
			£7089 0 6
	TELEGRAPHIC EXTENSION.		
	Lochbuie, Island of Mull.		
May 14.	By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 1st May 1889, from the telegraph office established at Lochbuie, . . .	£32 4 9	
	St Mary's (Holm), Burray, and St Margaret's Hope, Orkney.		
Aug. 14.	By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 3rd August 1889, from the telegraph offices established at St Mary's (Holm), Burray, and St Margaret's Hope, ...	209 11 2	
	Achiltibuie, Ross-shire.		
Aug. 19.	,, Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 7th August 1889, from the telegraph office established at Achiltibuie, . .	105 19 10	
	Carried over	£347 15 9	£7089 0 6

	Brought over			£30,271 19 3
	Lochranza and Pirnmill, Island of Arran.			
1889. Sept. 26.	To Guarantee received from His Grace the Duke of Hamilton and others, to meet their proportion of the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph offices established at Lochranza and Pirnmill, ...	£6 1 6		
	Castlebay, Barra.			
Oct. 25.	„ Guarantee received from Lady Gordon Cathcart to meet her proportion of the deficit in receipts from inland messages forwarded during the year ended 30th September 1889, from the telegraph office established at Castlebay, ...	116 8 3		
				122 9 9
	Carried over			30,394 9 0

1889.	Brought over		£347 15 9	£7089 0
	Coll and Tiree, Argyllshire.			
Sept. 12.	By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph offices established at Coll and Tiree, .	£458 7 7		
	Durness, Sutherlandshire.			
Sept. 13.	„ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph office established at Durness, . .	220 10 4		
	Lochranza and Pirnmill, Island of Arran.			
„ „	„ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph offices established at Lochranza and Pirnmill, ...	17 1 4		
	Brae, North Roe, and Ollaberry, Shetland.			
„ „	„ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 27th August 1889, from the telegraph offices established at Brae, North Roe, and Ollaberry, ...	78 2 6		
	Carried over		£1121 17 6	£7089 0 6

APPENDIX F.—*continued.*

		Brought over		£30,394 9 0
1889.		*Ness, Lewis.*		
Nov. 1.	To	Guarantee received from Committee of Lloyds to meet their proportion of the deficit in receipts from inland messages forwarded during the year ended 2nd October 1889, from the telegraph office established at Ness, ...	£20 0 0	
		Hillswick, Shetland.		
Nov. 16.	,,	Guarantee received from Mr John Anderson, fishcurer, Hillswick, to meet his proportion of the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph station established at Hillswick,	27 14 3	
				47 14 3
		Brought over .		30,442 3 3

		Brought over	£1121 17 6	£7089 0 6
1889.		*Hillswick, Shetland*		
Sept. 13.	By	Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 28th August 1889, from the telegraph office established at Hillswick, . .	£83 2 8	
		Walls and Reawick, Shetland.		
Sept. 23.	,,	Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 9th September 1889, from the telegraph offices established at Walls and Reawick,	145 15 10	
		Castlebay, Barra.		
Oct. 14.	,,	Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 30th September 1889, from the telegraph office established at Castlebay, . .	643 0 0	
		Portnaguran and Gress, Lewis.		
,, ,,	,,	Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 2nd October 1889, from the telegraph offices established at Portnaguran and Gress, ...	135 15 10	
		Carried over	£2129 11 10	£7089 0 6

Brought over	£30,442 3 3		Brought over	£2129 11 10	£7089 0 6
			Ness, Lewis.		
		Oct. 25.	By Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 2nd October 1889, from the telegraph office established at Ness, ...	£217 5 9	
			Arisaig, Inverness-shire.		
		Nov. 25.	„ Guarantee paid to H.M. Postmaster General to meet the deficit in receipts from inland messages forwarded during the year ended 13th November 1889, from the telegraph office established at Arisaig, . . .	188 6 5	
					2535 4 0
					9624 4 6
		Dec. 31.	By Balance at this date, ...		20,817 18 9
	£30,442 3 3				£30,442 3 3

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

DUGALD GRAHAM, *Secretary.*

APPENDIX G.

LOANS TO FISHERMEN.—STATEMENT showing the NUMBER of LOANS CARRIED OUT in each Crofting Fishery District, the AMOUNT PAID OVER, and the TOTAL REPAYMENTS since the Crofters Holdings (Scotland) Act, 1886, was passed, to 31st December 1889, together with the NUMBER and AMOUNT of LOANS in ARREAR.

DISTRICTS.	Total No. of Loans carried out.	Amount advanced as Loans, To 31st Dec. 1888.	Amount advanced as Loans, Total to 31st Dec. 1889.	Total Repayments to 31st Dec. 1889.	Arrears. No. of Loans.	Arrears. Amount.
		£ s. d.	£ s. d.	£ s. d.		£ s. d.
Cromarty,	2	...	303 10 0	17 8 5	1	7 12 9
Helmsdale,	8	492 0 0	1,145 0 0	122 13 8	5	65 11 10
Lybster,	6	312 0 0	907 0 0	95 3 2	2	20 11 6
Wick,	59	5,142 11 6	7,096 1 6	1,023 3 10	27	272 14 11
Orkney,	6	220 0 0	635 0 0	102 4 6	...	...
Shetland,	19	997 0 0	1,940 18 0	181 2 3	9	132 15 3
Stornoway,	73	3,038 10 9	6,526 11 9	738 13 0	31	252 3 5
Barra,	16	962 16 4	1,604 16 4	172 15 1	11	114 19 1
Ullapool,	8	647 0 0	767 9 0	85 12 11	5	71 7 11
Totals,	197	11,811 18 7	20,926 6 7	2,538 16 10	91	937 16 8

DUGALD GRAHAM, *Secretary.*

Fishery Board for Scotland,
Edinburgh, 1st May 1890.

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1890.

EIGHTH ANNUAL REPORT

OF THE

ISHERY BOARD FOR SCOTLAND,

WITH APPENDIX CONTAINING REPORT TO THE BOARD BY THE INSPECTOR OF SALMON FISHERIES.

Being for the Year 1889.

IN THREE PARTS.

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.
PART III.—SCIENTIFIC INVESTIGATIONS.

P[illegible]T II.—SALMON FISHERIES.

[illegible] to both Houses of Parliament in pursuance of Act 45 and 46 Vict., cap. 78.

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* A full Table of Contents will be found prefixed to this Report, pages 3 and 4.

EIGHTH ANNUAL REPORT.

TO THE MOST HONOURABLE

THE MARQUIS OF LOTHIAN, K.T.,

Her Majesty's Secretary for Scotland.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 1*st May* 1890.

MY LORD MARQUIS,

We, the Members of the Fishery Board for Scotland, have the honour to submit the Board's Eighth Annual Report, being for the year 1889.

The subject matter of the Report has been arranged, as was done last year, in three parts, under the following titles:—

Part I.—General Report.
Part II.—Report on Salmon Fisheries.
Part III.—Scientific Investigations.

We have the honour to be,

MY LORD MARQUIS,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEO. H. M. THOMS.
ALEXR. FORBES IRVINE.
J. R. G. MAITLAND.
J. COSSAR EWART.
JAMES JOHNSTON.
WILLIAM BOYD.
W. ANDERSON SMITH.

PART II.—REPORT ON SALMON FISHERIES.

The Salmon Fishery season of 1889 was not a successful one either for nets or rods, the season having been exceptionally dry. Only 21,101 boxes of salmon were sent to Billingsgate, the smallest number since 1880.

Salmon Fishing Season of 1889 not a successful one.

The following Table gives the number of boxes of Scotch salmon sent to Billingsgate market, in each year from 1834 to 1889, both years inclusive.

Table of Boxes of Scotch Salmon sent to Billingsgate from 1834 to 1889, both inclusive

Year.	Boxes of Scotch Salmon.	Year.	Boxes of Scotch Salmon.
1834	30,650	1862	22,796
1835	42,330	1863	24,297
1836	24,570	1864	22,603
1837	32,300	1865	19,009
1838	21,400	1866	21,725
1839	16,340	1867	23,006
1840	15,160	1868	28,020
1841	28,500	1869	20,474
1842	39,417	1870	20,648
1843	30,300	1871	23,390
1844	28,178	1872	24,404
1845	31,062	1873	30,181
1846	25,510	1874	32,180
1847	20,112	1875	20,375
1848	22,525	1876	34,655
1849	23,690	1877	28,189
1850	13,940	1878	26,465
1851	11,593	1879	13,929
1852	13,044	1880	17,457
1853	19,485	1881	23,905
1854	23,194	1882	22,968
1855	18,197	1883	35,506
1856	15,438	1884	27,219
1857	18,654	1885	30,362
1858	21,564	1886	23,407
1859	15,823	1887	26,907
1860	15,870	1888	22,857
1861	12,337	1889	21,101

During the first 7 years in the above Table, the average number of boxes of Scotch salmon sent from Scotland to Billingsgate was 26,107; during the second septennial period 29,011; during the third period ending in 1854, 18,210; from 1855 to 1861, 16,840; from 1862 to 1868, 23,065; from 1869 to 1875, 24,521; from 1876 to 1882, both inclusive, 23,938; and during the last septennial period, from 1883 to 1889, both inclusive, 26,765 boxes. The best year in the Table was 1835, when 42,330 boxes were sent to Billingsgate; and the worst was 1851, when only 11,593 boxes were sent; thus showing a difference of no less than 30,737 boxes between the best year and the worst.

If we take the value of the 21,101 boxes of Scotch salmon sent to Billingsgate in 1889, at the moderate valuation of £110,780, and add to this the same sum as the value of the salmon consumed in Scotland, and sent from Scotland elsewhere than to London, we get £221,560 as the value of the Scotch Salmon Fisheries for 1889.

Alteration of close time applicable to the Tay.

In the Inspector of Salmon Fisheries first Report to the Board in 1883, a return to the old close time of the Tay, previously to the passing of Home Drummond's Act in 1828, was strongly advocated for various reasons, and, in particular, because it would be likely to abate the poaching prevalent at Newburgh and other places on the river. This alteration has now been carried out by Order under the Secretary for Scotland's hand, dated 15th May 1888, so that the Tay now belongs to the largest group of Scotch Salmon Rivers whose close time is from 27th August to 10th February, both days inclusive. There is good authority for stating that the 6 days added to the netting season by this alteration have already had some effect in diminishing poaching.

Rental of the Tay Salmon Fisheries.

For the 2 last years there has been a falling off in the rental of the salmon fishings in the Tay, the chief salmon river in Scotland. The following is a statement of the rental from 1883 to 1889, both years inclusive:—

1883,	£17,773	2	0
1884,	19,655	14	5
1885,	20,417	0	2
1886,	22,542	2	8
1887,	22,143	16	7
1888,	19,655	0	0
1889,	17,731	0	8

This shows a falling off in the rental of 1888, as compared with 1887, of £2,488, 16s. 7d., and in that of 1889, as compared with 1888, of £1924. It is anticipated that the rental for 1890 will be about the same as that for 1889. The decrease has been almost entirely in the fishings between the mouth of the Earn and Perth, or what is known as the 'mid-water.'

In 1889, 261 salmon weighing 4925 lbs., or an average of 18 lb. 14 oz. each, were taken by the rod in Loch Tay—certainly the finest salmon loch in the United Kingdom, taking into consideration the number and size of the fish combined.

Salmon Fishings in Loch Tay.

The following are the results of the salmon fishings in Loch Tay for the last 7 years:—

Year.	No. of Fish.	Weight in lbs.	Average Weight.
1883	461	9679	19 lbs. 11 oz.
1884	240	4710	19 " 10 "
1885	398	8167	20 " 8 "
1886	379	7652	20 " 3 "
1887	227	4385	19 " 5 "
1888	378	7006	18 " 8 "
1889	261	4925	18 " 14 "

On studying the above Table it will be seen that, though there is a great difference in the number of fish caught annually during the 7 years—the most productive year, 1883, yielding more than twice as many salmon as 1887, the least productive—there is wonderfully little variation in the average weight, only 1 lb. between the heaviest and the lightest year—the average for the whole 7 years giving the remarkable weight of 19 lbs. 10 ozs. for each salmon.

Illicit traffic in Salmon.

In our last Report we found it necessary to advert to the illicit traffic in salmon from Scotland to English and foreign markets, and to the conferences which had taken place on the subject between Mr Young, Mr Berrington and Mr Towse, Clerk to the Fishmongers Company of London. We also pointed out what, in our opinion, is required to prevent or abate such traffic in Scotland. We are now informed that it is in contemplation to pass an Act for the purpose of putting a stop to this traffic—the said Act to embrace England, Scotland, and Ireland. Such an Act is much wanted, and if judiciously drawn up, would be of great value. We are prepared, on being called upon, to send a draft of the clauses in such an Act that should be applicable to Scotland, as it seems desirable that these clauses should be drafted in Scotland, the principles of the Scotch law relating to salmon fishings and the provisions of the Acts relating thereto being quite different from those of England and Ireland.*

Hang-nets in Rivers and Estuaries.

Of late years, hang-nets have been used in the Forth and Tay; and except on the Tweed, where they are classed among fixed engines, there is nothing to prevent any proprietor or lessee of salmon fishings using them in all the rivers in Scotland. Yet nothing seems more desirable than that their use in rivers and estuaries should be prohibited, which can be effectually done by including them in any future Salmon Fisheries Act under the category of fixed engines.

Destructiveness of Hang-nets in the Tyne.

How deadly they are in rivers, when used on a great scale, is best proved by the case of the Tyne, which falls into the sea not far from Newcastle. The hang-nets on the Tyne, in the course of a few years—as we are told in the 14th Annual Report of the English Inspectors of Salmon Fisheries—reduced the yield of that river from 129,100 fish to 21,746. They were then removed by a Bye-law of the Conservators outside the river, since which time the fisheries have improved. In the Blackwater, also, a large and important Irish salmon river which falls into the sea near Youghall, the hang-nets were rapidly ruining the river, and their removal was only procured by the Duke of Devonshire after one of the longest and most costly salmon fishery cases on record. Besides these cases, there is ample testimony as to the evil effects of hang-nets in rivers and estuaries, from those best qualified to judge. The late Mr Frank Buckland writes as follows about them:—'Even if they do not catch the fish, they frighten them and

Mr Buckland on Hang-nets.

* Since the above was written Mr Young has received a letter from Mr Berrington, Chief Inspector of Salmon Fisheries for England and Wales, dated Board of Trade, 18th April 1890, in which he writes as follows:—'It does not seem possible to do 'anything this year towards obtaining the desired amendments on the law relating 'to the illegal traffic in salmon; but the matter is not lost sight of.'

'deter them in their upward passage. Fish caught in the hang-'nets in the Tyne are not so good as those caught with other nets, 'inasmuch as they are both hanged and drowned. They struggle 'in the net till dead, and the flesh then becomes soddened with 'water. The fish caught in the whammel-nets in the Solway are, 'probably by the same rule, not so good as those caught in the 'stake and draft-nets.'

Mr Dunbar on Hang-nets.

The late Mr Dunbar, Brawl Castle, Thurso, for several years Superintendent of his Grace the Duke of Sutherland's Salmon Fisheries, agrees with and corroborates Mr Buckland's views:—'Hang-nets'—he writes, 'should be entirely abolished; they are 'the worst nets ever invented; they kill the foul as well as the 'clean fish; the fishermen cannot help it; they are blown up to 'an unnatural size by being hours dead, and they are just, like any 'drowned or strangled animal, unfit for human food.'

Mr Joseph Napier's evidence about Hang-nets.

Mr Joseph Napier, who has been Superintendent of the Forth Salmon Fisheries for 23 years, and who has had several years' experience of the working of hang-nets in the Forth, recently gave the following evidence with regard to them before the Commission on Crown Rights in Scotch Salmon Waters:—'The hang-net is a 'system which has been introduced into the Forth District within 'the last 14 or 15 years. First of all a man from Buckhaven 'started it with one net, and he was successful, and it has gone on 'increasing every year, until last year there were between 50 and '60 nets between Alloa and Kincardine. These nets are from '100 to 200 yards long. They are 9 feet deep. They are loaded 'with lead sinkers and are floated with cork floats so as to make 'them stand perpendicularly; and when 50 or 60 of these are 'stretched across a district of 5 or 6 miles, it is almost an impos-'sibility for any fish to get past them up to the upper waters. 'The fish that are caught in the hang-net are hung by the gills. 'The mesh of the net is 10 inches—that is 3 inches above the 'mesh of the sweep-net which is allowed by Act of Parliament. 'The hang-netter has thus a benefit. There is a penalty on any 'person using a net with a mesh of less than 7 inches, but there 'is no penalty attached to anyone using a net with a mesh above 7 'inches so that the hang-netter has the benefit of that and works 'accordingly. There are two men in each boat and sometimes 'there are three. Upwards of 100 men were employed last year in 'that mode of fishing. They are not regular fishermen at all. 'They are men who are employed at other work—dock labourers, 'shoemakers, blacksmiths, and others—who leave their ordinary 'work and go off to this fishing, and this in the very throng of 'the run of the salmon to the upper waters in July and August. 'They make a good thing of it. They get permission from a person 'at Dunmore who takes the fishings from the Earl of Dunmore 'and pays a small rent and lets them to all and sundry for 15s. 'a boat. These men are not regular fishermen and I regret to say 'that they are mostly of a very outrageous character. Our Board 'have been at considerable expense during last year in keeping an 'extra staff of men to put down poaching and protect the fisheries 'during the annual and weekly close times. Several very severe 'conflicts have taken place between the bailiffs and poachers, the 'end of which has been that a good many of them have been 'detected and convicted of fishing illegally during the weekly close 'time and also during the annual close time, after the fishing 'season has closed on 26th August. That is my knowledge 'of this hang-net fishing. All that the Fishery Board receives 'for protecting the fish so as to give a supply of salmon to 'upwards of 100 men during that time is some £2, 19s. a year 'from four proprietors of fishings where hang-nets are used below 'Alloa. Since these nets have been so extensively used a number 'of the fishings have been falling in rental every year. I may 'mention one very important fishing that used to let at £1100 or '£1200 and is now let at £725. Now that is a great sweep off the 'assessment for protection purposes, and undoubtedly will tell, 'because if the assessment is not kept up, it is impossible the 'watching staff can be kept up, and if it suffers the whole fishings 'will suffer. Lord Dunmore only gets £8 a year rental for all 'this great damage. There are four proprietors. Tulliallan, I 'think is let at £10. The assessment of £2, 19s., which is 10 per 'cent. represents a total rental of £30.'

It certainly does seem a monstrous thing that the lessees of the fishings of these four proprietors, who pay altogether a rental of only £30 a year, should be entitled to sublet to an unlimited number of men and boats, a right to fish for salmon with hang-nets in such a way as practically to bar the passage of the fish to the waters above; to materially reduce the value of the upper fisheries; and to cripple the income of the District Board by the utterly insignificant sum which they contribute for the protection of the river. What has happened in the Forth may happen in many other rivers in Scotland, with effects equally disastrous to the salmon fisheries.*

Mr Young's Inspection of east coast rivers.

During the summer and autumn of 1889, Mr Young, Inspector of Salmon Fisheries, inspected several of the rivers on the east coast of Scotland and met the Clerks of the Tay and Dee and Don District Boards with the view of ascertaining their opinion regarding the clauses that would be required in the event of a Bill being brought in to prevent the illicit traffic in salmon from Scotland to English and foreign markets; there being more traffic of that kind from these districts than from any other Fishery Districts in Scotland. The following clause was approved of by the Tay District Board on 4th October 1889:—Every person who, in any District of Scotland during the extension of the time for rod-fishing in force therein, sells, or offers, or exposes for sale, or, not being an owner or having the authority of an owner of fishings, has in his possession any salmon or part of a salmon, shall be liable to a penalty not exceeding £5, and to a farther penalty not exceeding £2, for every salmon or part of a salmon so sold, or offered, or exposed for sale, or found in possession; and any salmon or part of a salmon so sold, or offered, or exposed for sale, or found in posses-

* Lord Trayner, after proof taken, on the 23rd May, 1890, in the case of 'The Earl of Wemyss and Others *v.* The Earl of Zetland and Others,' assoilzied the defenders with expenses, holding that the case was ruled by the decision in the case of 'Masters of Allan's Mortification *v.* Thomson,' in which the legality of using hang-nets in the Forth was affirmed. A Reclaiming Note has, however, been lodged against this decision.

sion shall be forfeited; and the burden of proving that such salmon or part of a salmon was lawfully captured shall lie on the person selling, or offering, or exposing for sale, or having in possession such salmon or part of a salmon.

Approved by the Tay District Board.

MACKENZIE AND DICKSON, *Clerks.*

PERTH, *4th October* 1889.

The above clause is almost identical with that suggested by the Clerks to the Dee and Don District Boards. There can be little doubt that the insertion of such a clause, in any future legislative measure for regulating the exportation of salmon, would effectually put a stop to the sale of fish caught during the extension of time for rod-fishing in Scotland; which, unfortunately, though illegal in England and under the Tweed Fisheries Acts, is still legal in Scotland.

Inspection of Macdonald Fishways on the River Ericht.

The Inspector of Salmon Fisheries afterwards inspected the Macdonald Fishways on Westfield Weir and Ashbank Weir on the river Ericht, near Blairgowrie, which have been in operation for several years, in order to ascertain whether these fishways, when applied to obstructions on a rapid river, which brings down in floods quantities of gravel and other debris, will enable salmon to surmount the obstruction and reach the upper waters; or whether the tubes, on which the efficient action of the Macdonald Fishway so much depends, are liable to be choked up by the gravel swept down by the river, so that the proper and efficient action of the fishway is thereby destroyed. The result of the Inspector's examination of these Fishways was that he arrived at the conclusion that, as at present constructed, they are liable to be entirely deranged and rendered useless by the lodging in the tubes of the various substances brought down in floods by a rapid river like the Ericht. A detailed account of the Inspector's examination of the east coast rivers and of these fishways will be found in his Report to the Board, which forms the Appendix to this Report, where will also be found a Report on the Fishways by Mr Lumsden, Superintendent to the Tay District Board. The question of whether the Macdonald Fishway is, or is not, an efficient means of enabling salmon to surmount natural and artificial obstructions in salmon rivers is one of much interest and importance. Its slope is much shorter and steeper than that of any other fishway, and, in consequence, it is less costly; and so long as the tubes remain clear there is black water throughout the fishway, and salmon have no difficulty in ascending. But, when a number of the tubes cease to act, owing to their being choked up and disabled by gravel, twigs, or other rubbish brought down in floods, the black water in the fishway, owing to its steep gradient, becomes a white foaming torrent which no salmon will face.

The Report by Colonel Marshall Macdonald, the head of the United States Fisheries Commission, to the Tay District Board in 1884, as to the erection of Salmon-ladders on the Falls of Tummel and on obstructions on the river Ericht will be found in Note IV. to the Inspector's Third Annual Report to the Board.

Correspondence between the Inspector of Salmon Fisheries and Colonel Macdonald, Washington.

After inspecting the fishways on the Ericht, the Inspector wrote to Colonel Macdonald on the subject, and has since received from him a letter, accompanied by plans of an improved fishway, designed to obviate the faults which so materially interfere with the usefulness of fishways similar to those on the Ericht.*

Salmon Fishery Legislation.

Before closing our Report, we desire to direct attention to the following extract from the Seventh Report of the Inspector of Salmon Fisheries to this Board. Under the head of 'Salmon 'Fishery Law and Legislation,' the Inspector there writes as follows with reference to the Salmon Fisheries (Scotland) Consolidation and Amendment Bill, which was withdrawn in the last Session of Parliament:—'But that bill, which has now been withdrawn, was, 'to some extent, an attempt to reconcile the almost irreconcileable 'claims and interests of upper and lower proprietors; and it, there'fore, not unnaturally, excited an amount of opposition which proved 'fatal to it. But there are many provisions which would be un'questionable improvements to our Salmon Fisheries in Scotland 'about which both upper and lower proprietors are agreed. Might 'it not, therefore, be worth trying the experiment of embodying 'these in a new bill, without touching upon those matters with 'regard to which there is no chance of securing unanimity? For 'example, a bill providing for the following points would probably 'unite the suffrages of upper and lower proprietors, and would have 'a good chance of passing through Parliament. These points are 'the prohibition of the sale of salmon caught during the extension 'of time for rod-fishing; granting additional powers of search and 'seizure to water-bailiffs, &c.; provisions for District Boards remain'ing in office until their successors are appointed; for removing 'diseased fish from rivers and waters; for making obstructions in 'rivers passable for salmon; for effectually preventing the pollution 'of rivers; for prohibiting the use of the cleek for landing salmon 'until the 1st of May; for fixing minimum as well as maximum 'penalties for offences; for the prevention of 'sniggling;' for fixing 'a close time and a gauge, or both, for trout; for smolt-guards in 'the case of turbine wheels and similar engines; for giving District 'Boards additional powers to rent, lease, or purchase any salmon 'fishing, fixed engine, &c., for the benefit of the fisheries in their 'respective districts; and for conferring powers on the Fishery 'Board for Scotland to enforce the provisions of the Salmon Fishery 'Acts in those districts where there are no District Boards. Such 'a bill, it humbly seems to me, would have a fair chance of passing. 'Whereas a bill providing for lengthening the annual and weekly 'close times; for regulating and restricting the working of draft nets; 'for allowing District Boards to elect their own chairman, irrespective 'of rental; for prohibiting netting within a certain distance above 'and below dam dikes; for further regulating and restricting the 'construction and working of stake, fly, and bag nets; and for alter'ing estuary lines; would, almost certainly, be rejected.'

* For plan of this improved Fishway, see Note IX. to the Inspector's Report to the Board.

SALMON FISHERIES.

APPENDIX.

EIGHTH ANNUAL REPORT TO THE FISHERY BOARD FOR SCOTLAND.

By ARCHIBALD YOUNG, Advocate,
Inspector of Salmon Fisheries for Scotland.

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NOTES.

REPORT.

I HAVE the honour to report that, as directed by the Board, I went to Blairgowrie on the 29th of August last, accompanied by Mr Lumsden, Superintendent to the Tay District Board, in order to inspect the dams on the river Ericht above Blairgowrie Bridge, and especially those at Westfield and Ashbank where Macdonald Fishways have been put in, as I had heard that these Fishways were not acting properly in consequence of the liability of the tubes to become choked up by débris brought down by the river in floods.

Obstructions in Ericht below Macdonald Fishways.

I first inspected the Weir immediately above Blairgowrie Bridge. This presents no very formidable obstacle to the ascent of salmon as long as the cut in it is left clear and open. It is far otherwise with the dam immediately above. Here, the pass is near the left bank, not far from a plantation. The dam is about 7 feet in perpendicular height, and I very much doubt the efficiency of the pass which has been placed upon it. There is too much white water and a great wave at the bottom of it. I recommended some years ago, that the beam which runs right along the crest of the dam should either have a cut made in it or should be bevelled on the lower face so as to be on a uniform slope with the pass. I also recommended that cross pieces should be put on the pass so as to break the force of the water. In the state of the river I could not see whether or not these recommendations had been given effect to; but I was informed that they had been carried out. The pass, however, is not satisfactory, and Mr Lumsden believes that not 1 salmon in 100 that attempts it, succeeds in getting over the dam.

The Keith.

Some distance above this is the Keith, a rocky gorge of considerable length, and from 5 to 7 feet in breadth in which the whole volume of the river is imprisoned and concentrated, and through which it frets and foams in a strong, deep, rapid stream; while, at the head of this stream, there is a broken fall from 7 to 8 feet high which salmon must take after swimming the long rushing torrent below. I do not believe that they can do so; and none have ever been seen, either by Mr Lumsden or any of his men, in the river above. On the right side of the rapid, there is a sort of natural salmon-ladder in the rocks, extending from the corner of the pool just above the fall to the foot of the rapid, which by blasting and the use of the pickaxe might be made into an efficient fishway. It is a pity that Colonel Macdonald, when he inspected the obstructions on the Ericht, some years ago, did not make sure that salmon could pass the Keith and the dam immediately below it before he erected the Macdonald Fishways on the two dams higher up. At present, I very much doubt whether salmon ever succeed in reaching these fishways, though sea-trout, perhaps, may.

Macdonald Fishway at Westfield dam.

After leaving the Keith, I proceeded to Westfield dam the highest on the river. This dam is a tremendous obstruction, 13 feet perpendicular, and the intake lade draws off a perfect river of water for the use of the jute mill. The Macdonald Fishway is on the left bank close to the intake lade. When we arrived, there was but little water in the fishway, but even that little—far too little to enable fish to run up—was foaming and broken, there being white water even in the centre, where in a Macdonald Fishway in perfect working order, there should have been black and almost perfectly still water. Only four of the thirty and upwards of short tubes discharging water on to the fishway were in working order at the time of my visit; the rest were all more or less choked up with gravel and other debris brought down by the river. There were stones in the tubes varying in size from that of a man's fist to small gravel, also twigs, and branches, and other drift.

On taking out a plank that had been put in to prevent the admission of more than the very moderate quantity of water we found in the fishway, an ample stream poured down it in a white foaming torrent, so strong that when Mr Lumsden plunged a plank in it he had the greatest difficulty in holding it firm, and the water spurted from it in all directions. No fish could have looked at the water in the fishway. It would have been whirled backwards at once. The fact is that the working of the fishway depends almost entirely upon the steady and uniform acting of the water in the tubes; and if these tubes are disabled from acting, which was the case during my visit, the fishway becomes the worst of all fishways owing to its steep gradient, which, in the case of that on Westfield dam, is only four horizontal to one perpendicular. So long as the tubes are clear and act properly, the tendency of this steep gradient to produce white and broken water is counteracted, and there is black and comparatively still water in the fishway, up which a salmon can easily swim. But when the tubes are choked up, the Macdonald Fishway becomes the worst of all fishways instead of the best, so that it would seem to be unsuited for rivers which, in floods, bring down a great deal of gravel and detritus of various kinds which most of our Scotch salmon rivers do.

I observed that the bottom of the water above the dam close to the head of the fishway is entirely composed of gravel, which, in spite of the flood-guards and gratings intended to protect the fishway, seems to enter and disable the tubes whenever there is a flood. At the time of my visit, the Ericht was just beginning to fall and clear after a flood.

Macdonald Fishway at Ashbank Dam.

The other Macdonald Fishway on Ashbank dam, the dam below Westfield, was in the same unsatisfactory state as that at Westfield. Indeed, the water in it seemed even more rapid and tumultuous. Mr Lumsden informs me that no salmon have ever been seen above the Keith, and neither salmon nor sea-trout in the river above Westfield. My own impression and that of Mr Lumsden is that neither salmon nor sea-trout have been able to ascend as high as the foot of the Macdonald Fishway at Ashbank dam. But even if they were able to penetrate so far, I do not think that they would be able to ascend the fishways in the disabled condition in which they were when I inspected them.

It may possibly be said, that, except when the river is in flood, the Macdonald Fishways will work perfectly well. But fish, as a rule, do not run when a river is low, but when it is clearing and subsiding after a flood; and a fishway that is only in acting order when salmon are not running can scarcely be said to fulfil the functions of a fishway, which are to enable running fish to ascend otherwise impassable obstructions between them and the spawning grounds above. No doubt, the ability and experience and practical ingenuity of Colonel Macdonald will enable him to devise some means of overcoming these defects in his valuable fishway, so that it shall be available even in the case of rapid rivers whose beds are to a large extent composed of gravel liable to be swept down in floods.

Correspondence with Colonel Macdonald, inventor of the Fishway.

After my inspection of the Macdonald Fishways on the Ericht, I wrote to Colonel Macdonald at the United States Commission of Fish and Fisheries, Washington; and on the 11th December, I had the pleasure of receiving the following answer :—

I am greatly obliged to you for your remarks upon the Macdonald Fishways on the Ericht. I have long realised that the liability of the fishway to become obstructed by sand, stone, and other débris, was a fatal objection to its use, and have been busily engaged in modifying designs to meet difficulties that experience in using suggests. I have greatly simplified and cheapened the construction; the fishway, as now designed, will not become clogged up, nor will it be destroyed or damaged by freshets if properly constructed.

I send you a design of fishway for a type of dam much in use on our western rivers, which I have designed for the Government Engineer in charge of the improvements of Green and Barren Rivers in Kentucky, and which will be built the ensuing summer on several of the dams in those rivers. The drawings are plain enough, I think, but I also send you copy of a letter mailed to Lieutenant Sibert at the same time. I also send you another design where the fishway is carried against and parallel to the face of a vertical dam. This was intended to meet the wants of our small interior streams. You will see in both of these that the fishway is simply an inclined flume or sluice built of timber on masonry or iron. In this are set up cast-iron deflecting plates, arranged in alternating sets, which arrest a portion of the descending water, and deliver it obliquely up stream, by which it is mingled obliquely with the descending current, the velocity of which is thus controlled.

The arrangement of these is shown in *Plan of Construction* for a 24-inch way. The fishways already on the Ericht may be adapted to this plan at little cost, and, if securely covered, and the intake of water arranged as shown in plans for Green and Barren Rivers, you will not be troubled with the obstruction of the fishway by drift. I am, moreover, satisfied that covering the fishway, so as to exclude light, will, instead of interfering with the run of salmon, favour the same.

A design of fishway for the Falls of Tummel could doubtless be made, that would not show at all when completed, and which would open up all the water above the Falls to the salmon spawning. Would it not be well to modify the fishways on the Ericht as indicated, and if they prove satisfactory, then move to get the salmon over the Falls of Tummel? *

Opening up of Falls of Tummel.

With regard to the Falls of Tummel, mentioned in the concluding paragraph of Colonel Macdonald's letter, I deeply regret to have to report that the prospect of having them opened up, and the vast area of lakes and spawning ground in rivers above made accessible to salmon, seems to be as remote as ever. So far back as 1884, I made a special Report to the Fishery Board describing the 50 miles of rivers, and the 20,000 acres of lochs that would be opened up by placing an efficient salmon-ladder on the Falls; and, in their second Report to Parliament (page 62), the Board record the following resolution on the subject :—

The Board having considered the Report by Mr Young, on the opening of rivers and lochs, now closed against salmon, by the existence of such obstructions as the Falls of Tummel, the Falls of Mounessie, and the Falls on the Conon, approve of said Report; and having regard to the extensive area of spawning and angling water which would be opened in different districts in Scotland, by the removal of said obstructions, and the introduction of an efficient fishway, resolve to transmit a copy of said Report to the Secretary of State, with a request that a short Act should be brought in by the Government giving District Boards the requisite compulsory powers, subject to such control on the part of the Board, or otherwise, as may be considered just.

* For Report on the Macdonald Fishways on the Ericht, by Mr Lumsden, Superintendent to the Tay District Board, see Note X.

With reference to the above, I venture most respectfully to suggest to the Board that it would be desirable to bring this matter prominently under the notice of the Secretary for Scotland. The opening up of the Falls of Tummel would be the greatest experiment in the United Kingdom in the way of salmonising waters now destitute of salmon, and one from which we should probably derive most valuable experience. At Ballysodare, in Ireland, salmon were enabled, by skilfully constructed ladders, to surmount two waterfalls, each higher and steeper than the Falls of Tummel, and a salmon fishery was created where none had previously existed, which, a few years after the construction of the ladders, yielded 10,000 fish annually.

Under existing legislation, District Boards can only put a salmon-ladder on waterfalls by agreement with the riparian owners to whom the Falls belong. If they refuse their consent, the District Board is helpless. It has no compulsory powers. The proprietors veto on operations, which would vastly augment the value of the upper waters and increase the supply of salmon for the public, is absolute and final. There is no appeal. And it certainly seems somewhat strange and inconsistent that while in England, under the Salmon Fisheries Act of 1873, Boards of Conservators have power, under certain conditions and restrictions, to acquire compulsorily, in whole or in part, artificial obstructions to the passage of salmon, no similar power should be possessed by Scottish District Boards over natural obstructions; although, in consequence of the absence of such a power, salmon are absolutely excluded by impassable waterfalls, from about 500 miles of rivers and from many thousand acres of lochs.

The land-locked salmon.

In my last Report to the Board, I stated that I had applied to Colonel Marshall Macdonald, the head of the United States Fisheries Commission, to ascertain whether he would send over to this country a supply of impregnated ova of the land-locked salmon. He complied with my request in the handsomest and most liberal manner, and forwarded a consignment of 25,000 ova which arrived in this country with very trifling loss, and were deposited in hatching-trays at Taymouth Castle in February 1889. Since then, I have been informed that there are thousands of young fry, from 1 to 3 inches long, quite healthy and lively, in a pond which has been made for them in the park at Taymouth. It is to be hoped that these fry may be the means of introducing this game and handsome fish into some of our Scotch Lochs.

Mugiemoss Dam on the River Don.

When in Aberdeen, for the purpose of meeting the clerks to the Dee and Don District Boards on the subject of the illicit traffic in salmon, I took the opportunity of inspecting the dams on the Don, described in my first Report to the Board, and was sorry to find that none of their objectionable features have been in any way altered or improved; the dam at Mugiemoss, especially, preserving its bad eminence as being about the worst artificial obstruction in Scotland. The apron of this dam is no less than 94 feet 6 inches long—a fatal fault, as fish cannot swim so long a current of rapid water. When I first visited Mugiemoss the river was so low that I could walk across the face or apron of the dam. But when I inspected it in August last, the river was rather high, and the fish-pass on the dam was full of white foaming water, which no salmon could ascend; and then, to add to the difficulty, at the top of this foaming torrent, there is a jump of about 3 feet before the fish can reach the water above. The pass is the very last place in the dam which any ascending fish would select. On the left bank of the stream, a good many inches of black water were running over the apron of the dam, and it is here that running fish generally attempt to ascend. But, owing to the length of the apron, they are always washed back, and no heavy or gravid salmon succeed in surmounting it. On this side of the river, there is an intake lade with sluices belonging to the Messrs Crombie; and it would not be difficult or expensive to cut a passage from the dam to above the sluices through which salmon might ascend. But, undoubtedly, by far the most effectual means of doing away with the obstructive character of Mugiemoss dam would be to construct, about 20 yards below the toe of the apron of the dam, a subsidiary dam not less than 5 feet high. This salmon could easily surmount, and, after doing so, would find themselves in the pool created by the subsidiary dam which would have the effect of raising the water about half way up the long apron of the existing dam, which they would then have but little difficulty in ascending and reaching the waters above.

Number of salmon lifted over Mugiemoss Dam.

The strongest proof of the thoroughly obstructive character of Mugiemoss dam in its present state is furnished by the fact that last year the river watchers took out from the pool below it 560 salmon that were unable to surmount it, placed them in boxes and carried them up to the water above the dam; and, besides these, 400 fish were taken out, by landing nets with long handles, whilst falling back after attempting to ascend, and placed in the water above—thus making a total of 960 salmon in a single year, prevented from ascending to the upper waters to spawn by this most objectionable dam. During the previous year 660 salmon were, in like manner, taken from the pool below the dam and carried over it by the river watchers.

The Superintendent complains not only of the obstructive character of the dam at Mugiemoss, but also of the excessive quantity of water abstracted from the river by the works at Mugiemoss, at the Messrs Piries, and at the Messrs Crombies, so that when the river is low the intake lade contains a larger quantity of water than is left in the bed of the river, owing to which, in at least one case, the river-bed below the dam connected with the works is left almost perfectly dry. Another complaint connected with these works is that they inclose and entirely shut in large spaces of the banks of the river, from which the river-watchers are practically excluded. That is to say, they can only get access by applying at the doors of the works, so that if any poaching is going on inside, word may be passed along and everything made regular before the watchers enter.

River Ugie.

On the 9th of August I inspected the river Ugie, about which there is really very little to remark. It is well managed by the District Board—whose Report in answers to the printed queries will be found on pp. 23, 24, and with the exception of one or two dams which offer no great obstruction to the ascent of fish, but which might be improved by being made somewhat more water-tight than they are, there is nothing to complain of.

The river has a narrow and shifting entrance, and fixed nets may be placed within 200 yards of the mouth on either side. But there were none so close when I inspected it. I noticed some places, not far from the entrance and within tidal influence, which seemed well adapted for laying down mussels.

The South Esk.

After leaving the Ugie, I inspected the South Esk, which, in some respects, has been greatly improved since I visited it in 1883. In particular, a new pass, modelled on that on Morphie Dam on the North Esk, has been placed on the dam at Brechin Castle, formerly a most serious obstruction. Before putting in this pass the South Esk District Board went to see the Macdonald Fishways on the Ericht and did not approve of them. The new pass in the dam has been by no means an expensive one, as I was informed that it cost only about £100.

In company with Mr Don, clerk to the District Board, and the Superintendent, I inspected this pass and afterwards the highly interesting sewage farm which has been formed with the view of deodorising and utilising the pollutions from the manufactories at Brechin. The dam at Brechin Castle is a steep and lofty dike with rather a long apron particularly on the left or town bank of the river. A pass constructed about two years ago, modelled upon the excellent one at Morphie, though steeper in gradient and not widened out at the lower extremity, has been put into this dam. When I saw it, it had black water all down the centre of it, and as the river below the foot of the pass has been cleared out and deepened, salmon are said to have no difficulty in ascending it, so that the angling above should soon be greatly improved and the capabilities of the upper spawning grounds should be, at last, properly developed. The Earl of Dalhousie has a right of cruive fishing in connection with this dike, and though the space formerly occupied by the cruive-boxes has been filled up, they may again be put in on notice given. Below Brechin Dike is Eastmill Dam which does not present any insuperable obstacle to the ascent of salmon when the river is in such a state as to induce them to run. The lade connected with this mill is long, broad, and deep—quite a small river—and the tail-lade discharges into Craig Pool, near the sewage farm. The lowest weir is termed Kinnaird's Dam. This is a curved dam, and salmon should be able to take it when the river is high. The pass is not a good one, and it might have been better placed.

Sewage Farm in connection with Town of Brechin and South Esk.

After inspecting these dams, I proceeded to the sewage farm, which was quite in an infant state when I visited it six years ago. Now it is a thriving establishment, about 15 acres in extent, which is found to answer the purpose very well. When I saw it, besides grass, there were crops of mangold, splendid turnips, both yellows and swedes, cabbages, and mashley comprising beans, peas, etc. They take five or six crops of grass off the farm every year and could take more were there sufficient demand for it. The ground of this sewage farm, it should be mentioned, was originally good soil, not sandy or waste ground. There is a settling tank in one corner where the solid sewage is collected and sold. The sewage of Brechin and the refuse of two, at least, of the great mills on the river are conducted to the farm. The sewage water, after passing over and through the farm, is discharged into a deep and spacious part of the river called the Craig Pool. I am indebted to Messrs Shiell and Don, clerks to the South Esk District Board, for the following statement showing the cost of the formation of the sewage farm (£1123, 8s. 8d.), and a balance-sheet of the income and expenditure in connection with it for year ending 15th May 1889—

SEWAGE FARM (Extent about 15 Imperial Acres).

INCOME AND EXPENDITURE DURING YEAR ENDING 15TH MAY 1889.

Income.

	£	s.	d.
By amount of Receipts for Grass sold, ...	£50	8	11
,, ,, Mashley sold, ...	16	2	0
,, ,, Mangold sold, ...	8	5	0
,, ,, Turnips sold, ...	32	6	8
,, ,, Cabbage, Carrots, Peas, etc., sold, .	12	16	9
,, ,, Manure sold, ...	9	14	6
Debit Balance,	39	4	7½
	£168	18	5½

Expenditure.

To Rent.	£84	10	0
,, Taxes, ...	3	13	6½
,, Wages, ...	62	17	0
,, Horse Work, ...	11	10	11
,, Seeds and Plants, ...	5	5	0
,, Furnishings and Incidental Expenses, . . .	0	11	6
,, Crop measuring, ...	0	10	6
	£168	18	5½

EXPENSES INCURRED IN THE FORMATION OF SEWAGE FARM IN THE YEARS 1882 AND 1883.

To Sum paid to Contractor for laying out and forming Sewage Farm,	£1026	7	7
,, Sum paid to Inspector over the Works, ...	80	0	0
,, Sum paid for Erection of Tool House, ...	17	1	1
Total,	£1123	8	8

It will be observed from this balance-sheet that nothing is debited for interest on outlay; but without this there is shown to be a loss of £39, 4s. 7½d. upon the year's operations.

The following are the rentals of the fisheries in the district of the South Esk, inside and outside the estuary, for the years 1885, 1886, 1887, and 1888, kindly furnished to me by the District Board. Rentals of Fisheries in South Esk District.

RENTALS OF THE SALMON FISHERIES IN THE DISTRICT OF THE RIVER SOUTH ESK.

I. *Fisheries outside of Estuary Line.*

Names of Fisheries.	Names of Proprietors.	For Years 1885.	1886.	1887.	1888.
		£	£	£	£
Dunninald, .	Mrs Charlotte Arkley or Smyth and Mrs Elizabeth Arkley or Stansfield, Dunninald, . .	570	570	570	570
Rossie, . .	Joseph Johnston and Sons, Montrose, and James Johnston and William Douglas Johnston, individual partners of said firm,	500	575	575	575
Usan, . .	George Keith, Esq., of Usan, Montrose, ...	275	325	325	235
Lunan, . .	William Blair Imrie, Esq., of Lunan, Arbroath, . . .	150	200	200	200
Ethie Haven, . } Lunan Bay, . }	The Earl of Northesk, Lunan Bay, Arbroath, ...	184	184	184	184
Lunan Bay, .	The Earl of Dalhousie, Brechin Castle, ...	125	125	125	125
Dysart, . .	Misses Agnes, Magdalene, and Elizabeth Carnegy of Craigo, Montrose, ...	30	10	30	30
Dysart, . .	The Crown, ...	170	170	170	170
	Total, .	2004	2159	2179	2197

II. *River Fisheries inside of Estuary Line.*

Names of Fisheries.	Names of Proprietors.	For Years			
		1885.	1886.	1887.	1888.
		£	£	£	£
Brechin, etc., .	The Earl of Dalhousie, Brechin Castle, ...	20	20	20	20
Murthill, .	Thomas Wedderburn Ogilvy, Esq., of Coul, and others, .	20	20	20	20
Dun, . . .	A. J. W. H. K. Erskine, Esq., of Dun, ...	55	65	65	65
Cortachy, etc.,	The Earl of Airlie, Cortachy Castle, ...	20	20	20	20
Downiepark, .	The Earl of Airlie, Cortachy Castle, ...	20	20	20	...
Kinnaird, . .	The Earl of Southesk, Kinnaird Castle, ...	375	375	375	375
Aldbar, . .	Patrick Chalmers, Esq., Aldbar Castle, ...	20	20	20	20
Careston, . .	John Adamson, Esq., Careston Castle, ...	20	20	20	20
Finhaven, .	Charles Greenhill Gardyne, Esq., of Finhaven, ...	20	20	20	20
Clova, etc., .	Mrs Ann Sarah Ogilvy of Clova, .	20	20	20	20
Inshewan, etc.,	John Ogilvy, Esq., of Inshewan,	20	20	20	20
Rossie, . .	Joseph Jonnston & Son, . .	285	300	300	300
Usan, . .	George Keith of Usan, . .	25	25	25	25
	Total, . .	930	945	945	925
Abstract.					
1. Fisheries outside of Estuary Line,	. . . .	2004	2159	2179	2179
2. Fisheries inside of Estuary Line,	. . . .	930	945	945	925
	Total, . .	2934	3104	3124	3104

From the answers to the printed queries by the South Esk District Board, I select the following:—The take of fish has generally increased during the past seven years. It is difficult to assign the cause of the increase. 1889, however, was a bad fishing season. No information is given as to the number of fish caught in 1889. But the largest salmon caught by net and coble was 46 lbs.; by fixed nets, 46 lbs.; and by rod, 31 lbs. Protection is stated to be generally efficient. The watchers are not members of the County Constabulary force, but are employed by and subject to the District Board. Eight men, including superintendent, are generally employed in close time. There is some illegal fishing in the district. From six to eight prosecutions annually; but there were only three in 1888–9. The offences are generally taking or fishing for salmon in close time or for killing smolts.

The following is the statement with regard to the artificial obstructions in the district:—

There are three principal dams in the district, viz.:—(1) At Kinnaird, (2) East Mill, Brechin, and (3) Brechin Castle Dam for Paper Mill and East Bleachfield, Brechin. There are other minor dams at Blackiemill, Finavon, and Murthill. But the dikes in these latter are low in height and unimportant. There are no cruives. Except at Kinnaird, there are no hecks—otherwise, provisions of by-laws observed. Hecks intended to be placed at Finavon. A salmon-ladder has been recently placed in Brechin Castle Dike which answers its purpose well. All the other dikes are fairly passable without regular ladders.

With regard to natural obstructions, it is stated that:— Printed Queries.

There are no natural obstructions which prevent ascent of fish, except at Noran Falls, on a tributary of the South Esk. But the spawning grounds above these are not important. It is considered that it would be important for Boards to have compulsory powers of attaching a fish-pass to a waterfall, failing an agreement with the proprietor. Similar powers would also, be advantageous for purchasing, for removal, any dam, weir, cruive, or other fixed engines, for benefit of Fisheries. Compensation should, of course, be given to the proprietor affected, as might be fixed judicially. Proprietors of Fisheries, to extent of four-fifths in number and value, would require to approve of each purchase.

When I first inspected the South Esk in 1870, along with the late Mr Buckland, it was a very polluted river; but since then it has been greatly improved. The following is the answer to the query relating to Pollutions:—

The River South Esk, in past years, has been considerably polluted by the town sewers and public works. It has, however, been greatly improved since an action was raised against the Town and mill-owners. The case is still pending. Various operations have been done by direction of the Court, with the view of stopping the pollution. In particular, the Town established a sewage farm with the view of stopping the pollution. Ponds were made by the mill-owners, and the greater part of the Town drainage and polluted matter at the public works is carried to the sewage farm.

Previously to 1886 there was scarcely any salmon disease in the South Esk. But in 1886–7 and 1887–8 it was very bad. At present there is no disease. It is thought that more specific powers should be given for the removal and destruction of diseased fish.

In answer to the general question at the end of the printed queries, it is suggested:—

That all dam dikes and obstructions should be measured and the measurements scheduled in an Act of Parliament. This would prevent disputes about the increase made to height of dams and weirs.

At the close of the fishing season of 1889, I issued a Circular containing printed queries to District Board clerks, proprietors and lessees of salmon fishings, and others interested in, or acquainted with our Salmon and Trout Fisheries, of which the following is a copy. Printed Queries.

Take of Fish.

Has the take of fish in your district increased or diminished? To what cause do you attribute such increase or diminution—
- (*a*) In tidal waters?
- (*b*) In fresh waters?
- (*c*) In fixed engines?
- (*d*) Generally throughout the district?

Can you give the number of fish caught in your district—
- (*a*) By net and coble?
- (*b*) By fixed engines?
- (*c*) By rods?

At what period of the year in your district—
- (*a*) Are the first clean fish taken?
- (*b*) Is the main take of salmon?
- (*c*) Do the grilse run?

What was the weight of the heaviest salmon or trout caught in your district in 1889—
- (*a*) By net and coble?
- (*b*) By fixed engines?
- (*c*) By rods?

Printed Queries.

Annual and Weekly Close Times.

1. Are the Bye-Laws regulating the observance of the annual and weekly close times by net and coble, and by stake, fly, and bag nets, strictly observed in your district? If not, can you suggest any means which would conduce to their stricter observance.
2. Is the period fixed for the commencement and termination of the annual close time in your district satisfactory? If not, what change would you suggest?

Protection.

Is the system of protection in your district efficient? Are the men employed as river-watchers members of the County Constabulary Force, or are they employed by, and subject to the District Board? State the number of water bailiffs employed in your district.

Illegal Fishing.

Is illegal fishing prevalent in your district? Were any prosec tions instituted under the Salmon Fishery Acts in 1889; if so, for what offences were they instituted, and what has been their result?

Artificial Obstructions to the Passage of Salmon.

1. Mention the dams and cruives in your district, and state whether they are worked in accordance with the provisions of the Bye-Laws (Schedules F and G) regulating the same.
2. Are there salmon-ladders or passes on all the dams and weirs in your district; and if so, do they afford at all times a free passage to salmon wishing to ascend?

Natural Obstructions to the Passage of Salmon.

1. Mention the natural obstructions in the shape of waterfalls in your district which prevent the ascent of salmon. State whether there are good and extensive spawning grounds above them, and give your opinion as to the best mode of opening up such spawning grounds, by attaching a salmon-ladder to the fall; by blasting it; or by a combination of the two methods.
2. At present District Boards, under the 13th Section of the Salmon Fisheries Act of 1868, have power to attach a fish-pass to a waterfall by agreement with the proprietor. There is no compulsory power, similar to that which is conferred, under certain conditions, on Boards of Conservators in England by Section 49 of the Salmon Fisheries Act of 1873. Would you be in favour of giving such compulsory power; and if so, under what conditions and restrictions?

Pollutions.

Are any of the streams in your district contaminated by pollutions? If so, mention them, state the nature of the pollution, whether it is increasing or diminishing, and also whether any steps have been taken by the polluters to neutralise the pollution before returning the water used by them into the river.

The Salmon Disease.

1. Has the salmon disease shown itself in your district? If so, when did it first make its appearance? Has it attacked kelts only, or both kelts and clean fish? Is it increasing or diminishing?
2. Have you formed any opinion as to what has caused it, and what will prevent or cure it?
3. Do you think that there is sufficient provision made in the Acts of 1862 and 1868 to authorise District Boards to order their watchers to remove from the rivers and bury or burn diseased fish; or do you think that more specific authority should be given in a future Act?
4. Generally, have you any remarks or suggestions to make with regard to the salmon disease?

Artificial Propagation of Salmon.

Is there any hatchery in your district for the artificial propagation of salmon and trout, either belonging to the District Board or supported by private enterprise? If so, describe its situation, and state how many fish can be hatched out in it annually.

General Question.

Are there any other points relating to the Salmon Fisheries in your district to which you would wish to direct the attention of the Board, in addition to those suggested by the preceding queries?

To the above Queries I received the following answers:—

RIVER TAY.

The clerks to the Tay District Board write as follows:—The take of fish in our district has diminished for some years, which we attribute to defects in the present annual and weekly close times; the destruction of smolts in spring by so-called sparling-nets; and the use of hang-nets in the estuary. The former have been partially interdicted from 25th September to 25th February, and the latter are again before the Court of Session.

As to the take of salmon, they estimate it at 28,000 salmon and 12,000 grilse by net and coble; 5000 salmon and 2300 grilse by fixed nets; and 1500 salmon and 500 grilse by rods.

At all seasons there are some clean fish in the Tay. The main take as to number is in July and August, as to value perhaps in February, when the price is highest.

The largest salmon caught in the Tay in 1889 were one of 67 lbs., by net, and a good number from 40 to 45 lbs. By rod 57, 55, and 47 lbs.

The present annual close time pleases nobody. It is too much cramped by the statutory 168 days of close time. These now begin on 27th August, which necessitates deferring the commencement to 11th February, which is nearly a month too late. The principal proprietors were willing to give a 48 hours weekly close time, and prohibit nets above a certain point if the season were extended at both ends, especially in spring. But their proposed Bill was opposed.

The protection is by men under the Tay District Board. Eight constables are employed in the open, and from 22 to 26 in the close season, and they have the advantage of a steam launch, which keeps the poachers in their holes.

The artificial obstructions in the district of the Tay are:—

On the Earn, the dam and cruives at Dupplin, and dam at Dornoch; on Ericht, several mill-dams at Blairgowrie, for which there are two salmon-ladders, which have been inoperative from the fish not getting over the natural obstruction of the Keith. The natural obstructions are Falls of Tummel, Keith at Blairgowrie, and on tributaries of the Isla.

Would be in favour of giving compulsory power to District Boards to attach a fish-pass to natural obstructions, similar to that which is conferred, under certain conditions, on Boards of Conservators in England, by section 49 of the Salmon Fisheries Act of 1873, 'under condition that 'the pass shall not be a deformity.'

There is 'A Hatchery' at Dupplin capable of hatching four or five hundred thousand fish. It has hatched 350,000 on glass grills.

In answer to the general questions at the end of the queries, the clerks to the Tay District Board write as follows:—

When opinions regarding salmon differ so widely, it would be desirable that opportunity should be afforded for a tentative experience of annual close time, which might be provided for by Act of Parliament, and confided to the proprietors and Fishery Board to be sanctioned by the Scotch Secretary. Parliament will not pass an opposed Salmon Bill, and opposition is sure to arise from some quarter to any proposal, and for this reason, if it were proved to be a mistake, there would be no chance of its being remedied and altered.

NORTH ESK.

From the answers to the printed queries by the North Esk District Board, which their clerk, Mr Dickson, has kindly sent me, I extract the following:—It is thought that there has been an increase in the take of salmon in the district, owing to protection and killing kelt trouts, by whom the salmon fry are devoured.

The heaviest salmon taken in the district in 1889 by net and coble was 35 lbs., the heaviest by fixed engines 54 lbs., and the heaviest by rod 40 lbs. But a kelt fish was found dead in an upper pool, in November, weighing 58 lbs. In good condition its weight was estimated at 70 lbs. It is probably the largest fish ever got in the river.

The system of protection is stated to be efficient. The bailiffs are employed by the District Board. There are 12 in the close season, and 3 in the open season. Besides these bailiffs there are also several watchers appointed by the Tacksmen between 1st January and the commencement of the fishing season. There were three or four cases of prosecution in 1889. The offenders were people connected with the works on the waterside. The offences were clipping and dragging salmon, and were held proven.

There are no cruives on the North Esk. The artificial obstructions are (1) Morphie dam, (2) Craigo dam, (3) Pert dam. They are worked in accordance with the Bye-Law (Schedule G).

The natural obstructions on the North Esk are the Loups, about 16 miles from the sea, above which there are Loch Lee and good spawning grounds. In answer to the question regarding giving compulsory powers to District Boards to attach a fish-pass to waterfalls, the answer is:—Yes, under conditions and restrictions varying according to the special circumstances of each case.

With reference to the salmon disease, it is stated it appeared about the end of October, both before and after spawning. It is increased. It is thought that it may be caused by 'sniggering,' which tears and otherwise injures the salmon. The North Esk District Board have always removed and buried diseased fish. Special authority, however, might be given in a future Act.

The members of the District Board are unanimously of opinion that 'sniggering' should be suppressed; and it is suggested that all fish *hooked behind the gills* should be returned to the river.

BERVIE.

The Bervie is a small salmon river a little to the north of the North Esk. The fishings are said to be fairly satisfactory. Salmon are rarely taken by rod and line in the river, as they seldom enter it during the netting season, it being in general too low. The largest fish killed by net and coble in 1889 was 10 lbs., by fixed engines 48 lbs.

The bailiffs are employed by the District Board; a superintendent and four bailiffs during the close season, and one watcher during the open season.

There are no cruives on the Bervie. There is one dam dike. The Board do not insist upon the Bye-Laws being strictly observed. They think it better that the fish should have the chance of passing up the mill-lade, and besides the lade itself is used for spawning. The present pass on the dam is not considered efficient, and the Board have in contemplation the construction of a new one. There are no natural obstructions to the passage of salmon.

The salmon disease appeared recently, and hitherto there have not been many cases. Power should be expressly given to remove diseased fish.

SPEY

I have much pleasure in submitting the following Annual Report by the Superintendent laid before the meeting held in Elgin on 18th October 1889, for which I am indebted to Messrs Cooper and Wink, Clerks and Treasurers to the District Board of this important river:—

I.—Salmon Spawning.

The following Tables show the dates of the first appearance of salmon spawning beds, and the number seen and counted by the bailiffs during the last two spawning seasons of 1887–88 and 1888–89 on the following named streams or tributaries, viz.:—

1887–88.

Name of Stream.	Spawning Commenced.	Number of Beds for Season.
Fiddich,	21st October, 1887	920
Avon,	22nd October, 1887	1460 (Avon, Livet, Conglass, Lochy)
Livet,	"	
Conglass,	"	
Lochy,	"	
Dulnain,	13th October, 1887	521
Nethy,	15th October, 1887	220
Druie,	20th October, 1887	668 (Druie, Feshie, Tromie, Truim)
Feshie,	14th October, 1887	
Tromie,	"	
Truim,	"	
Spey (above Laggan, Badenoch),	15th October, 1887	60
	Total,	3849 Spawning Beds.

1888–89.

Name of Stream.	Spawning Commenced.	Number of Beds for Season.
Fiddich,	8th October, 1888	1045
Avon,	24th September, 1888	1338
Livet,	11th October, 1888	679
Conglass,	13th October, 1888	358
Lochy,	20th October, 1888	164
Dulnain,	10th October, 1888	651
Nethy,	22nd October, 1888	286
Druie,	17th October, 1888	336
Feshie,	15th October, 1888	447
Tromie,	11th October, 1888	125
Truim,	10th October, 1888	118
Spey (above Laggan, Badenoch),	9th October, 1888	90
	Total,	5637 Spawning Beds.

Increase over last year, 1788 Spawning Beds.

It will be seen that in the above Table for the year 1887–88 the returns for the spawning beds on Avon and the Avon tributaries are given in the aggregate. This is also the case with the tributaries of the Spey above Abernethy. I however, made the sergeant bailiffs last year make a return to me each week of the exact number of new spawning beds wrought on each individual stream throughout their respective beats, and this mode will be continued in future. Last year was certainly among the best spawning seasons ever witnessed on the Spey tributaries. The early spawning on the tributaries commenced on some of the streams almost a month earlier than has been the case for a number of years back. It must be understood that on some of these, especially the Avon, the figures given above do not give the absolute number of spawning beds which had been wrought by fish on the streams. As, for instance, on the Avon, Dulnain, Feshie, and Livet, from 10th until 26th November—being the height of spawning season—there was no sight to be got by the bailiffs of what was going on in the way of spawning in consequence of high, brown water, and it is only reasonable to conclude that during that time there must have been a large number of fish which formed beds, spawned, and left the beds again before the water settled down to allow a sight of them to be procured. It will be seen by the figures that the increase of spawning beds over last year on the tributaries alone is 1788, which is considerably over a third in increase. On the Fiddich the increase over last year is 125 beds; Avon, Livet, Conglass, and Lochy, 1079 beds; Dulnain, 130; Nethy, 66; Druie, Feshie, Tromie, and Truim, 358; and Spey (above Laggan, Badenoch), 30 beds. There are several small streams or burns which feed the Spey or other tributaries, such as Aberlour, Pitcroy, Tervie, Tulchan, Cromdale, &c., burns, in which grilse and sea-trout frequently spawn during the month of October or first part of November. Last season, during the above-mentioned time these burns did not increase in volume of water above that of their normal size, and, in consequence of this, there were few fish spawned in any of them during last season. The appearance of spawning on the river Spey was very good, and up to the average of previous years. In the Garmouth or Speymouth district the spawning commenced unusually early, and in numbers far exceeded previous seasons. The spawning continued on Spey until about the end of February. No damage was done during the season to spawning beds from ice. There were two spates on the river during the season, the first of these being on 22nd November, and the other from 18th till 20th February. Some damage was done to spawning beds on the Dulnain and Spey by the first or November spate, but concerning the second or February one I do not consider that much, if any, damage was done in any of the streams, as the rise of the water came on gradually until it gained its maximum height, and no ice accompanied the flood.

II.—Full Force of Bailiffs.

The full force of bailiffs or Spey police is constituted as follows, viz.:—The Superintendent, stationed at Aberlour; the Inspector, stationed at Grantown; and forty-two constables. Eight of said constables hold the rank of sergeant, and the following are their respective districts—Garmouth, Craigellachie, Ballindalloch, Upper Avon, Grantown, Duthil, Invereshie, and Kingussie. The full force of men are on duty from middle of October until end of November, at which time commencement to reduce the force begins in the higher reaches of the district. It would be confusing to attempt to state the number of constables and the different beats of same under each sergeant, as there is scarcely a week passes but some of the men have to be removed from one district to another, as different districts have their different spawning spurts, and must be attended to accordingly.

III.—Kelts or Foul Fish.

Kelts were as numerous in the Spey as in former years, and continued until into the month of April.

IV.—Smolt Season.

There were eleven men on duty protecting smolts over the whole district of Spey and tributaries during the smolt season, and they were stationed as follows:—Fochabers, one man; beat—Speymouth to Boat of Brig. Rothes, one man; beat—Boat of Brig to Craigellachie. Dufftown, one man; beat—Fiddich from Newton to top, and the Dullan stream. Aberlour, one man and Superintendent; beat—Spey from Bridge of Callie to Craigellachie, and Fiddich to Bridge of Newton. Advie, one man; beat—Spey from Bridge of Callie to Dalvey, and Lower Avon to Tommore. Glenlivet, one man; beat—Livet and centre of Avon. Lynagarrie, one man; beat—Upper Avon, Conglass, and Lochy. Grantown, the Inspector; beat—Spey from Dalvey to Dulnain. Duthil, one man; beat—Dulnain, Nethy, and Spey from Dulnain mouth to Aviemore. Kingussie, one man; beat—Spey about and beyond Newtonmore, Fesbie, and Tromie. Crathie, Lagan, one man; beat—Truim, and Spey from Truim mouth to Loch Spey. Twelve dozen of printed notices, cautioning persons against taking or killing smolts or the young of salmon, were posted up at conspicuous places along the sides of the Spey and tributaries over the whole district. The constable at Fochabers was an extra man to the usual force. This district was formerly left unwatched, and large numbers of smolts were being killed by anglers. The time that the smolt watchers were on duty was six weeks, nine of them going on duty on 22nd April, and leaving off duty on 1st June; two of them going on duty on 29th April, and coming off duty on 8th June.

There was a good appearance of descending smolts over the whole district, and there were no difficulties met with on the part of the bailiffs in getting anglers to use caution against killing the smolts.

V.—Disease among Fish.

With the exception of the Fiddich, there was not more than the usual amount of fungoid disease observable among the salmon during the winter or late spawning season. On the Fiddich, however, the disease was very prevalent, and from the said stream there was a very heavy 'death rate.' From 8th December 1888 till 8th February 1889 (two months), between the mouth of Fiddich and Dufftown, 4½ miles, no fewer than 134 dead fungoid diseased salmon were removed from the water and buried by the bailiffs. Some of these fish had not even commenced to spawn, others were half spawned, and some—the most part—were fully spawned. The disease generally commences to show itself about the middle of December among the late spawning fish, and is more confined to large, heavy old fish which remain about old spawning beds for a considerable time after their having spawned, than in young salmon and grilse. The first appearance or symptom of the disease on the affected fish is the appearance of one or more small white spots along the back. The spots grow more numerous and larger in size as the disease advances, and they begin to lie in still ebb water at the edge of the river, and become very timid. When they are in this stage it is sometimes the case that their head and eyes are covered with the spots, making them blind on one eye, and sometimes upon both eyes, and they will be found lying in so shallow ebb water that little more than their noses are below water, and they will allow you to go up to them and carry them out of the water. They are certain to die in a few days when they are thus far gone with the disease, and instead of allowing them to lie in the water in this state and attract public attention, the bailiffs are instructed to remove, kill, and bury them. Ninety per cent. of the fish that take the disease are males. The white spots that appear on their bodies are of a soft adhesive nature, and vary in size, beginning about the size of a threepenny piece, and extending to that of a penny piece. It will rub off quite easily with the point of the finger, andwhen off does not seem to have penetrated much further than the depth of the skin. It is, however, when the disease enters the gills of the fish that the fatal effect takes place. As soon as this organ shows signs of disease it becomes a disordered mass, causing death in a very short period. Concerning the disease on the Fiddich last year, as mentioned above, the disease spread very rapidly, and many of the fish found dead had (with the exception of the gills) scarcely any spots or marks of the disease over their bodies, and in some cases died on their spawning beds, which proved that it could not have been more than from one to three days previous that they had pushed their way up the stream from the Spey healthy fish. The Fiddich during last spawning season remained very small in size, coupled with this being the fact that the water of the stream runs through and over a great quantity of limestone, and as lime or anything approaching the nature of lime is poisonous or injurious to fish, the two foregoing facts might be reasonably entertained to having a good deal of effect upon the high death rate and disease on the Fiddich. There is little or no doubt but that the disease is infectious when fish become contiguous with other diseased ones. The stream being so small during the winter months, and the number of spawning fish being so large, it made it evident by the rate that the fish died that the stream was for a short time in a contaminated state.

VI.—Poaching during the Year.

If there was a large increase of spawning over the district during the year, I am glad to say there was more so of a decrease in poaching. The Avon district (in former years always prominent in such lawless pursuits) seemed not to have forgotten the results of their former year's experiences, notwithstanding that in said locality a larger or more tempting show of spawning fish have not for a number of years arrayed themselves in such an aggravating position before the gaze of the covetous poachers of the district, as that of last spawning season. Despite this, there was not the least appearance of poaching in the district during the whole of the season. Two members of the Lochy band of poachers of 1887 are still at large, they having never returned to the district since they absconded.

General Remarks.

The Bye-Laws as to hecks, dam-dikes, and sluices on mill-lades were all properly adhered to over the district during the year.

The sea-coast and river salmon net fishing opened on February 11th, and closed on 26th August. On each occasion of visits to the coast I found the weekly close time well attended to, when the weather and sea permitted the same to be carried out.

The alteration made last year, in having three bailiffs stationed in the Speymouth and Fochabers district, instead of the previous mode of watching in said section, has given every satisfaction, and during the year there was not the slightest appearance of poaching in said district.

GEO. K. MACGREGOR, *Superintendent.*

Abstract of Account Charge and Discharge of Clerks' Intromissions, Year 1888-89.

I.—CHARGE.

To Fishery Assessment on £10,664, 5s. of Rental, at 1s. 10d.	£977	11	2
„ Fines, &c., recovered,	5	15	0
„ Arrear of Assessment recovered,	1	16	8
„ Due to Royal Bank at close of this Account,	29	17	10
	£1015	0	8

II.—DISCHARGE.

By Wages to Bailiffs and Inspector for year,	£672	6	7
„ Superintendent and his expenses,	152	5	7
„ Legal Proceedings,	15	0	6
„ Clerks' Salary and Outlays,	25	17	7
„ Miscellaneous Payments,	8	18	1
„ Advances on account of ensuing year,	58	3	8
„ Due to Royal Bank, carried from last Account,	82	8	8
Equal to Charge,	£1015	0	8

COOPER & WINK, *Clerks and Treasurers.*

Elgin, 18*th October* 1889.

In their answers to the printed queries by the Spey District Board, it is stated that the fishings have diminished to a small extent in tidal waters, and to a great extent in fresh waters, and this latter diminution they attribute 'to low water and breaking of river into several streams of 'small dimensions by operations of Great North of Scotland Railway 'Company at their Viaduct across the Spey.' The weight of the heaviest salmon caught by net and coble in 1889 is said to be not known, but the heaviest caught by rod was 45 lbs. The system of watching is stated to be efficient. There are 42 constables and sergeants, with Inspector and Superintendent. There were four successful prosecutions for salmon poaching in 1889.

In answer to the query regarding artificial obstructions, the reply is that there are no cruives on the Spey, but numerous dams on tributaries. The Bye-law respecting hecks, dam dykes and sluices, is said to be 'duly 'observed.'

I can quite corroborate what is stated above with regard to the damage done to the salmon fishings in the Spey by the operations in connection with the construction of the Viaduct of the Great North of Scotland Railway across the Spey; as I carefully inspected that part of the river in the beginning of October last. The Viaduct has been so constructed as to convert what was formerly a compact, concentrated stream of water, up which salmon could always swim, into a number of scattered, shallow streams, which, when the river is low, do not afford a free passage to salmon. There ought to have been a series of arches across the whole bed of the river, and then there would have been in floods an equal distribution of gravel instead of a heavy accumulation at certain points. There should not have been, as there are now, 1300 feet of embankment and 950 feet of openings, unless the original intention of forcing the river to pass through the middle span of 350 feet, and maintaining it there, had been followed out. It seems generally admitted that the Spey, as a salmon river, between the Viaduct and the sea, has been materially injured by the operations of the railway. The deep channel on the right or eastern bank that I remember in 1870 and in 1883, in which was concentrated most of the water in the river, has been quite changed for the worse, and, instead of it, there are a multitude of shallow channels spread across the whole breadth of the river bed. There were five streams below the embankment when I examined the river; and instead of the greatest body of water passing under the central arch of the Viaduct, as was stipulated and intended, the chief current was flowing through the side arches, which were meant only as a relief to the centre arch in times of flood.

RIVER FINDHORN.

The fishing throughout the district of the Findhorn is stated to have been an average one, but the number of fish is not given, 'as lessees are 'unwilling to supply information of this nature.' The largest salmon caught by net and coble was 35 lbs.; the largest by fixed nets 50 lbs.; and the largest by rod 28 lbs. The Bye-laws are well observed, and the system of protection is efficient. One head constable and 2 permanent water bailiffs are employed by the Board; and during the spawning season, about 20 watchers are employed and paid by the Board for about 6 weeks. There has been no prosecution for many years, and illegal fishing is not prevalent. There has never been any salmon disease in the Findhorn.

RIVER NESS.

In the answers from the Ness Board it is stated that for the last ten years the average take of fish has been pretty equal. As to the number of fish caught, the reply is:—'We have no means of getting at this.' The largest salmon taken by net and coble in 1889 weighed 40 lbs., and the largest by rod was 36 lbs. The Bye-laws are said to be strictly observed, and if there is any breach it is punished. The present opening of the rod fishing is 11th February, but it is mentioned that 'Certain members 'of the Board would prefer it to open on 18th January and close on 30th 'September.' As to protection, 'the system is considered efficient. There 'is 1 superintendent, 3 permanent river watchers, and, in close time, '2 and sometimes 3 extra. They are employed by and subject to the 'Board. No constabulary are employed.'

Regarding fixed engines, the Board writes as follows:—'There are 'frequent complaints of the use of fixed engines, but it has been difficult 'to procure evidence. One case was, however, established, interdict was 'obtained, and the party found liable in expenses. The Board regret the 'absence of machinery, in the Salmon Acts, enabling them to deal with 'fishing by fixed engines.'

The pass on the waterfall at the mouth of the river Moriston—by far the most important work of the kind in Scotland—is said to work well; but an obstruction is mentioned 'situated on the river Doe, falling into 'the Moriston below Ceanacrock Lodge. Blasting is all that is required. 'There is excellent spawning ground above it.' It is stated 'that there 'has been practically no salmon disease on the Ness.' Regarding pollution, it is mentioned that 'there has been a long-standing complaint 'that the river Ness has been polluted by sewage. Several years ago the 'Board of Supervision intervened, but no action was taken. The town 'has adopted a new system of drainage, and the ground of complaint, 'although not entirely, is considerably abated.'

There are two Hatcheries in the Ness District—both of which are private property. One at Invermoriston, at a place called Blairy, which is capable of hatching out 180,000 fish annually. The other is at Glenquoich, and has a hatching capacity of about 100,000.

The Superintendent of the Ness District Board considers that the 'Wild 'Birds Protection Act' should be repealed. In this I entirely agree with him, both for the sake of salmon and herrings. In our Report of 1878, on the Herring Fisheries of Scotland, after a careful consideration of the evidence laid before us on the subject, Mr Buckland, Mr Walpole, and myself were unanimous in recommending that 'The Sea Birds 'Preservation Act, protecting gannets and other predacious birds which 'cause a great annual destruction of herrings, should be repealed so far 'as it applies to Scotland.'

ABERDEENSHIRE DEE.

It is stated that there was a great falling off in the take of fish during 1889, 'owing to the general scarcity of salmon in the pools over the early 'months of the season. Salmon came later in the spawning season in 'abundance.' There are 9 water-bailiffs. There are no obstructive dams on the Dee—fish-passes affording free ascent at all times. It is suggested that a stringent measure should be passed to keep the pools clear of dead and diseased fish.

RIVER YTHAN.

In the Ythan, there appears to have been a general diminution in the take of fish throughout the district during the year 1889. The following figures of the number of fish caught are given, not as absolutely accurate, but as an approximation to accuracy.

By net and coble, . .	20 salmon,	
By fixed engines, . .	60 ,,	and 20 grilse,
By rods, ...	150 ,,	and ; or,

230 salmon and 20 grilse in all. The heaviest salmon caught by net and coble weighed 18 lbs.; by fixed engines, 43 lbs.; by rod, 27 lbs. It is said 'that the Bye-laws could be better observed. There is a considerable 'extent of ground for the staff of watchers. The water-bailiff suggests 'that the time for rod-fishing should be extended for fourteen days, *i.e.*, 'to 14th November. The Board, in considering whether it should be 'extended to 20th November, resolved by a majority to make no change. 'The system of protection is fairly efficient. No watchers are employed 'by the District Board, but a certain number of gamekeepers give 'gratuitous assistance. The men employed by the Board are, 1 all the 'year round and 4 extra during close time. Illegal fishing is not pre-'valent to any great extent. The number of prosecutions averages about 'six or eight per annum. They are mostly all directed against farm 'servants taking fish during the close time, and usually result in the 'imposition of a small fine.'

There are several dams in the district, but there are passes on all of them by which swimming fish can easily ascend. There are no natural obstructions in the shape of waterfalls.

About 8 years ago, the salmon disease showed itself in the river, attacking chiefly kelts; but it has diminished, and is diminishing. More specific authority should be given for removing diseased fish from rivers.

RIVER UGIE.

The take of fish in the river Ugie and district is said to be about the same in 1889 as formerly. In fresh waters it was less, owing to the dry weather and consequent scarcity of floods. But it was larger in fixed engines, from the fish continuing longer in the sea owing to the dry weather instead of running up the river. 370 sea-trout were taken by net and coble; 5620 salmon and grilse were captured by fixed engines; and 14 salmon, 23 grilse, and 2000 sea-trout were caught by rod—certainly a most satisfactory total for so small a river as the Ugie. The largest fish captured by net and coble weighed 27 lbs.; the largest in fixed nets, 44 and 45 lbs.; and the largest by rod, 24 lbs.

The Bye-laws are strictly observed. The dates for the commencement and termination of the annual close time might be a fortnight later with advantage to the fisheries. There are 5 watchers employed by and subject to the District Board. Illegal fishing is not of very frequent occurrence. In 1889 there were two prosecutions for illegal capture of salmon.

There are cruives on the Ugie at Inverugie, but they have not been in use for many years. There are several dams on the river, the condition of which is engaging the attention of the District Board. There are no natural obstructions in the Ugie.

A strong opinion is expressed as to the expediency of giving to District Boards more extensive powers than they at present possess for opening up the numerous natural obstructions on our Scotch Salmon Rivers, which at present bar the way to some hundred miles of fine spawning grounds and to many thousand acres of lochs.

'It hardly seems necessary,' it is said, 'to provide for any conditions 'and restrictions being imposed on the exercise of a power of so much 'local and public utility.'

The salmon disease showed itself in the Ugie about 13 years ago; but it is now diminishing. 'It is caused,' say the Board, 'by scarcity of 'water necessitating fish collecting in large numbers in pools below mill-'dams, being unable to get over the dykes from scarcity of water, and 'fighting with each other—the sound are contaminated by contact with 'the diseased. There should be more specific authority to remove diseased 'fish, or utilise any other remedy or preventive.'

RIVER LOCHY.

On the West Coast of Scotland, where District Boards are few and far between, I have received answers to the printed Queries from the Board of the important River Lochy, which, with its principal tributary the Spean, is reserved entirely for angling.

The take of fish during 1889 is said to have diminished on account of great drought in May, June and July. In the latter two months the salmon could hardly ascend the river. The heaviest salmon caught weighed 35 lbs.

It is stated that the Bye-laws regulating the annual and weekly close times are not strictly observed,—and it is suggested that 'a small steam-'launch would assist very greatly in enforcing the observance of Bye-'laws by stake, fly and bag-nets, and in preventing poaching by net and 'coble. The police, coast-guard, and preventive service men should also 'be called in to assist.'

The system of protection in the Lochy is stated to be as efficient as is consistent with reasonable outlay. The men employed as watchers are not members of the County Constabulary force. The watchers are appointed by the Board, but are paid by various landowners having the use of their services. The number is 22. Illegal fishing is stated to be prevalent on the sea-coast. One prosecution was instituted against persons taking salmon without having a legal right to fish for them. Three men were convicted and fined.

There are no artificial obstructions on the Lochy. The great natural obstructions, shutting out about 40 miles of river and several lochs, including Loch Laggan, 8 miles long, from salmon, are the Falls at Mounessie and Inverlair, both on the Spean. It is said, however, that 'both of these can be easily blasted.'

A suggestion is made 'that fishermen, dealers, or others having salmon, 'or fish of the salmon kind in their possession, should be put on the 'same footing as game-dealers, and be also obliged to give an account to 'watchers, or other persons in authority, how the fish came into their 'possession. This to apply to all seasons of the year, and the legal 'presumption to be against the possessor of the salmon.'

RIVER ANNAN.

I have received answers to the printed Queries from only one of the District Boards on the Scotch side of the Solway,—that, namely, of the important river Annan. The take of fish in tidal waters is said to have diminished, owing to over-fishing, chiefly by the drift or whammel-nets at present in use in the Solway. In fresh waters it has likewise fallen off in 1889, owing to the dryness of the season, which prevented the fish from ascending to the upper waters. No information is given with regard to the number of fish caught in the Annan District, but it is stated that the heaviest salmon taken by net and coble was 36 lbs.; by fixed nets 36 lbs; and by rod 30 lbs.

The annual and weekly close times are said to be, on the whole, well observed, but 'some difficulty in observing weekly close time by fixed 'engines. This might be obviated by fixing the weekly close time for 'fixed engines as the three consecutive ebbings and flowings of the tide 'after 6 P.M. on each Saturday.'

The system of protection is stated to be 'good, but not sufficient. 'There are too few watchers, viz., 4 men appointed under section 7 of 'Police Act of 1857 (one of them acts as boatman), and an assistant is 'employed for three months from the end of the close time for net-'fishing.' Illegal fishing has much decreased. There were thirteen cases, including twenty-two persons, in which convictions were got in 1889.

On the River Annan there are 6 dams; on its tributaries—the Milk, Dryfe, Kinnell, and Ae—there are 9; and on the Kirtle water, in the Annan district, there are 3. It is stated that 'none of them are 'worked in strict accordance with Schedules F. & G., and some of them 'have no passes or ladders.' It is farther mentioned that 'on a few of 'the dams there are fish-passes enabling fish to ascend except when the 'water is low. In several of them there are no fish-passes, and one or 'two are very high, so that it is only when the river is in flood that fish 'get over.'

The salmon disease was first noticed in the Annan in 1876–7. It attacked both kelts and clean fish; it has somewhat decreased. More distinct powers should be given to remove diseased fish from the river than are to be found in the Acts of 1862 and 1868.

There is a hatchery in the Annan District at Craigielands near Moffat, belonging to James Smith, Esq., of Craigielands House. It is situated in a small burn running from a hill behind the House, and emptying into a pond at the house. A burn connects the pond with the river Annan, which is about a mile off. 30,000 trout can be hatched annually in this hatchery.

SUTHERLANDSHIRE RIVERS.

On the rivers Helmsdale, Brora, and Fleet the take of salmon is said to have diminished, owing to the exceptionally dry season of 1889. 1626 salmon; 1234 grilse; and 246 trout are stated to have been caught by nets; and about 800 by rods. A salmon of 42 lbs. was netted in the Brora District; and one of 30 lbs. was taken by rod in the Helmsdale.

The watchers are employed and paid by the Duke of Sutherland. There are no obstructions, natural or artificial, in these rivers, except on the Carnack, a small tributary of the Fleet, on which there is a very ingenious salmon-ladder, over, or rather round, a fall 40 feet in height.

No salmon disease is mentioned, but the watchers have instructions to remove from the rivers and destroy immediately all diseased fish.

There is a small hatchery near Loch Brora, belonging to the Duke of Sutherland. From 80,000 to 100,000 fish were hatched out in it last year.

In the Tongue District, in the north of Sutherland, the take of salmon has decreased, owing to three consecutive dry seasons. Last year there were taken by nets 1,817 salmon weighing 21,161 lbs.; 9977 grilse weighing 52,409 lbs.; and 199 trout weighing 330 lbs. About 300 fish were captured by the rod. The largest fish caught by net and coble was 25 lbs.; by fixed nets 30 lbs.; and by rods 27 lbs.

The Bye-laws, with regard to the observance of the annual and weekly close times, are said to be not very strictly observed; and it is stated that it is thought that the close time for nets should commence on the 15th instead of the 27th of August. Protection is said to be fairly efficient, there being '5 bailiffs and a lot of gamekeepers.' There has been no poaching; there are no prosecutions.

There are no artificial obstructions, and the natural obstructions, in the shape of waterfalls, on the Borgie and Kinloch rivers, are not serious. The salmon disease is unknown. There are no hatcheries in the district, though, some years ago, there were several.

From the Assynt District I have answers to the printed Queries, though not from an official source. The answers relate principally to trout-fishing, which is stated to be stationary, there being no marked increase or decrease. About 13,000 trout are said to have been got in 1889, the heaviest being 8½ lbs.

There are two waterfalls in the district—the falls of the Kirkaig and the Black Falls, between Cama Loch and Loch Veattie. There is excellent spawning ground beyond. It is suggested that salmon-ladders should be placed on these falls. Both these falls and their surroundings will be found fully described in my 6th Report to the Fishery Board (pages 42, 43).

There is no hatchery in the Assynt District, but it is suggested that one should be established, and that 'the trout in the various lochs in 'the district should be crossed with Loch Leven trout so as to improve 'the fishing.

RIVER CLYDE, INCLUDING LEVEN, LOCH LOMOND, &c.

From this district, (where there is no District Board, though there is very great need of one) I have the following answers:—

Salmon and sea-trout have been on the increase for the past ten years.

During the dry weather, the tacksmen on the Clyde shotts had an unprecedented take—said to have been 4000 lbs. weekly. Owing to dry weather, the rod-fishing was very poor up to middle of August, after which it was excellent for the smaller size of sea-trout.

The tacksmen, being well watched, observe the close time strictly. The poachers, however, are always at work, from year's end to year's end, on the white fish pretext. The watching of the spawning streams is quite neglected; Loch Lomond and lower waters (Leven and Clyde) are well watched by watchers of the Loch Lomond Angling Improvement Association and by gamekeepers, &c. Only 5 salmon and 800 to 900 sea-trout were caught, in 1889, by the members of the Loch Lomond Angling Association.

The salmon-ladder on the river Luss dam is very imperfect. Not more than 1 fish in 10, out of those trying it, gets over.* On the Endrick, another tributary of Loch Lomond, at Gartness, there is rather a bad fall, which could be improved easily by blasting a corner of rock. On the Douglas there is a very bad fall requiring extensive blasting. Above these are there are extensive and first class spawning grounds. It is thought, as regards such obstructions, that compulsory power, such as that conferred on Boards of Conservators in England by section 49 of the Salmon Fisheries Act of 1873, should be extended

* I am happy to be able to state that the Colquhoun Trustees are about to take the necessary steps to enable salmon to pass easily over this dam. They also contemplate opening up the fine spawning ground above the Falls on the Douglas, if it is possible to do so at a moderate expense.

to Scotland; to be exercised in special cases on detailed report by a competent Inspector. The proprietor to have opportunity of showing cause against such interference with his profit or amenity.

Pollutions on Clyde and Leven are as bad or worse than ever. There is no salmon disease in the district.

There is a general feeling amongst anglers, that tacksmen of salmon fishings and dealers in salmon should be licensed. It is thought that this might help to stop the traffic in immature fish now so largely carried on.

RIVER BROOM.

From the River Broom, in Ross-shire, I am informed that 'within the 'last thirty years, salmon and sea-trout have very considerably diminished, 'owing to bag-nets and scringing. Thirty or forty years ago, 8 or 10 'fish a day was a fine day's rod-fishing. Now 2 or 3 fish is considered 'good.' From 60 to 80 salmon and grilse were killed last year by rods. The heaviest fish weighed 32 lbs. The river is thoroughly protected by keepers. There were no prosecutions last year, but convictions were obtained in 1888. There is a private hatchery at Braemore, in which about 100,000 fish can be hatched out. I am happy to be able to state that the proprietors on the Broom, Ullapool, Kennart, and some other small adjacent rivers, propose to apply to get District Boards constituted, and then to combine, in terms of the 22nd section of the Salmon Fisheries Act of 1862, to maintain a common staff of officers for the protection of the fisheries in these districts.

Trout fishing—Loch Leven.

With regard to Trout-fishing, the famous Fifeshire Loch Leven, though far more productive and showing a better average weight than any other loch in the United Kingdom, has not yielded so many trout last year as it has sometimes done,—for example, as in 1888, when it produced upwards of 23,000 trout weighing more than 21,000 lbs. The balance-sheet of the Loch Leven Angling Association, who rent the loch, is, however, in a highly satisfactory position. The directors state that:—The Gross Receipts for the year including Bank Interest on the Revenue Account amount to £2033, 12s. 11d., and after providing for the maximum rent of £1000 and all Charges and expenses there remains a clear balance on Revenue Account of £48, 3s. 3d. To this there falls to be added £23, 7s. 8d. of interest on Capital paid up and invested, and the balance of £212, 14s. 3d. carried forward from last account, and these sums together give a disposable balance of £284, 5s. 2d. The directors recommend the declaration of a Dividend at the rate of 10 per cent. on the paid up Capital which will amount to £118, 4s., leaving a balance of £166, 1s. 2d. to be carried forward to next year.

By the permission of the proprietor, Sir Graham Montgomery, Bart., the angling on the loch was last year extended two weeks beyond the usual time for closing.

During the past year 325 pike have been killed, and vigorous means are still being adopted for keeping them down.

The usual hatching operations were again carried on during the winter with success. About 280,000 fry were in the spring deposited in the chief feeders of the loch.

The following Table shows the Number and Weight of Trout killed in each Month during the past Six Years.

	1889.			1888.			1887.			1886.			1885.			1884.		
Month.	Number.	Weight.	Average of Each.	Number.	Weight.	Average of Each.	Number.	Weight.	Average of Each.	Number.	Weight.	Average of Each.	Number.	Weight.	Average of Each.	Number.	Weight.	Average of Each.
		lbs.	lbs.		lbs.	lbs.		lbs.	lbs.		lbs.	lbs.		lbs.	lbs.		lbs.	lbs.
April.........	434	336¼	·774	1025	997½	·972	1559	1434½	·919	706	570¼	·807	1204	1070	·888	2319	1964¾	·846
May...........	2413	1928	·799	4456	2992¼	·671	3175	3581	1·127	2465	2071¾	·840	3676	3026	·823	3220	2742¼	·851
June..........	2449	1977¼	·807	7811	6669	·853	3285	3071¾	·934	3282	2907½	·885	5540	4412½	·796	5292	4318¾	·815
July	1382	1266½	·916	3992	3889¾	·974	2960	2986¼	1·908	1943	1991¾	1·025	1634	1524¼	·932	1384	1306	·943
August	6306	5184	·822	4833	5046¼	1·044	6688	6171	·922	3422	3630½	1·060	4331	4232¼	·977	3211	3040½	·946
September..	2501	2145	·857	1399	1479	1·057	235	219	·931	120	128	1·06	165	1600	·969	208	160¼	·769
Total......	15,485	12,837	·828	23,516	21,073¾	·896	17,902	7,464	·975	11,938	11,299¾	·946	16,550	14,425	·871	15,634	13,532½	·865
Netted....	298	387	1·298	90	114	1·266	178	256	1·438	219	325	1·484	225	327	1·453	306	400	1·307
Total.......	15,783	13,224	·837	23,606	21,187¾	·897	18,080	17,720	·980	12,157	11,624¾	·956	16,775	14,752	·873	15,940	13,932½	·874

Esk (Mid-Lothian) Angling Improvement Association.

The Esk (Mid-Lothian) Angling Improvement Association, which though it has existed for only four years, has already done so much to rescue an almost ruined river and turn it into a productive trouting stream, presents a satisfactory Report for last year. The following extracts will be found interesting :—

Statistics of Fish taken.—The following table of fish captured during the past angling season has been compiled from the water-bailiff's book. It is proper to state that the figures given in the table are *under the mark*, the water-bailiff not having been always able to obtain the particulars of every basket.

TABLE.

	1886.		1887.		1888.		1889.	
	Fish.	Weight.	Fish.	Weight.	Fish.	Weight.	Fish.	Weight.
February (from 11th, Opening Date),	39	$28\frac{1}{2}$	240	$151\frac{3}{4}$	80	46	183	112
March,	34	26	153	$85\frac{1}{2}$	79	$51\frac{1}{4}$	207	$118\frac{1}{2}$
April,	137	117	80	$35\frac{1}{4}$	350	$238\frac{1}{2}$	159	83
May,	37	31	70	$29\frac{1}{2}$	33	$18\frac{1}{4}$	56	25
June,	9	$5\frac{3}{4}$	85	32	15	$9\frac{1}{4}$	15	$7\frac{3}{4}$
July,	1	$\frac{1}{2}$	56	23	555	207	29	13
August,	63	$36\frac{3}{4}$	143	59	814	303	606	$337\frac{3}{4}$
September,	184	$103\frac{1}{4}$	568	375	224	$86\frac{1}{4}$	175	97
October,	158	$116\frac{1}{4}$	217	125	112	$51\frac{1}{2}$	404	$232\frac{1}{2}$
Approximate Totals,	662	465 lbs.	1612	916 lbs.	2262	1011 lbs.	1834	$1026\frac{1}{2}$lbs.
Average Weight,	...	$11\frac{1}{4}$ oz.	...	9 oz.	...	$7\frac{1}{3}$ oz.	...	9 oz.

The average weight of each fish for 1889 is a fraction less than 9 oz.

A number of fish have been taken during the season from 1 lb. to $1\frac{1}{2}$ lbs. The largest fish taken during year the was a yellow trout of 2 lbs. Several heavy sea trout, estimated at from 3 to 4 lbs. weights, were played and lost.

Stocking.—Since 1885, when the Association was formed, there have been placed in the Esk (directly or indirectly through the Association) over 41,000 young fish. These young fish consisted of Loch Leven, Common, American Brook Trout, and young salmon from the Tay and the Dumfriesshire Esk. A statement, detailing the yearly stocking operations of the Association since its institution, is given as an Appendix to the present report. Included in the above is a lot of 3000 young Loch Levens, which were got from Howietoun Fishery towards end of January in the eyed-ova state. These were all hatched out in the tanks in the water-bailiff's house, with fractional loss, by the 6th of February. Under careful attention they throve well, and, towards the end of May, 2000 were placed in Smeaton Pond, and the remainder in the small rill that enters the Esk above the Inveresk Weir

It may be mentioned that the Forth Fishery Board, through their Superintendent, Mr Joseph Napier, has, during the current month, most kindly presented the Association with some 11,000 Forth salmon ova, for distribution in the Esk and tributaries. These eggs are now being incubated in the Association's Hatching Tanks, under the water-bailiff's careful management.

Large shoals of sea-trout have been seen by the water-bailiff at the mouth of the river at intervals during the season. In the back end, some very large fish were noticed taking the fish pass—estimated to be as heavy as 20 lbs. More fish than usual have been noticed playing in the upper beat, which is purely fresh water, but the Tidal Beat still holds its own for number and size of fish. The yellow trout and Loch Levens are pretty well found throughout both beats, and, when the water is heavy, these seem to drop down into the tidal part of the river.

Four of the American Brook Trout, placed in the river as fry in June 1887, were taken during the season—very fine fish, averaging 1 lb. in weight.

Loch Awe Fishery Improvement Association.

The report of the Loch Awe Fishery Improvement Association is not so satisfactory as those just quoted. For several years that Association has done good work in killing down the pike in Loch Awe, and stocking the loch with trout, in order, to some extent, to supply the loss caused by the vast number killed annually, during the fishing season, by the anglers frequenting the half dozen hotels on its shores. Mr Hartley, the able and energetic Hon. Secretary, is about to resign, owing to the want of interest in the work of the Association, and the consequent deficiency of subscriptions, which make the continuance of protection, stocking, &c. impossible. 'Not much interest,' says Mr Hartley, 'is taken in the 'work of the Association, and the subscriptions fall off year by year. It is curious 'to note the different views which men—practical fishermen—take of the state of 'affairs. Some say that Loch Awe cannot be overfished—it is too large. Others 'say that with the great fleet of boats out on it daily it is useless to try and mend 'matters. A third class assert that while there are so many pike in the loch it is 'absurd to turn fry into the burns, and a fourth class almost threaten to stop their 'subscriptions on the ground that by killing off all the pike the trout have been 'made smaller, though more numerous. And yet another class grumble at the 'money spent in watching, and say that it is only of benefit to the salmon fishers 'on the Awe. Some of these critics have helped me generously with their money 'as well as their advice, though perhaps as a rule the latter has predominated. It 'was impossible to satisfy every one, and I have not tried to do so. We believed 'that there were too many pike in the loch, and a great many have been killed—'about 1600 in the last five years. The size of those got now is very much less 'that during the first two years. We have had a good staff of watchers out each 'year during the spawning season. Some people say that there is no necessity for 'this, as there is never any poaching, but it is within my knowledge that for the 'last two years just outside our district the water has been "burnt." We have 'turned into the burns during the last three years nearly 150,000 Loch Leven fry 'and ova.'

Hotels in Scotland with salmon and trout fishings attached.

There are a large number of hotels in Scotland to which trout or salmon, and sometimes both kinds of fishing, is attached, and I have endeavoured to get some statistics of the number of fish killed last year by the visitors to these hotels. There is no close time for trout in Scotland, and no gauge to prevent the killing of undersized fish; and a pretty long experience of Scotch waters enables me to state, with a good deal of confidence, that, both in size and number, trout are decreasing, especially in those localities where there is a great annual catch, and no attempt made, by artificial breeding or otherwise, to maintain the supply. It seems a pity that the proprietors of the fishings attached to these hotels do not insist on a gauge for yellow trout—say 8 inches—under which no trout should be allowed to be basketed. I have much pleasure in expressing my obligations to those hotel-keepers who have been good enough to send me information in answer to the queries forwarded to them.

Overscaig.

From Mr Mackay, Overscaig Hotel, Loch Shin, I learn that 7086 trout weighing $2761\frac{3}{4}$ lbs., were killed by parties fishing from his hotel. Seven salmon also were captured. Among the trout were 27 *Salmo ferox*, the heaviest of which weighed 12 lbs. The heaviest yellow trout was 3 lbs. There is another large hotel at Lairg, at the foot of Loch Shin, where a great many trout are killed, but I have not received returns from it. In 1888, the anglers fishing from that hotel captured 5 salmon and grilse, weighing 46 lbs.; 105 *Salmo ferox*, weighing 141 lbs.; and 1994 yellow trout, weighing 1061 lbs.

About the Falls on the River Shin, between the loch and the sea, Mr Mackay writes:—

There are good and excellent spawning grounds for upwards of 25 miles above these Falls; the best mode would be to blast them, which would render this an excellent district for salmon, grilse, and sea-trout. At present few can come over the Falls.

From Kyle of Sutherland, it is stated that the number of trout taken from the various lochs, as far as can be ascertained, was 1876, weighing 1003 lbs. Kyle of Sutherland.

From Scourie the hotel-keeper mentions, that for the past two years the take of trout has diminished, owing to the dry weather. The largest salmon taken in the district last year was caught in the stake-nets, and weighed 56 lbs.; and a brown trout of $4\frac{1}{2}$ lbs. was captured by rod in Loch Badnamoult. The total number of sea-trout and brown trout killed by parties fishing from Scourie Hotel was 1200. Scourie.

In 1889, 3440 brown trout were taken by anglers residing at Forsinard Hotel. The heaviest trout was 6 lbs. The take of salmon in the district is said to have diminished, owing to overfishing with bag-nets in Melvich Bay. There is no hatchery, but the innkeeper thinks that the fishings would be much benefited by the establishment of one. Forsinard.

From Riconich Hotel, west coast of Sutherland, Mr Wallace reports a general diminution of fish throughout the district, which he imputes to excessive fishing by bag-nets, and to the great destruction of gravid fish while in the act of depositing their spawn. Riconich.

About 800 salmon were caught by net and coble and 70 by rod. The largest fish caught by net and coble was 35 lbs.; the largest by rod, 20 lbs.; largest sea-trout, $6\frac{1}{2}$ lbs. It is stated that the Byelaws regarding the annual and weekly close times are strictly kept by those fishing from the hotel. But that the observance of the weekly slap by bag-nets in the district is the exception, and not the rule. I have not received a return of the number of fish caught in 1889 by parties fishing from Riconich Hotel. But, in 1887, the following was the return:—31 salmon, weighing $208\frac{1}{2}$ lbs.; 17 grilse, weighing $77\frac{1}{4}$ lbs.; 549 sea-trout, weighing $477\frac{1}{4}$ lbs.; and 1076 yellow trout, weighing $376\frac{1}{4}$ lbs.

With regard to the natural obstructions in the district, Mr Wallace writes as follows:—

The Fall on Achriesgill River. Good spawning ground above. The Parbh Alt Burn Fall is an insuperable obstruction at present. This burn is the outlet of a chain of five lochs, and if the salmonidæ had access to them, the fish would undoubtedly multiply in the district as the spawning ground is extensive and excellent, and the sport obtainable would be increased sixfold. Oldshore More Burn could be vastly improved at a trifling cost, so as to enable fish to ascend to the loch above; but the mill-dam on this burn is a source of annoyance. This could be rectified by constructing a lade on the same principle as that on the Culag Burn, Lochinver. Blasting would suffice for Achriesgill. Blasting and ladder for Parbh Alt Burn.

The system of protection is said to be far from efficient, with exception of Loch Garbetbeg, the loch nearest the hotel. The other lochs in the locality, which are very numerous, are stated to be ruined by otters, nets, set lines, leisters, and other destructive devices.

There is no hatchery near Riconich, but Mr Wallace is of opinion that the establishment of one would greatly improve the fishings, and he would be glad to undertake the supervision.

From the beautiful and popular hotel at Inchnadamph at the foot of Ben More, and close to the picturesque shores of Loch Assynt, 4 salmon, 6 grilse, 19 *Salmo ferox*, and 2533 brown trout were killed last year. The heaviest salmon weighed 12 lbs., and the heaviest *Salmo ferox*, $12\frac{1}{2}$. Inchnadamph.

Parties fishing from Altnahara Hotel last year had 50 salmon, $2188\frac{1}{2}$ lbs. of trout, and 26 lbs. of *Salmo ferox*. The heaviest salmon was 15 lbs. The take of salmon is said to have diminished. Altnahara.

Culfail Hotel, near the Pass of Melford, is surrounded by a great Culfail.

number of lochs containing abundance of trout, but not accessible to salmon. No fewer than 7698 trout were killed in these lochs last year by parties fishing from the hotel, and this is a much smaller number, owing to the dry season, than has been taken in former years.

The fresh-water trout—writes Mr M'Fadyen—have multiplied to such an extent that they are becoming small in size owing to the want of food. Proprietors are preserving their lochs, and there are no poachers, as the district has become depopulated. In olden times a good many trout were killed at the time of spawning, and as there is nothing of this now in our district, their number is legion. I may mention that I have been stocking some of my lochs with Loch Leven trout from Howietoun, and it has improved the quality and size a little. I have been doing this for the last nine years; but so long as there are so many native trout in the lochs, it is scarcely possible to improve them much farther.

Respecting the natural obstructions in the district, Mr M'Fadyen writes:—

There is a natural obstruction in the shape of a waterfall, which, if removed by blasting, would give access to three miles of river, constituting the best spawning ground on the west coast; and then the salmon could get into Loch Tralig, which is about one mile long by a quarter in breadth. The present spawning ground on the River Oude is very rough, and when there is a flood all the spawn is washed into the sea.

Tyndrum. From the Tyndrum Hotel, 2 salmon and 3134 trout were captured in 1889 in Loch-na-bea and in the River Fillan.

Loch Awe. The fishing in Loch Awe is said to be improving of late years, and the operations of the Loch Awe Fishery Improvement Association are stated to be doing great good both to salmon and trout fishing; to the former by watching the spawning beds; to the latter by putting large numbers of trout fry into the loch, and by killing down the pike. Pity it is that the labours of so useful and necessary an Association should be discontinued or suspended for want of funds. Mr Cameron, of the Port Sonachan Hotel, states that the number of trout taken last year by parties fishing from that hotel was 7299, averaging about half a pound; and if to this is added salmon and *Salmo ferox*, the total number was 7313. The heaviest fish was a *Salmo ferox* of 11 lbs.; the heaviest salmon was 8 lbs.

Mr Cameron wishes to direct the special attention of the Fishery Board for Scotland to the evil effects of the netting at the mouth of the River Awe upon the fisheries in the loch. The net fishing closes at present on the 27th August. He thinks that it should close a month earlier.

Dalmally. Mr Fraser reports from Dalmally that last year both the salmon fishing in the River Orchy and the fishing in Loch Awe were not so good as usual, owing to the dryness of the season. Forty-five salmon were caught in the Orchy by parties fishing from Dalmally Hotel, and 2000 trout from the Loch Awe Hotel. The heaviest salmon was 25 lbs.; the heaviest yellow trout 3 lbs.; and there were 2 *salmo ferox* of 8 and 8½ lbs. respectively. Mr Fraser thinks that 'nets should be off the River Awe two whole 'days every week during the open season.'

Taycreggan. From Taycreggan, another of the hotels on Loch Awe, I have no account of the number of salmon and trout killed. It is stated, however, that 'the take for 1889 was a very much diminished one owing to 'drought; but, upon the whole, for the five years previous to 1889, the 'takes of salmon, especially on Loch Awe, have increased. The cause is 'not well understood.'

Loch Katrine. I am informed that no account has been kept of the number of trout killed in Loch Katrine, but one is to be kept in future. A curious circumstance is mentioned with regard to the effect of the operations of the Glasgow Waterworks Commissioners, which have greatly raised the level of the lake, and which, it was generally expected, would have been prejudicial to the fisheries. 'I consider,' it is stated, 'that the take of 'fish in my district has rather increased, and besides that the quality is 'improved. The raising of Loch Katrine by the operations carried on by 'the Glasgow Waterworks Commissioners had a marked effect at the time 'in improving the quality of the fish in the lake. Then, also, I introduced 'some Loch Leven trout and some from Loch Arklet, an adjoining lake, 'which might, in some degree, account for the improved fishing. The 'weight of the heaviest trout caught by rod in 1889 was 4 lbs. Scarcely 'any salmon and no sea-trout have been caught in Loch Katrine, which 'is rather difficult to account for, as there is no natural obstruction, 'unless the embankment erected by the Water Commissioners for raising 'the level of the lake prevents them from entering it.'

Luss Hotel, Loch Lomond.

Mr M'Nab, the innkeeper at Luss Hotel on Loch Lomond, states, that, so far as known to him, the heaviest salmon caught was 13 lbs., the heaviest loch trout 12½ lbs., and the heaviest sea-trout 6 lbs. The watching is fairly efficient, though a few poachers use the otter on the loch.

With regard to obstructions he writes as follows:—'There is one dam 'on mill at Fruin, which salmon and sea-trout take and another at mill 'on Luss water which salmon do not take but sea-trout do: in both cases 'when the water is about half flood. Salmon presently spawn below the 'dam on Luss water. A ladder at the dam would open up several miles 'of water to them. A fall on the Douglas water prevents all fish getting 'up to several miles of good spawning ground. A combination of blast-'ing and ladder might enable them to get up.'

Concerning pollutions he writes:—'The above mentioned waters are 'free from pollutions, but the river Leven, up which all sea fish must come, 'is abominably polluted by chemicals from print-works on the banks and 'by sewage. The pollution is yearly increasing, and, so far as I am 'aware, no steps are taken to neutralise it.' Afterwards, he writes about the Leven as follows:—'The river Leven is the key to the district. At 'present a high loch is required to enable salmon and sea-trout to come 'up and smolts to go down. If the pollution was appreciably diminished, 'fish could run at any time. The pollution is specially deadly on smolts 'going to the sea. Doubtless the stock of fish could be largely increased 'by artificial hatching, but, until the Leven is purified, any attempt in 'that direction would be almost labour in vain.' He incloses the following remarkable cutting from the *Evening Citizen* of 14th May 1890, illustrative of the deleterious and destructive effect of the chemicals discharged into the Leven by the print-works on the fry of salmon and sea-trout:—'Yesterday forenoon the banks of the Clyde, from Dumbarton 'Castle to north bank opposite Cardross, were literally covered with millions 'of salmon fry and sea-trout that had been poisoned. At repeated intervals 'it has been noticed that fish have been destroyed by the discharge of 'sewage containing poisonous matter into the waters, but never before has 'such a large quantity of young fish been destroyed. It is presumed that 'the discharge of the poisonous liquid has come from one or other of the 'works situated on the banks of the Leven. Sometimes that river presents 'a blood-like appearance, as if the whole of the turkey-red in the Vale of 'Leven had been discharged into it; at other times the water is of a dark, 'muddy colour, showing unmistakable signs of refuse having been allowed 'to run in. All day yesterday bands of young and old were out on the 'banks of the Clyde collecting sickly salmon.'

Loch Maddy.

From the remote Loch Maddy, in North Uist, there is a good account of the fishings which, however, it is said would be capable of great development by judicious expenditure. The whole of the Island of North Uist is honeycombed by lochs—many of them communicating with each other—from the wide expanse of Loch Scadowa, said to have an Island for every day in the year, to the mere tarn in the midst of the moorland.

Last year, there were caught from Loch Maddy Hotel 20 salmon, 300 sea-trout, and 5000 brown trout. The heaviest salmon was 11 lbs.

There is no illegal fishing, and the only complaint made is that 'there is no satisfactory arrangement made for flooding lochs to meet spring tides. Consequently, run of salmon and trout depends altogether upon rainfall.'

Mason's Arms Hotel, Stromness, Orkney, and Lochs of Stenness and Harray.

This hotel is one of the points from which anglers resort to the great inland lochs of Stenness and Harray, magnificent and connected sheets of water, whose united expanse is 4224 acres, or nearly 7 square miles. The report given is most disheartening ; for though the fisheries in the Orkney Islands have for many years been brought under the operation of the Salmon Fishery Acts, and formed into a fishery district, there is no District Board, and there are no prosecutions. The consequence is that all sorts of poaching practices prevail, and the sea-trout and yellow trout fishings are steadily and inevitably decreasing.

It is stated in the answers to the printed queries that the take of fish has diminished owing to illegal netting and ottering. From the Mason's Arms Hotel 450 trout were caught by rod. A sea-trout of 16 lbs. was captured in Stromness Harbour by net and coble. But the great capture of the year was a yellow trout of 29 lbs. caught by a set line in the Loch of Stenness, probably the largest yellow trout ever taken in the United Kingdom. I have seen a coloured cast of this trout, made from the life by Mr Malloch, the well-known fishing-tackle maker, Perth, and it represents the handsomest yellow trout, both in shape and markings, that I ever saw. In a letter to the *Field*, dated 23rd March 1889, Mr Malloch writes as follows about this remarkable trout :—

Seeing several letters lately in the *Field* about Loch Stenness trout, I thought it might interest your readers to know that to day I received a Loch Stenness trout, a male, weighing 29 lbs. It measured 3 feet 3¼ inches in length, 2 feet in girth. It was caught on a set line with worm. It is a real fresh-water trout, and is the most perfect specimen I have ever seen ; with its small head, beautiful shape and colour, it is a perfect treat to look at. The following description of its colour may give you an idea of what it is like :—The belly is silvery white, merging into golden lemon up to the lateral line ; just below the line it is covered with faint red spots; above the line, silvery, covered with brown spots, each spot having a creamy-white ring round it ; above this, pale olive, merging into dark green on the back, all profusely covered with spots. The head is almost the same colour as the body only of a paler shade, and is covered with spots down to the nose, the gill-cover proper being light purple ; the dorsal fin olive, covered with light brown spots ; the dead fin, very pale olive, covered with orange and red spots, the outer edge of the fins tipped with orange ; the tail slightly rounded. When cut up, the flesh is orange, and, when cooked, tastes almost like salmon. Although it was caught on Thursday last, I weighed it to-day, and it weighed 28½ lbs., so that when it came out of the water it must have weighed over 29 lbs. I have taken a cast of it, and I am stuffing the skin as well.

With regard to the protection of the lochs from which this splendid trout was taken, and of the other waters in the Mainland of Orkney, Mr Mackay, the landlord of the Mason's Arms Hotel, writes :—

There is no protection of any kind. Illegal fishing is prevalent, and there are no prosecutions. There is no District Board. I would like to direct the Board's attention to the obstruction of small-meshed nets in the sea in the channel leading to the loch (Stenness) ; and after the close time also, sweeping with small-meshed nets in the fresh water loch.

The following extract from my fifth Report to the Fishery Board, describing the Fisheries in Orkney and Shetland which I inspected in

1886, will show what these great lakes have been; what they are; and what they might be if properly managed and protected:—

Before the Orkneys were constituted a Fishery District, and the usual bye-laws passed fixing estuaries, a close season, the meshes of nets to be used for the capture of fish of the salmon kind, and prohibiting certain methods of fishing,* all kinds of destructive and improvident modes of fishing were commonly practised on the Loch of Stenness, and more particularly on the upper part of it, the Loch of Harray. Set lines, set-nets, sweep-nets, and the otter, were in constant operation; and although the use of the otter and fixed nets is now illegal, the 'Harray lairds,' as the small proprietors on the banks of the Loch of Harray are called, cannot be prevented, as the law at present stands, from using the sweep-net or set lines, as they are udallers, that is freeholders, and many of their properties have a frontage to the loch. No District Board has been formed for the Orkneys, nor is there any Angling Association for the protection and improvement of the fishings; and from what I saw and heard when in Orkney, I am by no means convinced that the statutory restrictions intended to prevent wasteful and improvident modes of fishing are much attended to on the Lochs of Stenness and Harray. Were they fairly fished and properly protected, they ought to be equal to any lochs in the United Kingdom; and this is not merely my own opinion, after a pretty extensive acquaintance with these lochs, but that of every angler who has had much experience of them. In his admirable book on *The Orkneys and Shetland*, published in 1883, Mr Tudor writes as follows of these two great lakes:—

> For years, nets, set lines, and the infernal poaching machine the otter, have been used to such an extent that it is a wonder any trout have been left, but now the Orkneys have been formed into a Salmon Fishery District, set lines and otters became illegal, and netting can no longer be carried out with the herring-net mesh, and in the reckless manner hitherto in vogue. In fact, if only the fish can be protected during the spawning season, these two lochs should, for angling, be second to none in Scotland.

To the same effect Mr Sutherland Græme of Græmeshall, who has a large estate on the Mainland of Orkney, writes, in answer to my printed queries:—

> I believe that if the lochs of Stenness and Harray were properly looked after and preserved by an Angling Association, they would be the finest fishing lochs in Scotland, both for sea and loch trout.

But without a District Board or an Angling Association, what is the use of statutory prohibitions of destructive and unfair modes of fishing? What are laws good for if there is no one to enforce them? They are a mere dead letter, not likely to be respected or observed by those whose interest, or fancied interest, it is to break them.

Mr Heddle, the proprietor of the island of Hoy, an experienced angler, agrees with the views above expressed, and he stated to me, when I was in Orkney, that no good has, as yet, resulted from bringing the Orkneys under the operation of the Salmon Fishery Acts of 1862 and 1868. No District Board, no Association of Proprietors has been formed, no prosecutions have been instituted —matters go on just as before. With regard to the Lochs of Stenness and Harray, he believes that nothing short of the killing of the spawning fish and extensive ottering could have so much reduced the fishing on such great expanses of water, with such wonderful natural capabilities. Fair fishing would never do it. Twenty-one years ago, his father and he killed so many fish in Stenness in one day that they did not like to take any more. There were between 100 and 200, all good-sized trout. Four years ago he fished the same loch, and got only about half a dozen fish. One of these, however, was $2\frac{1}{2}$ lbs.

Mr Gould, chamberlain to the Earl of Zetland, corroborates these views. He told me that the Acts had done no good as regarded the great lakes of Stenness and Harray, in which poaching was as rife as before the Acts were made to apply to the islands. A clause should be put into an Act of Parliament absolutely prohibiting ottering. Mr Gould is of opinion that the right of salmon fishing, or rather sea-trout fishing, in the Lochs of Stenness and Harray belongs to the Earl of Zetland or to the Crown. He maintains that the Harray lairds are not udallers, and that their riparian rights give them a title to yellow trout-fishing only.

In the autumn of 1880, a public inquiry was held by the Commissioners of Scotch Salmon Fisheries at Kirkwall, Stromness, and the Bridge of Waithe, in connection with the proposal to erect the Orkney Islands into a Fishery District, and some interesting and important evidence was laid before them

* This was done in 1881 and 1882.

about the fisheries in Stenness and Harray, and the sea-trout fisheries in the Orkneys generally. With regard to the size attained by the Orcadian sea-trout, one witness stated that he had heard of one caught in a net, 21½ lbs. weight, and had seen one of 12½ lbs.; and another witness stated that he had seen one of 14 lbs. One of the witnesses examined at Kirkwall said, that about six years ago there was a curious epidemic among the trout in the Loch of Harray, when most of the fish died. He went down to the banks of the loch one day, and found them lying dead all along the shore. There was no appearance of any fungoid growth on any of the fish. They seemed just to have died from natural causes. The season had been a very hot and dry one. Next year there were very few fish. The majority of the witnesses examined agreed as to the evil effects of the destructive modes of fishing practised in Lochs Stenness and Harray, such as set lines, sweep-nets and fixed-nets, otters, and the non-observance of any annual close time. In consequence of this the sea-trout and loch-trout are less numerous, and the individual fish are smaller in size than they used to be. In short, the tendency of the evidence taken by the Commissioners clearly proved the evil effects of allowing fishing unrestricted, as to season or implements, and the necessity of imposing some restrictions. One witness deponed that he had seen eight or nine otters being used on the Loch of Harray one day, and the next day two on the Loch of Stenness. Another said that, during the last five years, there had been a marked falling off in the fishings, which he imputed to the use of sweep-nets, lines (each with several hooks) set during the night and drawn in the morning, and nets stretched and fixed across the whole breadth of the water above and below the Bridges of Waithe and Brogar, so as to intercept the passing fish. These nets have a small mesh, like herring-nets, and are set, not only in the lochs, but also across the burns running into them, where they do a great deal of mischief, especially during the spawning season. Another witness, who had then (1880) known the Loch of Stenness for 30 years, said, that when he first knew it, there was nothing but fair fishing with rod and line. He also said that he had, long ago, killed 30 sea-trout with rod and line in that loch in three hours. They weighed from 3 lbs. downwards. Such a take would be impossible now, owing to the otters, set lines, and nets; but if a close time were enacted and enforced, and the lochs protected, such are their natural advantages, that the fishings would recover in a few years.

A great number of burns, some of them of considerable size, fall into the Lochs of Stenness and Harray, and in autumn and early winter the sea-trout and loch-trout ascend these burns for the purpose of spawning. But these narrow streams afford peculiar facilities for destroying the spawning fish, and there is no doubt that a number of them are killed while engaged in reproducing their species. This, of course, is the most destructive and improvident of all illegal modes of killing fish, as the death of every ripe female means the destruction of many hundred ova. But the udallers do not like to be subjected to any restriction whatever. As one Orkney proprietor writes me, in answer to the printed queries—

> I fear the native Orcadian is too short-sighted to regard an attempt to preserve the fishings in any other light than that of an attempt of the 'bloated aristocrat' to interfere with the 'rights of the people.' An attempt to stop ottering on the Loch of Harray was much resented by some of the smaller proprietors and others.

The most destructive instrument used for killing fish during the spawning season is called a 'haevie.' It resembles a large landing-net, with a handle from 6 to 10 feet long, and is poked under the banks of the burns and swept through the pools. It is scarcely necessary to point out what an infernal machine this must be for the destruction of fish in the narrow Orcadian burns during the spawning season.

Powers of Fishery Board over the Salmon Fisheries of Scotland, under the Fishery Board Act of 1882.

The question as to what are the powers of the Fishery Board for Scotland, under the 2nd sub-section of the 5th section of 'The Fishery 'Board (Scotland) Act, 1882,' was prominently brought forward during the sittings of the Commission on Crown Rights in Scottish Salmon Waters. The Act of 1882 provides that 'The Fishery Board shall have 'the general superintendence of the Salmon Fisheries of Scotland, and 'shall have the powers and duties of Commissioners under the Salmon 'Fishery Acts, but without prejudice to or interference with the powers 'of District Boards.'

The powers of District Boards are regulated by the general Salmon Fishery Acts of 1862 and 1868, and the powers of each District Board are strictly confined to the Salmon Fisheries in the Fishery District of which it has the management; that is to say, the powers of District Boards are purely local. But the Fishery Board for Scotland seems to be in the position of a Central Board having the general superintendence of all the local Boards. If not, what is the reason or meaning of the words 'general superintendence?'

In the Report of 1860 by the Select Committee of the House of Lords, in connection with which so much valuable evidence was given respecting the Salmon Fisheries of Scotland, it is recommended '1st, 'that a Central Board or Commission be appointed to regulate the 'Salmon Fishings in Scotland. 2nd, That the Salmon Fishings be 'divided into districts by the Central Board. That a local Board of 'Conservators for each district be elected by the proprietors, with powers 'of assessment for payment of expenses, of appointing water-bailiffs and 'making Bye-Laws; *the proceedings of the District Boards to be subject to 'control by the Central Board.*'

The Fishery Board for Scotland seems to be very much in the position of the Central Board, recommended by the Select Committee of the House of Lords in 1860. The local management of the Fisheries is to be in the District Boards; but the general superintendence and supervision is to be in the Fishery Board for Scotland.

There may possibly be some doubt as to the powers of the Fishery Board in those districts where District Boards exist. But where there are no District Boards—which is the rule and not the exception along the West Coast of Scotland and in the Inner and Outer Hebrides—the natural construction of the words 'general superintendence,' surely is that the Board may and should interfere to enforce the provisions of the Salmon Fishery Acts and to punish their infringement. If it is maintained that, under the provisions of the Act of 1882, the Fishery Board can neither interfere where there are District Boards nor where there are none; then it follows that the words 'general superintendence' have no meaning or significance whatever, and might as well have been left out of the Act—a conclusion which should not be rashly arrived at.

It remains to consider the meaning of the words 'and shall have the 'powers and duties of Commissioners under the Salmon Fishery Acts.' Having been one of the Commissioners of Scotch Salmon Fisheries from 1867 to 1882, I have had some experience of the duties which devolved upon them. They fixed districts and estuaries; the commencement and termination of the annual close times; reported on obstructions in rivers; on the observance of the fishery Bye-Laws by millers and manufacturers; and on other matters included under the scope of the Salmon Fishery Acts of 1862 and 1868. But all these things were done not on their own initiative, but under the direction and with the sanction of the Secretary of State for the Home Department, whose place is now occupied, as regards the fisheries, by the Secretary for Scotland. A full account of the work done by the Commissioners of Scotch Salmon Fisheries during the years 1867, 1868, 1869, 1870, 1871 and part of 1872, will be found in a Parliamentary paper which I drew up in 1872, and which was ordered by the House of Commons to be printed 10th August 1872.

I have the honour to be,

Your obedient Servant,

ARCH^{D}. YOUNG.

THE FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 26*th May* 1890.

NOTE I.

ANNUAL CLOSE TIME APPLICABLE TO THE SCOTCH SALMON RIVERS.

N.B.—Observe that, in the following List, the days fixing the commencement and termination of the Annual Close Time and of the Extension of Time for Rod-fishing are, in all cases inclusive, as in the case of the Add, the first River in the list.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
ADD, ...	From Sept. 1 to Feb. 15, both days inclusive.	From Sept. 1 to Oct. 31, both days inclusive.
ALINE, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
ALNESS, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
ANNAN, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Nov. 15.
APPLECROSS, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
ARNISDALE (*Loch Hourn*), . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
AWE, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
AYLORT (*Kinloch*), . . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
AYR, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BAA AND GLENCOILLEADAR, . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BADACHRO and KERRY (*Gairloch*), .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BALGAY and SHIELDAG, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BEAULY, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
BERRIEDALE, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BERVIE, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
BLADENOCH, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BROOM	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
BRORA	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
CARRADALE (*in Cantyre*), . .	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
CARRON, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
Clayburn, Finnisbay, Aven-nan-geren, Strathgravat, North Lacastile, Scalladale, and Maw-rig (*East Harris*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
Clyde and Leven, . . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Conon, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Cree, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Creed, or Stornoway, and Laxay (*Island of Lews*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Creran (*Loch Creran*), .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Crowe and Shiel (*Loch Duich*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Dee (*Aberdeenshire*), . . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Dee (*Kirkcudbright*), . . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Deveron, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Don, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Doon, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Drummachloy or Glenmore (*Isle of Bute*),	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 15.
Dunbeath	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
Earn, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Eckaig, ...	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 31.
Esk, North, . . .	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 31.
Esk, South, . . .	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 31.
Ewe, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Fincastle, Meaveg, Ballanachist, South Lacastile, Borve, and Obe (*West Harris*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
Findhorn, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 10.
Fleet (*Sutherlandshire*), . .	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
Fleet (*Kirkcudbrightshire*), . .	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
Forss, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Forth, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Fyne, Shira, and Aray (*Loch Fyne*), .	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 31.
Girvan, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
Glenelg, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Gour, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
Greiss, Laxdale, or Thunga, .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
GRUDIE or DIONARD,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
GRUINARD and LITTLE GRUINARD,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
HALLADALE, STRATHY, NAVER, and BORGIE,	From Aug. 27 to Feb. 10.	Close time for Rod-fishing from 1 Oct. to Jan. 10.
HELMSDALE,	From Aug. 27 to Feb. 10.	Close time for Rod-fishing from 1 Oct. to Jan. 10.
HOPE and POLLA or STRATHBEG,	From Aug. 27 to Feb. 10.	From Jan. 11 to Feb. 10, and from Aug. 27 to Sept. 10.
HOWMORE,	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
INCHARD,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
INNER (*in Jura*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
INVER,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
IORSA (*in Arran*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
IRVINE and GARNOCK,	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
KENNART,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
KILCHOAN or INVERIE (*Loch Nevis*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
KINLOCH (*Kyle of Tongue*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
KIRKAIG,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
KISHORN,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
KYLE OF SUTHERLAND,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
LAGGAN and SORN (*Island of Islay*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
LAXFORD,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LEVEN,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LITTLE LOCH BROOM,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LOCHY,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LOCH DUICH,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LOCH LUING,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LOCH ROAG,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
LOSSIE,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
LUCE,	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
LUSSA (*Island of Mull*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
MOIDART,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
MORAR,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
MULLANAGEREN, HORASARY, and LOCH-NA-CISTE (*North Uist*),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
NAIRN, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
NELL, FEOCHAN, and EUCHAR, . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
NESS, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
NITH, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Nov. 15.
ORKNEY ISLANDS (River from Loch of STENNESS, &c.),	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
ORMSARY (*Loch Killisport*), LOCH HEAD, and STORNOWAY (*Mull*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
PENYGOWAN or GLENFORSA, and AROS,	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
RESORT, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
RUEL, ...	From Sept. 1 to Feb. 15.	From Sept. 1 to Oct. 31.
SANDA, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
SCADDLE, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
SHETLAND ISLANDS (River of SANDWATER, &c.,	From Sept. 10 to Feb. 24.	From Feb. 1 to Feb. 24, and from Sept. 10 to Nov. 15.
SHIEL (*Loch Shiel*), . . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
SLIGACHAN, BROADFORD, and PORTREE (*Isle of Skye*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
SNIZORT, ORLEY, OZE, and DRYNOCH (*Isle of Skye*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
SPEY, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 15.
STINCHAR, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
TAY, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
THURSO, ...	From Aug. 27 to Feb. 10.	From Jan. 11 to Feb. 10, and from Aug. 27 to Sept. 14.
TORRIDON, BALGAY, and SHIELDAG, .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
UGIE, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31.
ULLAPOOL (*Loch Broom*), . .	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
URR, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Nov. 30.
WICK, ...	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.
YTHAN, ...	From Sept. 10 to Feb. 24.	From Sept. 10 to Oct. 31

NOTE II.

Statistics of the Tweed for 78 Years.

Through the kindness of Mr Tait, Clerk to the Tweed Commissioners, and of the Berwick Salmon Fisheries Company, I am enabled to give statistics of the produce of the important river Tweed, for the long period of 78 years, if not with perfect accuracy, at least with a close approximation to it. These seem to me to be, in many respects, so interesting and instructive as to be well worth publishing.

Return of Salmon, Grilse, and Trout, taken in the River Tweed, from 1808 to 1885, both years inclusive. Perfect correctness is not claimed for these calculations, but they are generally believed in the District to be nearly accurate. Prior to 1857, the net fishing closed on the 14th October; from 1857 to 1859, on 30th September; and since 1859, on 14th September.

Year.	Salmon.	Grilse.	Migratory Trout.	Total.	Year.	Salmon.	Grilse.	Migratory Trout.	Total.
1808	37,333	25,324	21,033	83,690	1847	9,032	53,075	67,796	129,903
1809	30,949	32,679	21,402	85,030	1848	9,478	97,102	52,541	159,121
1810	40,782	49,332	23,963	114,077	1849	11,484	59,405	39,435	110,324
1811	38,566	24,852	12,439	75,857	1850	9,522	33,864	49,701	93,087
1812	27,711	82,538	33,604	143,853	1851	8,789	16,855	45,326	70,970
1813	35,273	61,643	36,319	133,235	1852	5,808	28,902	24,773	59,483
1814	58,890	73,521	34,161	166,572	1853	9,199	43,075	37,341	89,615
1815	41,044	97,734	39,653	178,431	1854	15,299	16,739	32,645	64,683
1816	54,041	120,594	62,074	236,709	1855	6,329	13,952	23,736	44,017
1817	36,199	66,694	37,131	140,024	1856	4,885	33,992	30,597	69,474
1818	39,267	59,848	37,346	136,461	1857	11,475	46,553	31,846	89,874
1819	31,895	71,813	47,386	151,094	1858	14,614	23,590	41,059	79,263
1820	28,288	116,495	61,454	206,237	1859	12,273	13,952	35,081	61 306
1821	34,657	55,291	61,339	151,287	1860	8,940	20,323	26,052	55,315
1822	25,250	47,266	70,413	142,929	1861	5,379	15,036	28,607	49,022
1823	12,122	50,794	49,934	112,850	1862	8,467	25,042	20,988	54,497
1824	23,644	73,381	71,161	168,218	1863	11,053	26,239	23,757	61,049
1825	18,957	61,506	59,531	139,994	1864	7,982	27,294	39,250	74,526
1826	12,040	85,378	59,203	156,621	1865	5,745	13,947	26,976	46,668
1827	10,725	54,034	43,441	108,200	1866	8,468	23,979	44,408	76,855
1828	13,511	39,248	39,563	92,322	1867	10,572	23,448	35,355	69,375
1829	5,350	34,773	64,630	104,753	1868	12,938	4,078	31,605	48,621
1830	7,415	66,520	37,486	111,421	1869	6,932	9,622	43,287	59,841
1831	13,197	43,244	77,037	133,478	1870	8,682	17,968	22,858	49,508
1832	9,709	41,411	77,308	128,428	1871	7,686	22,198	36,236	66,120
1833	10,428	93,939	60,178	164,545	1872	17,245	15,693	22,260	55,198
1834	16,106	59,262	48,852	124,220	1873	12,685	18,533	29,531	60,749
1835	22,642	87,707	82,229	192,578	1874	9,967	8,725	18,874	37,566
1836	16,957	34,846	63,616	115,419	1875	6,653	15,430	16,902	38,985
1837	14,577	60,429	57,426	132,432	1876	8,829	21,623	24,450	54,902
1838	12,785	78,577	40,876	132,238	1877	13,640	14,070	27,047	54,757
1839	15,508	35,449	56,124	107,081	1878	10,271	4,061	20,997	35,329
1840	10,920	52,117	56,342	119,379	1879	6,958	10,641	27,475	45,974
1841	16,464	71,254	64,672	152,390	1880	6,064	6,322	14,222	26,608
1842	19,198	109,935	76,071	205,204	1881	10,067	25,736	27,582	63,385
1843	17,777	66,293	54,209	138,279	1882	17,525	6,435	19,778	43,738
1844	21,830	88,003	99,256	209,089	1883	12,864	20,266	27,202	60,332
1845	18,962	69,752	54,355	143,069	1884	7,689	10,402	14,983	33,074
1846	17,878	37,500	38,679	94,057	1885	10,545	18,779	27,113	56,437

A brief study of the above Table will show that, so far as the Tweed is concerned, there has been a great decrease in the yield of the river during the last period of years as compared with the first. In the first period of 39 years, ending in 1846, the Tweed produced considerably upwards of 5 millions of salmon, grilse, and trout, or a yearly average of nearly 140,000—a yield which I believe to be greater than that of any river in the United Kingdom at the present day.

On four occasions during this first period, the river produced upwards of 200,000 fish in the course of a single year, and on three occasions upwards of 100,000 grilse in the same time. The largest number of salmon in any one year was in 1814, when 58,890 were captured; of grilse in 1816, when 120,594 were taken; and of migratory trout in 1844, when 99,256 were landed.*

During the second period of 39 years—from 1847 to 1885, both inclusive—only about 2½ millions of fish were captured or a yearly average of about 64,000 or less than half the average of the first period. The largest catch of salmon in any one year was in 1882, when 17,575 fish were got; the biggest take of grilse was in 1848, when 97,102 were captured; and the best year for trout was 1847, which yielded 67,796.

Some curious results with regard to the increase in the proportion of bull-trout to salmon and grilse in the last period of 39 years as contrasted with the first are afforded by the above Table. From 1808 to 1816, with the exception of 3 years, the number of trout was less than that of either salmon or grilse; and from 1808 up to 1829, the number of salmon and grilse combined always exceeded that of trout. 1829 was the first year when the trout exceeded in number the salmon and grilse combined. Between 1839 and 1885, this has happened in 18 years, and in one of these years—1869—the number of trout was considerably more than double that of salmon and grilse united—certainly not a healthy symptom of a salmon river. Yet it will be found, on reference to the Table, that although the take of salmon and grilse has so greatly fallen off in the last half of the period tabulated as to be often surpassed by the take of trout, that even the number of trout during the last period is not nearly equal to what it was in the first period; as up to 1848, the take of trout varied from 12,439 to 99,250 and averaged 50,000 annually, whereas since 1848, the largest take has been 49,701 and the smallest 14,222.

As was pointed out by Mr Walpole and myself in our Report of 1875 on the operation of the Tweed Fishery Acts of 1857 and 1859; there is a remarkable coincidence between the general drainage of the Tweed valley that followed upon the advance of money on easy terms by Parliament in 1846 to the landlords of the United Kingdom, and the falling off in the productiveness of the Tweed Fisheries. The character of the floods was changed. The land instead of being like a sponge which is gradually squeezed out became intersected by a network of drains which discharged the active rainfall into the river in a few hours. The river now rises suddenly and falls suddenly, instead of being in flood, more or less, for a week; so that migratory fish like salmon, which run in floods or rather when the water is beginning to subside and clear after a flood, have far less opportunity than formerly of entering the

* The most productive year on the Tweed of which any record exists was 1816. In that year, 54,041 salmon, 120,594 grilse, and 62,074 trout, or 236,709 fish were taken. But upwards of 208,000 fish were taken in 1820, and a take of 150,000 fish was not uncommon. Upwards of 58,000 salmon (excluding grilse) were taken in 1814 alone; and this take exceeds the aggregate taken in any 5 consecutive years since 1846. Again, the take of grilse in 1816, exceeds the take of the 8 years, 1867 to 1874. These surprising figures are corroborated by a letter in the *Edinburgh Magazine* of April 1888. The writer states the rental of the Tweed fishings for 14 miles from the mouth of the river at upwards of £5400, and the expenses of fishing at £5000, and calculates that to pay these sums the fishings must have produced 208,000 salmon annually, exclusive of grilse and trout. The highest rental of which we have any record was in 1816, when the fisheries were assessed at £13,705, 6s. 3d.

river. This cause, joined to the wholesale pollution of the Tweed and its tributaries, and the extensive poaching which prevails seem to render it improbable that the Tweed will ever again produce 200,000 fish in a year, as it occasionally did in the earlier years of the present century.*

NOTE III.

REPORT BY THE INSPECTOR OF SALMON FISHERIES ON LETTER FROM THE SOLICITOR TO THE FISHMONGERS COMPANY, LONDON, TO MR BERRINGTON, INSPECTOR OF SALMON FISHERIES FOR ENGLAND AND WALES, TRANSMITTED TO THE FISHERY BOARD BY THE SECRETARY FOR SCOTLAND, FOR THEIR OBSERVATIONS THEREON.

5TH SEPTEMBER 1888.

I have the honour to report that a letter, dated 26th July 1888, from Mr Charles O. Humphreys, Solicitor to the Fishmongers' Company, London, addressed to Mr Berrington, Chief Inspector of Salmon Fisheries for England and Wales, has been remitted to me by the Fishery Board for my observations thereupon.

Before proceeding to consider *seriatim* the suggestions contained in Mr Humphreys' letter, I think it is proper that I should, in the first place, direct the attention of the Board to his proposal that the provisions of the Bill, understood to be in preparation by the Lord Advocate, should be made 'general to the whole of the United Kingdom, and not exclusive to Scotland.'

With regard to this recommendation, I beg to observe that the laws applicable to the Salmon Fisheries in Scotland are so radically different in principle and practice from those of England and Ireland, that it would be almost impossible to assimilate them; and that it would be far better to have a separate bill for each division of the United Kingdom, instead of one attempting to reconcile the irreconcilable differences of principle which separate the Salmon Fishery law of Scotland from that of England and of Ireland.

To show how radical is the difference between the law of Scotland and the laws of England and Ireland, which are almost identical, I may mention that, while in Scotland there is no such thing as a public right of salmon fishing—all salmon fishings, whether in rivers, estuaries, or in the narrow seas, belonging either to the Crown or to the grantees of the Crown—in England, on the other hand, the salmon fishings in navigable rivers, and in the narrow seas, belong to the public as a general rule, the exception being where a proprietor can establish a right to what is termed a 'several fishery,' that is to say, to an exclusive right of fishing, presumably dating back to *Magna Charta.*

Then again, fixed engines, in the shape of stake and bag nets, are legal and in universal use around the coasts of Scotland, outside rivers and estuaries; whereas, in England and Ireland, they are prohibited as a general rule, though there are certain privileged fixed engines, such as those mentioned in section 41 of the English Salmon Fisheries Act of

* The statistics above given seem to show that high cultivation and other results of advanced civilisation which cannot be interfered with, are decidedly inimical to the productiveness of our salmon rivers; and that probably the only way to restore that productiveness and to maintain it is to follow the example of the United States and of Canada, and establish Government Hatcheries for the artificial breeding of the Salmonidæ.

1865. There are other important differences that might be mentioned, but those already stated seem to me sufficient to prove that Mr Humphreys' recommendation is one that should not be given effect to.

I now proceed to notice the special points which Mr Humphreys considers of material importance in any new Salmon Fishery Bill.

At the top of page 2, in the copy of his letter, he insists upon the necessity of prohibiting the 'taking, buying, selling, exposing for sale, or 'having in possession any unclean or unseasonable salmon, or any part 'thereof.' I understand that this is provided for in the Consolidation Bill, now in the hands of the Lord Advocate, in which another of Mr Humphreys' recommendations, namely, 'that the exportation of salmon 'from Scotland, during the close time, should be absolutely prohibited,' is also given effect to.

I think the following suggestions of Mr Humphreys worthy of the attentive consideration of the Board:—'(*b*) That a clause should be 'inserted, creating a venue, and making the consignor of unclean or 'unseasonable salmon liable to prosecution wherever such salmon is 'found or seized in the United Kingdom, without proof of the transit of 'the fish. (*d*) That the importation of Dutch and other salmon into the 'United Kingdom, during close time, should be prohibited, or, if 'permitted, be restricted under certain rules.'

With reference to this last recommendation, I may state that, in an able and elaborate report on the habits of the salmon, recently presented to the Minister of Marine and of the Colonies in France by M. Amédée Berthoule, and published in the *Journal Officiel de la Republique Française*, the reporter writes as follows concerning the importation of foreign salmon into France during the close season:—

'We strongly insist that such exceptions, injurious from every point of 'view, should be erased from our legislation; the public will not suffer, 'because it is exactly during the months of October, November, and December 'that the traffic in salmon is quite insignificant. For example, during the 'year 1887, when a million and a half of pounds of foreign salmon were sold 'in Paris, only ninety thousand pounds were sold in these three months 'combined.'

There is one suggestion in Mr Humphreys' letter of which I strongly disapprove. It is to the following effect:—'That an absolute and 'universal close season for salmon fishing, and the dealing in salmon, 'in the whole of the United Kingdom, should be definitely fixed.' The only thing to be urged in favour of such a recommendation is, that the hard and fast uniform close time thereby fixed would tend to prevent poaching, and would facilitate the detection of unseasonable salmon. But it is an outrage on the laws of nature, so far as our Scotch salmon rivers are concerned. To fix the same close time for the Tay and the Laxford, or for the Nith and the Naver, would be as unnatural as the doings of Procrustes, who cut short those of his captives who were too long for his bed, and violently stretched out those who were too short for it.

As a general rule, all our salmon rivers between the Hope—which flows into Loch Erribol on the North Coast of Sutherland—and Cape Wrath, and southward from Cape Wrath along the West Coast of Scotland and up to the head of the Scotch shore of the Solway Firth, are late; whereas almost all the rivers eastward of the Hope, between it and Duncansby Head, and southward between Duncansby Head and the Tweed, are early. The cause of this lateness or earliness I believe to arise from the relative temperatures of the fresh water of the rivers, and of the sea into which they flow. I stated this theory in letters to the *Scotsman* in October and November 1875; and afterwards more fully in my Treatise on *Salmon Fisheries* in Stanford's series of *British Industries*, and in the *Journal of the Scottish Meteorological Society* in 1878. The subject of early and late salmon rivers is also discussed pretty fully in my Third Annual Report to the Fishery Board (pp. 106–107). In the early rivers you find fresh run fish in December and January; in the late rivers they do not ascend until May or June; so that to apply the same annual close time to both groups would be preposterous.

Besides, we in Scotland have already had a most fatal experience of the baleful effects of a hard and fast uniform close time applied to all rivers, however different in physical characteristics, under the Act 9 Geo. iv. c. 39, commonly known as Home Drummond's Act. Those who wish to see the disastrous effects of this Act on the Scotch Salmon Fisheries, will find them fully and ably set forth in the late Mr Alexander Russel's well-known book, entitled *The Salmon.* I need here only refer to its effects on the Tay, which is an early river. Home Drummond's Act extended the netting season in all Scotch rivers to the 15th of September. The Tay had previously closed on the 26th August; so that the Act of 1828 gave three weeks longer netting. The ruinous results of this were soon made manifest. In 1828, the rental of the Tay was £14,574, 10s; in 1838 it had fallen to £10,285; and, in 1852, it reached its lowest point, £7,973, 5s. About this time the Tay proprietors, seeing the folly of the Act of 1828, resolved voluntarily to return to the old close time, commencing on the 27th August; and, in 1858, they applied to Parliament for a local Act, under which the net-fishing closed on 26th August. The good effects of this return to the old close time were speedy and satisfactory. In ten years from 1852 the rental rose to £14,080, 12s.; and in 1865 it had risen to £17,618, 0s. 7d.

I venture respectfully to press upon the Board the necessity of expressing their strong disapproval of Mr Humphreys' recommendation of a universal and absolute close time for the Salmon Fisheries of the United Kingdom.

I have the honour to be,

Your obedient Servant,

ARCHD. YOUNG.

THE FISHERY BOARD FOR SCOTLAND.

NOTE IV.

REPORT TO THE FISHERY BOARD BY THE INSPECTOR OF SALMON FISHERIES ON 'POINTS AND SUGGESTIONS WITH REFERENCE TO 'THE PROPOSED SALMON 'FISHERY BILL, BY MR. C. O. HUMPHREYS, SOLICITOR 'OF THE FISHMONGERS COMPANY, LONDON.'

3RD JANUARY 1889.

I have the honour to report that I have read over and carefully considered 'Points and Suggestions with reference to the proposed new Salmon 'Fishery Bill,' transmitted to the Secretary to the Fishery Board along with a letter from Mr Charles O. Humpreys, Solicitor to the Fishmongers Company, London.

In these suggestions Mr Humpreys proposes to have one Salmon Fisheries Act, applicable to the whole of the United Kingdom; and also, 'if practicable, to have one uniform and universal absolute close time for 'all the rivers in the United Kingdom.'

These suggestions of Mr Humphreys were brought before the Fishery Board in the end of September last and I had then the honour to lay before the Board a Report upon them which was printed and approved of by the Board. To that Report I still adhere and beg to refer to it for a detail of the strong reasons which exist for rejecting Mr Humphreys suggestions.

I think, however, that it would be quite practicable to draw up a short Bill applicable to the United Kingdom, for the special purpose of putting a stop to the illicit traffic in unseasonable salmon, and I have drafted the clauses which I think would be necessary in Scotland. At present, the English acts, though still defective in some particulars, give far greater power for putting a stop to such traffic than the Scotch. In England, for example, the buying, selling, offering for sale, or having in possession for the purpose of sale, any salmon caught during the extension of time for rod-fishing is absolutely prohibited; whereas, in Scotland, all these things are legal. Then the powers of search for and seizure of unseasonable salmon posessed by water-bailiffs, constables, &c., are much more stringent under the English Acts than under the Scotch; and it may farther be stated that, as a general rule, the English Acts throw the burden of proof on the person having unseasonable salmon in his possession; whereas the Scotch Acts, as interpreted by the decisions of the Courts, throw the burden of proof on the prosecutor. In these respects, the English Acts are unquestionably more efficient than ours.

Mr Humphreys' 4th suggestion relates to an extension and more precise definition of the powers of seizure possessed by the Fishmongers Company by their charter, in the city of London, the burgh of Southwark, and in the suburbs of the city of London, this humbly seems to me a matter for the consideration of the Fisheries Department of the Board of Trade, and not for this Board.

The 4th suggestion quotes from page 336 of Mr Willis Bund's 'Law 'of Salmon Fisheries in England and Wales,' and proposes that there should be a new definition of the terms 'unclean' and 'unseasonable' fish. I venture to think that these terms 'unclean and unseasonable 'salmon,' are pretty well understood in Scotland, though there is certainly no definition of them in the interpretation clause of the Salmon Fisheries Act of 1862. (See Stewart's 'Treatise on the Law of Scotland relating to Rights of Fishing,' pages 185-187).

Mr Humphreys' 5th suggestion is 'that it would be advisable in the 'new bill to give power to Municipal Corporations of Counties and 'Boroughs, through their sanitary inspectors, to seize unseasonable and 'unclean salmon, and authority to prosecute in such cases, even if the 'Fishmongers Company should receive a general power throughout 'England.' This seems a very good suggestion and powers in this direction should probably be given to our market authorities or sanitary inspectors in Scotland.

Mr Humphreys suggests that it would be advisable where *primâ facie* evidence appears as to the sender of the fish to admit such evidence in Courts of Justice as sufficient to call upon the person sending it to prove that he was not the sender; instead of having to call witnesses from a distance to prove the transmission of the fish from the country to London.

The following suggestion seems worthy of consideration, namely, that the power given by the 28 and 29 Vict. cap. 121, sect. 65, which creates a forfeiture of the fish, should be amended by also creating a forfeiture of the package and all its contents, and he gives as a reason for this that very often salmon are consigned with other fish, such as eels, whiting, &c., placed on the top of them, and in the seizure of the salmon it is not customary to seize the other contents of the box containing the salmon, nor is there any power to do so. By creating forfeiture of the box and its contents, it might prevent the sender, in many instances, transmitting small quantities of salmon at all, if the other contents of the package could be seized and forfeited.

He also proposes to make it an offence for fishmongers and others to deal with foreign salmon in the United Kingdom, unless they are in a condition to prove that the salmon is foreign, by means of a special form of declaration made at the place from which the fish is consigned, together with special marks upon the cases containing the consignment, leaving the *onus probandi* upon them, such declaration stating the number of fish and the sex and weight of each fish.

Mr Humphreys' thirteenth suggestion is, that the exportation of salmon 'should be absolutely prohibited during close time all over the 'United Kingdom, and not only from one particular portion. The word 'exportation should also include the consignment or sending of salmon 'from one part of the United Kingdom to another, such as from Scotland 'to England, or Ireland to England, &c.' I quite approve of this suggestion.

It is farther suggested that there should be a clause in the new bill making it an offence for railway servants to receive consignments of salmon from persons who give fictitious names, and that Fishery Boards should have increased powers for the purpose of putting a stop to poaching, and 'should be compelled to take means for the better preservation 'of the river by employing an additional staff during the close time and 'otherwise.'

With regard to this last suggestion for the compulsion of Fishery Boards to watch the river, and employ a larger staff of water bailiffs during close time, I can only say that in Scotland, our District Boards protect the rivers and prosecute poachers as far as the assessments which they are entitled to levy on the fishings will go. If they are to be compelled to go farther, they must have larger funds put at their disposal.

Mr Humphreys' closing suggestions are, that power of imprisonment as well as of inflicting a fine should be given for offences against the Act; and that 'the consignment of unclean or unseasonable salmon from Aberdeen 'or Hull, or other places, to London, should be liable to be prosecuted in 'any county and town through which the salmon passes, whether entirely 'by land, or partly by land and partly by water; as well as at the place 'from which the consignment is made, and the place to which it is 'consigned.'

I quite approve of both of these suggestions.

I have been thus particular in noticing the suggestions contained in Mr Humphreys' elaborate paper, in case any member of the Fishery Board should agree with him in thinking that it would be expedient and desirable to carry consolidation and centralisation so far as to have one Salmon Fisheries Act embracing the whole of the United Kingdom, and one universal and absolute close time for all salmon rivers, regardless of whether they are naturally late or naturally early. Personally, I have the strongest possible conviction that it would be difficult to imagine anything more impracticable and inexpedient than an attempt to construct a Salmon Fisheries Act which should apply both to England and Scotland. It is at all times a difficult task to engraft the laws and usages of one country upon those of another, where they have been, for centuries, essentially different. The extent and character of the waters over which rights of salmon fishing extend; the nature of the titles required to constitute a right of salmon fishing; the description of engines used; the constitutions and powers of Fishery Boards; the way in which money is raised for the protection of the fisheries; and many other things have long been essentially different in England and Scotland, and it humbly appears to me that any attempt to reconcile them by a consolidating Act would only end in failure and disaster.

I have the honour to be,

Your obedient Servant,

ARCH^D. YOUNG.

THE FISHERY BOARD FOR SCOTLAND.

NOTE V.

REPORT TO THE FISHERY BOARD BY THE INSPECTOR OF SALMON FISHERIES ON THE APPLICATION BY THE TWEED COMMISSIONERS TO THE SECRETARY FOR SCOTLAND FOR A GUNBOAT FOR THE TWEED.

12TH OCTOBER 1889.

I HAVE the honour to report that I have carefully read over and considered certain documents, relating to Memorials to the Secretary for Scotland from the Tweed Commissioners, praying for a gunboat to protect the mouth of the River Tweed against illegal fishing, transmitted to me for my observations thereon, in two letters from the Secretary to the Fishery Board, the first dated 26th September and the second 11th October 1889.

A Memorial from the Tweed Commissioners to have a gunboat stationed to protect the mouth of the Tweed against illegal netting, has already been under the consideration of the Fishery Board, and they reported against the prayer of that Memorial for the following reasons—because similar applications from other rivers had been refused, and it would be inexpedient to make an exception in favour of the Tweed; because the Board were not satisfied that the local authorities had done their utmost to put down illegal fishing in the mouth of the Tweed; because the Board do not consider it advisable to create undue friction between the public services and the fishermen; and because the Board have not hitherto acknowledged the principle that Government should protect the private interests of Salmon Fishery proprietors. The result was that the Secretary for Scotland informed the Tweed Commissioners that he did not feel justified in pressing the Admiralty for the services of a gunboat, until it has been shown that the responsible local authorities had done all in their power to check the evil complained of.

Since this refusal, another application for the services of a gunboat has been made to the Secretary for Scotland by the Tweed Commissioners. It is dated 13th September last, and narrates the steps taken by the Commissioners, since the refusal of their previous application, to cope with the organised bands of fishermen and others engaged in salmon poaching. An extra force of water bailiffs was not found sufficient, and it was therefore, resolved to get a steam-tug to carry a number of bailiffs, and to search for and destroy all nets and engines illegally fishing within the limits of the mouth of the Tweed; and it will be seen from the Report of the Tweed Commissioners, that no fewer than 175 nets, &c., were so taken during the last season; 103 being taken during the months of October, November, and December, when salmon come along the coast, and are ascending the river for the purpose of spawning. The expenses entailed by these measures for the repression of poaching were, however very heavy; and last year it is stated that they exceeded the revenue by £120, and the excess of expenditure over revenue amounted to £385, 15s. 7d. It must also be kept in view that the statutory assessment under the Tweed Acts is no less than 20 per cent. on the rental of the fishings, so that, accepting the above statements as correct, the local authorities on the Tweed appear to have spared no exertion and grudged no expense in order to carry out the provisions of the Acts which they were created to administer, and which it is their duty to enforce.

In their Memorial, the Commissioners farther state that they are in the course of making arrangements for the protection of the river during the close season which commenced on the 15th of last month; that they propose to carry out the same policy that they pursued last year in the sea district, namely, to rely chiefly upon suppressing poaching there by capturing nets illegally set, and thus rendering poaching unprofitable; and that they have already hired a steam tug-boat at considerable expense, which is to be at their command for several weeks. They point out, at the same time, that the resources of the Commissioners are already overtaxed, and that the present heavy assessment of 20 per cent. on the rental of the fisheries cannot be increased. They conclude their Memorial in the following terms:—

It has been reported, and the Commissioners have every reason to believe, that the fishermen on the sea coast and estuary of the river are preparing, whenever the close time for netting begins, at which time the boats, nets, and engines of the lessees and occupants of the fisheries must be removed and stored, to proceed with illegal fishing in a more determined manner than heretofore, and that quantities of nets have been manufactured for illicit use. The result of such a resolution on the part of the fishermen cannot be contemplated by the Tweed Board without concern, as from their antecedent conduct, and their present state of hostile determination, there is much reason to fear that they may employ their large keel boats in force to oppose the bailliffs while performing their duty at sea and on board the tug-boat, when a serious collision might ensue which might possibly lead to bloodshed or loss of life. The Commissioners have made all arrangements in their power, consistent with their means, to protect the interests under their management, and they cannot expect any material assistance from a landforce, such as the County or Burgh Police, in endeavouring to suppress lawlessness which can only be successfully combated at sea, they would, therefore, respectively venture again to solicit the assistance of the Government in the critical position in which they are placed. They hope and have no reason to doubt that, as on former occasions, the mere presence of one of Her Majesty's gunboats will be sufficient in itself to prevent any serious infraction of the law, and they earnestly trust that the desired help will be immediately afforded.

Since the above Memorial was forwarded, Mr Tait, Clerk to the Tweed Commissioners, has transmitted to the Secretary for Scotland, on the 5th of this month, a copy of a Police Report made to the Tweed Commissioners by the Superintendent of Bailliffs, on the 29th of last month, showing the course of events at the mouth of the river and along the seacoast. From this it appears that, between the 7th and 27th September, thirty hang-nets were seized and destroyed. A collision is also reported to have taken place between the bailliffs and a number of Burnmouth fishermen, who left Burnmouth in twelve boats in order to prevent the bailliffs from capturing certain nets illegally set in Burnmouth Bay. It is stated that these fishermen surrounded the cobles in which the bailiffs were, threw stones at them and struck them, and followed them to the steam-tug which came to their rescue.

From what has been stated above, it seems clear that the position now taken up by the Tweed Commissioners is this. We have done all in our power—we have even overtaxed our resources and got into debt –in order effectually to enforce the provisions of the Tweed Fisheries Acts which we were created to carry into effect. In spite of this, however, we find ourselves unable to put down the organised system of salmon poaching which is carried on during the annual close time in the mouth of the river and along the sea-coast by large bodies of fishermen, who have shown that they are ready to resort to violence, if necessary, in order to prosecute their illegal calling. Under these circumstances, we call upon Her Majesty's Government to assist us in vindicating the law, which, in spite of all our efforts, we have found ourselves unable adequately to enforce. We think that the mere presence of one of Her Majesty's gunboats, stationed near the mouth of the Tweed, would be sufficient to overawe the law breakers, and we therefore earnestly request it.

There is, it humbly seems to me, a good deal to be said in support of the position taken up by the Tweed Commissioners. It is their duty to enforce the Tweed Fishery Acts: and if the means at their disposal are too weak to put down organised and determined lawlessness, then Government, as the great protector of law and order, may legitimately step in and supply the assistance needed. On the other hand, if the Tweed Fisheries Acts are unjust and oppressive, they ought to be repealed, but by legal and constitutional means, and they should certainly not be suffered to fall into abeyance in deference to organised violence and lawlessness. If Government declines to afford assistance to the Commissioners in the present critical position of affairs, it seems not at all unlikely that the result will be that the law breakers, having the larger force on their side, will succeed in violating the law with impunity, and so make the Tweed Acts and their local administrators practically useless. No doubt, if a gunboat were stationed on the Tweed, a collision might take place between her and the poachers, and serious consequences might ensue; and the question to consider and decide is just this—Is it better to run the risk of such consequences, by enforcing the law, or to avoid all chance of such consequences by leaving the suppression of poaching entirely in the hands of the local authorities, who have publicly and repeatedly declared that they are unable to put it down?

About fifteen years ago, a gunboat was stationed in the Tweed for the protection of the fishings, and a collision took place between the poachers and some of her crew while engaged in assisting the water bailliffs, in which two of the former were wounded. Full details regarding this collision will be found in the second volume of the Report of 1875 on the operation of the Tweed Fishery Acts, by Mr Spencer Walpole and myself (pages 1 to 3), to which reference is made.

It is, perhaps, proper to state, in conclusion, that the limits of the mouth of the Tweed, about which such complaints have been made on account of their extending five miles seawards, or beyond the limits of the territorial seas were first fixed, more than ninety years ago, by the third section of the Act of 1797, the preamble of which is especially worthy of attention, as it clearly sets forth the reasons which induced the Legislature to fix the five-mile limit seawards from low-water mark, to which the Berwick fishermen so strongly object. It is as follows:—

Whereas, notwithstanding the provisions of the said Acts, idle and disorderly persons make a practice of fishing for salmon, grilses, salmon-trouts, and whitlings within the mouth or entrance of the said river Tweed, and by setting of bob-nets and other nets therein, intercept and obstruct the free passage of such fish into the said river, to the manifest detriment and loss of the proprietors and occupiers thereof; and whereas also, by means of sloops, vessels, cobles or boats constructed for the purpose of catching white fish at sea, or for other purposes, such idle and disorderly persons fish for salmon, grilses, salmon-trouts, and whitlings beyond and further towards the sea than the mouth or entrance of the said river extends, by such means not only destroying and dispersing the said fish (which at certain seasons of the year are known to make in shoals to the fresh water), and by such means driving many of them from the coast; for remedy of which, may it please your Majesty that it may be enacted, &c.

I have the honour to be,

Your obedient Servant,

ARCH[D]. YOUNG.

The Fishery Board for Scotland.

NOTE VI.

REPORT BY THE INSPECTOR OF SALMON FISHERIES TO THE FISHERY BOARD FOR SCOTLAND, ON THE RIVER LOSSIE.

18th March 1890.

I have the honour to report that, in accordance with the instructions of the Board, I inspected last week the River Lossie.

In my first Report to the Fishery Board I wrote as follows with regard to the Lossie:—

'The Lossie rises in a small loch called Loch Trevie, and falls into the 'Moray Firth at Lossiemouth after a course of 25 miles. Near 'the town of Elgin it is very much obstructed by several dams, which 'prevent the ascent of fish to the upper waters. It also suffers from 'pollutions. When I inspected the uppermost dam in March last, it had 'been partially broken down close to the right bank of the river by a flood-'but if it be repaired, its long sloping wooden face will be quite imprac; 'ticable, especially for spawning fish. The dam immediately below is in 'connection with a brewery. It is high and steep, and has no salmon pass. 'The lowest dam, which supplies water for Mr Johnston's tweed manu-'factory, is the highest, steepest, and worst of the series. It has no pass 'or ladder of any kind. These dams quite block up the river, and the 'lowest is not above 6 miles from the sea. There are no hecks at the 'tail-lades; and the tail-lade of Mr Johnston's mill, where it joins the 'Lossie, when I saw it, was nearly as large as the river. In very dry 'weather it must withdraw much the greater part of the stream in order to 'supply the mill. Stake and bag-nets are allowed to fish within 200 'yards of each side of the mouth of the river. The rental of the Lossie is '£185, and the sea fishing is in the hands of two proprietors—the Duke of 'Richmond and Captain Dunbar Brander. There is no District Board. 'The river itself belongs to the Earl of Moray, and is rented by Captain 'Dunbar Brander.'

What I then wrote, seven years ago, applies to the Lossie to-day. There are no fish-passes on the dams; no hecks at the intake and tail-lades; no District Board. The Bye-law regulating dams and lades might as well never have been past so far as the Lossie is concerned. The only difference since my first Report to the Board is that the sloping wooden face mentioned in the third sentence of the quotation has not been replaced. The apron of the dam is now of stone, but still there is no pass or ladder of any kind.

Bishop's Mill.

On the 13th March I inspected the three principal dams on the Lossie. Owing to the melting of the snows, the river was a good deal swollen—about 18 inches, perhaps, above its average level. Bishop's Mill was the first I examined. The dam which supplies this mill had a mere fringe of black water flowing over its crest. All below was white, broken water, down to the very foot of the apron of the dam. A fish-pass, however, might easily be made. There is no heck on the intake-lade connected with this dam, which flows under several houses, and, in the absence of a heck to prevent the entrance of fish into it from the river, it affords exceptional facilities for poaching. After emerging from its subterranean course under the houses, the lade flows for a considerable distance through open ground. But there is no heck at the tail-lade where it joins the river—at which point the tail-lade is about 20 feet wide. When the river is low, I have no doubt that this lade draws off by far the larger part of the water; and, there being no heck at the tail-lade, any fish that may be running up naturally enters the tail-lade, where there is the chief run of water, instead of ascending the river.

Deanshaugh Mill.

I next inspected Deanshaugh Mill. The dam here is not a serious obstruction; and, when I saw it, the water being high, fish might easily have got up at one corner of the dyke. But when the river is low, this and the other dams are said to have no water flowing over them, almost all the water going to the mills. There are no hecks on the lade.

Messrs Johnston's Tweed Mill.

The dam for the supply of this extensive mill is the highest and most obstructive on the river, and the lade connected with it draws off the largest quantity of water. The dam cannot be less than 7 feet in height, and the apron is a very steep one. The water flowing over it was white and broken. There is no fish-pass. But it would neither be difficult nor expensive to make a subsidiary dam at the narrowest point of the river, about 20 yards below the main dam, which would enable salmon and sea-trout to ascend easily. There are no hecks on the lade connected with this mill; and even in the high state of the river, there was as much water in the lade as in the river; and after a long course of dry weather I have no doubt that the river bed between the foot of the dam and the tail-lade must be nearly dry.

Captain Dunbar Brander's title to prosecute for contravention of the Bye-law.

Captain Dunbar Brander is both a proprietor of salmon fishings in the district of the Lossie and the lessee of all the salmon fishings in the river. But when he prosecuted for a breach of the provisions of the Bye-law (Schedule G), ordering hecks to be placed on every intake and tail-lade, the Sheriff found that he had no title to prosecute, and that such a prosecution could only be raised at the instance of the Clerk to a District Board. Captain Dunbar Brander states that as the other two proprietors on the Lossie decline to apply to the Sheriff of the county, in terms of the 3rd section of the Salmon Fisheries Act of 1868, to have a District Board constituted, he is utterly helpless under the above decision, and can do nothing whatever to enforce the provisions of the Salmon Fishery Acts, which he would do at once, if he had the title to prosecute.

Sections of the Salmon Fishery Acts concerning title to prosecute.

The 28th section of the Salmon Fishery Act of 1862, and the 30th section of the Salmon Fishery Act of 1868, provide that 'all offences under 'this Act may be prosecuted, and all penalties under this Act may be 'recovered, before any Sheriff, or any two or more Justices of the Peace 'acting together and having jurisdiction in the place where the offence 'was committed, at the instance of the Clerk of any District Board, or of 'any other person.' The 37th section of the Act of 1868 provides that 'any proprietor of a fishery shall be held to have a good title and interest 'at law to sue by action any other proprietor or occupier of a fishery 'within the district, or any other person who shall use any illegal engine 'or illegal mode of fishing for catching salmon within the district.'

These sections of the Acts, it humbly seems to me, are sufficient to entitle Captain Dunbar Brander to prosecute the mill-owners on the Lossie for contravening a Bye-law under the 15th section of the Salmon Fisheries Act of 1868, which inflicts penalties on every person 'who in any way 'contravenes any Bye-law.' I was informed that the section upon which the Sheriff relied in support of his decision that Captain Dunbar Brander is not entitled to prosecute is the 29th section of the Salmon Fisheries Act of 1862, which provides that 'in the event of any person refusing or 'neglecting to obey any Bye-law made by the Commissioners, or any 'regulation made by the District Board, the Clerk may apply to the 'Sheriff by summary petition in ordinary form, praying to have such 'person ordained to obey the same, and the Sheriff shall take such 'proceedings and make such orders thereupon as he shall think just.'

Case of 'Kennedy *v.* Murray.'

With regard to the validity of the Commissioners' Bye-law (Schedule G), ordering hecks to be placed on the intake and tail-lades of mills and manufactories, and the obligation on owners and occupiers to put such hecks on at their own expense, there cannot be the slightest doubt, since the decision in the case of 'Kennedy *v.* Murray, 8th July 1869,' in which it was held (1) that the Commissioners had power to make Bye-laws as to lades, dams, &c., although not in process of construction or repair; (2) that they had power to impose an obligation on owners and occupiers to execute the works embraced in the Bye-laws at their own cost; and (3) that the provision to the effect that the regulations to be made by the Commissioners should not interfere with any right held at the passing of the Act under royal grant or charter, or possessed from time immemorial, did not free the proprietor of a mill so held from the obligation under the Act to place hecks, &c., as specified in the Regulations.

I have the honour to be,

Your obedient Servant,

ARCH^D. YOUNG.

P.S.—Since writing the above, I find a case ('Blair *v.* Sandeman & 'Lumsden, 20th July 1869') in which the decision of the Court of Session may possibly be considered adverse to Captain Dunbar Brander's title to pursue. In that case, a complaint under the Summary Precedure Act, 1864, for contravention of Bye-law relative to the construction and alteration of mill dams, &c., concluding for penalties, was dismissed as incompetent, on the ground that proceedings for enforcement of Bye-law must first be taken under section 29 of 25 and 26 Vict. cap. 97, the respondent, failing obedience, being then liable to be proceeded against under section 28 of that Act, as kept in force by section 30 of 31 and 32 Vict. cap. 123.

With reference to the above it should be mentioned that if the decision of the Sheriff at Elgin should be appealed from, and should be confirmed by the Court of Session, the result would be that, in those Districts where there are no District Boards, and consequently no District Board Clerks, no proprietor of Salmon Fisheries could prosecute for the contravention of any Bye-law—a most unfortunate result, when it is considered that more than half the Fishery Districts in Scotland have no District Boards.

It is somewhat curious that a decision has recently been given in England which will have something like the effect on the English inland fisheries, which a confirmation of the Sheriff of Elgin's judgment would have on the inland fisheries of Scotland, and which is thus commented on in *Land and Water* of 10th May last in a leading article entitled 'A 'Danger to our Fisheries':—'A decision given by the Queen's Bench 'Division last week, in the case of Andrews *v.* Hamlin, is of more than 'ordinary importance to Fishery Boards. The precise facts of the case are 'not worth discussing, but the decision is of far-reaching importance. In 'effect it decided that no one but Fishery Boards can prosecute for 'penalties under the Salmon and Fresh-water Fishery Acts. It had 'previously been decided that under the Sea-fishery Act, only the officers 'appointed under it could sue for penalties, and that is now followed up by 'this, that only the Fishery Boards can sue for penalties under the Salmon 'and Fresh-water Fishery Acts, the reason for the decision being that it is a 'rule of law, extending from the time of Lord Mansfield, that when the 'penalties under a statute are given to any particular body that body alone 'can sue for them. Under the Salmon Fishery Act, 1873, sec. 62, if the 'penalty is recovered on the information of a Fishery Board, or of a person 'authorised by a Fishery Board, the whole of the penalty goes to the Board, 'and, taking hold of this provision, the Court held that this gives the 'penalties to the Board; and that, therefore, the Board alone could sue for 'them. The first thing that strikes us is, how is the law to be enforced in 'places where there is no Fishery Board? If only Fishery Boards can sue 'for the penalty, then who can do so in places like the Thames, where there 'is no Board, the Thames Conservancy not being a Fishery Board, within 'the meaning of the Act, or in places like Essex, Cambridgeshire, or the 'other places on the coast of England, where there is no board? The logical 'conclusion seems to be that in these places the Act cannot be enforced. 'At first this may seem to be a very small matter, but it is of a far more 'widely-reaching nature than is imagined, for the penalties of the Fresh-'water Fisheries Act can only be enforced by means of the Salmon Acts, 'and if there is no Fishery Board the penalties of the Fresh-water Fishery 'Act cannot be enforced at all. So that in the parts of England where 'coarse fish are mostly found the Act that has been passed for their pro-'tection will be a dead letter. Where no Fishery Board exists a still more 'serious difficulty exists; for instance, for some part of its course half the 'Avon that flows by Stratford is in Worcestershire and half in Warwickshire. 'The Worcestershire half is in the Severn Fishery District, the Warwickshire 'half is not; the result is that a man can be prosecuted for fishing in one half 'the stream, but not in the other half. Or further, if a man catches fresh-'water fish and offers them for sale out of a fishery district, he cannot be 'prosecuted. Hitherto the idea has been that the law prohibited the sale 'of fish during close time throughout the whole of England and Wales, now 'the law is that this only applies to fishery districts, and that outside 'fishery districts a person cannot be prosecuted for selling fish during close 'time; for Fishery Boards have no jurisdiction outside their districts. 'And as only Fishery Boards can enforce the Act, and they cannot enforce 'it outside their districts, all throughout the Thames watershed, in London, 'Reading, and Oxford, fresh-water fish can be sold without any difficulty. 'There is another view of the question that is still more important. There 'are certain streams, like the Test and the Itchen, that are full of trout, 'and the landowners have always refused to have such streams made into 'fishery districts. We have often thought they were wise in doing so; but 'the result is startling; there being no Fishery Board, none of the penalties 'under the Act of 1861 can be enforced. There is nothing to prevent the 'trout being speared, roe being used for bait, or trout taken all the year 'round. It is rather a judgment on the selfishness of some of the landowners. 'They would not come into a district for the common good, but stood out 'for their own ends in refusing to have common action. The consequence 'is that they now find themselves delivered over as a prey to the poacher.

'But all these are but minor matters compared to the stop this decision 'has put to that most important work that the Fishmongers' Company 'has been doing for some years past in connection with our salmon fisheries. 'As is well known, the Fishmongers' Compauy, with a zeal that does them 'the greatest credit, have taken up the question of the traffic in salmon 'during close time to France and the Continent, and have succeeded, after 'much hard work, to a great extent in reducing that traffic, the result 'being to cause a reduction of poaching in the winter on our rivers. The 'effect of the decision of the Queen's Bench Division is to put an end to 'this work of the Fishmonger's Company. They are not a Fishery Board 'appointed under the Fishery Acts, and, according to the Lord Chief-'Justice, they cannot, therefore, take proceedings under these Acts. 'There is for the future no one that can do this in London, and next close 'season, unless something is done, the trade in unclean salmon will go on 'with France without any restriction. Anything more unfortunate 'it is difficult to imagine. The good work the Fishmongers' Com-'pany have done for some years past will be all undone, and our rivers 'will be far more poached than ever. We do not hesitate to say that 'unless something is done in the course of the present Session to empower 'it to stop the trade in unclean salmon in the course of next autumn and 'winter, our fisheries will receive a blow that it will take years to get over. 'The question arises, What is to be done? If the Board of Trade had 'really the interests of the fishermen at heart, they would have moved in 'the matter, but we see no sign of their doing it. We presume they know 'of the decision, which, no doubt, they are considering if it applies to any-'thing, or is of any importance, not recognising that it upsets the whole of 'our system of fish preservation. Some member might get up in Parlia-'ment and ask if the Board had heard of the case, and what they intended 'doing; but, while they are considering, precious time is being lost. We 'feel that immediate action should be taken, and our great hope is that 'the Fishmongers' Company, who have already done so much for the 'fishermen, will come to our aid at this pinch. A short Bill of one clause, 'saying that where no Fishery Board exists any person could recover the 'penalties under the Fishery Acts, is all we want, and we feel sure that 'the Fishmongers' Company have enough members of Parliament in their 'ranks to push such a Bill through at once. If it is said that the power 'should not be given to private persons, then give it to public bodies like 'this great company; but it must be given to some one, and unless given 'at once it will be too late.'

NOTE VII.

REPORT BY THE INSPECTOR OF SALMON FISHERIES TO THE FISHERY BOARD FOR SCOTLAND ON THE CRUIVES ON THE RIVER EARN.

22ND APRIL 1890.

I have the honour to report that, as directed by the Fishery Board, I inspected the cruive dike at Dupplin, and the other cruive dikes on the River Earn, on the 7th and 8th of April 1890.

The Earn is one of the largest and most important tributaries of the Tay. It has its source in Loch Earn. Its length, measured along the windings, is 46¼ miles—13⅜ from Loch Earn to Crieff Bridge; 24¾ from Crieff Bridge to Bridge of Earn; and 8⅛ thence to its junction with the Tay. In many places it winds greatly, especially from Forteviot to Bridge of Earn. It receives a good many tributary streams, such as the Ruchill, the Lednoch, the Turret, the Machany, the Ruthven, and the May.

There are several obstructions in the course of the Earn, three of them being cruive dikes belonging to proprietors who have titles to fishing by means of cruives. These cruives seem to have attracted the attention of the Tay District Board a long time ago; as in a 'Note of Particulars 'requiring attention in any new Salmon Fisheries Act, agreed to at a 'meeting of the Tay District Board of 13th May 1870,' which is printed in the Appendix to the Report of 1871 by Messrs Buckland and Young, on the effect of recent legislation on the Salmon Fisheries in Scotland, there is the following paragraph:—'The Board recommend to the Com- 'missioners to take into consideration the subject of cruives, which is at 'present in an unsatisfactory state.'

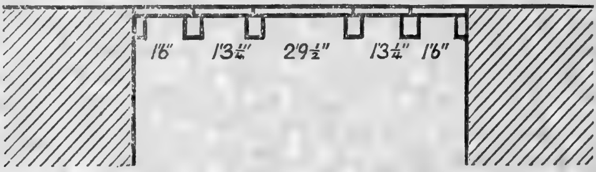
All cruives—and I have inspected all the cruives in Scotland—confer more or less of a monoply of the fishings on their possessor, and, more or less, injure the fishings of the proprietors above them; and these proprietors are entitled to insist that the provisions of the Bye-law (Schedule F) which regulates the construction and use of cruives, shall be strictly observed; and it is the duty of the District Board, where there is one, to see that these provisions are enforced.

On the other hand, it should be remembered that the right to cruive fishing, when legal, is held by such ancient and special titles, and has been so often recognised and sanctioned by statute, that it cannot be done away with without giving compensation to the owner or owners of the cruives.

Where the title to cruive fishing exists and is generally recognised, the question with regard to it is a very simple one. The right exists, and the only restraints upon it are the provisions of Schedule F, which forms part of the Salmon Fishery Acts of 1862 and 1868, and which regulates the construction and use of cruives. Given the right of cruive fishing, no one can interfere with it, provided it is carried on in conformity with the provisions of the Bye-law. But if it is not so carried on, then the owner renders himself liable to the penalties for the contravention of a Bye-law, in terms of the 15th section of the Salmon Fisheries Act of 1868.

The lowest and most important cruive dike on the Earn is that at Dupplin. The dike here is very long and very old, stretching across the river in a curved form, and having a length of about 200 yards. It has a perpendicular height of at least 10 feet, with a very steep gradient or slope. There is no fish-pass on it, nor is it necessary that there should be one, as it is a cruive dike. But, except in very high water, it is a great obstruction to the upward progress of fish. It is not constructed and worked in terms of the Bye-law in many respects; and here it should be remembered that cruives being in the character of monoplies, all the provisions of the Bye-law regulating them must be viewed as *strictissimi juris*, that is to say, they must be carried out to the very letter.

The cruive box at Dupplin is 15 feet long by 10 feet in width. The gradient of the apron below sill is 1 in 14. On the down stream side of the upper hecks there are four wooden posts, each 5 inches square, placed at irregular intervals, which I think are illegal, and most decidedly interfere with the ascent of salmon, even when the hecks are removed, and the inscales removed or kept open for the space of 4 feet; the intention of the Bye-law clearly being that, during the annual and weekly close times, the cruive should present no obstruction whatever to the upward progress of fish. The following sketch, for which I am indebted to Mr James Ritchie, C.E., Perth, will show the position of these posts, and the spaces between them.



The upper hecks, though 3 inches apart, are not bevelled off as directed in the Bye-law, and are 6 inches in the up and down way of the stream, and 3¼ inches thick, instead of, as directed in the Bye-law, 'not more 'than 2 inches thick, and not more than 4 inches broad in the up and 'down way of the stream.' The opening between the extremities of the inscales was 7 inches, and the space between the bars of the inscales varied from 1¾ to the statutory 2 inches.

I am pleased to be able to say that the factor and agent of Lord Kinnoul, when this was pointed out to them, at once intimated their willingness to have the cruive altered so as to be in conformity with the provisions of the Bye-law.

It was stated to me, on my first visit to the Earn, when the river was too high to admit of my inspecting the Dupplin cruive, that the cruive dike had been heightened 2 feet in defiance of the provisions of the Bye-law, the last section of which provides that 'no cruive shall be so 'altered as to create a greater obstruction to the free passage of fish than 'at present exists.' The date of that Bye-law is 19th July 1865; and the head keeper at Dupplin, who has been there for thirty-five years, most distinctly declares that the dike has never been heightened in his time.*

There is another cruive on the Earn, above Dupplin, at Strathallan, about 6 miles below Crieff, which is a very serious obstruction to the passage of salmon; and, still further up, there is the dam at Dornoch, where Lord Willoughby has a right to cruive fishing. But he has in the

* Since writing the above, I have received from Messrs Condie & Co., writers, Perth, the precognitions of James Irvine, head keeper, Dupplin, and of David Taylor, contractor, Perth, to the effect that, though Dupplin dike has been more than once restored in part, since the date of the Bye-law (Schedule F), in order to repair the damage done by floods, it has never been heightened, but always kept at the same level.

most liberal manner done away with the cruive, and has incurred considerable expense in putting a fish-pass on the dike. Unfortunately, the fish-pass has been very badly constructed, with far too steep a gradient, so that, instead of facilitating the ascent of salmon over the high and steep dike on which it has been placed, it is really about the worst place in the whole extent of the dike for fish to surmount. This dike is in a curved form, and probably the best way to assist the ascent of salmon would be to build a short subsidiary dam, about 4 feet high, below the main dam across the curve, which is on the right bank of the river.

Between Dornoch dike and Strathallan there are mill-dams at Colquhalzie and Millearn, neither of which have fish-passes. But they are not very serious obstructions when the river is in such a state as to induce salmon to run. Still the fact remains that in about fifteen miles of river there are three cruive dikes—all of them steep and lofty—and two mill-dams.

I have the honour to be,

Your obedient Servant,

ARCHD. YOUNG.

THE FISHERY BOARD FOR SCOTLAND.

NOTE VIII.

THE M'DONALD FISHWAY UNSUITABLE FOR SCOTCH RIVERS.

The M'Donald Fishways at Ashbank and Westfield Dam Dykes, on the River Ericht, give ample proof that until some plan be devised for keeping sand and gravel from entering the tubes, they are totally unsuited for the mountain streams of Scotland. The construction of the M'Donald Fishway is a long square-made spout, made of strong planking with two floors or decks. The under floor or deck being filled with square wooden tubes running from the left side of the spout to the right side in a direction slanting downwards, so that the lower end of the tubes strike the right side of the spout several feet lower down. The lower end of the tube then turns upwards, and the water which has acquired considerable force by this time is delivered in an upward direction on to the top floor or upper deck (which is the deck the salmon pass over), where it strikes against the water coming down the upper deck, the meeting of the opposing currents causing the water to remain slack, thus allowing the salmon to pass up. Four or five of the tubes at the top of the fishway are filled directly from the river, and the remaining tubes all the way down are filled by the water from the upper deck, the water being caught by a sort of flange at the top of each tube. The water thus caught runs down the tube in the lower deck, and is again thrown in an upward direction on to the upper deck, and this is repeated all the way down.

Now what inevitably happens in these tubes is this. Whenever a spate comes, be it large or small, a lot of sand and gravel is hurled down the streams into and over the fishway, finding its way into these tubes, passing along them right enough until it reaches the lower end of the tube at the elbow or upward turn. Layer after layer of sand and gravel whirl about in the corner (the strength of the water although considerable, being unable to throw the sand and gravel on to the upper deck) until it ultimately gets filled up, and the tube gradually gets filled up. The flow of water from the tubes of course is then at an end, and the water on the upper deck, having now no check by the water thrown backwards from the tubes, rushes down unobstructed at a fearful pace, especially when on a gradient of 1 in 4, as it is on these fishways, and no salmon could possibly go over them.

This was discovered after the first flood had passed over these fishways, and two things were done to prevent it in future but neither of the two have had the desired effect. One of the plans was putting crossbars of iron and wire across the entrance to each tube, so as to prevent stones, etc., from getting into them, the fault of this plan being that if the grating was close enough to prevent sand and gravel from entering the tubes, it also prevented the water from getting in in sufficient quantity to give it any force when it reached the far end of the tube, and it simply oozed up at the right side of the top-deck and has no effect in checking the downward flow of water, and besides, the grating gets covered with leaves and other rubbish, and soon stops the entrance of water into the tubes almost entirely. Another attempt was made to avoid this at Westfield Fishway by means of two iron hecks or gratings, one being placed right across the stream some distance in front of the top of the fishway, and another running up and down stream, the top end reaching within a few feet of the one across stream, the gap being left to allow the salmon to get out; the result of this was that the heck across the stream caused an eddy behind it, where the sand and gravel whirled round and found its way down the opening left for the salmon to get up. The only plan I could suggest as a remedy against this filling of the tubes with gravel, is to have the top end of the fishway 3 or 4 feet above the bed of the river, and the objections to this is that it would only be during high floods that there would be any water in the fishway at all; in fact, I see no practical remedy for this, and until such a remedy is discovered the M'Donald Fishway as at present constructed is unsuited to our Scotch rivers.

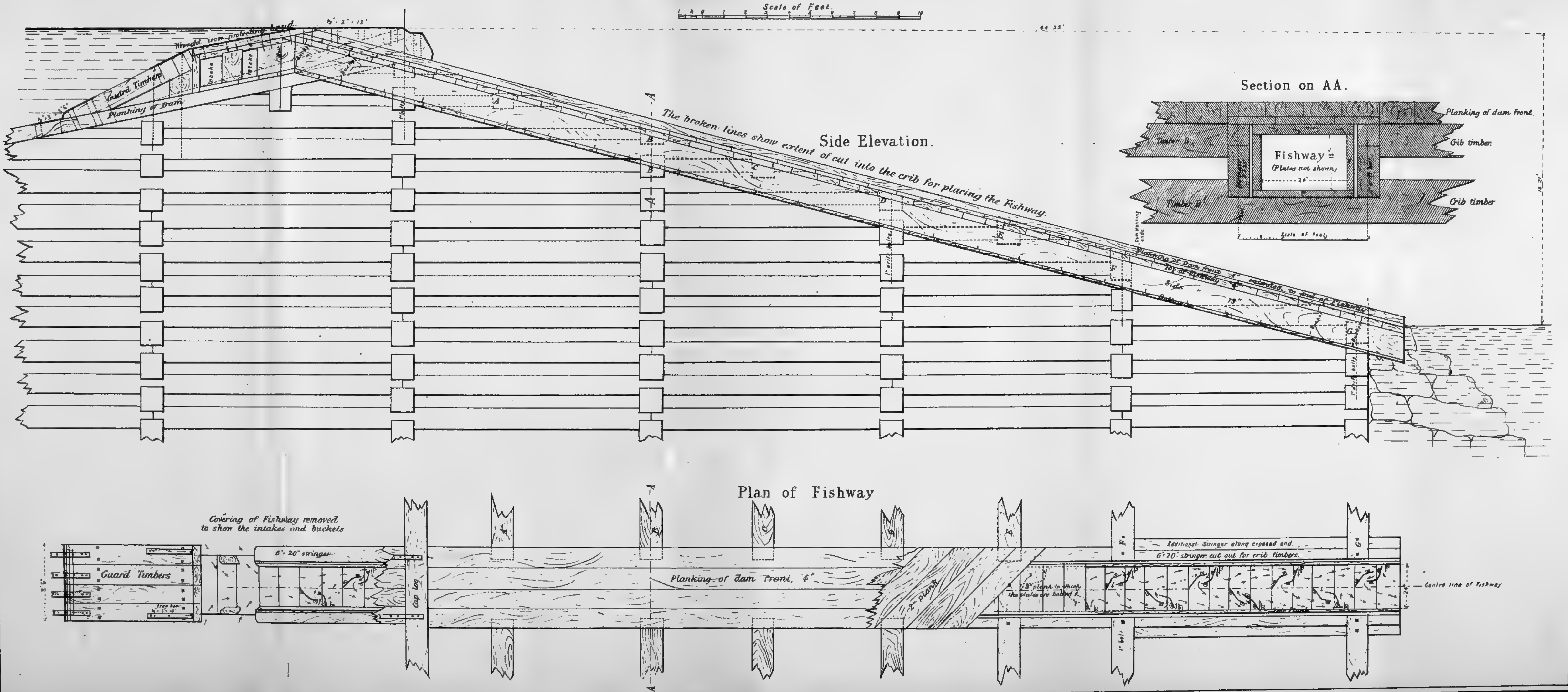
ALEX. LUMSDEN,
Superintendent, Tay District Board.

NOTE IX.

Design of an Improved Macdonald Fishway sent to Mr Young, by Colonel Marshall Macdonald, Washington, head of the Fisheries Department of the United States, in answer to a Letter from Mr Young pointing out the defects of the Macdonald Fishways on the Ericht.

McDonald Fishway System.

Plan of construction adapted to Crib Dam with sloping front.



NOTE X.

MALLOCH'S PATENT AUTOMATIC FISH PASS.

My invention has for its object to make automatic fish passes, to be placed or built at dikes, weirs, or natural falls on rivers or streams.

Figure 1 on the sheet of drawings is a section through the pass when the sluice is shut. Figure 2 is an elevation of the lower end of pass. Figure 3 is a perspective view of the pass when the sluice is open.

The pass to be 6 feet wide and 3 feet deep at the lower end, or more according to the depth of water in the stream, boarded on the top and sides A with planking.

The sides of pass to be fitted into the dike D and securely fixed, and also into the natural bed of the river B. The pass to be strongly bound together with angle iron R bolted through the planking, and the pass besides being securely fitted into the dike, to be strongly bound with iron straps V bolted into the stonework of dike. The lower portion of the pass to extend down the stream to the distance shown on drawings or further if found necessary.

A beam C to be placed across the mouth of the pass, fitted into the natural bed, but kept sufficiently high that not less than 7 inches of water will be kept inside the pass when the sluice is open, where this cannot be done the natural bed of the pass to be dug out to a sufficient depth.

A sluice S to be put across the bottom of the pass of the dimensions shown, made of planking bolted together with iron rods having screws and nuts on ends. The sluice to be let into grooves in two upright posts P, which will be firmly fixed into the bed of the stream having cross beam at bottom of each and struts from same to posts.

A cross beam K connecting the two upright posts at top and forming rest for three strong iron pulleys L and chains connected to loops at ends of iron plates F bolted to the sluice.

The chains to be passed over the pulleys and attached to iron straps binding trough T on opposite side of pulleys from sluice. This trough to be made sufficiently heavy to almost lift the sluice when no water is pressing against it.

A 2-inch metal pipe M to be placed at the top of the fall let into the water and carried down the pass and up the side of upright post and have a spigot at end J turned down over end of trough. The top of trough being lower than inlet at top of fall the water will pass through this pipe and fill the trough.

When the trough is about filled it will be sufficiently heavy to raise the sluice from the water, and will itself fall down on the top of the pass to the position shown on the perspective view. To prevent a too sudden fall of the trough on the pass, spiral springs Q, one on each post, are fixed in the top of the grooves for the sluice striking against. The water supply to trough falling on slanting iron scoop N attached to post, will then be thrown over the trough and pass into the stream and the water in the pass will have a clear run through it. The water in the trough will gradually run out through a small spigot O in the end of trough at the bottom of same. When the trough is about empty the sluice will again fall down and dam back the water in the pass and thus fill it, and all fish that are inside will escape over the fall to the upper reaches of the stream or river.

The supply pipe to trough is much larger than the spigot for emptying the trough so that the pass may remain open much longer than the time it is shut.

The whole work to be painted a dark green colour.

The pass and sluice, &c. may be wholly constructed of iron.

The sides and top of the pass may be built of stone or concrete, and the sluice and uprights, &c. made of iron or wood.

The pass and sluice, &c. may be constructed of any combinations of these materials.

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FIGURE 1.
SECTION THROUGH PASS WHEN SLUICE IS SHUT.

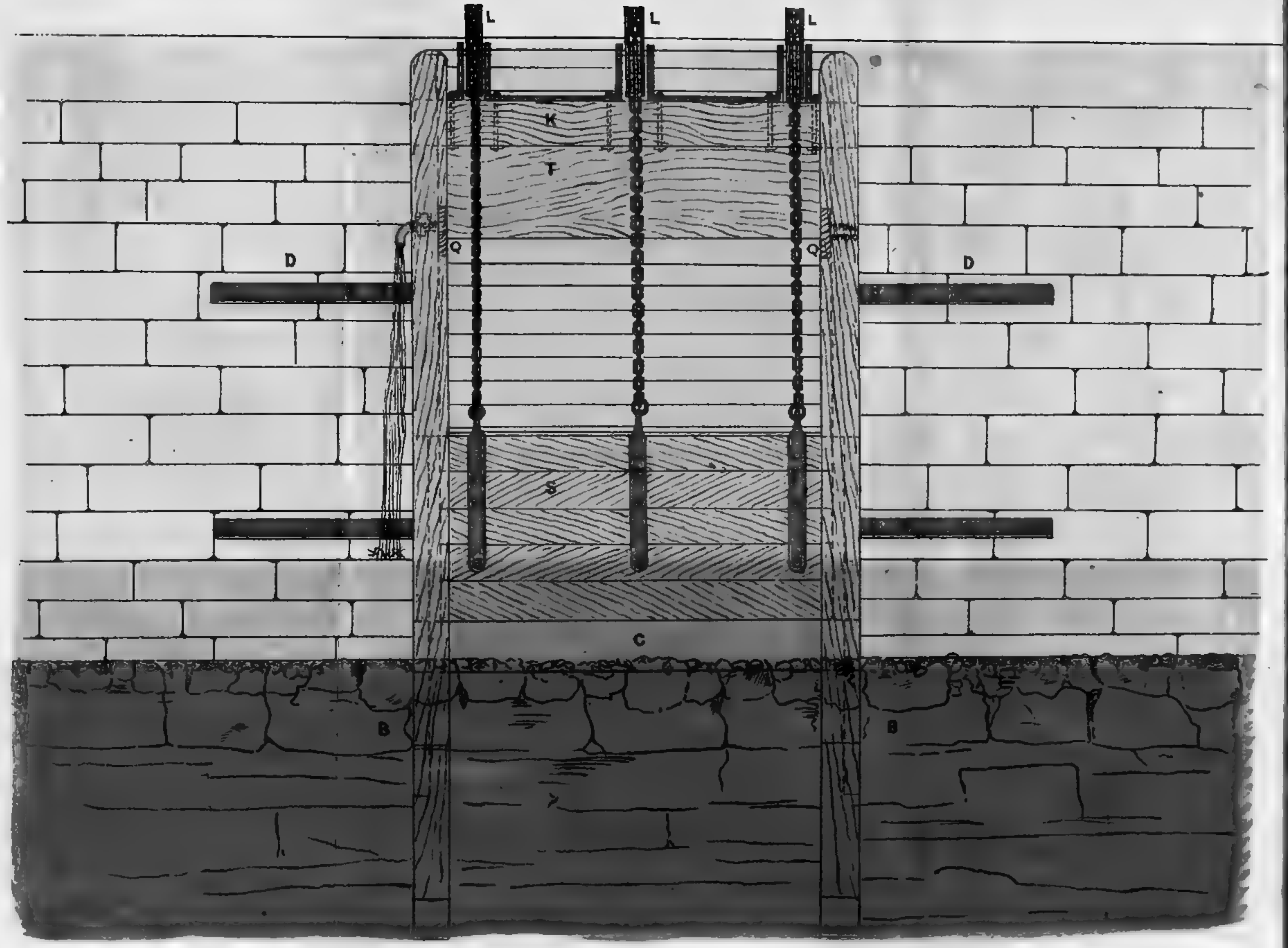

FIGURE 2.
ELEVATION OF LOWER END OF PASS.

209 HIGH STREET, PERTH.
JANUARY 1890.

DRAWING OF MR. P. D. MALLOCH'S AUTOMATIC FISH PASS. **Patented 1890.**

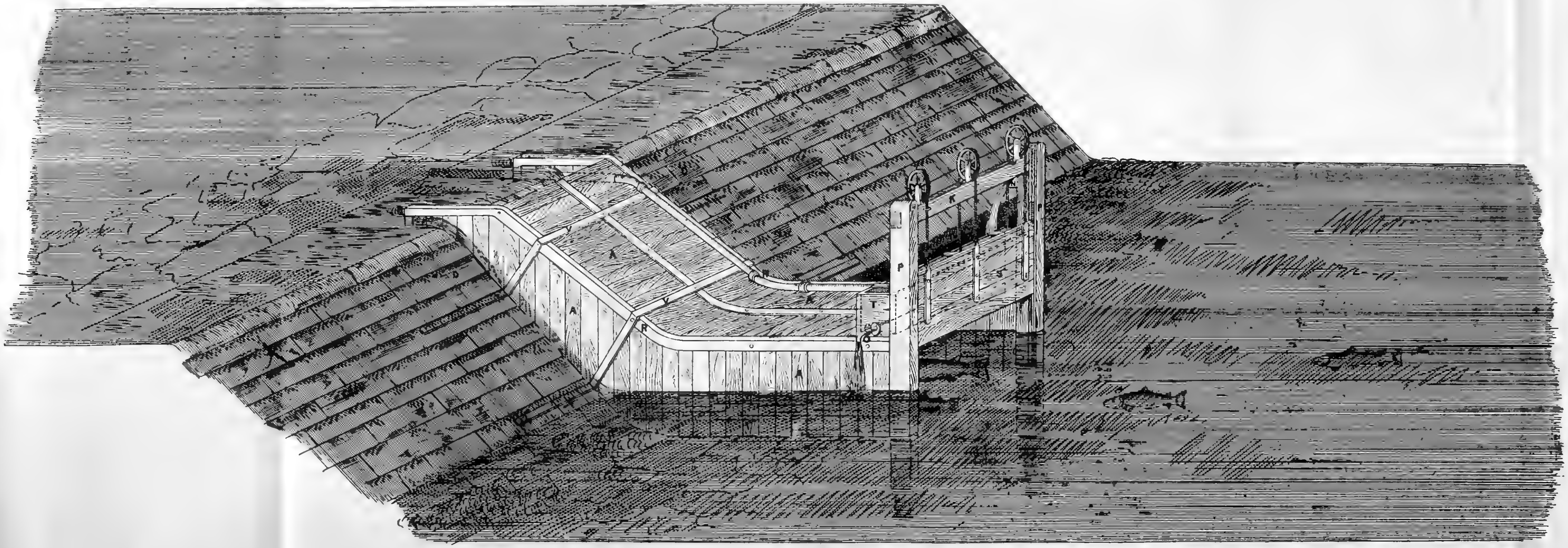

FIGURE 8.

PERSPECTIVE VIEW OF PASS WHEN SLUICE IS OPEN.

...mentary—*continued.*

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EIGHTH
ANNUAL REPORT

OF THE

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WITH APPENDIX CONTAINING REPORT TO THE BOARD BY THE INSPECTOR OF SALMON FISHERIES.

Being for the Year 1889.

IN THREE PARTS.

PART I.—GENERAL REPORT.
PART II.—REPORT ON SALMON FISHERIES.
PART III.—SCIENTIFIC INVESTIGATIONS.

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CONTENTS.

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EIGHTH ANNUAL REPORT.

TO THE MOST HONOURABLE

THE MARQUIS OF LOTHIAN, K.T.,

Her Majesty's Secretary for Scotland.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 1*st May* 1890.

MY LORD MARQUIS,

We, the Members of the Fishery Board for Scotland, have the honour to submit the Board's Eighth Annual Report, being for the year 1889.

The subject matter of the Report has been arranged, as was done last year, in three parts, under the following titles:—

Part I.—General Report.
Part II.—Report on Salmon Fisheries.
Part III.—Scientific Investigations.

We have the honour to be,

MY LORD MARQUIS,

Your Lordship's most obedient Servants,

THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEO. H. M. THOMS.
ALEXR. FORBES IRVINE.
J. R. G. MAITLAND.
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WILLIAM BOYD.
W. ANDERSON SMITH.

PART III.—SCIENTIFIC INVESTIGATIONS.

GENERAL STATEMENT.

This, the third part of the Annual Report of the Fishery Board, deals with the trawling experiments of the 'Garland,' the distribution of immature fish, and other scientific inquiries which have been carried on by the Board during 1889. An account is also given of the scientific and other fishery work carried on elsewhere in the United Kingdom, and in the United States, Canada, Newfoundland, Holland, Spain, France, Denmark, Norway, Italy, and Germany.

The scientific work has been carried out and the scientific report prepared by Dr T. Wemyss Fulton, the Secretary for Scientific Investigations, acting under the direct instructions of the Board.

During 1889, besides other investigations, the following were carried on:—The influence of beam-trawling in the territorial and adjacent waters; the distribution of immature flat-fish and round-fish at various distances from shore, and in various depths of water, and their capture by different modes of fishing; the spawning and spawning grounds of the food-fishes; the food of fishes and their migrations; the pelagic ova and the pelagic fauna which provides nutriment for the young fishes when hatched; the cockle beds at Barra, in the Hebrides; the development of the clam, which forms a valuable bait, and the development of skates.

A large part of the above investigations have been made on board the Fishery Board's steamer 'Garland,' which is under the command of Captain R. E. Simpson.

It is now generally recognised that an important part of scientific fishery work ought to consist in endeavouring, by artificial propagation, to increase the natural yield of valuable but declining fisheries. This principle has been carried into practice by the United States Fish Commission to a very large extent, and with most encouraging results; thoroughly equipped hatcheries for sea fish and lobsters have been established there for years. A well-known hatchery has also been in operation at Flödevig in Norway for several years, and was lately reconstructed and enlarged under the auspices of the Norwegian Government. By voluntary effort, a hatchery has been erected by the Marine Fisheries Society at Grimsby, with the view of developing the resources of the great English fisheries in the North Sea. Last year the Newfoundland

Government erected a large hatchery at Dildo Island, Trinity Bay, for the hatching of sea-fish and lobsters; and it is proposed to form similar establishments at other parts of the Newfoundland Coast.

The Board, with a like object in view, and after due inquiry, selected Dunbar as on the whole the best adapted and most convenient place on the Scottish Coast for such an institution. The water is of great purity, and there exist natural creeks which could readily be transformed into rearing ponds. Through the intermediation of Colonel E. Malcolm, C.B., the War Office courteously granted a suitable site on their ground at the Castle Park.

Provost Brand, the magistrates, and council of the burgh have also given every facility for the purpose in view, and have ceded to the Board the use of the natural creeks and the ground required. The aim of the Board is supported by the hearty sympathy of the fishermen, who quite understand its importance. It was not found possible, however, from the want of the necessary money, to proceed last year with the enclosure of the creeks and the formation of the rearing ponds and buildings. But a small Marine Laboratory has now been acquired at Dunbar, in proximity to the creeks proposed to be utilised; and the Board hope that a special sum will soon be granted by the Government to enable them to complete the works necessary for the hatching and rearing of lobsters, and of turbot, soles, and other flat fishes. The Board are making arrangements for the establishment of a lobster enclosure at Brodick, Arran, as supplementary to a hatchery, which will enable them to obtain an abundant supply of ova for replenishing the exhausted grounds on the East Coast, while at the same time allowing of the restocking of grounds on the West Coast.

The Board's Marine Laboratory at St Andrews continues under the able direction of Professor M'Intosh, F.R.S., who devotes his services gratuitously to the fishery investigations. Under the auspices of the Board Professor M'Intosh and Mr Prince have recently completed the most extensive research yet made on the development of the food-fishes, and the habits of the young.

The following is an account of the chief Scientific Investigations undertaken during last year.

1. The Influence of Beam Trawling.

The Trawling Experiments of the 'Garland.'

The Special Report dealing with this subject will be found at page 22. During 1889, the 'Garland' conducted the trawling experiments in the Firth of Forth, St Andrews Bay, and at the Stations at Montrose, Aberdeen Bay, in the Moray Firth, and at the Orkney Islands. In 1889, 153 hauls of the trawl were made, as compared with 90 in 1888. In addition, a large number of special observations were carried on along specially selected lines in inshore and offshore waters, and at important fishing grounds lying off the mouth of the Firth of Forth and in the Moray Firth.

The 'Garland' is not large enough to venture far from shore, especially during the unsettled weather at the end of winter and in spring, when from the presence of spawning shoals off the coast the observations are of special value. It was rendered possible, however, through the courtesy of Mr James Johnston of Montrose, to send Mr Scott, one of the naturalists, to accompany the 'Southesk,' or other steam trawler belonging to Messrs Johnston and Sons, during fishing operations at offshore grounds; and much valuable information was thus obtained. The incapacity of the 'Garland' to carry on the work at moderate distances from shore forms a serious hindrance to the prosecution of the trawling and other fishery investigations.

On 26th July 1889, the Herring Fishery (Scotland) Act came into operation. This Act excludes beam-trawling from the territorial waters of Scotland, and from certain bays and areas specified in the Schedule.

The results of the trawling experiments of the 'Garland' are given in full detail in the special report. During 1889, it was found that no increase, but, on the whole, a decrease, occurred in the closed waters, and likewise in the open waters adjacent. The decrease was mainly in the migratory round fishes, especially haddock and whiting. The former follows the shoals of spawning herring into the territorial waters to feed upon their spawn; but last year the inshore herring fishery in the Firth of Forth was a failure, and a great falling off of haddocks occurred. There was a slight decrease in most of the flat fishes at the majority of the stations; but an increase of many at several stations and in the open waters. The flat fishes which have increased in numbers are especially plaice and flounders; lemon soles and witch soles have diminished. Plaice has everywhere increased in numbers. As is shown in the report on the distribution of immature fish, the territorial waters form nurseries for young plaice; it is reasonable to infer that by the protection of these nurseries this valuable food fish is increasing in numbers, both on inshore and offshore grounds.

It appears that the results obtained in 1887 were exceptional, and that experimental observations must be carried on for a number of years. The results of concurrent investigations carried on on board the 'Garland' into the food of fishes, their spawning, and the distribution of the young, show that great and important differences prevail among the various food-fishes, and that it will be necessary to take these differences into account. A few instances may be given on the East Coast. The lemon sole and the witch sole spawn offshore, their young are most abundant beyond the territorial waters, and in 1889 their numbers had diminished. Flounders spawn inshore and offshore; their young are chiefly found inshore, and their numbers have increased. Plaice spawn exclusively offshore, but their young are practically confined to the territoral waters, gradually migrating to offshore waters as they increase in size; and they have augmented in numbers. It is shown in the report on immature fish that the greater proportion of young fishes inhabit the zone just beyond the territoral waters; further inquiries may show the desirability of limiting the capture of immature individuals of certain species in such localities. On the other hand, it may be shown to be desirable not in any way to protect certain species of little value, such as dabs, which compete with more valuable food-fishes.

The experimental observations on the capture of immature flat fish show that these are captured in great numbers by the beam-trawl, but in much smaller proportions, and these chiefly belonging to the least valuable kinds, by line fishermen.

Special Fishery Statistics.

The special statistics collected by the Scientific Department of the Board are discussed at page 26.

In 1889 the line fishermen along the East Coast of Scotland landed 55,566 tons of line-caught fish, or above 1000 tons more than they did in 1888. These amounts were landed by 7535 boats in 1888, and by 7380 boats in 1889. On the other hand, beam-trawlers landed in 1889, on the East Coast, 11,370 tons of trawled fish, or above 800 tons less than they did in 1888. There are no reliable statistics of the number of beam-trawlers engaged, for a considerable number of English trawlers work off the Scottish coast and land their fish at Scottish ports, but these vessels are not included in the official returns. Considering the whole East Coast, there was an increased amount of round fish landed by line fishermen, and a diminished amount of flat fish; while there was a decrease in the quantities both of round fish and flat fish landed by trawlers. When the northern and southern sections of the coast are compared, it appears that while in 1889 line fishermen in the northern section landed a larger quantity of round fish and a smaller quantity of flat fish, they landed less round fish, and a considerably greater quantity of flat fish in the southern section, where beam-trawling has been longest interdicted. Beam-trawlers in the northern section landed larger quantities of both round fish and flat fish in 1889 than in 1888; and in the southern section smaller quantities both of round fish and flat fish. The statistics referring to this subject are graphically represented on Plate II.

The statistics dealing with the productiveness of the territorial waters to line fishermen, show that in 1889 the average catch per boat was greater than in 1888; the increase was most marked in the Montrose and Stonehaven districts, and was mainly due to an increased catch of cod. In the southern districts there was relatively a greater increase in flat fish than in the northern.

Other statistics refer to the Buckhaven haddock and cod fishery carried on in the territorial waters. They show an increase in large haddocks, and a decrease in small haddocks and whitings in 1889, as compared with 1888.

Special statistics were obtained as to the relative proportions of small and large fish landed by fishermen and beam-trawlers; these are dealt with more in detail in the Report on Immature Fish.

2. The Distribution of Immature Sea Fish and their Capture by various Modes of Fishing.

The capture of immature sea fish by various modes of fishing has on several occasions been made a subject of inquiry by Royal Commissions. At the present time it is engaging the close attention of the fishery authorities in France, Holland, Belgium, Denmark, and other countries; and, by the intermediation of the various

Governments concerned, an International Conference, under the auspices of the National Sea Fisheries Protection Association, has been called to meet in London to consider the subject. Hitherto there has been very little scientific evidence regarding the distribution of immature individuals of the various kinds of sea fish at different depths and distances from shore, and as to their capture by the various engines and appliances used in fishing.

Dr T. Wemyss Fulton, who, by the instructions of the Board, has carried on, by means of the 'Garland,' the most extensive and elaborate inquiry into this subject yet made, gives the results of the investigations in a report in the present volume. A review is given of various Acts of Parliament dealing with the subject since the reign of Edward III., and of the results of the inquiries of recent Royal Commissions. The fundamental question as to what an immature fish is, has, for the first time, been determined, 13,000 fishes having been examined and measured for the purpose. It is shown that the maximum size of immature fish varies very much according to the species; that an immature fish may be a large fish, and a mature fish may be very small. The results of this part of the inquiry show that those portions of the Italian Fishery Law of 1877, and of the Danish Fishery Law of 1888, which render penal the sale of certain fish under a fixed size, are not based on accurate data as to the immaturity of the fish dealt with. Tables are given showing the maximum size of immature fish. The distribution of immature fish varies very much according to the species. Dr Fulton shows that the territorial waters, and especially those portions quite near the shore, where the bottom is sandy, serve as nurseries for plaice, and that young plaice are practically absent beyond the territorial waters. Very young lemon soles, flounders, dabs, cod, and whiting also frequent the inshore waters in great abundance. In September 1889, the 'Garland' discovered the presence of a vast shoal of young whitings, from three to five inches long, in the Firth of Forth. These young whitings covered the bottom for a distance of 36 miles, and were computed to number over 230,000,000. They were not found offshore, and their presence in the territorial waters shows to what an extent this region serves as a nursery for young fish. Very young cod and dabs may exist in large numbers at a distance from shore; immature haddocks are there most abundant. It does not appear that on the East Coast immature turbot, brill, or ling specially frequent the territorial waters. At offshore fishing grounds there is a paucity of immature fish, except dabs and haddocks. Tables are given showing the distribution of immature fish at distances from shore up to 22 miles, and in various depths of waters.

The proportions of immature food-fishes captured by various modes of fishing are detailed. In regard to the beam-trawl the conclusions are—(1) that, especially in inshore waters, immature flat fish and round fish may be captured in large numbers by the beam-trawl; (2) that relatively more immature flat fish than immature round fish are taken; (3) that on the East Coast of Scotland immature flat fishes of all kinds are caught by the beam-trawl; but especially, in regard to absolute numbers in inshore waters, immature plaice and dabs; and in regard to relative proportion of immature to adults (a most vital point) chiefly plaice, flounder, lemon soles, turbot, and brill; (4) that very large numbers of immature cod are captured, especially inshore; also considerable quantities of immature whitings and gurnards, and fewer immature haddocks; (5) that the ordinary trawl-net used by large beam-trawlers probably, in ordinary circumstances, captures very few fish under 6 inches in length; (6) that the size of the mesh of the trawl-net, *per se,* exerts a most important influence on the proportion of immature fish captured; and (7) that the majority of the immature fish captured by the beam-trawl, as now used, would probably perish if returned to the sea.

Dr Fulton points out that shrimp-fishing, and especially shrimp-trawling, involves the capture of large numbers of immature flat fish, and the destruction of many, and recommends that an exhaustive scientific inquiry be made into this subject.

The conclusions in regard to line-fishing are—(1) that considerable quantities of immature round fish, especially cod, and at some seasons haddocks and whitings, are taken by hook and line; but, except in the case of cod, the proportion of immature to adults is not great; (2) that comparatively few immature flat fish are caught by hook and line, and then mainly the commoner and less valuable kinds.

The capture of immature fish by bag-nets, weirs, seines, &c., is also described.

In dealing practically with the wasteful destruction of immature food-fishes, Dr Fulton points out the necessity of carefully distinguishing between the different species; and shows how difficult it will be to preserve immature fish from capture and destruction by the beam-trawl, as that engine is now employed. Enlargement of the mesh of the net will not alone solve the difficulty. The recommendations are, briefly:—that an inquiry should be made as to the retention of vitality by the various kinds of immature fish brought up in the trawl, in order to ascertain their chances of survival if replaced in the sea; the protection of nurseries whose areas are capable of definition, as in the case of immature plaice in territorial waters; the preservation of valuable flat fish under a certain size; and the establishment of hatcheries for sea fish, as in Norway, Newfoundland, and the United States. A simple method is explained, by which fishermen and trawlers might add to the fish supply by fertilising the ova of ripe fish when captured.

3. Inquiries into the Food, the Spawning, and Spawning Grounds and the Migrations of the Food-Fishes.

An important branch of fishery investigations comprises those into the food, reproduction, and habits of the food-fishes. The value of the work of the Board in this department has been recognised by continental fishery authorities, who, as may be seen from the section on contemporary fishery work, are organising similar inquiries. These investigations have been made almost entirely on board the 'Garland.'

The Food of Fishes.—This important subject is dealt with in an elaborate report by Mr Ramsay Smith, B.Sc., based upon the examination of many thousand food-fishes. Such fishes live chiefly upon crustacea, annelids, echinoderms, and molluscs, and upon one another. There are great differences, however, as to the proportions of the organisms selected as food by different fishes. The whiting, for instance, is a very dainty feeder, and lives chiefly upon fish, such as young herrings, sprats, sand-eels, and its own species. The chief food of plaice consists of worms and molluscs; while the lemon sole which lives also largely upon worms prefers crustacea to molluscs. The witch sole lives almost entirely upon worms. Haddocks are not so particular, and devour crustacea, echinoderms, molluscs, annelids, herring spawn, and young fish. The proportions of the dietary vary to some extent at different places and at different seasons.

These observations upon the food of edible fishes will ultimately demonstrate what organisms are valuable as fish-food and what are not; the proportions in which the various invertebrates compose the dietary of fishes; and the possibility of success in introducing a valuable food-fish, such as the English sole, in a locality where it is absent or scarce. They will also show in what way the organisms forming the food of fishes may be protected and improved. Investigations are being made by the 'Garland' as to the question of the destruction of the food of fishes by the beam-trawl.

The Spawning and Spawning Places of the Food-Fishes.—In a report on this subject Dr T. Wemyss Fulton describes the results of the observations made during the year, many thousands of fishes having been examined on board the 'Garland,' and all along the coast, and the duration of their spawning period in most cases determined. The duration of the spawning season varies much in different fish; and in some cases fully grown adults appear not to spawn every year.

These investigations have proved that the old idea that the majority of the food-fishes, and especially the valuable flat-fishes, come into bays and estuaries to spawn is not correct. The only fishes which appear to spawn within the territorial waters are the almost valueless dabs, the flounder, and to some extent the gurnard. These fish spawn almost anywhere, both offshore and inshore. It is different with the more valuable fishes. The majority of the food-fishes congregate at the spawning time in immense shoals on the East Coast at grounds lying from about eight to above twenty miles from shore, in what may be termed the extra-territorial spawning zone. This is the case with plaice, cod, haddock, whiting, &c., which do not spawn at all in the territorial waters on the East Coast. The young fishes are not, as a rule, found at the place of spawning, the floating pelagic eggs being carried by the surface currents chiefly shorewards. The 'Garland' has obtained large numbers of these eggs, and of the larval fishes, in the tow-nets. Dr Fulton gives reasons for the belief that the selection of a particular offshore ground for spawning depends upon the set of the surface currents at the spawning season; these carry the floating eggs during their development to the zones where food for the young fishes is most abundant and shelter most readily secured. The value of the investigations into the spawning grounds of the food-fishes, the distribution of immature fish, &c., would be very greatly increased if the Board were in possession of a vessel capable of carrying on such work at distances from shore. It is very desirable to have a thorough examination made of the great fishing banks lying off the Scotch coast.

The Proportional Numbers and Sizes of the Sexes among Sea Fishes.—In another paper Dr Wemyss Fulton gives the results of his inquiries into this subject, based upon an examination of 12,666 fishes. Females are as a rule much more numerous than males; the proportion of females to each 100 males is, among sea fishes generally, 228 females to 100 males; among lemon soles the proportion is 297; among plaice, 138; flounders, 84; long rough dabs, 842; turbot, 196; cod, 133; haddock, 188; and gurnard, 409. The females are also as a rule larger; but the male is the larger among cod, haddock, and a few other fishes.

Experiments on the Migratory Movements of Sea Fishes.—A series of experiments, designed to ascertain the migrations of the food-fishes and their rate of growth, were carried on last year on board the 'Garland,' chiefly in the Firth of Forth and St Andrews Bay. Such experiments are also being carried on in Denmark. Brass labels, bearing a number, were attached to about a thousand fishes, which were then replaced in the sea. Several of the plaice and cod, and one of the skates were recaptured, in some cases after the lapse of six months. The results serve to show that in correspondence with what has been ascertained in regard to the distribution of immature fish, that plaice under twelve inches in length do not quit the territorial waters during the offshore spawning. They also serve to show that fish do not probably travel such distances as has been supposed, nearly all having been recaptured within a mile or so of the place where they were returned to the sea.

The Pelagic Fauna, Pelagic Ova, and Larval Fishes.—Professor W. C. M'Intosh, F.R.S., has made an elaborate study of the pelagic fauna of St Andrews Bay. The first portion of his report on this subject was published last year; the second part, dealing with the distribution of the invertebrate organisms which form the food of many larval and other fishes, will be found in the present volume.

Professor M'Intosh has also in another paper described the ova of the food-fishes and the larval and post-larval stages obtained in the 'Garland's' tow-nets at various parts of the coast. These include the ova or larvæ of plaice, lemon sole, flounders, dabs, cod, haddock, ling, whiting, &c.; and they constitute an indispensable part of the general study of the reproduction of the food-fishes.

Additions to the Fauna of the Firth of Forth.—Mr Thomas Scott, F.L.S., one of the naturalists of the Board, while superintending the prosecution of the trawling experiments of the 'Garland,' and the inquiry into the food of fishes, has made large collections of the invertebrate fauna. Mr Scott's industry is indicated by the fact that in his paper describing these, he records over 80 species of organisms not previously recognised as belonging to the Firth of Forth. Several of these are for the first time recorded for the East of Scotland; some are new to Britain and a few new to science. This paper is illustrated by two plates.

The Invertebrate Fauna of Inland Waters.—The first part of the investigation into the invertebrate organisms present in Scottish lochs and inland waters is given in the present volume; that, namely, by Mr Thomas Scott, F.L.S, dealing with Loch Coulter and its affluent. While scientific inquiries into the nature and distribution of the fauna of fresh-water lakes have been made with noteworthy results abroad, as in Italy and Switzerland, no systematic investigation of the kind has been carried on in this country. These inquiries will throw light upon the special organisms that form the food of trout and other fresh-water fishes. An investigation of the fauna of Lochleven—so famous for the excellence of its trout—is now being proceeded with.

The Presence of Anchovies in Scottish Waters.—Dr T. Wemyss Fulton gives the results of the inquiries made into the recent incursion of anchovies (*Engraulis encrasicholus*) into Scottish seas. During November, December, January, and February anchovies were captured in herring-nets at various places along the Scotch coast, from Dunbar to the Hebrides.

This temporary incursion of anchovies, while of little importance from a practical fishery point of view, is of some zoological interest.

4. The Development of Food-Fishes and Molluscs.

The Development of the Scallop.—Dr J. H. Fullarton, one of the Board's naturalists, has completed a research on the embryology and development of the scallop, which is commonly known to the fishermen of the Firth of Forth and district as the clam, and is largely used by them as a most excellent bait. No study of the development of the clam had been made previously. While its reproduction may extend over a considerable portion of the year, it reaches its maximum in July and August. Dr Fullarton succeeded in artificially fertilising the ova and tracing the various changes which the developing ovum undergoes, and the various stages of the embryo. Immense numbers of free-swimming larvæ were captured in September in the tow-nets used over the scallop-beds. This paper is accompanied by four plates.

The Development of the Common Skate.—Dr John Beard, one of the naturalists, has been engaged on a study of the development of the common skate. Although the skate is one of the commonest elasmobranch fishes of our seas very little has been written of its life-history and development. The development of the embryo of the common skate as it lies within its 'purse' at the bottom of the sea occupies a long period, probably nine or ten months; it is much more rapid in summer than in winter. The eggs may be deposited throughout the year, but chiefly in March and April. Dr Beard furnishes a minute description of the egg-cases or 'purses' of the various species of skates and rays, and of the various stages in the development of the embryo. He discusses the function of the temporary external gills, so characteristic in advanced stages of development; and, in opposition to some other authorities he gives good reasons for the belief that they are purely respiratory in function, and are adapted to the special conditions under which the developing embryo is placed. Dr Beard's paper is illustrated by three plates.

Hybridism among Sea Fish.—In the Notes and Memoranda will be found an account of certain ingenious and interesting experiments made by Mr Thomas Scott, F.L.S., on board the 'Garland,' on the artificial fertilisation of the ova of certain species of sea fishes with the milt of other species, sometimes widely separated zoologically.

5. Shore and Bait Fisheries.

The shore fisheries, comprising lobsters, oysters, mussels, &c., require constant care and supervision.

Mussel Bait.

The supplies of mussels are of special importance to the line fishermen of Scotland. From quite recent information obtained from various parts of the coast it is evident that the supplies of Scotch mussels are very inadequate for the needs of the fishermen. On some parts of the coast, where extensive mussel beds exist, supplies are fairly abundant. The Fifeshire fishermen obtain nearly all their mussels from Newhaven. Mr Mair, the fishery officer at Anstruther, states that at the beginning of the year a reduction was made in the cost of the carriage of mussel-bait from Newhaven to the east of Fife. Previously the cost was sixpence per cwt. for a ton or more than a ton, and eightpence per cwt. for quantities below a ton. Now the charge per cwt. is eightpence for three cwts. or under, sixpence for three or more cwts., and fourpence halfpenny for three tons or over. This is an important concession in favour of line fishermen. There is also a reduction in the cost of carriage of clams. At Stonehaven the supply has been abundant and of excellent quality, but expensive. The mussels are obtained chiefly from Holland, *viâ* Leith, and cost the fishermen about £2, 15s. per ton. Irish mussels cost about £2, 10s. per ton, but they are not so good in quality, nor so free from dirt and refuse as the Dutch mussels. At Peterhead, owing to the increased prosecution of haddock fishing, there has been a scarcity of mussels; those used are obtained chiefly from Holland and the North of Ireland. The Irish mussels cost about £2, 6s. per ton, about £1, 8s. of which represents the cost of carriage. The Dutch mussels, which are preferred, cost the fishermen about £3 per ton. On account of the great demand and the scarcity, prices have lately risen considerably. The fishermen at Fraserburgh complain of the inferior quality of the mussels and the increase of price. In the Moray Firth Dutch mussels are now largely used. They are of excellent quality but expensive. A ton costs £3, 3s. at Macduff. Irish mussels cost about £2, 10s., but are considered less economical, as a ton of Dutch mussels will bait fully double the number of lines that a ton of Irish mussels will. At Buckie mussels are obtained from Tain, Dundee, Port-Glasgow, Newhaven, Hull, Ireland, and Holland. Dutch mussels landed at Buckie in February 1890 sold at £3, 10s. per ton.

On the East Coast, therefore, the Dutch mussel is now being very largely used as bait. The fishermen say they form the best bait they have had for many years; but complaint is made of their great cost.

In the opinion of the Board it is very desirable to do everything possible for the relief of the burdens placed upon the fishermen of Scotland by the present great cost of mussel bait. For this purpose it is necessary that the working of existing beds should be placed under proper regulations, and that every effort should be made to extend the system of bed-culture, which was introduced with so much success at Montrose, through the intelligent enterprise of Mr James Johnston. Abstract recommendations are of little utility unless means are at the same time provided by which these recommendations can be carried out. As in the cultivation of oysters, an essential condition of success is that mussel-beds should be farmed either by lease or otherwise (as in France, Holland, and elsewhere) by individuals, corporations, or associations, and that they should be worked under regulations drawn up by the Board.

The Bouchôt system of mussel-culture should also be carefully tested. The second Bouchôt erected at the Eden estuary has now been completed, and will serve to show whether or not this system could be introduced more largely with a prospect of success, or whether its cost will outweigh its advantages.

Oysters.

It has been shown elsewhere that the Scottish oyster fishery has been for a long period of years gradually declining. At one time large quantities of oysters were exported from Scotland. There can be little doubt that this fishery will not be revived until measures similar to those adopted in the United States, Holland, France, and other countries are introduced into Scotland; that is to say, the systematic cultivation of the oyster under simple proprietary conditions, which will ensure the protection of the oysters, and the preservation of the produce to the oyster-culturist. Many efforts have been made, and a great deal of money has been lost, in attempts to introduce systems of oyster-culture into Scotland without a proper preliminary knowledge having been obtained as to the suitability of the locality chosen for the experiment. The results of such attempts in the Firth of Forth and elsewhere have shown that it by no means follows that because extensive oyster beds once existed in a given place, they may now without much trouble be re-created.

The 'Garland' is at present engaged in the West Coast of Scotland, under the direction of Mr W. Anderson Smith, who has special knowledge and experience of oysters and oyster-culture, and Dr J. H. Fullarton, in making an investigation into the remnants of the once famous oyster-beds there, in order to ascertain, if possible, the causes of their depletion, to determine their physical and biological conditions, especially in relation to the fall of spat, and to discover places likely to be suitable for oyster-culture.

During last autumn Dr J. H. Fullarton visited the oyster-culture farms in France and Holland, and he gives in the present volume an interesting account of the various systems employed.

Questions of ownership of foreshore rights and rights to neighbouring bottom are comparatively simple in France and Holland. In France the State is proprietor of all the foreshores and of the sea bottom within the territorial waters, and it does not divest itself of this right. Areas are let to capitalists and to fishermen, the State exacting a rental therefor, and granting certain privileges of fishing on natural banks to the seamen of its marine. In Holland there is a slight difference. The Government owns most of the oyster and mussel ground; but there are cases where it is difficult to say whether the Crown, as representative of the public, or the proprietor of the *ex adverso* land, is proprietor of the fishery banks. The system of letting the ground differs in the two countries, though in some respects it is similar. Before 1870 the oyster industry of Holland hardly existed, but in that year the Yerscke banks in the East Schelde were let to a society of fishermen for a period of eighteen years, at an annual rental of £2250. The fishermen, however, were incapable of managing this new venture, and on their application they were relieved of their obligation, and the banks were let to a society of merchants at a rent £500 less than was paid by the fishermen. At present these banks are let on lease, which expires in 1915, and the annual rental to the Dutch Treasury is £30,000. The beds are parcelled out in rectangular lots of limited size—2 acres being the usual extent—and these are, on a fixed and advertised date, let by public auction for a limited number of years. The result of this system is an increasing revenue to the Dutch Treasury. In France the Naval Department, or Ministry of Marine, are charged not only with Admiralty duties, but also with the management of the fisheries. In parcelling out the oyster ground the French, like the Dutch, divide it off by means of stakes into lots of from half an acre upwards. These lots are either given to the conscripts who have served their time in the navy at a nominal rental, or they are let to ostreiculturists at 30 to 35 francs per hectare in Arcachon, and at 80 francs per hectare in the Morbihan. The rental is therefore about 10s. per acre at Arcachon, and about 25s. per acre in the Morbihan. In Holland leases are generally given for a period of fifteen years, though there are cases where the let is for thirty years, with certain breaks in the lease. Some of the mussel-banks are let for five years only. In France, on the other hand, the tenure, though nominally a yearly one, is in practice longer, as if the beds are well cultivated and to the approval of the maritime authorities, there is no disturbance of tenure. When the Government in this way lets oyster-beds and derives a revenue therefrom, it exercises a certain amount of protection, the lessees also guarding their own interests. In addition to police patrol, the larger ostreiculturists have also boats and watchmen of their own. In France the *gardes-de-peche* protect chiefly the Government oyster-beds, which are reserved for the marine conscripts, but they and the servants of the ostreiculturists also watch the parcs of the capitalist. At Arcachon the bay is dotted over with *pontons*, species of arks, being in fact boats with houses built on them, which serve as watch-houses for the fishermen—*parquers*—of the proprietors of the parc.

Dr Fullarton describes fully the various methods of oyster-culture practised in France and Holland, and draws attention to the importance of distinguishing between the two processes of oyster-production and oyster-fattening.

Cockles.

The cockle industry is large and important on many parts of the English coast. In Scotland the chief cockle fishery is at Barra, in the Hebrides, and since the yield of these beds is rapidly diminishing it was deemed desirable to institute an inquiry into the subject. This inquiry was conducted recently by Dr J. H. Fullarton, and the results are given in the present volume. The history of the Barra Beds, their extent, position, and their yield are described; and it is recommended that, as the fishermen themselves desire, measures should be adopted to prevent the taking of undersized cockles, and to ensure the working of the beds by a system of rotation. A chart of the Barra cockle-beds is given.

Lobsters.

On the West Coast the lobster fishery has generally deteriorated; there has been a diminution of numbers, and also a diminution in size. At Barra, lobsters have become so scarce on the east side of the island that the fishermen have abandoned this fishery and have taken to the cod and ling fishing. Some of the West Coast lobster fishermen desire a close time, but a close time is now enforced by nature in the storms of winter, and the fishery can only be profitably carried on for a few months in summer.

More than in any other sea fishery, close times and other restrictions have been applied in that for lobsters (especially in Canada and Norway), and have been unsuccessful. Recourse is being had in the United States, Newfoundland, Norway, and Canada to artificial culture.

The Fishery Board are, as has been said, constructing a lobster enclosure at Brodick, on the West Coast, and hope that means will be provided to enable them to carry on operations at Dunbar, where lobster fishing was once of great importance, large numbers being exported in welled smacks.

6. Physical Observations.

In the determination of the physical conditions of the sea which are related to fishery questions, especially temperature and density, it is of essential importance that the observations should be continuous. Scattered or occasional observations, and observations in a given area only at considerable intervals of time, are of little or no value by themselves in connection with scientific fishery inquiries. Hence the most important observations are those taken daily at fixed stations, as is done on the Continent and in America. In 1888, the Northern Lighthouse Commissioners courteously consented to the proposal that daily observations should be taken at Lighthouses and Lightships in the Forth and Tay area, and these observations are now going on. Physical observations are now being made as follows:—

1. *At Fixed Stations.*—(1) Bell Rock Lighthouse, (2) Lightship 'Abertay,' at the mouth of the Tay, (3) Lightship at North Carr Rocks, (4) Oxcar Lighthouse, (5) Dunbar, (6) Ardrishaig, (7) Brodick, (8) Stornoway.

2. *On Board the Fishery Cruisers*:—'Garland, 'Vigilant,' and 'Jackal.'

When sufficient observations have accumulated there is little doubt the results of their study will throw much light upon various fishery problems.

7. Scheme of Scientific Investigations for the year 1890–91.

The following is the outline of the scheme of work for the current year:—

I. Sea Fisheries.

A. *Special Inquiries.*

1. Inquiries into the influence of beam-trawling and other modes of fishing on the productiveness of the fishing grounds.

2. Investigations as to the distribution of immature and under-sized fish in inshore and offshore waters at different seasons, and their capture by different modes of fishing.

3. Experiments on bait and the best modes of preserving it. East coast fishermen pay above £20,000 a year for the carriage of mussel bait. Three-fourths of the weight carried consists of the useless shells and refuse, the carriage of which thus costs the fishermen above £15,000 annually. Unsuccessful experiments have been made with some preservatives, but Dr Fulton believes a simpler process may be found effective.

4. Inquiry into the destruction of food-fishes by sea-birds. Enormous quantities of immature fish and herrings are destroyed by certain sea-birds, which are of no economic value, but are protected by Acts of Parliament. Since the destruction of immature fish is so important in relation to the fish-supply, it is desirable to obtain definite information as to this source of loss.

B. *Investigations into the Food, Reproduction, Migrations, and Habits of the Food-Fishes.*

1. Inquiries into the food of the edible fishes.

2. Inquiries into the reproduction of the food-fishes; determination of the period and duration of spawning, the location of spawning grounds, and the limits of size of mature and immature fish.

3. Inquiries into the migratory movements and rate of growth of food-fishes.

C. *The Development of the Food-Fishes.*

Investigation into the development of (1) the *Turbot*, (2) the *Plaice*, (3) the *Lemon Sole*, (4) the *Skate*, (5) the *Haddock*.

II. Shore Fisheries.

These include the fisheries for oysters, mussels, clams, cockles, lobsters, crabs, &c.

1. Inquiry into the causes of the depletion of oyster-beds; the determination of the biological, thermal, and other physical conditions of existing beds, especially in relation to the fall of spat, and of places suitable for oyster-culture.

2. Experiments as to mussel-culture.

3. Experiments in the hatching and rearing of lobsters.

III. Inland Fisheries.

Inquiry into the invertebrate fauna of the Scottish lochs, and of the organisms which form the food of fresh-water fishes.

IV. Physical Observations.

In addition to those referred to above, it is intended to commence a series of observations at other places on the West Coast; and that special observations be made by carefully-selected, intelligent fishermen, while fishing at the principal fishing grounds around the Scottish coast, who will also keep a comparative record of their catches.

8. Contemporary Fishery Work.

An account is given by Dr T. Wemyss Fulton of the contemporary fishery work undertaken in this country and in the United States, Canada, Newfoundland, Spain, France, Belgium, Holland, Denmark, Norway, and Germany.

The chief questions engaging attention at present are:—

1. The influence of certain modes of fishing on the capture of immature fish.

2. The artificial propagation of sea fishes, lobsters, &c.

3. The food, spawning and spawning grounds, the migrations, and the habits of the food-fishes.

The Board is indebted to a large number of foreign fishery authorities and others for co-operation in their scientific work. Among these may be mentioned Colonel Marshall M'Donald, the United States' Fish Commissioner; Dr P. P. C. Hoek, the Scientific Superintendent of Dutch Fisheries; Professor Pouchet, the Director of the Concarneau Laboratory; Professor Marion, the Director of the Marine Laboratory at Marseilles; M. Raveret Wattel, Secretary to the Société Nationale d'Acclimatation de France; Captain Dannevig, the Superintendent of the famous Sea Fish Hatchery at Flödevig, Norway; Captain Drechsel, Superintendent of Danish Fisheries, and the naturalist, Dr C. G. J. Petersen; Señor Rafael Gutierren Vela, of the Spanish Fisheries Department; and Professor Giglioli, Florence.

The Board have also to thank Sir Thomas F. Brady and the other Inspectors of Irish Fisheries, and Professor W. C. M'Intosh, F.R.S., of St. Andrews, for much assistance received.

SECTION A.—GENERAL REPORTS.

I.—REPORT ON THE TRAWLING EXPERIMENTS OF THE 'GARLAND,' AND ON THE STATISTICS OF EAST COAST FISHERIES. Part IV. (Plates I.–III.)

I. INTRODUCTORY.

The trawling experiments of the 'Garland' during 1889 were conducted on the same general lines as in former years, but with greater continuity. The stations in the Firth of Forth and St Andrews Bay were examined at short intervals; and those off the Forfarshire and Aberdeenshire Coast, and in the Moray Firth, as often as opportunity would allow. In the month of July the 'Garland' proceeded to the Orkney Isles, where four stations were selected and examined.

During the year 1889, the 'Garland' made 153 hauls of the trawl at the various stations in the closed waters and the waters adjoining (as compared with 90 hauls in 1888), besides a large number of hauls at other carefully selected places in the inshore and offshore waters, and a large number of observations, which are dealt with in the special report on the Distribution of Immature Fish.

On the 26th July, 1889, the Herring Fishery (Scotland) Act came into operation. This Act closes the whole of the territorial waters of Scotland, together with certain bays specified in the Schedule to the Act, against beam-trawling or otter-trawling.

By a Bye-law passed under Section 6 (which gives to the Fishery Board certain powers), the area in the Firth of Clyde lying inside of a line between the south end of Bute and the Ayrshire Coast was opened to sailing trawlers under eight tons burden. Before this Act came into force the greater part of the territorial waters on the East Coast was closed against trawling by Bye-laws of the Fishery Board; namely, from the south side of the Firth of Forth to the Ord of Caithness. It may be well to give a *résumé* here of the successive Bye-laws passed by the Fishery Board in relation to beam and otter trawling before the Herring Fishery (Scotland) Amendment Act came into force:—

1. On the 5th of April 1886, the first Bye-law was passed, by which the Firth of Forth and St Andrews Bay were closed within a line drawn between Tantallon Castle, the Isle of May, Fife Ness, and the Fairway Buoy at the mouth of the Tay.
2. On the same date Aberdeen Bay was closed within a line drawn between Girdle Ness Lighthouse and the Cruden Scars Rocks. This Bye-law was revoked on July 4th, 1887.
3. On July 4th, 1887, the territorial waters of the Moray Firth were closed between the Ord of Caithness and Kinnaird Head.
4. On July 4th, 1887, the Bye-law relating to St Andrews Bay was modified so as to include the territorial waters from the mouth of the Tay to Red Head in Forfarshire.
5. On February 28th, 1889, the territorial waters between Red Head and Kinnaird Head were closed.

Besides the periodic examination of the stations in the territorial waters, a large number of special observations were made at the fishing grounds in the offshore waters, and along carefully selected lines in the Firth of Forth. Through the courtesy of Mr James Johnston, a member of the Fishery Board, Mr Thomas Scott, F.L.S., was allowed to accompany the steam-trawler 'Southesk' in its visits to the great fishing grounds in the Moray Firth and at other parts of the East Coast, and much valuable information was thus obtained. In addition to the ordinary trawling experiments a large number of observations were made by means of a special net, as to the distribution of immature fish in the territorial and extra-territorial waters, and at some of the chief fishing grounds. The results are referred to in a special Report on the subject (p. 157).

The statistics in connection with the trawling experiments which have been collected, as to the relative amounts of fish landed by line fishermen and beam-trawlers along the East Coast; the quantities obtained by line fishermen from the territorial waters where trawling is prohibited; and the proportional amounts of small fish landed by beam-trawlers and line fishermen, are discussed below. A part of the work connected with the tabulation of some of these statistics has fallen upon the fishery officers of the districts concerned, namely, Mr John Murray, Newhaven; Mr Mair, Anstruther; Mr Donald Miller, Montrose; Mr Bain, Stonehaven; and Mr Couper, Aberdeen. The trawling returns were kept by Mr Thomas Scott, F.L.S. I have also to acknowledge the assistance of Mr Ramsay Smith, B.Sc., and Dr J. H. Fullarton, in the tabulation of the statistics.

II. THE WORK OF THE 'GARLAND.'

1. The Firth of Forth.

Plate I.

The various stations in the Firth of Forth area were examined in January, February, March, April, May, June, July, August, October, and November. Altogether 90 hauls of the trawl were made, as compared with 50 in 1888, each of the nine stations having been examined on ten occasions. Thus, 70 hauls were made within the closed or territorial waters and 20 in the open waters outside. The tables referring to these observations will be found at page 41. From a careful analysis of the results (*vide* page 38) it is found that, as compared with 1888, there has been a general decrease in the numbers of fish taken. In 1888 the general average of all kinds of fish captured in the closed area was 211 per 'shot.' In 1889 it was 164·8 per 'shot,' which is the lowest average since these experiments were begun. There has also been a large decrease in the average per 'shot' for the open waters, where trawling is not restricted. In 1888 it was 151, while last year it was only 111·9. The above figures refer to the total of all kinds of fish brought up in the trawl-net. On an examination of the returns as to flat-fishes and round-fishes it will be found that the diminution is chiefly owing to a decrease in round-fish. In 1888 the average number of flat-fish captured in each haul in the closed waters was 117; and in 1889, 110·9—thus showing a slight decrease last year. In the open waters the average for 1888 was 34·4, and for 1889 40·3, indicating, therefore, a slight increase. The decrease of round-fish is much more marked. In 1888, in the closed area, the average per 'shot' was 92·1, and last year only 49·8. In the open area the averages are :—114·7 in 1888, and 68·6 in 1889. The averages for the past four years are as follows :—

		Flat-Fish.	Round-Fish.
Closed Area,	1886,	112·8	131·8
	1887,	203·1	144·1
	1888,	117·0	92·1
	1889,	110·9	49·8
Open Area,	1886,	47·5	36·7
	1887,	89·8	123·4
	1888,	34·4	114·7
	1889,	40·3	68·6

It would therefore appear that 1887 was an exceptional year.

So much for the general proportions of flat-fish and round-fish. In the case of the various kinds of flat-fish obtained in the closed waters it will be seen from the tables that plaice, flounders, and long rough dabs have slightly increased, while lemon soles, witch soles, and common dabs have diminished; skate also have slightly decreased. In the unclosed waters there has been a slight increase in plaice, lemon soles, common dabs, long rough dabs, and flounders, and a decrease in witch soles. Among round-fish we find that in the closed area there has been a considerable decrease of haddock and whiting, while cod and gurnard have remained pretty much as in 1888. In the open area exactly the same thing has occurred, namely, a considerable diminution of the numbers of haddock and whiting, while cod and gurnard have remained stationary.

If the takes at the various stations in the closed area are compared in the two years, it will be found that there has been a general decrease at Stations I., II., III., V., and VII., and an increase at Stations IV. and VI. The increase at Station IV. is entirely owing to an increase in flat-fish, and almost wholly to plaice, the average per 'shot' of plaice in 1888 being 147, while in 1889 it was 192·8. At Station VI. the increase is also due to an increase in flat-fish, and chiefly to plaice, common dabs, and long rough dabs. At the other stations, diminution has occurred both in round-fish and flat-fish (especially in round-fish), except at Station V., where flat-fish have considerably increased. Plaice have decreased at all the stations except at Stations IV., V., and VI.; lemon soles have decreased at all stations except Stations V., and VI.; flounders have increased at all the stations; common dabs have increased at Stations I., IV., V., and VI., and decreased at Stations II., III., and VII.; long rough dabs have increased at Stations I., III., V., and VI., and diminished at Stations II., IV., and VII. The average numbers of cod taken per 'shot' at the various stations show a remarkable correspondence in the two years. Haddocks have decreased in numbers at all stations, sometimes to a very great extent; and whitings at all stations except V., where a slight increase occurred. If a comparison be made between the monthly average per 'shot' of the whole of the closed area in 1888 and 1889, it will be found that there has been a general increase, especially in flat-fish, during the latter months of 1889; and the same remark is true of the open area.

2. St Andrews Bay.

Plate I.

The fishing grounds within the protected area were examined on twenty-eight occasions, and those in the open waters beyond on seven occasions. As in the Firth of Forth there was a decrease in the general average in the closed waters, and also at Station V. in the open waters. In 1888, the average for the closed waters was 286; in 1889 it was 209·5. At Station V. the average in 1888 was 221·2; it 1889 it was 183·1. There has thus been a general decrease both in the closed area and in the unclosed area. The decrease in the closed area in 1889 was due to a diminution in the numbers both of round-fish and flat-fish, but especially of round-fish. The averages are as follows:—flat fish, 215·6 in 1888 and 189·1 in 1889; round-fish, 68·9 in 1888 and 19·2 in 1889. In the open area the decrease has been entirely in round-fish, flat-fish showing a slightly better average. The averages for each year since the trawling experiments were begun are as follows:—

		Flat-Fish.	Round-Fish.
Closed Area,	1886,	148·7	27·7
	1887,	346·1	87·6
	1888,	215·6	68·9
	1889,	189·1	19·2
Open Area,	1886,	96·6	73·0
	1887,	133·5	173·2
	1888,	148·8	72·4
	1889,	152·5	29·8

It will thus be seen that, as in the averages for the Firth of Forth, 1887 was an exceptional year.

In the closed area, plaice showed an increase in 1889, as did also flounders; while common dabs and long rough dabs diminished, and the numbers of lemon soles remained the same as in 1888. In the case of round-fish there was a very slight increase in cod, a very great decrease in haddocks, and a slight decrease in whitings. In the unclosed area there was, as in the closed waters, an increase in plaice and flounders, a decrease in lemon soles, and a slight decrease of long rough dabs, while the numbers of the common dab remained much about the same.

If we consider the stations in St Andrews Bay separately, it will be found that at Stations I. and II. there was a considerable increase in flat-fish (almost entirely of plaice), and a large decrease at Stations III. and IV. (chiefly of common dabs and plaice). Whitings, and especially haddocks, were obtained in much less numbers at all the stations.

It is a remarkable circumstance that, although there has been a general decrease in the flat-fish, there has been, both in the closed and open areas of the Forth and St Andrews Bay, an increase in the numbers of plaice.

3. Other East Coast Districts.

The trawling stations at Montrose, in Aberdeen Bay, in the Moray Firth, and at the Orkney Islands were also examined. The results of the observations are given at page 107.

The two stations at Montrose were described in last year's Report (p. 18), and were examined in June and in September. The data for comparison with those of 1888 are too few to be of much value, but so far as they go they show that in 1889 there was a very great increase in flat-fish, and a slight decrease in round-fish. The increase of flat-fish was due entirely to an increase in common dabs and plaice; and the decrease in round-fish to a great decrease in haddocks.

The stations at Aberdeen Bay were also examined in June and September. Here, likewise, the number of hauls was too few to yield results of much importance. The general average shows an increase from

72·1 to 174·4, the increase being chiefly due to an increase in flat-fish, especially, as at Montrose, to common dabs and plaice.

The stations in the Moray Firth were examined in June. The general results show a decrease both in round-fish and flat-fish.

The results of the experimental trawlings at the Orkney Islands are given at page 119.

Besides the examination of the ordinary stations above referred to, the 'Garland' was on several occasions employed in trawling operations in the offshore waters, especially at the well-known spawning ground, Smith Bank, in the Moray Firth; and at a fishing ground lying about 21 miles east of May Island (Liston Bank). The results obtained are referred to more particularly in the special Reports dealing with the spawning of marine fishes (p. 257) and the distribution of immature fish (p. 157).

III. SPECIAL STATISTICS OF FISH CAUGHT BY LINE FISHERMEN AND BEAM-TRAWLERS.

The statistical information obtained for comparison with the results of the 'Garland's' trawling experiments on the East Coast are given on p. 121. These refer to (1) the fish landed by fishing boats and by beam-trawl vessels in the Leith, Anstruther, Montrose, Stonehaven, and Aberdeen Districts, during each month in the year, with the total value (Table E., p. 122); (2) the amounts of fish caught from month to month by fishing boats within the territorial waters of the Leith, Anstruther, Montrose and Stonehaven Districts (Tables G., H., p. 137); (3) the amount of fish landed by beam-trawlers and line fishermen along the whole East Coast of Scotland (Table I., p. 156); (4) the quantities of large haddocks, small haddocks and whiting, and of cod landed monthly by the Buckhaven fishing boats in 1888 and 1889, (Table D., p. 121); (5) the amounts of large and small fish landed in the Leith, and Aberdeen districts by beam-trawlers and line fishermen (Table F., p. 133).

1. Relative Quantities of Fish taken by Line and by Beam-Trawl.

The statistics referring to this subject are given in Table E. (p. 122), which shows in detail the amounts landed monthly in five East Coast districts; and also in Table I. (p. 156), which shows the gross amounts landed in the northern and southern group of East Coast districts, and along the whole East Coast, during each month in the year.

It must be noted that these tables give only the amounts *landed*, without furnishing any indication of the localities where the fish were caught. In the Leith district, in 1889, line fishermen landed a much greater quantity of cod, ling, and saithe, and also a larger amount of halibut, lemon soles, and skate, than they did in 1888. On the other hand they landed less haddock, whiting, turbot, flounder, and plaice. Beam-trawlers in 1889 landed about the same quantity of cod, a slightly greater amount of ling, turbot, halibut, and skate; slightly less saithe, and much less haddock, whiting, lemon sole, flounder, and plaice. The total value of the fish landed in 1889 by fishermen (which, however, includes net-caught fish and shell-fish) was £78,014, as compared with £77,439 in 1888. The value of the fish landed by beam-trawlers in 1889 was £35,876, and in 1888 £41,423.

In the Anstruther district no fish caught by the beam-trawl were landed. The quantities landed by fishermen showed an increase of cod, torsk, saithe, whiting, and turbot; a slight decrease of haddock, ling, and skate, and a considerable decrease in halibut, flounders, and plaice. The value (including net-caught fish and shell-fish) was £55,596 in 1889, and £59,383 in 1888.

In the Montrose district the line fishermen in 1889 landed larger quantities of cod, ling, and turbot; somewhat diminished quantities of saithe and whiting, and much less halibut, haddock, flounders, and plaice. The amounts landed by beam-trawlers show an increase in cod, saithe, turbot, haddock, lemon soles, flounder, plaice, and skate, and a decrease in ling and whiting. The value of the fish landed by fishermen (inclusive of net-caught fish and shell-fish) was £80,550 in 1889 and £78,648 in 1888. In 1889, beam-trawlers landed fish valued at £12,956, and in 1888 at £9316; the increase being chiefly due to more fish being landed by trawlers at Dundee.

In the Stonehaven district the only fish landed were landed by fishermen. As compared with 1888 there was a slight increase in haddocks, turbot, and skate, a considerable increase in cod, ling, saithe, whiting, and halibut, and a considerable decrease in flounder and plaice. The value (including net-caught fish and shell-fish) in 1889 was £24,179, and in 1888 £28,699.

In the Aberdeen district the fish landed by fishermen showed a slight increase in turbot, a considerable increase in cod, ling, saithe, and halibut, a slight decrease in whiting and skate, and a considerable decrease in haddock, flounder, and plaice. Beam-trawlers landed considerably more saithe, haddock, turbot, and lemon sole than in 1888, slightly less cod, ling, flounder, and plaice, and much less whiting. The value of the fish landed by fishermen (exclusive of net-caught fish and shell-fish) was £93,460 in 1889, and £90,908 in 1888. Beam-trawlers landed fish valued at £98,652 in 1889, and at £82,088 in 1888.

The total quantity of fish landed by beam-trawlers and line fishermen along the whole East Coast, in 1889, was 1,338,734½ cwts. as compared with 1,334,511 in 1888; or an increase of 4223½ cwts. In 1889 the line fishermen landed 1,111,320¾ cwts. of fish, and the beam-trawlers 227,413¾ cwts. In 1888 the figures were:—1,090,7713¼ landed by line fishermen, and 243,797¾ landed by beam-trawlers. Thus the line fishermen landed on the East Coast in 1889, 20,607½ cwts. (or above 1000 tons) more fish than they did in 1888, while the beam-trawlers landed 26,384 cwts. (or above 800 tons) less than they did in 1888. There is no definite information as to the number of beam-trawlers engaged—for English trawlers land large quantities of fish on the Scotch coast—but it appears from the statistics in Part I. that the number of fishing boats belonging to the East Coast was 155 less than in 1888.

Of the gross amount landed in 1889, 1,224,268 cwts. consisted of round-fish (cod, haddock, whiting, &c.), and 114,466½ cwts. of flat-fish (turbot, plaice, lemon soles, &c.). In 1888 the total amount of round-fish landed on the East Coast was 1,209,035 cwts., and of flat-fish 125,476 cwts. Thus there was in 1889 an increase of 15,233 cwts. of round-fish, and a decrease of 11,009½ of flat-fish landed on the East Coast. Line fishermen landed a larger quantity of round-fish and a smaller quantity of flat-fish, and beam-trawlers landed a smaller amount of both round and flat-fish in 1889 than in 1888.

When the amounts landed in the southern group of districts (from Aberdeen to Berwick, but exclusive of Aberdeen) are compared with the amounts landed in the northern group of districts in 1888 and 1889, the following results appear. Line fishermen landed a larger quantity of round-fish, and a smaller quantity of flat-fish, in the northern section of the coast in 1889 than they did in 1888. In the southern section—where trawling has for some years been prohibited in the greater portion of the territorial waters—the line-fishermen landed less round-fish in 1889 than in 1888, but a considerably larger quantity of flat-fish. In 1889, in the northern section of the coast, beam-trawlers landed larger quantities of both round-fish and flat-fish, and in the southern section smaller quantities of both round and flat-fish. The general results of the statistics referring to this subject are graphically represented on Plate II.

2. Statistics showing the Quantities of Line caught Fish obtained from the Territorial Areas where Trawling is prohibited.

In Tables G., H. (p. 137) are given the monthly quantities of fish caught by line and net within the territorial waters of a large portion of the East Coast, viz., from North Berwick, on the south side of the Firth of Forth, to Skateraw, a few miles south of Aberdeen; that is to say, in the Stonehaven, Montrose, and Anstruther districts, and the greater part of the Leith district. The monthly and yearly averages per boat for each kind of fish are also given.

The whole of the territorial waters are now closed to beam-trawling; but this part of the coast was closed in successive portions, as described on p. 22.

These statistics therefore serve to show the result of the closure of successive portions of the territorial waters upon their productiveness to line fishermen; and will, in future years, allow most valuable comparison to be made as to the productiveness of the territorial waters from which trawling is completely excluded.

The total quantity of fish caught by line in the territorial area under consideration in 1888 and 1889 is shown in Table H. (p. 155). In the four districts in 1888, 127,137½ cwts. were caught, or an average of 2·95 cwts. per 'shot,' in 1889 the total quantity was 129,965¼ cwts., or an average of 3·02 cwts. per 'shot.' There was therefore a general increase of fish in the territorial waters. This increase occurred in Anstruther, Montrose, and Stonehaven districts; but especially in the two latter. In the Leith district there was a very slight decrease (from 2·43 cwts. per 'shot' to 2·40 cwts.). The average per 'shot' in the Montrose district was 3·953 in 1889, as compared with 3·712 in 1888. When the quantities of the different kinds of fish are considered, it appears that the increase was due to an increased catch of cod in 1889 in all the districts, and to an increase of whiting in the Stonehaven district. In 1888 the average per 'shot' for cod was 0·68 cwts.; in 1889 it was 0·94 cwts. There was a decrease of haddocks in all the districts, the average per 'shot' for the year was 1·26 cwts. in 1888 and 1·02 cwts. in 1889. Whitings also decreased slightly in all the districts except Stonehaven, where there was an increase. The yearly average in 1888 was 0·17 cwts. per 'shot'; in 1889 it was 0·20 cwts. Lemon soles, flounders, and dabs, which are classed together, decreased from an average per 'shot' of 0·20 cwts. in 1888 to an average of 0·15 in 1889. The decrease was most marked in Anstruther district, but it also occurred in the Leith and Stonehaven districts. In the Montrose district there was a slight increase. Skate and turbot are also classed together. They showed an increase in 1889 as compared with 1888, the averages for the two years being 0·01 cwts. per 'shot' in 1888 and 0·02 cwts. per 'shot' in 1889. The increase was most marked in the

Leith district. The average per 'shot' for other white fish decreased from 0·19 cwts. in 1888 to 0·14 cwts. in 1889. The decrease occurred in the Anstruther, Montrose, and Stonehaven districts. In the Leith district there was a large increase from 0·009 cwts. per 'shot' in 1888 to 0·14 cwts. in 1889.

All the territorial waters of these districts were closed to beam-trawling by the Herring Fisheries (Scotland) Act, which came into force on 26th July, 1889. The results of a comparison between the averages for a month in 1888 and 1889, for the areas open and closed, would be of no value, owing to the brief periods comparable. But comparison may be made between the Leith and Anstruther districts, which have been closed since 1886, and the Stonehaven district, which was only closed last year. When this is done, it appears there was a slightly greater relative increase of cod in the Stonehaven district than in the southern districts, although the increase in the Anstruther district was also large. The decrease of haddocks was somewhat more marked in the Stonehaven district; there was a large increase in the Leith district. Whitings increased in the Stonehaven district and diminished slightly in the southern districts. Lemon soles and flounders decreased relatively more in the Stonehaven district than in Leith and Anstruther districts. In Stonehaven district skate and turbot diminished much more than in the two districts south, as did also 'other white fish.'

Mr William Mair, the Fishery Officer at Anstruther, has kept a record during the past two years of the amounts of haddocks and whitings captured within the territorial and extra-territorial waters, by the boats fishing from his district. The results are shown in the following table.

Year.	Caught within the Enclosed Area.		Caught outside the Enclosed Area.		Total.	
	Haddocks.	Whitings.	Haddocks.	Whitings.	Haddocks.	Whitings.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
1888.	18,419	1,800	17,862	1,131	36,281	2,931
1889.	12,499	1,972	19,405	1,645	31,904	3,617
Increase.	...	172	1,543	514	...	686
Decrease.	5,920	...	...	...	4,377	...

The decrease in the inshore haddock fishing is explained by Mr Mair to have been coincident with the failure in the winter herring fishing in the Firth of Forth; haddocks enter the Forth usually in large numbers in succession to the herring shoals.

3. Buckhaven Haddock and Cod Line Fishing.

The statistics of this fishery have now been collected since 1884. Those for 1888 and 1889 are given on p. 121, and represent the numbers of cod, of large haddocks, and of small haddocks and whiting caught by Buckhaven boats in the territorial waters, with the average number of fish per 'shot' in each month of the year.

In 1889 the number of cod taken averaged 0·46 per 'shot,' as compared with 0·45 per 'shot' in 1888, practically the same numbers in each year although the average per 'shot' in the corresponding months of the two years varied considerably. The large haddocks in 1889 showed a great increase. In 1888 the average was 62·6 per 'shot'; in 1889 in was 80·1, while in 1887 it was only 42·8. There has thus been a progressive increase in the capture of large haddocks by the Buckhaven boats during recent years. In all the months of 1889 the average for large haddocks was greater than in the corresponding months of 1888, except in September, October, November, and December. The small haddocks and whitings taken have, on the other hand, very much diminished. In 1888 the average per 'shot' for the year was 228·4, while in 1889 it was only 68·4. There is, however, no means of determining in what proportions the small haddocks and the whitings contributed to the decrease; the whitings of all sizes are included with the small haddocks. The average per 'shot' of large and small fish for each of the years since these statistics began to be collected, is as follows:—

	Average Number of Large Haddocks per Shot.	Average Number of Small Haddocks and of Whitings per Shot.
1884, ...	22·1	38·3
1885, ...	23·4	221·5
1886, ...	31·8	147·0
1887, ...	42·8	208·9
1888, ...	62·6	228·4
1889, ...	80·1	68·4

The average numbers of small haddocks and whitings taken per 'shot' was less in every month in 1889 than in the corresponding months of 1888. The highest average was 101·1 in June; in 1888 the highest average was also in June, viz., 390·7. The lowest average in 1889 was in December, when it was only 23·8; in 1888 the lowest average was also in December, and was 58·3. The small haddock and whitings are taken in greatest abundance in the summer months from May to September.

4. The Proportion of Large and Small Fish captured by Beam-Trawlers and Line Fishermen.

Statistics have been obtained from certain districts showing the proportional quantities of large and small fish landed by beam-trawlers and line fishermen in 1889. These statistics are given in Table F. (p. 133).

In the Aberdeen district it will be seen that the proportion of small round-fish landed by beam-trawlers is very much greater than the proportions landed by line fishermen. The large cod landed by trawlers amounted to 7946 cwts. and the small cod to 7047 cwts: while line fishermen landed 19,258 cwts. of large cod and only 1383 cwts. of small. The proportion of small to large was in the case of the trawlers nearly equal; in the case of line fishermen it was about 1 to 14; the proportion of small to large haddocks and whitings landed by beam-trawlers was also much greater than with the line fishermen. The line fishermen landed nearly two small haddocks and whitings for every large one, while the trawlers landed small and large in nearly equal proportions.

In the Leith district beam-trawlers landed 8012 cwts. of large cod and 829 cwts. of small cod; line fishermen landed 32,717 cwts. of large cod and 3967 of small. The proportions of small to large are, for the trawlers about 1 to 10, and for the fishermen about 1 to 8. In the Leith district, therefore, line fishermen landed a slightly larger proportion of small cod than did beam-trawlers. In the case of the haddock and whiting the Table shows that line fishermen landed a total of 22,998 cwts. of large haddocks, 2061 cwts. of large whitings, and 12,173 cwts. of small haddocks and small whitings. The beam-trawlers landed 22,315 cwts. of large haddocks, 1700 cwts. of large whitings, and 14,397 cwts. of small haddocks and small whitings. The proportions are, therefore, about 1 small fish to 2 large ones in the case of the line fishermen, and about 2 small ones to 3 large ones in the case of the trawlers. Of 862 cwts. of turbot landed by trawlers, 774 cwts. are described as large, and 88 cwts. as small,—a proportion of nearly 9 large fish to 1 small. The line fishermen landed 146½ cwts. of turbot, of which 130½ cwts. are described as large and 16 cwts. as small—a proportion of about 8 large fish to 1 small one; of halibut the trawlers landed 24¾ cwts., of which 22¾ were large and 2 cwts. small,— a proportion of 11 to 1. The line fishermen landed 886½ cwts. of halibut, 799½ cwts. being large and 87 cwts. small, or a proportion of about 9 large to 1 small one. Most of the flat-fish are combined in these statistics; of lemon sole, flounder, plaice, and brill, trawlers landed 6962 cwts. and fishermen 2929 cwts. Of those landed by trawlers 6171 were large and 791 cwts. small. The fishermen landed 2338 cwts. of large and 591 cwts. of small; the proportions of large to small are, therefore, about 1 small to nearly 8 large in the case of the trawlers, and with the fishermen about 1 small to 4 large.

It would therefore appear, so far as these statistics go, that proportionally much larger quantities of small round-fish are landed by trawlers than by line fishermen; while the latter land a somewhat larger proportional quantity of small flat-fish. It must be borne in mind, however, that these statistics are to a large extent arbitrary. No measurements of the fish are made; and as large and small fish are not always separated from one another for sale, the figures given can at the best be regarded only as approximate. The subject of the capture of immature fish by trawlers and line fishermen is discussed fully in a special report.

IV. SUMMARY.

The results of the trawling experiments of the 'Garland,' and of the analysis of the statistics obtained for comparison therewith, are detailed in the foregoing pages.

The year 1887, following the closure of the Firth of Forth and St Andrews Bay, appears to have been of an exceptional character, both in regard to in-shore and off-shore grounds. Considering the extent of coast along which these experiments are carried on, and from which the statistics are derived, and the natural great fluctuations which everywhere occur in fisheries from year to year, it is evident, as Professor Huxley has observed, that it will be necessary to carry on the inquiry for many years. During 1889 the trawling experiments showed that there was a general diminution of fish both in the closed and open areas. This decrease was chiefly in round fish; to a less extent in flat fish. There was a general decrease in the open waters of the Firth of Forth, but to a less extent than in the closed area, and it was there limited to round fish—plaice and most other flat fish having slightly increased in numbers. In the closed waters of the Firth of Forth plaice, flounders, and long rough dabs increased, while there was a decrease in lemon soles and common dabs. The decrease in round fish was chiefly noticeable among haddocks and whitings. In St Andrews Bay there was a decrease also in both the closed and open areas, chiefly due to a diminution in the numbers of round fish. In both the closed and open areas there was an increase in plaice and flounders.

The statistics show that in 1889 there was a general increase of the fish captured by fishermen in the territorial waters. Those regarding the capture of flat fish in the Leith and Anstruther districts show more favourably, as compared with the statistics of 1888, than in the case of the districts further north. In 1889 the line fishermen along the East Coast landed a larger quantity of fish than in 1888. They landed a larger quantity of round fish, and a smaller quantity of flat fish than in 1888; while beam trawlers landed less flat fish and round fish. In the southern group of districts, however, the amount of flat fish landed by fishermen in 1889 was greater than in 1888.

It is a remarkable circumstance that, although there has been a general diminution of fish in the closed and open areas, plaice should have increased in both the closed and open waters of the Firth of Forth and St Andrews Bay. In the special report on the distribution of immature fish (p. 157) it is very clearly brought out that the distribution of young plaice is peculiar, inasmuch as they are practically confined to the territorial waters. The supposition, therefore, appears to be justified that the protection of the immature plaice in the territorial waters during the past few years has been followed by a general increase in the numbers of that fish both on the in-shore and off-shore grounds. The inquiries carried on on board the 'Garland' into the food, spawning, and migration of the food fishes, and into the distribution of immature flat fish and round fish, bear very closely upon the trawling experiments. They have shown that the territorial waters do not to any extent serve as spawning grounds, but as nurseries for young plaice, whiting, cod, and other food fishes. In September last year a vast shoal of small immature whitings was present in the Firth of Forth, their numbers being calculated to be above 230,000,000.

T. WEMYSS FULTON,

Secretary for Scientific Investigations.

TABLE A.—Showing Summary of Fish taken by the 'Garland' on the East Coast in 1889.

Note.—t. means turbot, *l.* means ling.

Station and Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
Firth of Forth—															
Station I.															
Jan. 10, .	.	6	.	2	24	.	1	33	29	1	23	.	53	8	94
Feb. 12, .	4	6	.	4	25	.	2	41	46	4	20	.	70	10	121
Mar. 11, .	6	14	.	42	23	.	1	86	85	1	2	.	88	5	179
April 11, .	37	50	.	10	6	.	5	108	29	4	7	.	40	9	157
May 2, .	22	15	.	28	24	3	1	93	19	4	6	5	34	3	130
June 4, .	69	35	.	38	27	.	1	170	10	24	3	51	88	3	261
July 30, .	41	31	.	17	43	.	3	135	21	2	47	12	82	7	224
Aug. 31, .	82	36	.	8	54	.	14	194	24	1	74	7	106	13	313
Oct. 4, .	51	.	.	12	12	.	2	77	9	1	1	6	17	.	94
Nov. 9, .	1	22	.	3	50	.	9	85	47	2	36	.	85	9	179
	313	215	.	164	288	3	39	1022	319	44	219	81	663	67	1752
Station II.															
Jan. 10, .	.	.	.	4	12	.	.	16	8	26	5	.	39	.	55
Feb. 11, .	11	.	.	.	1	.	.	12	1	2	.	.	3	.	15
Mar. 8, .	28	3	.	14	2	.	.	47	.	.	.	.	.	2	49
April 11, .	32	4	.	18	4	6	1	65	5	1	3	1	10	1	76
May 3, .	11	2	.	.	9	.	.	22	11	3	6	13	33	2	57
June 8, .	93	28	.	50	20	.	1	192	1	12	1	27	41	2	235
July 27, .	129	17	.	63	19	.	.	228	4	20	21	9	54	2	284
Aug. 29, .	127	35	.	77	11	.	.	250	16	8	13	16	53	2	305
Oct. 1, .	131	27	.	138	49	.	3	348	2	1	4	45	52	.	400
Nov. 8, .	3	1	.	8	28	.	13	53	8	6	11	1	26	.	79
	565	117	.	372	155	6	18	1233	56	79	64	112	311	11	1555
Station III.															
Jan. 7, .	.	3	.	.	6	.	.	9	43	4	28	.	75	7	91
Feb. 5, .	.	.	.	.	2	.	.	2	6	.	6	.	12	1	15
Mar. 11, .	3	7	.	18	18	.	3	49	4	4	.	.	8	4	61
April 3, .	4	26	.	16	16	1	1	64	15	1	15	.	31	5	100
May 2, .	24	62	.	4	17	4	1	112	46	3	10	1	60	1	173
June 3, .	173	75	.	64	22	2	1	337	32	3	19	68	122	8	467
July 30. .	34	12	.	15	4	.	.	65	13	.	80	6	99	1	165
Aug. 30, .	69	53	.	43	47	.	4	216	22	.	41	6	69	3	288
Oct. 3, .	59	53	.	53	35	.	7	207	53	2	33	15	103	2	312
Nov. 11, .	.	1	.	.	3	.	3	7	8	.	34	.	42	.	49
	366	292	.	213	170	7	20	1068	242	17	266	96	621	32	1721
Station IV.															
Jan. 3, .	100	.	.	7	5	.	.	112	13	.	4	.	17	12	141
Feb. 5, .	383	3	.	21	.	.	.	407	31	.	.	.	31	4	442
Mar. 9, .	236	.	.	5	.	.	.	241	1	.	.	.	1	7	249
Apr. 3, .	209	.	.	9	.	2	1	221	.	.	.	.	.	5	226
May 1, .	33	.	.	.	.	.	.	33	1	.	1	.	2	5	40
June 3, .	182	20	.	72	4	1	11	290	2	.	.	34	36	12	338
July 31, .	205	12	.	126	.	.	10	353	4	.	5	36	45	37	435
Aug. 30, .	215	7	.	103	2	2	.	329	2	.	4	35	41	29	399
Oct. 5, .	135	1	.	44	.	.	.	180	2	.	1	.	3	.	183
Nov. 12, .	230	1	.	36	3	3	.	273	2	.	2	.	4	.	277
Total, .	1928	44	.	423	14	8	22	2439	58	.	17	105	180	111	2730

TABLE A.—Showing Summary of Fish taken by the 'Garland' on the East Coast in 1889—*continued.*

Station and Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
Firth of Forth—*continued.*															
Station V.															
Jan. 9, .	.	.	2	1	17	.	1	21	3	36	.	.	39	.	60
Feb. 11, .	.	.	7	3	25	.	.	35	5	22	16	.	43	.	78
Mar. 8, .	2	2	3	13	23	.	.	43	1	9	7	.	17	2	62
April 12, .	5	10	.	1	7	5	1	29	7	35	12	1	55	1	85
May 3, .	8	3	.	1	60	1	1	74	5	23	13	18	59	4	137
June 7, .	9	29	.	29	3	.	2	72	.	.	1	11	12	2	86
Aug. 3, .	15	19	.	14	62	3	3	116	9	193	51	34	287	(in. 1 t.) 3	406
Aug. 29, .	19	19	.	2	32	.	2	74	6	30	16	13	65	(in. 1 t.) 4	143
Oct. 2, .	25	5	.	7	33	1	3	74	19	67	47	2	135	1	210
Nov. 7, .	.	1	6	10	34	.	3	54	14	73	39	.	126	(in. 1 t.) 1	181
	83	88	18	81	296	10	16	592	69	488	202	79	838	18	1448
Station VI.															
Jan. 9, .	2	.	.	.	1	.	.	3	10	7	3	.	20	.	23
Feb. 11, .	53	2	.	.	.	.	.	55	7	.	.	.	7	3	65
Mar. 8, .	37	4	.	8	.	.	.	49	1	.	.	.	1	(in. 1 t.) 4	54
April 12, .	30	7	.	5	.	.	.	42	6	.	1	.	7	4	53
May 3, .	27	7	.	7	.	.	.	41	.	.	.	6	76	(in. 2 t.) 3	50
June 7, .	11	17	.	9	56	4	.	97	4	15	2	14	35	1	133
Aug. 3, .	28	24		37	10	.	.	99	1	19	38	65	123	3	225
Aug. 29, .	90	46	.	34	2	.	1	173	2	8	5	36	51	(in. 2 t.) 3	227
Oct. 1, .	34	11	.	20	20	1	1	87	7	29	43	24	103	(1 l.)	191
Nov. 7, .	64	8	.	14	7	.	.	93	6	3	5	.	14	(1 t.)	108
	376	126	.	134	96	5	2	739	44	81	97	145	367	23	1129
Station VII.															
Jan. 8, .	.	1	.	6	7	.	2	16	4	28	6	.	38	.	54
Feb. 6, .	2	1	.	1	7	.	6	17	4	.	3	.	7	.	24
March 8, .	12	2	.	.	13	13	1	41	29	9	5	.	43	(in. 1 l.) 9	93
April 12, .	2	1	.	24	1	6	1	35	7	5	13	.	25	(in. 1 t.) 2	62
May 7, .	19	3	.	14	17	5	.	58	1	33	8	144	186	2	246
June 6, .	32	18	.	47	24	1	1	123	.	5	4	53	62	2	187
Aug. 2, .	25	9	.	169	22	.	3	228	1	1	6	41	49	2	279
Aug. 28, .	1	.	.	.	3	.	.	4	.	.	4	.	4	.	8
Oct. 3, .	42	1	.	37	50	4	3	137	4	42	25	3	74	2	213
Nov. 7, .	1	.	.	2	8	.	.	11	2	4	16	.	22	2	35
	136	36	.	300	152	29	17	670	52	127	90	241	510	21	1201
Station VIII.															
Jan. 8, .	.	.	.	12	10	.	.	22	2	26	9	.	37	1	60
Feb. 6, .	1	2	3	2	12	.	2	22	8	67	9	.	84	3	109
March 4, .	.	.	1	7	9	.	1	18	6	43	19	.	68	1	87
April 18, .	5	2	.	17	13	7	3	47	1	31	10	48	90	.	137
May 7, .	5	4	9	5	9	.	1	33	.	14	4	56	74	2	100
June 6, .	2	2	.	3	20	5	3	35	1	18	8	42	69	.	104
July 26, .	1	1	.	2	12	8	1	25	.	9	17	19	45	4	74
Aug. 27, .	25	11	.	66	63	4	3	172	2	64	74	19	159	13	344
Oct. 2, .	2	2	.	8	21	3	4	40	3	18	16	2	39	4	83
Nov. 6, .	2	1	2	6	14	.	7	32	4	29	41	1	71	3	106
	43	25	15	128	183	27	25	446	27	315	207	187	736	31	1213
Station IX.															
Jan. 8, .	1	.	.	12	12	.	3	28	.	10	4	.	14	1	43
Feb. 6, .	.	2	.	6	13	.	4	25	12	47	10	.	69	(in. 1 l.) 3	97
March 4, .	3	1	2	6	5	.	.	17	3	80	27	.	110	.	127
April 18, .	1	1	.	3	9	2	4	20	4	3	2	3	12	2	34
May 7, .	1	5	9	15	6	1	.	37	.	8	2	38	48	1	86
June 6, .	.	4	.	18	10	4	3	39	1	13	12	16	42	3	84
July 26, .	.	4	.	10	25	5	.	44	2	29	18	18	67	12	123
Aug. 27, .	3	4	.	27	44	.	.	78	2	79	68	41	190	2	270
Oct. 2, .	21	.	.	1	24	2	1	49	6	7	25	.	38	1	88
Nov. 6, .	1	6	.	4	12	.	.	23	10	12	24	1	47	(in. 1 l.) 4	74
Total, .	31	27	11	102	160	14	15	360	40	288	192	117	637	29	1026

TABLE A.—Showing Summary of Fish taken by the 'Garland' on the East Coast in 1889—*continued.*

Station and Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
St Andrews Bay—															
Station I.															
Jan. 21, .	.	.	.	.	.	.	No.	Fish.	.	.	.	.	.	.	.
March 19, .	83	.	.	22	.	12	1	118	.	.	.	.	.	.	118
April 18, .	37	.	.	9	.	2	1	49	.	.	.	19	19	(t.) 1	69
June 14, .	112	1	.	146	2	.	2	263	.	.	.	94	94	.	357
Aug. 16, .	380	.	.	203	1	2	6	592	.	.	3	58	61	2	655
Oct. 11, .	72	.	.	17	.	.	1	90	.	.	.	3	3	.	93
Nov. 14, .	148	.	.	27	1	.	1	177	.	.	.	15	15	.	192
	832	1	.	424	4	16	12	1289	.	.	3	189	192	3	1484
Station II.															
Jan. 22, .	.	.	.	.	1	.	.	1	.	10	1	.	11	.	12
March 18,	61	1	.	11	.	7	.	80	.	.	.	.	.	.	80
April 19, .	85	1	.	21	.	.	4	111	.	.	3	5	8	.	119
June 14, .	80	.	.	144	.	1	5	230	.	3	4	82	89	(t.) 2	321
Aug. 16, .	393	1	.	313	.	1	2	710	.	.	.	18	18	5	733
Oct. 11, .	153	1	.	44	.	1	1	200	.	.	.	17	17	(t.) 2	219
Nov. 14, .	71	.	.	12	.	.	.	83	.	.	4	2	6	.	89
	843	4	.	545	1	10	12	1415	.	13	12	124	149	9	1573
Station III.															
Jan. 21, .	28	.	.	3	.	.	.	31	.	.	.	.	.	.	31
March 19,	64	.	.	1	2	2	3	72	5	1	.	.	6	.	78
April 19, .	70	.	.	43	1	16	3	133	.	.	.	7	7	.	140
June 14, .	125	.	.	90	.	.	.	215	.	.	.	34	34	1	250
Aug. 15, .	7	.	.	5	.	.	.	12	.	.	.	.	.	.	12
Oct. 11, .	190	1	.	68	.	1	3	263	.	.	2	16	18	(in. 1 t.) 4	285
Nov. 14, .	69	.	.	6	.	2	.	77	.	.	6	7	13	.	90
	553	1	.	216	3	21	9	803	5	1	8	64	78	5	886
Station IV.															
Jan. 22, .	7	.	.	.	.	.	3	10	3	2	.	.	5	.	15
March 18,	139	.	.	1	.	17	.	157	1	.	.	.	1	(brill) 1	159
April 19, .	264	.	.	4	.	10	1	279	.	.	.	3	3	.	282
June 13, .	271	.	.	37	.	4	2	314	.	.	.	6	6	4	334
Aug. 16, .	332	.	.	43	.	39	6	420	.	.	.	79	79	3	502
Oct. 10, .	6	.	.	13	.	.	2	21	5	1	16	.	22	8	51
Nov. 13, .	566	.	.	8	.	13	.	587	.	.	.	3	3	.	590
	1585	.	.	106	.	83	14	1788	9	3	16	91	119	16	1923
Station V.															
Jan. 22, .	1	1	.	3	.	.	.	5	1	1	.	.	2	(t.) 1	8
Mar. 19, .	11	.	.	26	.	9	.	46	.	1	.	1	2	1	49
Apr. 19, .	11	.	.	12	4	6	1	34	.	4	1	30	35	.	69
June 13, .	134	1	.	77	4	.	2	218	.	7	1	112	120	1	339
Aug. 16, .	145	1	.	260	12	.	3	421	.	.	.	25	25	.	446
Oct. 9, .	65	1	.	180	3	.	2	251	.	2	1	10	13	2	266
Nov. 13, .	12	.	.	79	2	.	.	93	.	.	11	1	12	.	105
	379	4	.	637	25	15	8	1068	1	15	14	179	209	5	1282
Montrose—															
Station I.															
June 19, .	63	.	.	58	6	.	5	132	.	2	2	48	52	(in. 5 t.) 10	194
Sept. 18, .	43	.	.	183	2	.	1	229	.	2	4	3	9	(t.) 1	239
Total .	106	.	.	241	8	.	6	361	.	4	6	51	69	11	433

TABLE A.—Showing Summary of Fish taken by the 'Garland' on the East Coast in 1889—*continued.*

Station and Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
MONTROSE—*continued.*															
Station II.															
June 19, .	33	.	.	10	3	.	.	46	.	11	1	91	103	.	149
Sept. 18, .	76	.	.	222	.	.	1	299	.	.	7	16	23	(in. 1t.) 3	325
	109	.	.	232	3	.	1	345	.	11	8	107	126	3	474
ABERDEEN—															
Station I.															
June 22, .	24	.	.	16	.	.	.	40	.	6	3	81	90	.	130
Sept. 21, .	42	.	.	31	.	.	.	73	.	.	16	7	23	1	97
	66	.	.	47	.	.	.	113	.	6	19	88	113	1	227
Station II.															
June 21, .	4	.	.	2	.	.	.	6	.	.	.	.	.	.	6
Sept. 21, .	13	.	.	64	14	.	.	91	.	6	2	18	26	(t.) 2	119
	17	.	.	66	14	.	.	97	.	6	2	18	26	2	125
Station III.															
June 21, .	46	.	2	28	9	.	2	87	.	10	5	35	50	1	138
Sept. 24, .	74	.	.	85	8	11	.	178	1	69	80	23	173	..	351
	120	.	2	113	17	11	2	265	1	79	85	58	223	1	489
Station IV.															
June 21, .	27	.	.	35	1	.	1	64	.	10	8	89	107	.	171
Sept. 24,	170	.	.	54	.	72	.	296	1	23	78	.	102	.	398
	197	.	.	89	1	72	1	360	1	33	86	89	209	.	569
Station V.															
June 21, .	47	.	.	213	.	2	..	262	.	1	.	58	59	(t.) 4	325
Sept. 9, .	55	.	.	145	.	5	.	205	.	.	.	1	1	(in. 5 t.) 8	214
	102	.	.	358	.	7	.	467	.	1	.	59	60	12	539
Station VI.															
June 20, .	25	.	.	6	.	.	2	33	.	2	.	27	29	2	64
Sept. 20, .	5	.	.	67	6	.	1	79	.	1	1	14	16	(t.) 1	96
	30	.	.	73	6	.	3	112	.	3	1	41	45	3	160
Station VII.															
June 20, .	27	1	.	11	.	.	.	39	1	4	15	34	54	.	93
Sept. 9, .	61	.	.	138	9	1	1	210	.	3	4	18	25	(in. 3 t.) 5	240
	88	1	.	149	9	1	1	249	1	7	19	52	79	5	333
MORAY FIRTH—															
Station I.															
June 26, .	36	.	.	14	.	.	1	51	.	15	.	22	37	(in. 1 t.) 2	90
Station II.															
June 26, .	56	.	.	38	.	.	1	95	2	23	.	10	35	1	131

TABLE A.—Showing Summary of Fish taken by the 'Garland' on the East Coast in 1889—*continued.*

Station and Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
Moray Firth—*continued.*															
Station III.															
July 1, .	136	10	.	3	.	.	2	151	3	.	1	2	6	2	159
Station IV.															
June 27, .	35	1	.	31	.	.	.	67	.	17	.	40	57	.	124
Station V.															
June 27, .	13	3	.	33	.	.	.	49	.	6	.	23	29	1	79
Station VI.															
June 27, .	6	2	.	15	.	.	.	23	.	.	.	28	28	.	51
	282	16	.	134	.	.	4	436	5	61	1	125	192	6	634
Orkney Islands—															
Station I.															
July 16, .	5	10	.	47	1	.	3	66	13	3	.	12	28	1	95
Station II.															
July 19, .	3	1	.	3	.	.	.	7	.	.	.	.	.	1	8
Station III.															
July 17, .	6	.	.	5	.	.	1	12	1	1	.	1	3	.	15
Station IV.															
July 18, .	10	15	.	10	.	.	.	35	.	7	.	3	10	2	47
Total, .	24	26	.	65	1	.	4	120	14	11	.	16	41	4	165

TABLE B.—ANALYSIS OF THE 'GARLAND'S' STATISTICS RELATING TO THE RELATIVE ABUNDANCE OF FISH.

A. Showing the Average per 'Shot' of each kind of Fish taken.

Station.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
I. *Firth of Forth*, 1889.															
Closed Area.															
I.	31·3	21·5	–	16·4	28·8	0·3	3·9	102·2	31·9	4·4	21·9	8·1	66·3	6·7	175·2
II.	56·5	11·7	–	37·2	15·5	0·6	1·8	123·3	5·6	7·9	6·4	11·2	31·1	1·1	155·5
III.	36·6	29·2	–	21·3	17·0	0·7	2·0	106·8	24·2	1·7	26·6	9·6	62·1	3·2	172·1
IV.	192·8	4·4	–	42·3	1·4	0·8	2·2	243·9	5·8	--	1·7	10·5	18·0	11·1	273·0
V.	8·3	8·8	1·8	8·1	29·6	1·0	1·6	59·2	6·9	48·8	20·2	7·9	83·8	1·8	144·8
VI.	37·6	12·6	–	13·4	9·6	0·5	0·2	73·9	4·4	8·1	9·7	14·5	36·7	2·3	112·9
VII.	13·6	3·6	–	30·0	15·2	2·9	1·7	67·0	5·2	12·7	9·0	24·1	51·0	2·1	120·1
Average per shot of 70 shots.	53·8	13·1	0·2	24·1	16·7	0·9	1·9	110·9	12·0	11·9	13·6	12·2	49·8	4·0	164·8
Unclosed Area.															
VIII.	4·3	2·5	1·5	12·8	18·3	2·7	2·5	44·6	2·7	31·5	20·7	18·7	73·6	3·1	121·3
IX.	3·1	2·7	1·1	10·2	16·0	1·4	1·5	36·0	4·0	28·8	19·2	11·7	63·7	2·9	102·6
Average per shot of 20 shots.	3·7	2·6	1·3	11·5	17·1	2·0	2·0	40·3	3·3	30·1	19·9	15·2	68·6	3·0	111·9
II. *St Andrews Bay*, 1889.															
Closed Area.															
I.	118·8	0·1	–	60·5	0·5	2·2	1·7	184·1	–	–	0·4	27·0	27·4	0·4	212·0
II.	120·4	0·5	–	77·8	0·1	1·4	1·7	202·1	–	1·8	1·7	17·7	21·2	1·2	224·7
III.	79·0	0·1	–	30·8	0·4	3·0	1·2	114·7	0·7	0·1	1·1	9·1	11·1	0·7	126·5
IV.	226·4	–	–	15·1	–	11·8	2·0	255·4	1·2	0·4	2·2	13·0	17·0	2·2	274·7
Average per shot of 28 shots.	136·1	0·2	–	46·1	0·2	4·6	1·6	189·1	0·5	0·6	1·3	16·7	19·2	1·1	209·5
Unclosed Area. V. Average of 7 shots.	54·1	0·5	–	91·0	3·5	2·1	1·1	152·5	0·1	2·1	2·0	25·5	29·8	0·7	183·1
III. *Montrose, June and September* 1889.															
Average of 4 shots.	53·7	–	–	118·2	2·7	–	1·7	176·5	–	3·7	3·5	39·5	46·7	3·5	226·7
IV. *Aberdeen, June and September* 1889.															
Average of 14 shots.	44·2	–	0·1	63·9	3·3	6·7	0·2	118·7	0·2	9·6	15·1	28·9	53·9	1·7	174·4
VI. *Moray Firth, June* 1889.															
Average of 6 shots.	47·0	2·6	–	22·3	–	–	0·6	72·6	0·8	10·1	0·1	20·8	32·0	1·0	105·6
V. *Orkney Islands, July* 1889.															
Average of 4 shots.	6·0	6·5	–	16·2	0·2	–	1·0	30·0	3·5	2·7	–	4·0	10·2	1·0	41·2

B. Showing the Monthly Average Per 'Shot' of each kind of Fish taken in 1889.

Date.	Flat-Fish.								Round-Fish.					Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Skate.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.		
I. *Firth of Forth.*															
Closed Area.															
Jan.	14·5	1·4	0·2	2·8	10·2	–	0·5	30·0	15·7	14·5	9·8	–	40·1	3·8	74·0
Feb.	64·7	1·7	1·0	4·1	8·5	–	1·1	81·2	14·2	4·0	6·4	–	24·7	2·5	108·5
Mar.	46·5	4·5	0·4	14·2	11·2	1·8	0·7	79·4	17·2	3·2	2·0	–	22·5	4·7	106·7
April	45·7	14·0	–	11·8	4·8	2·8	1·4	80·5	9·8	6·5	7·2	0·2	24·0	3·8	108·4
May	20·5	13·1	–	7·7	18·1	1·8	0·4	61·8	11·8	9·4	6·2	26·7	54·2	2·8	119·0
June	81·2	31·7	–	44·1	22·2	1·1	2·4	183·0	7·0	8·4	4·2	36·8	56·5	4·2	243·8
July	68·1	17·7	–	63·0	22·8	0·4	2·7	174·8	7·5	33·5	35·4	29·0	105·5	7·8	288·2
August	86·1	28·0	–	38·1	21·5	0·2	3·0	177·1	10·2	6·7	22·4	16·1	55·5	7·7	240·4
Oct.	76·1	19·0	–	46·4	25·8	0·7	2·7	170·8	13·0	17·2	16·5	15·2	62·1	1·1	234·1
Nov.	42·7	4·8	0·8	10·4	19·0	0·4	4·0	82·2	12·4	12·5	20·4	0·1	45·5	1·8	129·7
Unclosed Area.															
Jan.	0·5	–	–	12·0	11·0	–	1·5	25·0	1·0	18·0	6·5	–	25·5	1·0	51·5
Feb.	0·5	2·0	1·5	4·0	12·5	–	3·0	23·5	10·0	57·0	9·5	–	76·5	3·0	103·0
Mar.	1·5	0·5	1·5	6·5	7·0	–	0·5	17·5	4·5	61·5	23·0	–	89·0	0·5	107·0
April	3·0	1·5	–	10·0	11·0	4·5	3·5	33·5	2·5	17·0	6·0	25·1	51·0	1·0	85·5
May	3·0	4·5	9·0	10·0	7·5	0·5	0·5	35·0	–	11·0	3·0	47·0	61·0	1·5	97·5
June	1·0	3·0	–	10·5	15·0	4·5	3·0	37·0	1·0	15·5	10·0	29·0	55·5	1·5	94·0
July	2·0	2·5	–	14·5	28·0	4·0	0·5	51·5	1·0	44·0	42·5	30·0	117·5	3·0	172·0
August	14·0	7·7	–	46·5	53·5	2·0	1·5	125·0	2·0	71·5	71·0	30·0	174·5	7·5	307·0
Oct.	11·5	1·0	–	4·5	22·5	2·5	2·5	44·5	4·5	12·5	20·5	1·0	38·5	2·5	85·5
Nov.	1·5	3·5	1·0	5·0	13·0	–	3·5	27·5	7·0	18·5	32·5	1·0	59·0	3·5	90·0
II. *St Andrews Bay.*															
Closed Area.															
Jan.	8·7	–	–	0·7	0·2	–	0·7	10·5	0·7	3·0	0·2	–	4·0	–	14·5
Mar.	86·7	0·2	–	8·7	0·5	9·5	1·0	106·7	1·5	0·2	–	–	1·7	0·2	108·7
April	114·0	0·2	–	19·2	0·2	7·0	2·2	143·0	–	–	0·7	8·5	9·2	0·2	152·5
June	147·0	0·2	–	104·2	0·5	1·2	2·2	255·5	–	0·7	1·0	54·0	55·7	1·7	313·0
August	278·0	0·2	–	141·0	0·2	10·5	3·5	433·5	–	–	0·7	38·7	39·5	2·5	475·5
Oct.	105·2	0·5	–	35·5	–	0·5	1·7	143·5	1·2	0·2	4·5	9·0	15·0	3·5	162·0
Nov.	213·5	–	–	13·2	0·2	3·7	0·2	231·0	–	–	2·5	6·7	9·2	–	240·2
Unclosed Area.															
Jan.	1	1	–	3	–	–	–	5	1	1	–	–	2	1	8
Mar.	11	–	–	26	–	9	–	46	–	1	–	1	2	1	49
April	11	–	–	12	4	6	1	34	–	4	1	30	35	–	69
June	134	1	–	77	4	–	2	218	–	7	1	112	120	1	339
August	145	1	–	260	12	–	3	421	–	–	–	25	–	–	446
Oct.	65	1	–	180	3	–	2	251	–	2	1	10	13	2	266
Nov.	12	–	–	79	2	–	–	93	–	–	11	1	12	–	105

LIST OF COMMON AND SCIENTIFIC NAMES (DAY) OF FISH MENTIONED IN THE RETURNS.

Angler,	*Lophius piscatorius.*
Bib,	*Gadus luscus.*
Brassie,	*Gadus luscus.*
Brill,	*Rhombus lævis.*
Butter-fish,	*Centronotus gunnellus.*
Cat-fish,	*Anarrhichas lupus.*
Coal-fish,	*Gadus virens.*
Cod,	*Gadus morrhua.*
Dab, common,	*Pleuronectes limanda.*
,, lemon,	,, *microcephalus.*
,, long rough,	*Hippoglossoides limandoides.*
Dragonet,	*Callionymus lyra.*
Eel, greater sand,	*Ammodytes lanceolatus.*
Father-lasher,	*Cottus scorpius.*
Fishing-frog,	*Lophius piscatorius.*
Five-bearded rockling,	*Motella mustela.*
Flounder,	*Pleuronectes flesus.*
,, long,	*Pleuronectes cynoglossus.*
Fluke, little black hairy,	*Zeugopteris punctatus.*
Fluke, sail,	*Arnoglossus megastoma.*
,, sand,	*Pleuronectes microcephalus.*
Gurnard, common,	*Trigla gurnardus.*
,, red,	,, *cuculus.*
Haddock,	*Gadus æglefinus.*
Hake,	*Merluccius vulgaris.*
Herring,	*Clupea harengus.*
Horse-mackerel,	*Caranx trachurus.*
John Dory,	*Zeus faber.*
Ling,	*Molva vulgaris.*
Lump-sucker,	*Cyclopterus lumpus.*
,, ,, diminutive, . .	*Liparis montagui.*
Lythe,	*Gadus pollachius.*
Mackerel,	*Scomber scomber.*
Monk-fish,	*Lophius piscatorius.*
Plaice,	*Pleuronectes platessa.*
Pogge,	*Agonus cataphractus.*
Ray, sandy,	*Raia circularis.*
,, shagreen,	,, *fullonica.*
,, spotted,	,, *maculata.*
,, starry,	,, *radiata.*
,, thornback,	,, *clavata.*
Saithe,	*Gadus virens.*
Sand-eel, greater,	*Ammodytes lanceolatus.*
Skate, flapper,	*Raia macrorhynchus.*
,, gray,	,, *batis.*
Sole,	*Solea vulgaris.*
,, black,	,, ,,
,, little,	,, *lutea.*
,, witch,	*Pleuronectes cynoglossus.*
Sprat,	*Clupea sprattus.*
Turbot,	*Rhombus maximus.*
Whiting,	*Gadus merlangus.*
Wolf-fish,	*Anarrhichas lupus.*

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth.

E. before the figures indicating temperature means east end of station; W., west; N., north; and S., south.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn and young Fish.†	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.†	Wind, Weather, and other Observations.
Station I. 10th January 10 a.m. to 12 noon.	W. 38·0	42·0	43·0 16 fath.	Surface-net. — *Parathemisto oblivia*, fr.; Medusids (*Cydippe*, *Bolina*), *Calanus finmarchicus*, f.	Starry ray,*	1	5½	...	...	...	...		At beginning—Wind W.N.W., force 3; hazy but fine; sea smooth; transparency, disk just visible at 1¾ fathoms; tide, 1 hour ebb.; bar. 29·55. At finish—Wind N.W., force 2; transparency, 3 fathoms.
					Lemon soles,	1	13	2	12	3	10		
					Common dabs,	1	7	1	6	...	...		
					Long rough dabs,	2	11½	7	9½	10	7½		
					" "	5	6½	...	...	...	...		
	E. 41·0	43·0	43·6	Bottom-net.—*Sagittæ*, com.; *Calanus finmarchicus*, fr.; Medusids, fr.; *Tomopteris*, f.; *Boreophausia raschii*, f.; Isopods, f.	Haddocks,	1	16	...	...	...	...		
					Cod,	1	25	1	22	4	19		
					"	1	15	5	13½	6	12		
					"	6	11	4	10	1	9		
					"	1	8	...	...	...	...		
					Whitings,	1	16	1	15	3	14		
					"	2	13	3	10	5	9		
					"	5	8	2	6	1	4½		
					Catfish,	1	32½	...	...	...	...		
					Herrings,	7	7	...	...	...	...		
Station II. 10th January 12.33 p.m. to 2.10 p.m.	E. 39·0	42·6	43·0 13 fath.	Surface-net. — *Parathemisto oblivia*, f.; Medusids, fr.; some pieces of Algæ, 1 with a *Botryllus* attached.	Common dabs,	1	9	2	7½	1	5½		At beginning—Wind N.W., force 2; moderately clear, fine; sea smooth; transparency, 2 fathoms; tide about 3½ hours ebb; bar. 29·60. At finish—Wind N., force 2.
					Long rough dabs,	1	12	4	9	4	8		
					" "	3	7	...	...	...	...		
					Haddocks,	1	19	9	13	11	12		
	W. 42·0	42·6	43·1 11 fath.	Bottom-net. — *Boreophausia raschii*, com.; *Sagittæ*, com.; *Parathemisto oblivia*, f.; *Tomopteris*, f.; *Calanus finmarchicus*, f.; *Caligus*, sp. f.	"	3	11	2	10	...	...		
					Cod,	1	29	1	21	1	20		
					"	1	11½	2	10½	2	9		
					Whitings,	1	14½	1	13	2	11		
					"	1	12	...	...	...	...		

* The measurement of skates and rays is a measurement of width, and not of length.

† sp.=species unidentified; juv.=young; r.=rare; f.=few; fr.=frequent; com.=common; a.=abundant; v.a.=very abundant.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued*.

Station. Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION III. 7th January 2.10 p.m. to 4.15 p.m.	E. 38·0	42·0	42·8 13 fath.	Surface-net. — Medusids, fr. (*Geryonia circe*); *Metopa*, sp. f. (apparently sheltering under the Medusids, most being found so situated); *Clio borealis*, 1 specimen. Bottom-net.—*Sagittæ*, a.; *Boreophausia raschii*, com.; *Calanus*, fr.; *Erythrops*, f.; *Mysidopsis gibbosa*, f.	Lemon soles,	3	12½	...	...	...	...		At beginning—Wind S.E. by E. force 2; hazy, fine; sea smooth; transparency of water, 2 fathoms; tide about 1½ hou flood; bar. 29·97. At finish—Wind S.S.E.; force 3; transparency, 1¾ fathoms.
					Long rough dabs,	2	9	1	8	2	7		
					" "	1	6	...	...	...	...		
					Brassie,	1	7	...	...	...	...		
					Herring	6	7	...	...	...	...		
					Haddocks,	1	17½	2	12	1	10		
					Cod,	1	7½	...	...	...	...		
	W. 40·9	42·8	43·0 9 fath.		"	1	28½	1	23	1	26		
					"	1	29	2	20	1	18		
					"	15	13	8	12	12	11		
					Whitings,	1	18	1	21	1	15		
					"	1	14	9	13	2	12		
					"	2	11	5	10	6	8½		
STATION IV. 3rd January 2.15 p.m. to 4.10 p.m.	W. 45·4	41·3	41·5 7 fath.	Surface-net. — *Parathemisto oblivia*, f. Bottom-net.—*Sagittæ*, fr.; *Calanus finmarchicus*, fr.; *Boreophausia raschii*, f.; *Caligus* sp., f.; Medusids, f. One Nereid, probably *Myriana*—no young fish nor fish eggs.	Plaice,	1	18	20	15	61	13		At beginning—Wind W., force 7; cloudy; sea moderate; transparency of water, 1¾ fathoms; tide near high water; bar. 30·51. At finish—Wind W. by N., force 6; transparency 1½ fathoms.
					"	12	12	6	10	...	...		
	E. 45·3	41·6	41·4 7 fath.		Common dabs,	1	10½	1	9½	2	8		
					" "	2	7	1	6	...	...		
					Long roughs,	1	11½	1	10½	2	9½		
					" "	1	6½	...	...	...	...		
					Herring,	12	6¾	...	...	...	...		
					Cod,	2	23	1	19	1	17		
					"	2	13	5	10	2	8		
					Whiting,	2	10	1	8½	1	7½		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station V. 9th January 11.5 a.m. to 12.45 p.m.	W. 43·0 E. 43·6	43·3 43·4	44·5 32 fath. 44·5 29 fath.	Surface-net. — *Parathemisto oblivia*, fr.; Schizopods, f.; *Sagittæ*, f. Bottom-net.—*Sagittæ*, v.a., Schizopods, f.; Amphipods, f.; *Calanus finmarchicus*, f.; Medusids, f.	Thornback ray,	1	17	...	...	...	...		At beginning—Wind S.E., force 4; hazy, fine sea, considerable swell from S.E.; transparency of water, 3¼ fathoms; tide about 3 hours ebb; bar. 29·31. At finish—Wind, sea, transparency, &c., as above.
					Common dabs,	1	7½	...	...	...	...		
					Witch sole,	1	16½	1	15	...	...		
					Long rough dabs,	12	8	4	7	1	5½		
					Haddocks,	1	16	2	14	18	13		
					"	2	12	12	11	1	10		
					Cod,	1	24	1	15	1	10		
Station VI. 9th January 1.25 p.m. to 2 p.m.	E. 43·1 W. 43·5	43·2 43·2	44·2 12 fath. 43·5 12 fath.	Surface-net. — *Parathemisto oblivia*, f.; *Sagittæ*, f. Bottom-net.—*Sagittæ*, fr.; Medusids, f.; *Calanus finmarchicus*, *Boreophausia raschii*, f.	Plaice,	1	14½	1	13½	...	...		At beginning—Wind S.E., force 7; dull; sea rough; transparency, 1¾ fathoms; tide near low water; bar. 29·20. At finish — As above; dull, beginning to rain.
					Long rough dabs,	1	8	...	...	...	...		
					Haddocks,	1	19½	1	16	1	14½		
					"	3	13	1	11½	...	...		
					Cod,	1	22	5	11	1	10		
					"	3	9	...	...	...	...		
					Whitings,	1	22	2	10½	...	...		
Station VII. 8th January 4.10 p.m. to 5.50 p.m.	E. 42·6 W. 44·4	42·4 42·2	43·9 18½ fath. 43·0 15 fath.	Surface-net. — Almost nil. Bottom-net.—*Sagittæ*, a.; *Crangon allmanni*, fr.; *Erythrops goesii*, f.; *Mysis ornata*, fr.; *Calanus finmarchicus*, fr.; *Ampelisca* sp., f.; other Amphipods, f.	Starry ray,	1	10	1	6	...	...		At beginning—Wind S.E., force 2; hazy; sea smooth; transparency, 3 fathoms; tide, fully 2 hours flood; bar. 29·63. At finish—Wind N.E. by E., force 2; weather dull but fine.
					Lemon soles,	1	14	...	...	...	...		
					Common dabs,	2	10	3	8	1	7		
					Long rough dabs,	1	10	5	7½	1	5½		
					Haddocks,	3	17	1	15	1	14		
					"	2	13	13	12	8	9½		
					Cod,	1	34	2	12	1	8		
					Whitings,	1	17	1	9	2	8		
					"	2	6	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station VIII. 8th January 2.5 p.m. to 3.35 p.m.	E. 42·2	42·9	44·8 27 fath.	Surface-net. — *Parathemisto oblivia*, fr.; *Sagittæ*, f.	Common dabs, .	1	12	1	9	8	8		At beginning—Wind S.E., force 5; hazy; sea moderate; transparency, 3 fathoms; tide, a little after low water; bar. 29·68. At finish—Wind S.E., force 4; weather, &c., as above.
					" " . .	2	6	...	...	...	...		
					Long rough dabs, .	1	11	7	7½	2	6		
					Sand fluke, . .	1	12½	...	...	...	...		
	W. 42·6	42·8	43·9 26 fath.	Bottom-net.—*Sagittæ*, v.a.; *Calanus finmarchicus*, f.; Medusids, f.	Haddocks, . .	6	12	11	11	4	10		
					" . .	5	9	...	...	...	...		
					Cod, . . .	1	41	1	10	...	...		
					Whitings, . .	1	14	2	12	2	8½		
					"	4	8	...	...	...	...		
Station IX. 8th January 11.52 a.m. to 1.40 p.m.	S. 40·8	42·8	44·7 27 fath.	Surface-net. — *Parathemisto oblivia*, fr.; *Sagittæ*, f.; 1 *Metopa alderi*, 1 *Idotea marina*.	Thornback ray, .	2	14	1	9	...	...		At beginning—Wind S.E., force 4; hazy; sea, moderate; transparency, 3 fathoms; tide about 4½ hours ebb; bar. 29·71. At finish—Wind S.E., force 5; weather, &c., as above.
					Plaice, . . .	1	13	...	...	...	...		
					Common dabs, .	2	9½	5	8½	3	7½		
					" . .	2	6½	...	...	...	...		
	N. 42·0	43·1	44·9 27 fath.	Bottom-net.—*Sagittæ*, com.; Medusids, fr. (*Cydippe*), Schizopods (*Mysis*); Amphipods, f.	Long rough dabs, .	3	8	8	7	1	6½		
					Haddocks, . .	3	11	3	10	4	9		
					Whitings, . .	3	13	1	6½	...	...		
					Angler . . .	1	14	...	...	...	..		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inces	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION I. 12th Feb. 10.45 a.m. to 1.15 p.m.	E. 30·8 W. 40·0	40·5 40·1	41·0 23 fath. 40·6 13 fath.	Surface-net. — Small Medusids, fr.; *Sagittæ*, r. Bottom-net. — Small Medusids, fr.; *Sagittæ*, fr.; *Boreophausia raschii*, fr.; *Caligus*, sp., fr.; *Erythrops goesii*, 1; *Mysis*, sp., 1; young sprat, 1.	Thornback ray .	1	19	1	13	...	...		At beginning—Wind N.W., force 3; moderately clear, fine; sea smooth; transparency, 2¼ fathoms; tide about 4 hours flood; bar. 30·25. At finish—Wind W., force 3; weather, &c., as above.
					Plaice, . . .	3	12	1	6	...	...		
					Lemon soles, .	3	12	2	10	1	9½		
					Common dabs, .	1	9	3	7	...	...		
					Long rough dabs, .	2	11	5	9½	8	8½		
					,, ,, .	6	7	4	6	...	...		
					Haddocks, . .	4	12	...	...	...	...		
					Cod, . . .	1	33	1	38	1	32		
					,, . . .	1	28	1	23	3	21		
					,, . . .	5		21	12	10	10		
					,, . . .	2	9	...	...	...	...		
					Whitings, . .	1	18	5	11	6	9½		
					,, . .	6	7½	2	5½	...	...		
					Catfish, . . .	1	37	1	35	1	27		
					Angler, . . .	2	19	1	21	2	17		
					,, . . .	1	20	...	...	...	...		
					Cobbler, . .	1	10	...	...	...	...		
STATION II. 11th Feb. 4.5 p.m. to 5.20 p.m.	W. 34·2 E. 35·0	40·9 40·2	41· 12 fath. 40·3 11 fath.	Surface-net. — Medusids, f. Bottom-net.—*Sagittæ*, f.; *Boreophausia raschii*, f.; Medusids, f.; *Calanus finmarchicus*, f.; *Caligus*, sp., f.	Plaice, . . .	3	15	8	13	...	...		At beginning—Wind N.N.E., force 4; snow showers; sea moderate; transparency, 2¾ fathoms; tide, 4½ hours ebb; bar. 29·84. At finish—Wind N.E., force 4; squally; snow showers; transparency, 2¼ fathoms.
					Long rough dabs, .	1	7	...	...	...	...		
					Haddock, . .	1	11½	1	10	...	...		
					Cod, . . .	1	12	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Sur-face.	Water. Bot-tom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station III. 5th Feb. 9.30 a.m. to 11.40 a.m.	W. 40·0 E. 41·4	41·4 41·0	41·5 9 fath. 41·2 12 fath.		Long rough dabs,	2	8½	...	...	...	...		At beginning—Wind W., force 8; cloudy; sea moderate; transparency, 1 fathom; tide, 4 hours ebb; bar. 30·10. At finish—Wind W., force 6.
					Cod,	1	43½	1	28	1	18½		
					,,	1	16½	2	15	...	...		
					Whitings,	2	11	2	9	1	8		
					,,	1	6	...	...	...	...		
					Herring,	1	7½	...	...	...	...		
Station IV. 5th Feb. 12.10 p.m. to 2.30 p.m.	E. 42·2 W. 46·0	39·8 39·6	39·9 4 fath. 39·8 5 fath.		Plaice,	160	14	100	13	47	12		At beginning—Wind W.N., force 5; cloudy; transparency, ¾ fathoms; tide the first of the flood; bar. 30·04.
					,,	32	11	44	9	...	...		
					Common dabs,	8	9½	7	8	6	6		
					Lemon sole,	3	9½	...	...	...	...		
					Sail fluke,	1	15	...	...	...	...		
					Cod,	1	36	4	19½	5	17½		
					,,	12	14	7	12	2	9		
					Herring,	1	11	...	...	...	...		
					Cobbler,	1	12	1	8	...	...		
Station V. 11th Feb. 10.45 a.m. to 12.30 p.m.	E. 33·0 W. 36·5	41·4 41·0	41·8 26 fath. 42·0 28 fath.	Surface-net.—*Parathemisto oblivia*, f.; small Medusids, f.; *Sagittæ*, f. Bottom-net.—*Sagittæ*, fr.; *Boreophausia raschii*, f.; *Parathemisto oblivia*, f.; *Tomopteris*, f.	Common dabs,	1	10½	1	6½	1	5½		At beginning—Wind N.N.W., force 4; clear, fine; sea moderate; transparency, 2¾ fathoms; tide about high water; bar. 29·73. At finish—Wind N.N.W., force 6; transparency, 3 fath.
					Witch soles,	3	20	2	16½	2	15½		
					Long rough dabs,	3	11	12	8	6	6½		
					,, ,,	4	6	...	...	...	...		
					Haddocks,	3	19	1	15	6	13		
					,,	7	12	5	12	...	...		
					Cod,	2	22	3	10	...	...		
					Whitings,	1	20	4	15	4	12½		
					,,	2	9	5	8	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VI. 11th Feb. 1.12 p.m. to 2.15 p.m.	W. 35·0	40·0	40·0 10 fath.	Surface-net. — Medusids, f.; *Sagittæ*, f.	Plaice,	32	$15\frac{1}{2}$	14	$14\frac{1}{2}$	7	13		At beginning—Wind N.N.W., force 6; somewhat cloudy; sea moderate; transparency, $2\frac{1}{2}$ fathoms; tide, $1\frac{1}{2}$ hours ebb; bar. 29·73.
					Lemon soles,	2	12	...	...	...	...		
					Brill,	1	20	...	...	...	...		
	E. 37·0	39·8	39·8 13 fath.	Bottom-net.—*Sagittæ*, com.; *Caligus*, sp. f.; *Calanus finmarchicus*, f.; greater sand-eel, 1 (about 7 inches long).	Cod,	1	24	3	21	1	19		At finish—Wind N., force 6; with snow showers; transparency, $2\frac{1}{4}$ fathoms.
					,,	1	18	1	16	...	...		
					Catfish,	1	27	1	25	...	...		
STATION VII. 6th Feb. 4.20 p.m. to 6.15 p.m.	E. 43·0	41·8	42·0 18 fath.	Surface-net.—*Sagittæ*, f.	Starry ray,	1	12	1	9	...	...		At beginning—Wind veering N.N.W. to N.E., force 3; detached clouds; sea heavy, swell from S.E.; transparency, $1\frac{1}{2}$ fathoms; tide nearly 4 hours flood; bar. 29·96.
					Thornback ray,	1	13	2	10	...	...		
					Gray skate,	1	10	...	...	...	...		
	W. 40·0	41·1	41·2 11 fath.		Plaice,	1	20	1	10	...	...		
					Lemon sole,	1	13	...	...	...	...		
					Common dabs,	1	10	...	...	...	...		
					Long rough dabs,	1	11	2	$8\frac{1}{2}$	3	$7\frac{1}{2}$		
					,, ,,	1	5	...	...	...	...		
					Cod,	1	34	1	$10\frac{1}{2}$	2	$8\frac{1}{2}$		
					Whitings,	1	7	2	5	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VIII. 6th February 2 p.m. to 4 p.m.	E. 42·5 W. 43·0	42·0 42·0	42·4 28 fath. 42·2 22 fath.	Surface-net.—A small cluster of what looks like eggs, but not *floating* fish-eggs. Probably part of a cluster of eggs attached to littoral sea-weed, broken off by waves and carried to sea, just as bits of sea-weed, littoral Amphipods and Isopods (*Gammarus* and *Idotea*) are carried.	Thornback ray,	1	11	...	...	...	...		At beginning—Wind N., force 3; sky, clear with a few clouds; sea heavy, east swell; transparency, 2¾ fathoms; tide, 1 hour flood; bar. 29·96.
					Gray skate,	1	14	...	...	...	...		
					Plaice,	1	14½	...	...	...	...		
					Lemon soles,	1	14	1	9	...	...		
					Common dabs,	1	9	1	6½	...	...		
					Witch soles,	2	17	1	9	...	...		
					Long rough dabs,	4	9	5	7½	3	6½		
					Haddocks,	6	20	4	14	39	12		
					"	9	11	9	9	...	...		
					Cod,	1	32	1	30	1	28		
					"	1	26	2	24	1	21		
					"	1	19	...	...	...	...		
					Whitings,	5	16	4	12	...	...		
					Monk or angler,	1	26	1	19	...	...		
					Herring,	1	11	...	...	...	...		
STATION IX. 6th February 11.20 a.m. to 1.30 p.m.	E. 40·6 W. 42·5	42·0 42·1	42·2 30 fath. 42·2 28 fath.		Thornback ray,	1	15	...	...	...	...		At beginning—Wind N.N.W., force about 4; weather cloudy, but fine; sea heavy, east swell; transparency, 2½ fathoms; tide, ¾ ebb; bar. 29·98.
					Gray skate,	1	45	1	18	1	15		
					Lemon soles,	2	10½	...	...	...	...		
					Common dabs,	2	11	2	8½	2	7		
					Long rough dabs,	2	10	8	8	3	6		
					Haddocks,	1	19	2	17	1	16		
					"	19	13	12	11	10	10		
					"	2	8½	...	...	...	...		
					Cod,	1	42	1	33	2	31		
					"	1	28	2	21	1	18		
					"	2	16	2	13	...	...		
					Whitings,	2	19	1	17	2	15½		
					"	1	13	2	12	2	10		
					Ling,	1	36	...	...	...	...		
					Cat fish,	1	25	1	23	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station I. 3rd March 9.20 a.m. to 11.30 a.m.	W. 40·0	39·5	39·9 11 fath.		Thornback ray,	1	14	...	...	...	...		At beginning—Wind N.N.W., force 2; clear and fine; transparency, 1¾ fathoms; bar. 30·10. At finish—transparency, 2¼ fathoms.
					Plaice,	1	14½	3	13	2	10		
					Lemon soles,	2	14	6	12	5	10½		
					" "	1	8	...	...	...	...		
	E. 42·0	39·8	40·0 15 fath.		Common dabs,	8	10	17	8½	13	7		
					" "	4	6	...	...	...	...		
					Flounder,	1	9	...	...	...	...		
					Long rough dabs,	3	13	8	10	8	7		
					" "	4	6½	...	...	...	...		
					Haddock,	1	10½	...	...	...	...		
					Cod,	1	23	4	20	9	18		
					"	20	14	24	12	25	10		
					"	2	7	...	...	...	...		
					Whiting,	1	13	1	10½	...	...		
					Angler,	1	20	1	19½	1	18		
					"	1	13	...	...	...	...		
Station II. 8th March 4.10 p.m. to 6 p.m.	E. 39·8	39·2	39·3 11 fath.		Plaice,	11	14½	10	12½	4	11		At beginning—Wind E., force 2; very dull; transparency, 2¾ fathoms; bar 29·40.
					"	2	8	1	6½	...	...		
					Lemon soles,	2	14	1	11	...	...		
	W. 39·0	39·2	39·2 13 fath.		Common dabs,	1	12	2	9	6	8		
					" "	5	7	...	...	...	...		
					Flounder,	1	12	...	...	...	...		
					Long rough dabs,	2	7	...	...	...	...		
					Cobbler,	1	7	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION III. 11th March 12.20 p.m. to 2.30 p.m.	W. 43·0	40·0	38·9		Skate,	3	16½	...	...	...	...		At beginning—Calm, force 0; clear and fine; transparency, 2¼ fathoms; bar. 30·10. At finish—transparency, 2½ fathoms.
					Plaice,	3	14	...	...	...	...		
					Lemon soles,	2	12	4	11	1	9		
	E. 42·0	39·8	39·2		Common dabs,	6	9	8	8	4	6		
					Flounders,	1	13½	1	11½	...	...		
					Long rough dabs,	2	10	9	9	7	6		
					Cod,	1	17	2	6	1	4		
					Whitings,	4	4½	...	...	...	...		
					Catfish,	1	13½	...	...	...	...		
					Angler,	1	28	...	...	...	...		
STATION IV. 9th March 10.50 a.m. to 1 p.m.	W. 42·0	38·4	38·5 5 fath.		Plaice,	71	14	75	11	55	10		At beginning—Wind W.N.W force 6; clouds and sunshine; transparency, 1½ fathoms; bar. 29·44.
					"	31	9	4	7½	...	...		
					Common dabs,	1	10	2	9	2	7½		
			39·0		Flounders,	4	11	...	...	...	...		
	E. 42·0	38·9	5 fath.		Cod,	1	20½	...	...	...	...		
					Cobbler,	1	12½	1	10½	1	8		
STATION V. 8th March 11.40 a.m. to 1.40 p.m.	E. 40·8	39·6	39·8 24 fath.		Plaice,	1	14	1	12	...	...		At beginning—Wind W., force 3; hazy, but fair; transparency, 2½ fathoms; bar. 29·40. At finish—Transparency, 3¼ fathoms.
					Lemon soles,	1	15	1	12	...	...		
					Common dabs,	2	12	5	10	5	7½		
					" "	1	5	...	...	...	...		
	W. 43·0	39·9	40·0 27 fath.		Witch soles,	1	19	2	14½	...	...		
					Long rough dabs,	5	10½	10	9	3	7½		
					Haddocks,	1	20	6	12½	1	9½		
					Cod,	1	10	...	...	...	...		
					Whitings,	2	17	5	12	...	...		
					Angler,	1	30	1	26	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION VI. 8th March 2.15 p.m. to 3.10 p.m.	E. 41·0	39·4	39·6 14 fath.		Plaice, . . .	1	24	14	16½	19	13		At beginning—Wind E., force 2; hazy; transparency, 2¾; bar. 29·49.
					" . . .	2	11½	1	10	...	8		
					Lemon soles, . .	1	14½	1	11	2	9		
					Common dabs, .	2	12	1	10	3	8		
	W. 40·6	39·4	39·5 13 fath.		" " .	2	7	...	...	...	...		
					Brill, . . .	1	21	1	20½	1	19		
					Turbot, . . .	1	17	...	...	...	...		
					Cod, . . .	1	18	...	...	...	...		
STATION VII. 8th March 8.45 a.m. to 10.45 a.m.	W. 39·0	39·0	39·5 10 fath.		Gray skate, . .	1	10½	...	...	...	...		At beginning—Wind W., force 3; hazy; easterly swell; transparency, 1¾ fathoms; bar. 29·40. At finish—Transparency, 2½ fathoms.
					Plaice, . . .	9	14½	1	17	2	11		
					Lemon soles, . .	2	13	...	...	...	...		
					Common dabs, .	1	11	8	8½	4	7		
	E. 42·2	39·4	39·8 16 fath.		Flounders, . .	1	10½	2	8½	...	...		
					Long rough dabs, .	5	8	6	7	2	6		
					Brill, . . .	1	19	...	...	...	...		
					Haddocks, . .	1	16	6	12	1	11		
					" . . .	1	10	...	...	...	...		
					Cod, . . .	10	18	13	14½	6	12		
					Whitings, . .	2	14½	2	9½	1	13		
					Ling, . . .	1	31	...	...	...	...		
					Lump-sucker, .	1	19	1	14	...	...		
					Cobbler, . .	1	12	1	6	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VIII. 4th March 12.30 p.m. to 2.30 p.m.	E. 38·5	40·0	40·0 27 fath.		Skate,	1	12	...	...	...	...		At beginning—Wind N., force 2; clear sky; heavy swell from eastward; transparency, 3¼ fathoms; bar. 30·06.
					Common dabs,	3	10½	4	7½	...	...		
					Witch sole,	1	17	...	...	...	...		
					Long rough dabs,	1	15½	1	11	7	8		
					Haddocks,	1	18	3	16	21	12		
	W. 37·8	40·0	40·0 20 fath.		,,	18	11	...	...	...	...		
					Cod,	1	31	1	19	2	16		
					,,	2	14	...	...	...	...		
					Whitings,	1	17	4	13	2	10½		
					,,	12	8	...	...	...	...		
					Brassie	1	7	...	...	...	...		
STATION IX. 4th March 10 a.m. to 12 noon.	E. 32·0	39·9	40·0 30 fath.		Plaice,	1	16½	2	13	...	...		At beginning—Wind S.E., force about 2; clear sky; heavy swell from eastward; transparency, 2¾ fathoms; bar. 30·06. At finish—Transparency, 3½ fathoms.
					Lemon sole,	1	13½	...	...	...	...		
					Common dabs,	4	8	2	6½	...	...		
					Witch soles,	2	16½	...	...	...	...		
					Long rough dabs,	1	12½	4	7½	...	...		
	W. 38·0	40·0	40·0 28 fath.		Haddocks,	2	18½	1	16½	21	13½		
					,,	27	11½	29	10	...	...		
					Cod,	1	23½	2	19½	...	...		
					Whitings,	1	18	1	15	13	13		
					,,	5	11½	4	10	3	8½		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station I. 11th April 11 a.m. to 1.30 p.m.	W. 39·8	41·0	41·0 13 fath.		Gray skate,	1	15	...	...	...	...		At beginning—Wind E.N.E., force 5; sea very rough; raining; transparency, 1½ fathoms; bar. 29·52.
					Starry ray,	1	12	1	7	...	...		
					Thornback ray,	1	19	1	6	...	...		
					Plaice,	1	24	21	14	10	11		
	E. 39·8	41·0	41·0 16 fath.		,,	5	9	...	...	...	...		
					Lemon soles,	24	13½	15	11	11	8½		
					Common dabs,	1	12	6	8	3	6½		
					Long rough dabs,	1	11	1	10	4	7½		
					Haddocks,	1	14	3	12	...	...		
					Cod,	1	30	4	24	7	20		
					,,	9	16	8	12	...	...		
					Whitings,	7	11½	...	...	...	...		
					Catfish,	5	33	1	36	2	29		
					Angler,	1	13½	...	...	...	...		
Station II. 11th April 2 p.m. to 4 p.m.	W. 39·8	41·0	41·0 13 fath.		Starry ray	1	7½	...	...	...	...		At beginning—Wind E.N.E., force 5; sea very rough; raining; transparency, 1½ fathoms; bar. 29·52. At finish—Transparency, 2 fathoms.
					Plaice,	2	19	16	13½	10	12		
					,,	3	11	1	8	...	...		
					Lemon soles,	1	14½	3	12½	...	...		
	E. 39·4	40·9	40·8 12 fath.		Common dabs,	12	9	6	7	...	...		
					Flounders,	1	16	1	13	2	12		
					,,	2	9	...	...	...	...		
					Long rough dabs,	2	7½	1	8½	1	5½		
					Haddocks,	1	11	...	...	...	...		
					Cod,	1	23	2	18	2	12½		
					Whitings,	2	12½	1	10½	...	...		
					Common gurnards,	1	14½	...	...	...	...		
					Catfish,	1	23½	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION III. 3rd April 11 a.m. to 1.10 p.m.	E. 42·0	41·2	41·0 13 fath.		Thornback ray,	1	17	...	...	...	...		At beginning—Wind S.S.W., force 3; overcast, very dull; transparency, 1¼ fathoms; bar. 29·64. At finish—Wind S.S.W., force 4; overcast; transparency, 1 fathom; bar 29·56.
					Plaice,	3	13½	1	11	...	...		
					Lemon soles,	6	13	9	12	7	11		
					" "	2	9	2	8	...	...		
	W. 41·4	41·0	41·0 7 fath.		Common dabs,	11	9	3	7	1	8		
					" "	1	5½	...	...	...	...		
					Long rough dabs,	2	8	2	7	7	6½		
					" "	5	5	...	...	...	...		
					Flounder,	1	9	...	...	...	...		
					Haddock,	1	12½	...	...	...	...		
					Cod,	1	27	2	22	5	13½		
					"	5	7½	2	7	...	...		
					Whitings,	2	13½	2	11	7	9		
					"	4	8	...	...	...	...		
					Herring,	5	7	...	...	...	...		
STATION IV. 3rd April 1.50 p.m. to 4 p.m.	E. 40·8	41·2	41·5 6 fath.		Thornback skate,	1	12	...	...	...	...		At beginning—Wind S.S.W., force 4; overcast; transparency, 1¼ fathoms; bar. 29·52. At finish—Raining; transparency, 1¼ fathoms.
					Plaice,	62	15	96	11	36	8		
					"	6	9	9	6½	...	...		
	W. 38·0	41·2	41·0 6 fath.		Common dabs,	5	8½	4	7½	...	...		
					Flounders,	1	10½	1	7½	...	...		
					Father-lasher,	4	11	1	8½	...	..		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION V. 12th April 1.20 p.m. to 3.30 p.m.	W. 41·0	40·8	40·7		Gray skate,	1	16	...	...	...	...		At beginning—Wind E., force 5; haze and rain; sea very rough; transparency, 2½ fathoms; bar. 29·74. At finish—As above.
			27		Plaice,	1	15	2	10½	2	7½		
			fath.		Lemon soles,	3	14	3	12	4	10		
					Common dabs,	1	9½	...	...	...	...		
	E. 40·2	40·8	40·7		Witch soles,	1	19	3	17	1	15		
			22		Long rough dabs,	5	10½	2	8	...	...		
			fath.		Haddocks,	19	13	14	10	2	9		
					Cod,	1	23	1	20	1	15		
					,,	4	11	...	...	...	...		
					Whitings,	2	15	3	14	4	11		
					,,	3	10	...	...	...	...		
					Common gurnard,	1	12½	...	...	...	...		
					Catfish,	1	35	...	...	...	...		
STATION VI. 12th April 11.30 a.m. to 12.40 p.m.	E. 40·0	40·8	40·8		Plaice,	24	15	6	11½	...	...		At beginning—Wind E., force 6; rain and haze; sea very rough; transparency, 2½ fathoms; bar. 29·70. At finish—Wind E., force 5.
			15		Lemon sole,	7	11½	...	...	...	...		
			fath.		Common dabs,	1	9½	2	9	2	7½		
					Brill,	3	19	...	...	...	...		
	W. 41·0	40·8	40·8		Cod,	1	23	1	19	2	15½		
			15		,,	2	13	...	...	...	...		
			fath.		Whitings,	1	9½	...	...	...	...		
					Catfish,	1	32	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station VII. 12th April 4 p.m. to 6 p.m.	W. 40·2	40·8	40·8 10 fath.		Thornback skate,	1	12	...	...	...	...		At beginning—Wind E., force 5; raining; sea very rough; transparency, $2\frac{1}{4}$ fathoms. At finish—Wind E., force 6; bar. 29·76.
					Plaice,	2	$11\frac{1}{2}$	...	...	...	...		
					Lemon soles,	1	$10\frac{1}{2}$	...	...	...	...		
					Common dabs,	14	$8\frac{1}{2}$	9	7	1	6		
					Long rough dabs,	1	9	...	...	...	...		
	E. 41·0	41·0	40·9 18 fath.		Flounders,	1	11	4	$9\frac{1}{2}$	1	$8\frac{1}{2}$		
					Turbot,	1	19	...	...	...	...		
					Haddocks,	5	$11\frac{1}{2}$	...	...	...	...		
					Cod,	2	23	3	21	2	18		
					Whitings,	4	12	5	$10\frac{1}{2}$	4	8		
					Lump-sucker,	1	21	...	..	...	...		
Station VIII. 18th April 9.45 a.m. to 11.50 a.m.	W. 47·0	41·9	41·5 19 fath.		Thornback skate,	1	27	1	21	1	17		At beginning—Wind W., force 6; weather clear; sea moderate; transparency, 2 fathoms; bar. 29·90. At finish—Wind W., force 6 to 7; sea rather rough; transparency, $2\frac{1}{2}$ fathoms.
					Plaice,	1	$17\frac{1}{2}$	2	$14\frac{1}{2}$	2	13		
					Lemon soles,	1	$13\frac{1}{2}$	1	$10\frac{1}{2}$	...	...		
					Common dabs,	5	$8\frac{1}{2}$	8	7	4	$5\frac{1}{2}$		
					Witch soles,	2	18	2	16	2	14		
	E. 47·0	41·4	41·0 26 fath.		Flounder,	1	$10\frac{1}{2}$	...	...	...	...		
					Long rough dabs,	9	$7\frac{1}{2}$	4	$6\frac{1}{2}$	...	...		
					Haddocks,	12	12	19	9	...	...		
					Cod,	1	25	...	...	...	...		
					Whitings,	1	14	6	12	2	10		
					,,	1	8	...	...	...	...		
					Common gurnards,	33	$12\frac{1}{2}$	15	10	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION IX.	E. 47·0	41·5	41·0		Gray skate,	1	24	1	17½	...	...		At beginning—Wind W., force 6 to 7; weather clear; sea rather rough; transparency, 2¾ fathoms; bar. 29·90. A finish—Wind W., force 7 to 8.
18th April			32		Starry ray,	1	8	...	...	...	...		
12.30 p.m.			fath.		Thornback skate,	1	18	...	...	...	...		
to 2.40 p.m.					Plaice,	1	13½	...	...	...	...		
	W. 46·0	41·8	41·2		Lemon sole,	1	12	...	...	...	...		
			30		Common dabs,	1	8	2	7	...	...		
			fath.		Witch soles,	1	16½	1	9½	...	...		
					Long rough dabs,	1	10½	5	9	3	6½		
					Haddocks,	1	13½	1	11	1	9		
					Cod,	1	28	1	18	2	12½		
					Whitings,	1	15½	1	13	...	...		
					Common gurnards,	2	13	1	11	...	...		
					Cat-fish,	1	14½	...	...	...	...		
					Lump-sucker,	1	18	...	...	...	...		
STATION I.	E. 46·5	44·5	43·8		Gray skate,	1	11	...	...	...	...		At beginning—Wind E., force 5; cloudy; sea rather rough; transparency, 2 fathoms; tide, flood; bar. 29·62. At finish—Wind E., force 4; transparency, 1½ fathoms; tide, slack water.
2nd May			17		Plaice,	8	13	6	12	7	10½		
2.30 p.m. to			fath.		,,	1	9	...	...	...	...		
4.35 p.m.					Lemon soles,	7	13	5	12	3	9		
	W. 46·8	44·0	43·5		Common dabs,	4	10	11	8½	13	7½		
			15		Flounders,	1	11	2	8	...	...		
			fath.		Long rough dabs,	8	8½	16	7	...	...		
					Haddocks,	3	13	1	10	...	...		
					Cod,	1	32	3	19	1	17		
					,,	4	14½	5	12	2	11		
					,,	3	6½	...	...	...	...		
					Whitings,	4	11	2	10	...	...		
					Common gurnards,	3	13½	2	9	...	...		
					Angler,	1	43	1	19	...	...		
					Cat-fish,	1	32	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station II. 3rd May 3 p.m. to 4.40 p.m.	E. 49·0	43·6	43·6 13 fath.		Plaice,	4	13	5	11	2	9½		At beginning—Wind S.E., force 4; overcast; sea rough; transparency, 2½ fathoms; tide, flood; bar. 29·70. At finish—Raining; transparency, 2½ fathoms; tide, slack water.
					Lemon soles,	2	11	...	...	...	...		
					Long rough dabs,	5	8	4	6½	...	...		
					Haddocks,	2	11	1	9	...	...		
					Cod,	1	22	4	18	6	12		
	W. 48·3	43·8	43·7 14 fath.		Whitings,	3	12	3	9	...	...		
					Common gurnards,	4	13	3	9½	6	8		
					Angler,	1	13	...	...	...	...		
					Cat-fish,	1	15	...	...	...	...		
Station III. 2nd May 11.45 a.m. to 1.50 p.m.	E. 46·0	44·5	44·6 8 fath.		Thornback skate,	1	21	...	...	...	...		At beginning—Wind E., force 4; weather clear; sea moderate; transparency, 1 fathom; bar. 29·62. At finish—Transparency, 1 fathom; tide, flood.
					Plaice,	17	14	7	10	...	...		
					Lemon soles,	23	15	16	11½	14	10		
					" "	9	8½	...	...	...	...		
	W. 47·4	44·5	44·0 9 fath.		Common dabs,	3	10	1	8½	...	...		
					Long rough dabs,	4	10	2	9	11	8		
					Flounders,	1	11	3	7½	...	...		
					Haddocks,	1	12½	2	11	...	...		
					Cod,	3	28	13	26	11	20		
					"	8	16	11	12	...	...		
					Whitings,	3	10	7	8	...	...		
					Common gurnards,	1	15	...	...	...	...		
					Cat-fish,	1	39	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION IV. 1st May 1 p.m. to 3.20 p.m.	E. 49·0	44·9	44·8 7 fath.		Plaice, . . .	6	14½	21	11	6	9		At beginning — Wind S.S.E. force 7 to 8; overcast; sea rough; transparency, 1½ fathoms; bar. 29·48. At finish—Wind S.S.E., force 6 to 7; sea moderate; transparency, 1 fathom; tide, flood.
					Cod, . . .	1	6	...	...	...	...		
					Whitings, . .	1	4½	...	...	...	...		
					Sprats, . . .	3	4	...	...	...	...		
	W. 52·0	44·9	44·8 6 fath.		Angler, . . .	1	19	1	13½	...	...		
STATION V. 3rd May 10.20 a.m. to 12.30 p.m.	E. 44·0	43·0	42·0 23 fath.	Surface-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, r.; Larval Decapods, com.; *Sagittæ*, fr.; fish ova, com.	Thornback skate, .	1	12	...	...	...	...		At beginning—Wind S.E., force 4; hazy and drizzling rain; sea rough; bar. 29·70; transparency, 3 fathoms; tide, flood. At finish—Transparency, 2½ fathoms.
					Plaice, . . .	2	16	5	14	1	8		
					Lemon soles, . .	1	13	1	11½	1	10		
					Common dabs, .	1	7½	...	...	...	...		
	W. 44·2	43·5	42·2 28 fath.		Long rough dabs, .	6	9½	24	8	25	7		
					" " .	5	6	...	...	...	...		
					Flounder, . .	1	11	...	...	...	...		
					Haddocks, . .	12	13	9	11½	2	9		
					Cod, . . .	1	34	3	17	1	11½		
					Whitings, . .	6	13	2	10½	5	8½		
					Common gurnards,	5	13	9	11½	2	8½		
					" " .	2	7	...	...	...	...		
					Angler, . . .	2	21	1	13½	...	...		
					Cat-fish, . . .	1	33	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VI. 3rd May 1 p.m. to 1.45 p.m.	E. 43·4	43·4	43·0 13 fath.		Plaice,	2	18½	20	14½	5	13		At beginning — Wind S.E., force 4; hazy and rain; sea rough; transparency, 2¼ fathoms; bar. 29·70; tide, flood. At finish—Transparency, 2 fathoms.
					Lemon soles,	1	15	3	13	3	10½		
					Common dabs,	2	9	2	7	3	6		
					Turbot,	1	27	1	17½	...	...		
	W. 45·2	43·4	43·1 15 fath.		Brill,	1	23	...	...	...	...		
					Common gurnards,	2	14	4	10½	...	...		
STATION VII. 7th May 3.30 p.m. to 5.20 p.m.	E. 46·2	45·0	42·3 10 fath.		Plaice,	3	14½	12	12½	4	10		At beginning — Wind E., force 4; very hazy; sea rough; transparency, 3½ fathoms; bar. 29·70; tide, flood. At finish—Transparency, 2¼ fathoms.
					Lemon soles,	1	13½	2	12½	...	...		
					Common dabs,	3	8	4	7	2	6		
	W. 45·6	44·0	42·8 18 fath.		" "	5	5½	...	...	...	...		
					Flounders,	4	9	1	6	...	...		
					Long rough dabs,	1	10½	9	8½	7	6½		
					Haddocks,	2	18	2	15½	18	11½		
					"	11	9	...	...	...	...		
					Cod,	1	21	...	...	...	...		
					Whitings,	1	11	5	9	2	7½		
					Common gurnards,	3	13	51	10	78	8		
					" "	12	6	...	...	...	...		
					Angler,	1	19	...	...	...	...		
					Cat-fish,	1	34	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION VIII. 7th May 1 p.m. to 3 p.m.	E. 47·0	44·6	42·2 27 fath.		Gray skate,	1	21	...	...	...	...		At beginning — Wind E., force 3; fog; sea rough; transparency, 4 fathoms; bar. 29·72; tide, slack water. At finish—Wind E., force 4; very hazy; transparency, 3¾ fathoms; tide, flood.
					Plaice,	2	21	2	15	1	12		
					Lemon soles,	2	12	1	9½	1	8½		
					Common dabs,	5	8	...	...	...	...		
	W. 46·0	45·0	42·2 21 fath.		Witch soles,	5	19	3	15	1	14		
					Long rough dabs,	8	7	1	6	...	...		
					Haddocks,	1	16	6	12	5	10		
					,,	2	9	...	...	...	...		
					Whitings,	2	13	1	12	1	9½		
					Common gurnards,	20	14½	22	11½	12	9		
					,, ,,	2	5½	...	...	...	...		
					Angler,	1	9	...	...	...	...		
					Cat-fish,	1	28½	...	...	...	...		
STATION IX. 7th May 10.30 a.m. to 12.30 p.m.	E. 47·2	44·8	42·0 32 fath.		Plaice,	1	11½	...	...	...	...		At beginning—Wind E., force 4; cloudy; sea rough; transparency, 4 fathoms; bar. 29·76; tide, ebb. At finish—Wind E., force 3; fog; tide, ebb.
					Lemon soles,	2	12½	3	9	...	...		
					Common dabs,	6	9½	5	7	4	6		
					Witch soles,	4	17	5	14½	...	...		
					Long rough dabs,	4	7½	2	6	...	...		
	W. 47·0	44·6	42·2 30 fath.		Flounder,	1	13½	...	...	...	...		
					Haddocks,	1	18	2	12	5	10½		
					Whitings,	2	12	...	...	...	...		
					Common gurnards,	10	14½	13	11	10	8½		
					,, ,,	5	7	...	...	...	...		
					Angler,	1	14	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air.	Temperature. Water.		Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invetebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION I. 4th June 12.40 p.m. to 2.50 p.m.	E. 58·0	51·0	44·9 16 fath.	Surface-net. — Copepods, Larval Decapods, and fish eggs.	Gray skate, . .	1	7	...	...	...	...		At beginning—Wind W., force 2; weather fine; sea smooth; tide, 1 hour flood; transparency, 3½ fathoms; bar. 30·8. At finish—Wind W. by S., force 3; tide, 3 hours flood; transparency, 3 fathoms.
					Plaice, . . .	12	15	1	14	20	13		
					" . . .	26	12	5	11	5	10		
					Lemon soles, . .	1	14	8	13	8	12		
	W. 58·3	50·2	49·9 14 fath.	Bottom-net. — Copepods, com., *Sagittæ*, fr., Medusids, fr.	" " . .	7	10	10	9	1	8		
					Common dabs, .	1	10	5	9	10	8		
					" " .	18	7	4	6	...	...		
					Long rough dabs, .	2	12	7	9	8	8		
					" " . .	8	7	2	6	...	...		
					Haddocks, . .	1	16	1	14	7	13		
					" . . .	7	11	8	10	...	...		
					Cod, . . .	1	23	1	20½	1	17½		
					" . . .	3	15	4	12	...	...		
					Whitings, . .	1	13	1	11½	1	5		
					Common gurnards, .	2	13½	4	12	14	11		
					" .	20	10	10	9	1	8		
					Angler, . . .	1	19	...	...	...	...		
					Cat-fish, . . .	1	31	1	26	...	...		
STATION II. 8th June 7.51 a.m. to 9.5 a.m.	E. 52·1	53·5	45·1 14 fath.	Surface-net. — Copepods, f.; Medusids, f.; Larval Decapods, r.	Starry ray, . .	1	11	...	...	...	...		At beginning—Wind S.E., force 2; weather hazy, but fine; sea smooth; transparency, 4 fathoms; tide, 4 hours flood; bar. 29·89.
					Plaice, . . .	22	14½	13	13	16	12		
					" . . .	22	11	10	10	8	9		
					" . . .	2	8	...	...	...	...		
	W 57·0	53·8	45·0 13 fath.	Bottom-net. — Medussids (*Bolina*, &c.), fr.; *Calanus finmarchicus*, f.; *Sagittæ*, f.; one very young flat-fish.	Lemon soles, . .	2	14	3	13	9	12		
					" " . .	5	11	6	10	2	9		
					" " . .	1	8	...	...	...	...		
					Common dabs, .	6	8½	21	7½	13	6½		
					" " .	8	5½	1	5	1	4		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Sie of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION II. 8th June 7.15 a.m. to 9.5 a.m.—*continued.*					Long rough dabs,	2	10	2	8½	11	7½		At finish—Wind E., force 2; transparency, 4 fathoms; tide about high water.
					,, ,,	3	7	2	6	...	...		
					Haddock,	1	14½	2	13	5	11		
					,,	3	10	1	9½	..	...		
					Cod,	1	30	...	...	...	...		
					Whitings,	1	9	...	...	...	...		
					Common gurnards,	4	11½	7	10	7	9		
					,, ,,	2	8	7	6½	...	...		
					Angler,	1	16	1	13	...	...		
STATION III. 3rd June 3.40 p.m. to 7.45 p.m.	60·5	51·0	48·3 7 fath.	Surface-net. — Fish ova, com.; Medusids, com.; *Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, fr.; Larval Decapods, fr.; Tow-net at 3 fathoms; no fish ova; Copepods, f.; Larval Decapods, f. Bottom-net. – Copepods, fr.; Medusids, fr.; *Metopa alderi*, 1.	Thornback ray,	1	13½	...	...	...	...		At beginning—Wind, force 0; weather hazy; sea smooth; tide fully 4 hours flood; transparency, 3 fathoms; bar. 29·71. At finish—Wind S.W., force 3; weather, clear, fine; sea smooth; tide about 2 hours ebb; transparency, 3 fathoms.
					Plaice,	4	15½	72	13½	42	12		
					,,	39	11	2	10½	6	9		
					,,	7	8	1	6	...	...		
	56·4	49·7	44·9 21 fath.		Lemon soles,	10	14	10	12	22	11		
					,, ,,	25	10	7	9	1	7		
					Common dabs,	1	11	1	10	4	9		
					,, ,,	17	8	15	7	19	7		
					,, ,,	7	6	...	...	...	...		
					Long rough dabs,	1	10	9	9	1	8		
					,, ,,	7	7	4	6½	...	...		
					Sail fluke,	1	18½	...	...	...	...		
					Flounders,	1	11	1	7	...	...		
					Haddocks,	1	12	2	11	...	...		
					Cod,	1	39	3	23	1	17		
					,,	7	16	7	15	12	11		
					,,	1	9	...	...	...	...		
					Whitings,	1	16½	3	14	9	11½		
					,,	5	10	1	9	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION III. 3rd June 3.40 p.m. to 7.45 p.m.—*continued.*					Common gurnards,	1	15	3	13	5	11		
					,, ,,	18	10	31	8	10	7		
					Herring,	1	7	...	...	...	...		
					Sprat,	1	4	...	...	...	...		
					Angler,	1	33	1	28	...	...		
					Cat-fish,	1	34	1	39	1	16½		
STATION IV. 3rd June 8.55 a.m. to 11.25 a.m.	W. 53·4	51·0	50·2 4½ fath.	Surface - net. — Copepods, f. Medusids, f. Bottom - net. — Copepods, f. Medusids, f. *Caligus*, sp. r; Larval Decapods, f., *Balanus* (Ostracod stage), f. *Evadne* f.; very young round fish, fish eggs, f.	Gray skate,	1	11	...	...	...	...		At beginning—Wind N.E. by N., force 1; weather very hazy; sea smooth; tide about 4 hours ebb; transparency, 2 fathoms; bar. 29·63. At finish — Wind calm sea smooth; tide; about low water; transparency, 2 fathoms.
					Thornback ray,	1	24	1	20	1	18		
					,, ,,	5	16	2	12	...	...		
					Plaice,	1	16	5	13½	45	12½		
	E. 54·0	50·3	50·3 4 fath.		,,	59	11	44	10	8	9		
					,,	11	8	5	7	4	6		
					Lemon soles,	3	13	5	12	8	11		
					,, ,,	3	9	1	6	...	...		
					Common dabs,	15	11	12	9½	12	8		
					,, ,,	22	7	8	6	1	5		
					,, ,,	1	4½	1	3	...	...		
					Flounder,	1	7	...	...	...	...		
					Long rough dabs,	1	11	2	9	1	7		
					Cod,	2	17	...	...	...	...		
					Common gurnards	2	14½	5	10½	11	9½		
					,, ,,	7	8	6	7	2	6		
					,, ,,	1	4	...	...	...	...		
					Sprat,	1	4	...	...	...	...		
					Angler,	1	21	1	18	...	...		
					Father-lasher,	1	8	1	13½	2	7		
					Pogge,	1	5½	...	...	...	...		
					Goby,	2	2¼	2	1½	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION V. 7th June 10 a.m. to 12.35 p.m.	W. 53·0	52·1	44·6 26 fath.	Surface-net.—*Anomalocera patersonii*, fr.; Larval Decapods, f.; Medusids, f.; *Boreophausia*, sp. 1. Bottom-net.—*Sagittæ*, fr. *Calanus finmarchicus*, f.; *Temora longicornis*, f.; small annelid, r.	Starry ray,	1	4	...	...	...	...		At beginning—Wind E., force 3; sea slight; dull; transparency, 5 fathoms; tide, 1½ hour ebb; bar. 30·06. At finish—Wind S.S.E., force 3; cloudy, with some sunshine; transparency, 5½ fathoms; tide, 4 hours ebb.
					Thornback ray,	1	9½	...	...	...	...		
					Plaice,	1	26	1	24	1	21		
					,,	1	18	1	17	3	13½		
	E. 54·0	50·8	44·8 20 fath.		,,	1	11	...	...	...	...		
					Lemon soles,	6	12	8	11	11	10		
					,, ,,	2	9	2	7	...	...		
					Common dabs,	1	8½	4	7½	18	6		
					,, ,,	3	5	3	4½	...	...		
					Long rough dabs,	1	9	2	7	...	...		
					Sail fluke,	1	16	...	...	...	...		
					Whitings,	1	12	...	...	...	...		
					Common gurnards,	8	8½	2	9½	1	6½		
					Dragonet,	1	8	...	..	...	...		
STATION VI. 7th June 3.10 p.m. to 4.35 p.m.	E. 54·0	52·0	45·1 15 fath.	Surface-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, com.; *Centropages hamatus*, f.; *Pleurobrachia*, fr.; fish ova, f. Bottom-net. — Copepoda com. (chiefly *Temora longicornis*), Larval Decapods, com.; Schizopods, com.; Medusids, fr. (*Pleurobrachia*, *Bolina*), *Sagittæ*, f.; *Atylus*	Plaice,	1	26	1	24	1	21		At beginning—Wind S.E. by E., force 3; fine, a little hazy; sea slight; tide, low water; transparency, 5 fathoms; bar. 30·06. At finish—Wind E.S.E., force 3; weather and sea as above; tide, 1½ hour flood; transparency, 4½ fathoms.
					,,	3	15½	2	13½	1	10		
					,,	1	8½	1	8	...	...		
					Lemon soles,	5	14	5	12½	6	11		
	W. 53·7	52·5	45·0 16 fath.		,, ,,	1	7½	...	...	...	...		
					Common dabs,	1	14	2	13	2	9		
					,, ,,	4	8	...	...	...	...		
					Long rough dabs,	5	8½	38	7½	1	7		
					,, ,,	6	6½	4	6	15½	1 at 3½		
					Witch soles,	2	18	1	16	1	15		
					Haddocks,	4	14	3	13	3	12		
					,,	13	11	2	10	...	...		
					Cod,	1	21	1	14	2	11		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Surface Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station VI. 7th June 3.10 p.m. to 4.35 p.m.—*continued.*				*bispinosus*, f.; young fish f.	Whitings,	1	14	1	11	...	...		
					Common gurnards,	1	14	1	13	2	12		
					,, ,,	3	11	2	10	4	9		
					,, ,,	1	8	...	...	...	...		
					Cat-fish,	1	28	...	...	...	...		
Station VII. 6th June 1.55 p.m. to 4 p.m.	E. 54·2	51·4	45·1 16 fath.	Surface-net. — Copepods, f.; a few Larval Decapods, f; *Sagittæ*, f; Medusids, f.; fish ova, com. Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, com.; *Centropages hamatus*, f.; *Anomalocera patersonii*, f.; Larval Decapods, fr.; *Balanus* (Ostracod stage), f.; *Sagittæ*, fr.; very young flat and round fish, fr.	Thornback ray,	1	15	...	...	...	...		At beginning—Wind E.S.E., force 4; cloudy, slight shower of rain; sea moderate; transparency, 3½ fathoms; tide, low water; bar. 30·11. At finish—Wind E.N.E., force 3; weather, cloudy with some sunshine; transparency, 3¼ fathoms; tide, 2 hours flood.
					Plaice,	9	14	10	13	1	16		
					,,	8	12	2	11	1	8½		
					,,	1	7	...	...	...	...		
	W. 54·0	52·0	46·2 12½ fath.		Lemon soles,	4	12	3	11½	6	10½		
					,, ,,	2	9	2	8	1	7½		
					Common dabs,	3	9	10	8	12	7		
					,, ,,	17	6	5	5	...	...		
					Witch soles,	1	18½	...	...	...	...		
					Long rough dabs,	2	11½	1	10	2	9		
					,, ,,	5	8	9	7	5	6½		
					Haddocks,	1	15	3	11½	1	9½		
					Whitings,	1	15	1	14	1	9½		
					,,	1	8½	...	...	...	...		
					Common gurnards,	3	12	12	10	13	9		
					,, ,,	14	8	6	7	5	6		
					Dragonet,	1	8	1	7	...	...		
Station VIII. 6th June 10.45 a.m. to 12.50 p.m.	E. 54·6	51·0	44·5 26 fath.	Surface-net. — Copepoda, fr.; *Anomalocera patersonii*, (*Calanus, finmarchicus*, &c.), *Evadne*, r.; *Sagittæ*, f.; 1 young lump-sucker; fish ova, com.	Gray skate,	1	18	1	15½	...	...		At beginning—Wind E.S.E., force 3; sea slight; cloudy; transparency, 8½ fathoms; tide about ½ ebb; bar. 30·16.
					Starry ray,	1	7	...	...	...	...		
					Plaice,	1	15	1	13½	...	...		
					Lemon soles,	1	11½	1	10½	...	...		
	W. 54·0	53·4	44·4 22 fath.		Common dabs,	3	6½	...	...	...	...		
					Witch soles,	1	18	2	16½	1	14		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VIII. 6th June 10.45 a.m. to 12.50 p.m. —*continued.*				Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Centropages hamatus*, f.; *Anomalocera patersonii*, com.; *Balanus* (Ostracod stage), f.; young Decapods; (Carida), f.; *Sagittæ*, f.; young fish, r.	Witch soles, . .	1	11	...	...	...	...		At finish—Wind E., force 3; overcast; transparency, 4½ fathoms; tide about 5 hours ebb.
					Long rough dabs, .	1	9½	3	8	12	7		
					,, ,, .	2	6½	2	4	...	...		
					Haddocks, . .	1	13½	3	12½	4	11½		
					,, . .	5	10½	4	9	1	8		
					Cod, . . .	1	37	...	...	...	...		
					Whitings, . .	5	12	2	10½	1	8		
					Common gurnards,	2	12	5	11	11	10		
					,, ,,	13	9	10	8	1	7		
STATION IX. 6th June 7.20 a.m. to 9.30 a.m.	W. 54·8 E. 54·0	51·0 57·1	44·5 28 fath. 44·1 32 fath.	Surface-net. — Copepodes, f. (*Anomalocera patersonii*, &c.); Larval Decapods, f.; *Sagittæ*, r.; larval *Bolina* (Ostracod stage), r. Bottom-net.—*Sagittæ*, fr.; Copepods fr.; *Boreophausia*, sp. f.; Amphipods, f.; one or two young fish (flat fish, lump-sucker).	Starry ray, . .	2	9	1	7	...	...	*Brissopsis lyrifera*, three specimens.	At beginning—Wind E.N.E., force 2; a little hazy, but fine; sea smooth; tide nearly flood; transparency, 8½ fathoms; bar. 30.23. At finsh—Wind E.S.E., force 3; tide about 2 hours after flood; transparency as above.
					Lemon soles, . .	1	17	1	15½	2	11½		
					Common dabs, .	1	10	2	9	8	8		
					,, ,, .	6	7	1	6	...	...		
					Witch soles, . .	1	16½	3	14½	...	...		
					Long rough dabs, .	4	8	5	7	1	5½		
					Sail fluke, . .	1	15	...	...	...	...		
					Haddocks, . .	1	14	6	11½	5	10½		
					,, . . .	1	7½	...	...	...	...		
					Cod, . . .	1	18	...	...	...	...		
					Whitings, . .	2	15	1	12½	4	11½		
					,, . . .	5	11½	...	...	...	...		
					Common gurnards,	3	13	1	14	6	11		
					,, ,,	4	10	2	9	...	...		
					Cat-fish, . .	1	38	...	...	...	...		
					Brassie, . . .	1	9	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulbs.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION I. 30th July 3.53 p.m. to 5.53 p.m.	E. 61·7	57·3	51·8 16 fath.	Surface-net.—Larval Decapods, com.; Medusids, com. (*Bolina*, *Pleurobrachia*, *Geryonopsis*).	Gray skate,	1	16	1	11	1	7	Clams (*Pecten opercularis*), v.a., *Nephrops norvegicus*, a.; *Echinus esculentus*, fr. (one with dark red spines), *Solaster papposa*, fr.; *Solaster endeca*, fr.; *Asterias rubens*, fr.; *Eupagurus bernhardus*, f.; *Alcyonium digitatum*.	At beginning—Wind E., force 4; a little hazy, fine; sea moderate; tide, high water; transparency, 3½ fathoms; bar. 29·99. At finish—Wind, &c., as above; tide about 2 hours ebb; transparency, 2 fathoms.
					Plaice,	1	24	3	15	8	13		
					,,	12	12	16	10	1	9		
					Lemon soles,	1	14	1	13	10	12		
					,, ,,	8	10½	9	9	2	7½		
	W. 59·6	56·0	53·0 11 fath.	Bottom-net.—*Calanus finmarchicus*, fr.; *Hyperia* (jun.), f.; *Iphinæ gracilis*, r.; young Paguridæ, fr.; young Caridæ, fr.; *Boreophausia* (juv.), c.; *Leucon*, f.; *Sagittæ*, fr.; *Tomopteris*, f.; Medusids, fr. (species as above); very young Father-lashers, 1 very young Goby.	Common dabs,	1	12½	4	10	7	8½		
					,, ,,	4	7½	1	6½	...	...		
					Long rough dabs,	1	11	10	9½	25	7½		
					,, ,	3	6	3	5½	1	4		
					Haddocks,	1	15	1	14	...	...		
					Cod,	1	22	1	20	5	17½		
					,,	2	15	2	11	10	8½		
					Whitings,	1	14	6	12	9	10½		
					,,	2	9	20	8	9	7		
					Lythe,	2	10	...	...	...	...		
					Common gurnards,	2	13	3	12	5	10		
					,, ,,	2	7½	...	...	...	...		
					Angler,	1	25	1	21	1	18		
					,,	1	11	...	...	...	...		
					Cat-fish,	1	37	...	...	...	...		
STATION II. 29th July 9.50 a.m. to 11.40 a.m.	E. 59·6	54·8	52·0 13 fath.	Surface-net.—Very young Decapods, f.; Medusæ, f. (*Pleurobrachia*), fish ova, f. (very little in net).	Plaice,	1	23	5	16½	23	15		At beginning—Wind N.W., force 3·4; fine, clear; sea moderate; tide nearly 2 hours flood; transparency, 4½ fatoms; bar. 29·80.
					,,	16	14	36	12	30	11		
					,,	12	10	6	9	...	...		
					Lemon soles,	1	14	7	13	3	12		
					,, ,,	4	10	2	8	...	...		
	W. 63·4	54·8	51·8 13 fath.	Bottom-net.—*Calanus finmarchicus*, com.; *Hyperia galba*, f.; young	Common dabs,	4	8	1	9	17	7		
					,, ,,	37	6	4	5	...	...		
					Long rough dabs,	1	11	6	8	12	7		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom			No.	Inches	No.	Inches	No.	Inches		
STATION II. 29th July 9.50 a.m. to 11.40 a.m.—*continued.*				*Crangon* and *Hippolyte*, fr.; *Boreophausia raschii*, f.; *Actinia* (*Arachnitis?*), f.; Medusids, fr.	Haddocks,	3	16	1	14½	6	13		At finish—Wind N., force 5; cloudy, fine; sea a little rough; tide nearly 4 hours flood; transparency, 4 fathoms.
					,,	8	12	2	10½	...	...		
					Cod,	1	16	1	10	2	8		
					Whitings,	1	14	3	10½	4	9½		
					,,	3	9	1	8	8	7		
					,,	1	6½	...	...	...	...		
					Common gurnards,	2	12½	2	10	2	8		
					,, ,,	3	7	...	...	...	...		
					Angler,	1	22	1	13	...	...		
STATION III. 30th July 1.7 p.m. to 3.37 p.m.	E. 60·7	57·9	54·9 8 fath.	Surface-net.—Larval Decapods, f.; Medusids, fr. (*Geryonopsis*, *Thaumantias*, and *Pleurobrachia*).	Plaice,	1	15	4	14	5	13	*Pecten opercularis*, v.a.; *Echinus esculentus*, fr.; *Solaster papposa*, fr.; *Solaster endeca*, f.; *Asterias rubens*, *Alcyonium digitatum*, *Nephrops norvegicus*, fr.	At beginning—Wind E., force 3; a little hazy, fine; sea moderate; tide about ½ flood; transparency, fathoms; bar. 30·02.
					,,	3	12	11	11	10	10		
					Lemon soles,	4	12½	5	11½	3	9		
					Common dabs,	1	9½	6	8½	4	7½		
					,, ,,	1	6½	3	5½	...	...		
	W. 60·6	55·4	53·6 7 fath.	Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, r.; *Evadne nordmanni*, f.; Larval *Balani*, f.; *Hyperia galba*, f.; *Metopa alderi*, f.; *Atylus bispinosus*, r.; very young *Pandalus* and *Crangon*, *Caligus*, sp.; 1 very young *Rossia*, Medusids (*Geryonopsis*, *Bolina*, &c.), fr.; 1 very young Lump-sucker.	Long rough dabs,	1	11	1	9	2	8		At finish—Wind E., force 4; tide near high water; transparency, 2 fathoms.
					Cod,	1	18	2	15	1	14		
					,,	1	11	8	9	...	...		
					Whitings,	3	10½	6	8½	46	7½		
					,,	25	6½	...	...	...	...		
					Common gurnards,	1	9	2	8	3	7		
					Angler,	1	21	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued*.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station IV. 31st July 3.55 p.m. to 5.55 p.m.	E. 69·5	59·7	56·2 5½ fath.	Surface-net. — Larval Decapods, f.; Medusids, com. (*Bolina*, *Pleurobrachia*, &c.). Bottom-net.—*Calanus finmarchicus*, com.; Medusids, a. (*Bolina*, *Geryonopsis*, *Pleurobrachia*, *Thaumantias*); *Tomopteris*, r.; Larval Decapods, f.; one or two very small flat fishes (dabs).	Thornback ray,	4	19½	5	15	1	8	*Pecten opercularis*, v.a.; *Nephrops norvegicus*, f.; *Solaster papposa*, f.; *Solaster endeca*, f.; *Portunus corrugatus*, com.; *P. holsatus*, f.; *Philine aperta*, com.; several small specimens of *Loligo valgaris*, *Aphrodite aculeata*, f.; *Alcyonium digitatum*, f.; *Asterias rubens*, f.	At beginning—Wind N.W., force 2; weather, hazy, fine; sea smooth; tide, 5 hours flood; transparency, 2¼ fathoms; bar. 29·87. At finish—Wind W., force 2; tide about 1 hour ebb; transparency, 2¼ fathoms.
					Plaice,	1	18	6	16	10	14		
					,,	74	12	61	10	46	8		
					,,	2	7	5	6	...	...		
	W. 62·0	60·0	55·8 6 fath		Lemon soles,	1	14	1	13	6	12		
					,, ,,	2	7½	2	7	...	...		
					Common dabs,	1	13	4	12	2	11		
					,, ,,	4	10	20	9	43	8		
					,, ,,	20	7	21	6	2	4		
					,, ,,	6	3½	2	3	1	1½		
					Cod,	2	11	2	9	...	...		
					Whitings,	1	11	1	9	2	8		
					,,	1	7	...	...	...	...		
					Common gurnards,	2	14	3	13	3	11		
					,, ,,	3	10	6	9	6	8		
					,, ,,	2	7	9	6		4½		
					Angler,	1	39	...	..	...	...		
					Dragonet,	1	9	...	...	...	...		
					Father-lasher,	2	7½	...	.	...	...		
					Goby,	33	2½–2¼	...	...	...	...		
Station V. 3rd August 9.42 a.m. to 12 noon.	W. 55·6	55·4	52·8 25½ fath.	Surface-net.—*Anomalocera patersonii*, r.; Medusids, f. (*Pleurobrachia*, *Beröe*). Bottom-net. — Larval Decapods and *Boreophausia*, fr.; Amphipods, fr. (*Atylus bispinosus*,	Gray skate,	1	13	1	8	...	...	A good many *Nephrops norvegicus*, a few *Solaster papposa*, and *Solaster endeca*, *Asterias violacea*, *Spatangus pur-*	At beginning—Wind E., force 3; overcast, showery; sea moderate; tide about ½ flood; transparency, 5 fathoms; bar. 29·50.
					Starry ray,	1	11	...	...	...	...		
					Plaice,	1	18	4	16	5	14		
					,,	3	13	1	11½	1	10		
	E. 57·2	55·4	51·9 20 fath.		Lemon soles,	2	15	7	13	3	11½		
					,, ,,	6	10	1	7	...	...		
					Common dabs,	4	9½	3	8½	5	7		
					,, ,,	2	6	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION V. 3rd August 9·42 a.m. to 12 noon. —*continued.*				*Hyperia galba*); *Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; one or two *Caligi*; *Sagittæ*, fr.; *Bolina*, fr.; *Geryonopsis*, fr.; and *Thaumantias*, fr.	Witch soles,	1	16½	2	12	...	...	*pureus*, *Actinoloba dianthus*, *Alcyonium digitatum*, *Aphrodite aculeata*, *Hyas araneus*, and *Mytilus modiolus*.	At finish—Wind S.E., force 2; thick, with rain; sea smooth; tide nearly flood, or high water; transparency, 5¼ fathoms.
					Long rough dabs,	1	16½	2	11	2	12		
					,, ,,	6	9	25	8	22	7		
					,, ,,	2	6	2	5	...	...		
					Turbot,	1	23	...	...	...	...		
					Haddocks,	34	15½	33	14	47	12½		
					,,	67	11	11	10	1	9		
					Cod,	1	36	1	17	1	14		
					,,	1	13	2	10½	3	8½		
					Whitings,	14	12½	25	10½	12	9		
					Common gurnards,	10	11½	14	10	8	9		
					,, ,,	...	...	...	...	2	7		
					Angler,	1	49	1	14½	...	...		
STATION VI. 3rd August 1.25 p.m. to 2.30 p.m.	E. 56·7	55·8	53·9 14 fath.	Surface-net. — *Dias longiremis*, f.; Larval Decapods, f.; *Pleurobrachia*, f.; *Bolina*, f.	Plaice,	1	19	1	22	5	18	*Solaster endeca*, com.; *S. papposa*, f.; *Asterias rubens*, f.; *Alcyonium digitatum*, f.	At beginning—Wind E.N.E., force 2; thick, rainy sea smooth; tide about 1 hour flood; transparency, 4¾ fathoms; bar. 29·49.
					,,	16	14	2	12½	3	11		
					Lemon soles,	8	14	8	12	2	11		
					,, ,,	3	10	3	7½	...	...		
				Bottom-net.—*Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Dias longiremis*, fr.; Larval Decapods and Schizopods, f.; Amphipods, f.; *Caligus*, sp. r.; *Geryonopsis*, fr.	Common dabs,	1	12	6	8½	19	7½		At finish—Wind S.E., force 2; hazy, fair; tide about 2 hours flood; transparency, 4¼ fathoms.
	W. 57·8	54·3	53·5 15 fath.		,, ,,	11	6½	...	...	...	...		
					Long rough dabs,	8	8	2	7	...	...		
					Haddocks,	3	14	2	13	8	12		
					,,	4	10½	2	9½	...	...		
					Cod,	1	11	...	...	...	...		
					Whitings,	3	12	8	10½	12	9½		
					,,	15	8	...	...	...	...		
					Common gurnards,	8	13	13	12	24	9½		
					,, ,,	20	7	...	...	...	...		
					Angler,	1	25	1	24	1	22		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	No.	Inches	No.	Inches	No.	Inches	Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station VII. 2nd August 2.24 p.m. to 3.55 p.m.	E. 63·8	57·2	52·0 23 fath.	Surface-net.— Larval Decapods, r; *Bolina*, sp. f.; *Thaumantias*, sp. f.; (very little in net). Bottom-net. — *Calanus finmarchicus*, a., Larval Crustaceans, a. (mostly Schizopods), *Parathemisto oblivia*, f., *Hyperia* (jun.), f.; *Sagittæ*, f., Medusids, com. (*Pleurobrachia*, *Beröe*, *Thaumantias*, *Bolina*, &c.), very young cod.	Gray skate,	2	13½	...	...	...	...	*Asterias rubens*, com.; *Asterias violacea*, com.; few *Solaster papposa*, f.; *Solaster endeca*, f.; *Luidia sarsii*, r. (broken); *Amphidotus cordatus*, r.; *Alcyonium digitatum*, f.; *Eupagurus hernhardus*, f.; *Actinoloba dianthus*, f.	At beginning—Wind W.S.W., force 5; cloudy, fine; sea moderate; tide about 2½ hours flood; transparency, 4½ fathom; bar. 29·65. At finish—Wind W.N.W., force 3; tide about 5 hours flood; transparency, 4 fathoms.
					Starry ray,	1	9½	...	...	...	...		
					Plaice,	8	15	2	14	3	11½		
					,,	12	10½	...	...	...	...		
					Lemon soles,	1	13½	5	12	1	10½		
	W. 62·0	58·0	53·4 11 fath.		,, ,,	1	9	1	8	...	...		
					Common dabs,	1	9	16	8	76	7		
					,, ,,	66	6	5	5	4	4		
					,, ,,	1	3	...	...	...	...		
					Long rough dabs,	2	12	1	10	2	9		
					,, ,,	11	8	6	7	...	...		
					Haddocks,	1	11	...	...	...	...		
					Cod,	1	23	...	...	...	...		
					Whitings,	2	11	3	7½	1	6½		
					Common gurnards,	1	14	3	12½	1	11		
					,, ,,	17	8½	15	7	4	6		
					Angler,	1	17	.	...	...	...		
					Dragonet,	1	8	...	...	...	...		
Station VIII. 26th July 3.55 p.m. to 6 p.m.	E. 54·3	53·3	51·6 28 fath.	Surface-net. — *Calanus finmarchicus*, f.; *Anomalocera patersonii*, f.; *Sagittæ*, fr.; Medusids, fr.; a young Lumpsucker (very little in net). Bottom-net. — *Calanus finmarchicus*, f.;	Starry ray,	1	5½	...	...	...	...		At beginning—Wind N.E., force 2; cloudy, showery, sea moderate; easterly swell; tide fully 2 hours ebb; transparency, 5½ fathoms; bar. 29·63.
					Plaice,	1	14	...	...	...	...		
					Lemon sole,	1	14	...	...	...	...		
					Common dabs,	2	7	...	...	...	...		
	W. 55·7	55·1	50·2 21 fath.		Witch soles,	3	17½	2	16½	1	15½		
					,, ,,	1	14	1	11½	...	...		
					Long rough dabs,	5	8	6	7	1	6		
					Little black hairy fluke,	1	7½	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VIII. 26th July 3.55 p.m. to 6 p.m. —*continued.*				young *Crangon*, and other Macrura, com.; *Sagittæ*, com.; Medusids, f.; a very young Lump-sucker.	Haddocks,	4	11½	3	9	2	8½		At finish—Wind N.E. force 5; tide fully 4 hours ebb; transparency, 5 fathoms.
					Whitings,	1	15½	4	12½	5	11		
					"	2	9	5	8	..	...		
					Lythe,	1	33	...	...	...	...		
					Common gurnards,	1	14	2	13	2	11		
					" "	2	10	8	9½	3	8½		
					" "	1	6	...	..	...	...		
					Angler,	1	24	1	21	...	...		
STATION IX. 26th July 1.30 p.m.	E. 53·7	53·9	49·6 23 fath.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Anomalocera patersonii*, com.; very young *Nephrops*, f.; Medusids, com. (*Pleurobrachia*, and other small forms; *Aurelia*, *Cyanea*); a young *Motella mustela*; fish ova, f. Bottom-net—*Calanus finmarchicus*, com.; *Temora longicornis* f.; young Macrura (*Nephrops*, *Pandalus*), fr.; *Sagittæ*, f.; *Pleurobrachia*, com.	Lemon dab,	2	16	1	10½	1	8½		At beginning—Wind N.E., force 3; overcast, showery; sea a little rough; swell from eastward; tide, high water; transparency, 4½ fathoms; bar. 29·61. At finish—Tide nearly 2 hours ebb; transparency, 5½ fathoms.
					Common dabs,	1	9	1	8	7	7		
					" "	1	6½	...	...	..	...		
					Witch soles,	1	18	1	17	2	15		
	W. 54·0	53·2	51·8 28 fath.		" "	1	14	...	...	...	...		
					Long rough dabs,	6	8½	11	7	8	6½		
					Haddocks,	1	14	2	13	7	12		
					"	3	11	8	10	3	9		
					"	5	8	...	...½	...	...		
					Cod,	1	18	1	15	...	...		
					Whitings,	2	12½	2	11	5	10		
					"	7	9	2	7	...	...		
					Lythe,	2	20	1	18	2	15		
					"	2	14	...	...½	...	...		
					Common gurnards,	1	14	3	12	3	11		
					" "	4	10	6	9½	1	8		
					Brassie,	1	12½	2	7	1	7		
					Cat-fish,	1	18	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued*.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION I. 31st August 10.15 a.m. to 12.20 p.m.	60·4	55·5	55·1 14 fath.	Surface-net. — Larval Crustacean (Brachyura, *Nephrops*) com.; small Medusids, fr.; *Aurelia*, f.	Gray skate,	1	19	1	14	6	13	*Pecten opercularis*, v.a.; *Nephrops norvegicus*, com.; *Solaster*, *Asterias*, fr.; *Actinoloba dianthus*, fr.; *Eupagurus bernhardus*, fr.; *Buccinum undatum*, fr.; *Lolgo vulgaris*; *Alcyonium digitatum*; *Hydrallmania falcata*, *Eudendrium*, sp.	At beginning — Wind W., force 1–2; a little hazy, but fine with sunshine sea smooth; tide about 5 hours ebb; transparency, 1 fathom; bar. 30·12. At finish —Tide fully 1 hour flood; transparency, 2 fathoms.
					„ „	2	9½	1	6½	...	...		
					Starry ray,	1	7½	...	...	...	...		
					Thornback ray,	1	18	1	17	...	...		
					Plaice,	16	15	25	14	30	12		
	63·7	56·7	54·8 18 fath.	Bottom-net. — *Calanus finmarchicus*, f.; *Temora longicornis* f.; *Boreophausia*, *raschii*, fr.; *Mysis ornatus*, f.; Larval Schizopods, f.; young *Crangon* and *Hippolyte*, embryo Gastropods and Lamellibranchs, fr.; *Tomopteris*, f.; *Sagittæ*, com.; Medusids, fr.; one or two small round fish.	„	2	8½	...	...	...	...		
					Lemon soles,	1	16	19	14	11	11½		
					„ „	5	9	...	...	...	...		
					Common dabs,	3	9½	3	8½	2	7½		
					Long rough dabs,	4	10	15	9	22	7½		
					„ „	13	6	...	...	...	...		
					Haddocks,	1	12	...	...	...	...		
					Cod,	1	25	3	24	2	21		
					„	3	18	9	16	4	11		
					„	2	10	...	...	...	...		
					Whitings,	1	16½	15	14	28	11		
					„	24	9½	5	7	1	4		
					Ling,	1	26	...	...	...	...		
					Horse-mackerel,	1	13	...	...	...	...		
					Common gurnards,	2	14	3	11	2	7½		
					Angler,	1	32	1	24	4	22		
					„ „	4	26	1	18	...	...		
STATION II. 29th August 3.45 p.m. to 5.12 p.m.	E. 57·9	55·5	54·8 15 fath.	Surface net.—Copepods, f.; Larval Crustaceans, f.; small Medusids, f.	Plaice,	2	16½	48	15	62	12	*Solaster papposa*, fr.; and *Solaster endeca*, fr.; *Asterias*	At beginning—Wind W., force 3, hazy, damp; sea slight; tide near
					„	15	10½	...	...	...	...		
					Lemon soles,	8	14	16	13	9	10		
					„ „	1	9	1	7	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION II. 29th August 3.45 p.m. to 5.12 p.m.—*continued.*	W. 56·0	55·5	55·0 12 fath.	Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; Amphipods, f.; very young Crustacea, com. (Eupaguridæ, Caridæ, *Crangon*, and others); Schizopoda (*Mysis*, sp.; *Boreophausia*); embryo Gastropods, com.; *Sagittæ*, com.; *Tomopteris*, f.; small Medusidæ, fr.	Common dabs,	1	10	53	9	20	6½	*rubens*, fr.; *Ophiothrix rosula*, f.; *Nephrops norvegicus*, fr.; *Portumus holsatus*, f.; *Flustra foliacea*, f.; *Eudendrium*, sp., f.; young *Loligo vulgaris*, f.; *Pecten opercularis*, fr.; *Alcyonium digitatum*, *Aurelia*, and sea-weed.	high water; transparency, 3 fathoms, bar. 29·89. At finish—Sea smooth; tide first of ebb; transparency, 3 fathoms.
					,, ,,	3	5½	...	...	...	...		
					Long rough dabs,	2	11	3	9	2	7½		
					,, ,,	4	6½	...	...	...	...		
					Haddocks,	1	18	2	14½	2	12½		
					,,	2	11	1	8	...	...		
					Cod,	1	14½	6	10	9	8		
					Whitings,	3	12	1	10	7	8		
					,,	2	7	...	...	...	...		
					Ling,	1	16½	...	...	...	...		
					Common gurnards,	3	11½	1	10	5	9		
					,, ,,	7	8	...	...	...	...		
					Angler,	1	17	...	...	...	...		
STATION III. 30th August 10.20 a.m. to 12.45 p.m.	W. 55·5 E. 57·6	55·3 56·1	55·2 7½ fath. 56·5 7 fath.	Surface-net.—Larval Crustaceans, f.; *Pleurobrachia*, f. (Very little in net.) Bottom-net.—*Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, fr.; very young Crustacea (*Crangon*, *Nephrops*, *Boreophausia*), fr.;	Thornback skate,	2	26	1	21	1	14	*Pecten opercularis*, a.; *Nephrops norvegicus*, com.; *Portunus corrugatus*, f.; *P. holsatus*, f.; *Hyas coarctatus*, f.; and *Pandalus annulicornis*, f.; small *Eupagu-*	At beginning—Wind W., force 1–2; foggy; sea smooth; tide near low water; transparency, 1 fathom; bar. 30. At finish—Tide about 2 hours flood; transparency, 2 fathoms.
					Plaice,	6	14	14	12½	25	11		
					,,	24	9	...	...	...	...		
					Lemon soles,	7	13	14	12	14	11		
					,, ,,	7	10	4	9	7	7½		
					Common dabs,	13	9	16	7½	6	6		
					,, ,,	2	5	4	4½	2	3½		
					Long rough dabs,	1	13	7	10	17	8½		
					,, ,,	18	7½	3	8	1	5½		
					Cod,	8	11½	5	10	8	9		
					,,	1	8	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION III. 30th August 10.20 a.m. to 12.45 p.m.—*continued.*				Amphipods, f.; *Caligus*, sp., f.; very young Lamellibranchs and Gastropods, fr. (*Cardium*, *Telline*, *Littorina*); *Sagittæ*, com.; *Tomopteris*, f.; small Medusids, f.	Whitings,	6	17	5	10	15	8½	*rus*, sp., f.; *Flustra*, *Thuiaria*, *Eudendrium*, *Hydrallmannia falcata*, com.	
					,,	14	7	1	3½	...	...		
					Lythe,	1	11½	...	...	...	...		
					Common gurnards,	2	9½	1	8½	3	7		
					Angler,	1	15	1	12	...	...		
STATION IV. 30th August 1.20 p.m. to 4 p.m.	E. 58·9	57·0	56·4 5 fath.	Surface-net. — Copepods, f.; larval Crustacea, f.; small Medusidæ, f.; *Aurelia*, com. Bottom-net.—*Calanus finmarchicus*, f.; larval Crustacea, fr. (*Nephrops*, *Crangon*, &c.), embryo Gastropods, f.; *Tomopteris*, f.; larval Ascidians, f.; *Sagittæ*, com.; small Medusids, fr.	Plaice,	4	16	8	14	61	12	*Pecten opercularis*, v. a.; *Portunus corrugatus*, fr.; *P. holsatus*, f.; *Nephrops norvegicus*, com.; many carrying ova, one carrying *Loligo vulgaris*, f.; *Ommatostraphes todarus*, *Philine aperta*, f.; *Chalina oculata*, f.; *Antennularia antennina*, *Sertularia*, *Flustra*; *Asterias*.	At beginning—Wind W.; force 1–2; overcast, hazy; sea smooth; tide nearly 2½ hours flood; transparency, 2 fathoms; bar. 30. At finish—Wind W., force 3; sea smooth; tide about 5 hours flood; transparency, 2 fathoms.
					,,	38	11	77	10	10	9		
					,,	17	7	...	...	...	...		
					Lemon soles,	1	13	3	12	3	7½		
					Common dabs,	1	13	5	12	14	10½		
	W. 62·0	56·6	55·8 4½ fath.		,, ,,	40	8½	24	7½	8	6		
					,, ,,	9	5	2	4	...	...		
					Flounders,	1	15	1	10½	...	...		
					Long rough dabs,	1	9	1	6½	...	...		
					Cod,	1	11½	1	10½	...	...		
					Whitings,	2	7½	1	8	1	5½		
					Common gurnards,	1	16	3	14	3	12		
					,, ,,	11	10	12	7½	4	6		
					,, ,,	1	5	...	...	...	...		
					Dragonet,	1	8	1	6	...	...		
					Goby,	27	32¼	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station V. 29th August 10.35 a.m. to 12.40 p.m.	W. 59·8	55·1	55·0 29 fath.	Surface-net. — *Dias longiremis*, f.; *Temora longicornis*, f.; *Centropagus typicus*, f.; larval Crustacea, com. (young *Nephrops*?); small Medusids, f. Bottom-net.—*Calanus finmarchicus*, fr.; *Temora longicornis*, fr.; *Metopa alderi*, fr.; *Atylus bispinosa*, fr.; *Hyperia galba*, fr.; very young *Crangon* and *Nephrops*, fr.; *Sagittæ*, com.; small Annelids, f.; *Caligi*, f.	Grey skate,	1	18	...	...	...	...	*Nephrops norvegicus*, f.; *Asterias*, sp., n.; *Actinoloba dianthus*, r.; *Fusus antiquus* 1; small *Loligo vulgaris*, com.	At beginning—Wind W., force 3; overcast, fair; sea slight; tide about low water; transparency, $4\frac{1}{2}$ fathoms; bar. 29·89. At finish—Wind, weather, and sea as above; tide fully 2 hours flood; transparency, $5\frac{1}{2}$ fathoms.
					Starry ray,	1	$10\frac{1}{2}$	...	...	...	...		
					Plaice,	4	$16\frac{1}{2}$	9	14	4	12		
					,,	2	$10\frac{1}{2}$	...	...	...	...		
	E. 57·8	55·3	55·3 26 fath.		Lemon soles,	3	14	10	$12\frac{1}{2}$	5	11		
					Common dabs,	1	9	1	$7\frac{1}{2}$	...	...		
					Long rough dabs,	4	$9\frac{1}{2}$	4	$8\frac{1}{2}$	21	$7\frac{1}{2}$		
					,, ,,	3	$5\frac{1}{2}$	...	...	...	...		
					Turbot,	1	28	...	...	...	...		
					Haddocks,	1	17	9	16	8	$13\frac{1}{2}$		
					,,	7	12	5	11	...	...		
					Cod,	1	31	1	19	1	14		
					,,	2	$11\frac{1}{2}$	1	10	...	...		
					Whitings,	1	$13\frac{1}{2}$	1	11	3	$9\frac{1}{2}$		
					,,	4	$8\frac{1}{2}$	7	8	...	...		
					Common gurnards,	1	14	2	13	7	$10\frac{1}{2}$		
					,, ,,	2	$9\frac{1}{2}$	1	$8\frac{1}{2}$	...	...		
					Angler,	1	22	1	19	1	14		
Station VI. 29th August 1.30 p.m. to 2.30 p.m.	E. 57·4	55·9	54·8 $13\frac{1}{2}$ fath.	Surface-net. — *Dias longiremis*, f.; Larval Decapods, f.; and small Medusids, f. Bottom-net.—*Temora longicornis*, fr.; *Evadne nordmanni*, f.; *Caligus*, sp., f.; *Atylus bispinosus*, fr.; very young *Crangon*	Thornback skate,	1	3	...	...	..	..	*Nephrops norvegicus*, f.; *Asterias*, sp., f.; *Solaster papposa*, f.; *S. endeca*, f.; small *Loligo vulgaris*, fr.; *Actinoloba dianthus*, r.	At beginning—Wind W., force 3; overcast; sea slight; tide about half flood; transparency, 3 fathoms; bar. 29·88. At finish — Sea smooth; tide about
					Plaice,	1	19	9	16	30	$14\frac{1}{2}$		
					,,	29		21	11	...	...		
					Lemon soles,	18	14	12	13	8	$11\frac{1}{2}$		
	W. 57·8	55·6	55·0 15 fath.		,, ,,	5	10	3	8	...	...		
					Common dabs,	3	10	11	$8\frac{1}{2}$	17	7		
					,, ,,	1	6	2	5	...	...		
					Long rough dabs,	1	10	1	$8\frac{1}{2}$	...	...		
					Turbot,	1	23	1	17	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VI. 29th August 1.30 p.m. to 2.30 p.m.—*continued.*				and *Nephrops*; *Sagittæ*, com.; *Tomopteris*, r.; embryo Gastropods, fr.; very young round fishes.	Brill,	1	24	...	...	...	...		4 hours flood; transparency, 3 fathoms.
					Haddocks,	1	15½	1	14	4	12		
					"	2	11	...	...	...	...		
					Cod,	1	17	1	12	...	...		
					Whitings,	1	12	3	11	1	10		
					Common gurnards,	8	12	6	10	12	8		
					" "	10	7	...	...	...	...		
STATION VII. 28th August 6.52 a.m. to 8.25 a.m.	W. 56·0	55·0	55·2 10½ fath.	Surface-net. — Very young *Nephrops*, fr.; very young Schizopods and *Crangon*, f.; *Geryonopsis*, f.; *Thaumantias*, f.	Plaice,	1	12	...	...	..	...	Large *Aurelia* and *Cyanea*, fr.; *Solaster*, sp., f.; *Asterias*. sp., f.;	At beginning—Wind W., force 5 to 6; overcast, fair sea, moderate; tide fully half ebb; transparency, 1½ fathoms; bar. 29·73.
					Long rough dabs,	1	7½	1	7	1	6½		
					Whitings,	1	11	2	8½	1	7½		
	E. 58·0	55·0	54·8 19 fath.	Bottom-net. — Very young and Larval Crustacea, com. (Brachyura, *Crangon*, Schizopods), *Calanus*, *finmarchicus* f.; *Caligus*, sp., r.; *Atylus bispinosus*, r.; embryo Gasteropods, f.; small Annelids, f.; small Medusids, fr.; *Sagittæ*, com.									At finish — Sea rough; tide about 5 hours ebb; transparency, 3 fathoms.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION VIII. 27th August 2.20 p.m. to 4.25 p.m.	E. 56·2 W. 53·2	55·6 55·2	53·7 26 fath. 54·8 20 fath.	Surface-net. — Copepods, f.; young *Nephrops*, f.; Medusids, f. Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; young *Nephrops* and *Crangon*, f.; *Caligus*, sp., f.; *Hyperia galba*, f.; *Atylus bispinosus*, f.; *Tomopteris*, r.; *Sagittæ*, fr.; other small annelids, f.; Medusidæ, f.; one or two very young round fish.	Grey skate,	1	19	...	...	...	...	*Nephrops norvegicus*, f.; *Solaster papposa*, f.; *S. endeca*, f.; *Asterias violacea*, f.; *Echinus esculentus*, f.; *Actinoloba dianthus*, f.; *Alcyonium digitatum*, f.; small fragments of *Flustra* and sea weed. (Very few organisms.)	At beginning—Wind W., force 4–5; overcast, hazy, with slight rain; sea moderate; tide near high water; bar. 29·93; transparency, 6½ fathoms. At finish — Tide about 1½ hours ebb; transparency, 4 fathoms.
					Thornback ray,	1	24	1	3	...	...		
					Plaice,	1	23	1	18	3	16		
					"	2	15	10	13½	8	9½		
					Lemon soles,	2	14	1	13	6	12		
					" "	2	10	...	...	...	...		
					Common dabs,	4	9½	15	8	32	7		
					" "	15	6	...	...	...	...		
					Witch soles,	2	18	1	16	1	13½		
					Long rough dabs,	1	10½	5	8½	33	7½		
					" "	18	6½	6	5	...	...		
					Haddocks,	7	14	17	13	11	11		
					"	10	10	11	9	4	8		
					"	4	5	...	...	...	...		
					Cod,	1	13	1	11	...	...		
					Whitings,	4	11	7	10	50	8½		
					"	13	7	...	...	...	...		
					Common Gurnards,	3	14½	13	12	3	10		
					" "	3	8	7	7	...	...		
					Brassie,	1	8½	...	...	...	...		
					Angler,	1	17	...	...	...	...		
					Catfish,	1	17	...	...	...	...		
STATION IX. 27th August 11.38 a.m. to 1.43 p.m.	E. 57·7 W. 56·3	55·2 56·5	52·0 24 fath. 53·3 27 fath.	Surface-net. — *Temora longicornis*, f.; young *Nephrops* and Brachyura; *Evadne nordmanni*, f.; Larval Ascidians, f.	Plaice,	2	15½	1	13½	...	...	*Nephrops norvegicus*; *Solaster papposa*, f.; *Actinoloba dianthus*, f.; *Alcyonium di-*	At beginning—Wind W. force 4–5; overcast, hazy, with slight rain; sea moderate; tide nearly ½ flood;
					Lemon soles,	1	12½	1	11½	2	8		
					Common dabs,	1	9½	5	8½	18	7½		
					" "	1	6	2	5	...	...		
					Long rough dabs,	19	8½	10	7	9	6		
					" "	6	5	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station IX. 27th August 11.38 a.m. to 1.43 p.m. —*continued.*				Bottom-net.—*Calanus finmarchicus*, fr.; *Dias longiremis*, fr.; *Temora longicornis*, fr.; young Schizopods, com.; *Caligus*, sp., f.; *Hyperia galba*, r.; other Amphipods, f.; young Lamellibranchs and Gasteropods (*Cardium*, *Littorina*); *Sagittæ*, a.; *Tomopteris*, f.; small Medusids, f.	Haddocks,	7	13½	30	11½	11	10	*gitatum*, f.; *Brissopsis lyrifera*, 1.	transparency, 7 fathoms; bar. 29·94. At finish — tide about 5 hours flood; transparency, 7 fathoms.
					,,	13	9	1	7½	11	5		
					,,	6	4	...	..	...	...		
					Cod,	1	21	1	14	...	...		
					Whitings,	7	12½	18	10½	9	9		
					,,	17	8	17	4	...	...		
					Common gurnards,	1	14	18	12½	5	11		
					,, ,,	12	9½	5	8	...	...		
					Angler,	1	31	1	21	...	...		
Station I 4th October 9 a.m. to 11 a.m.	W. 48·0	53·0	52·6 12 fath.	Surface-net.—*Metopa* sp., n.r.; *Porcellana longicornis* (juv.), f.; Larval Crustacea, f.; *Aurelia* 1. (small). Bottom-net.—*Boreophausia*, f.; *Metopa* (juv.), r.; *Porcellana* (juv.), f.; *Hippolyte* (juv.), r.; *Eupagurus* (juv.), r.; *Temora longicornis*, r.; *Calanus finmarchicus*, r.; *Sagittæ*, f.; *Tomopteris*, r.; young Gastropods, f.	Thornback ray,	1	14	1	12	...	...		At beginning—Wind N.E., force 2; very hazy; sea, slight swell E.; transparency, 1½ fathoms; tide, high water; bar. 29·66 At finish.—transparency, 2 fathoms.
					Plaice,	9	14	14	12	15	11		
					,,	13	9	...	...	...	...		
					Common dab,	7	7	5	6	...	...		
	E. 49·6	53·0	52·4 17 fath.		Long rough dabs,	6	8½	4	7½	2	5		
					Haddock,	1	5	...	...	...	...		
					Cod,	2	12	6	10	1	8		
					Whiting,	1	5½	...	...	...	...		
					Common gurnards,	4	8½	2	7½	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION II. 1st October 1.45 p.m. to 3.40 p.m.	E. 50·0	53·4	53·5 12 fath.		Gray skate, . .	1	23	...	...	...	...		At beginning—Wind N.E., force 7; clouds and sunshine; sea, rough; transparency, 3 fathoms; tide, flood; bar., 29·74. At finish—Cloudy; transparency, 2½ fathoms; tide, flood.
					Thornback ray, .	1	17	1	10	...	...		
					Plaice, . . .	1	24	6	14	47	12		
					,, . . .	33	11	38	10	6	9		
	W. 52·0	53·2	53·4 13 fath.		Lemon soles, . .	13	13	3	11	8	9		
					,, ,, . .	3	6	...	...	...	...		
					Common dabs, .	3	9½	68	8	40	7		
					,, ,, .	21	6	6	5	...	...		
					Long rough dabs, .	3	11½	22	9	10	8		
					,, ,, .	12	7	2	5½	...	...		
					Haddock, . .	1	11	...	...	...	...		
					Cod, . . .	2	11	...	...	...	...		
					Whitings, . .	2	8½	2	6	...	...		
					Common gurnards,	4	16	1	10	20	8		
					,, ,, .	16	6½	4	5½	...	...		
STATION III. 3rd October 2.0 p.m. to 4.15 p.m.	E. 54·2	52·3	52·0 8 fath.		Gray skate, . .	1	7½	...	...	...	...		At beginning—Wind, S.W., force 3; clouds, sunshine, and haze; sea, E. swell; transparency, 2 fathoms; tide, low water; bar., 29·84. At finish—Overcast, hazy; transparency, 2 fathoms; tide, flood.
					Thornback ray, .	2	18	1	15	2	14		
					Starry ray, . .	1	9	...	...	...	...		
					Plaice, . . .	1	18	4	14	14	13		
	W. 52·6	52·6	52·3 7 fath.		,, . . .	18	11	12	9	10	8		
					Lemon soles, . .	5	13½	18	12	15	11		
					,, ,, . .	8	10	4	9	3	7		
					Common dabs, .	2	11½	4	10	12	8		
					,, ,, . .	28	7	7	6	...	...		
					Long rough dabs, .	2	11	14	9	13	7½		
					,, ,, . .	6	6½	...	...	...	...		
					Haddocks, . .	2	13	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl. down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station III. 3rd October 2.0 p.m. to 4.15 p.m.—*continued.*					Cod,	1	28	1	25	1	18		
					"	26	13	20	10	4	5		
					Whitings,	4	12	14	10	9	8		
					"	6	4½	...	...	...	...		
					Common gurnards,	1	15	1	13	3	9		
					" "	4	8	5	6	1	4½		
					Angler,	2	16	..	...	...	...		
Station IV. 5th October 11.30 a.m. to 1.45 p.m.	W. 49·2	51·0	51·0		Plaice,	1	16	13	14	38	13		At beginning—Wind W. by N., force 3; foggy; sea, slight; transparency, 1 fathom; tide, ebb; bar., 29·43. At finish—Wind W.N.W., force 4; transparency, 1½ fathoms; tide, ebb.
			5½		"	40	12	18	11	14	10		
			fath.		"	8	7	3	6	...	..		
					Lemon soles,	1	10	...	...	...	...		
	E. 50·0	50·8	51·0		Common dabs,	1	13	5	12	4	11		
			6½		" "	8	9	9	8	5	7		
			fath.		" "	8	6	4	5	...	...		
					Cod,	1	32	1	12	...	...		
					Whiting,	1	8½	...	...	...	...		
Station V. 2nd October 8.50 a.m. to 11.0 a.m.	W. 48·0	53·2	53·2		Gray skate,	1	21	1	16	1	14		At beginning—Wind N.E., force 7; cloudy; sea, rough; transparency, 4 fathoms; tide, ebb; bar., 29·96.
			27		Plaice,	11	16	10	13	4	12		
			fath.		Lemon soles,	1	14	4	12	...	...		
					Common dabs,	1	11	4	9	2	8		
	E. 50·0	53·2	53·1		Witch soles,	1	16	...	...	...	...		
			24		Long rough dabs,	4	9	21	8	8	7		
			fath.		Haddocks,	16	16	22	13	13	12		
					"	13	10	3	6	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION V. 2nd October 8.50 a.m. to 11.0 a.m.— *continued.*					Cod,	1	34	1	27	2	22		At finish—Clouds and sunshine; transparency, 4 fathoms.
					,,	4	16	2	15	6	11		
					,,	3	10	...	...	...	...		
					Whitings,	1	16	13	14	9	12		
					,,	7	10	13	9	4	6½		
					Common gurnards,	2	11	...	...	...	...		
					Angler,	1	25	...	...	...	...		
STATION VI. 1st October 11.30 a.m. to 12.30 p.m.	E. 48·0	53·2	53·3 13 fath.		Starry ray,	1	6	...	...	...	...		At beginning—Wind N.E., force 8; cloudy and sunshine; sea, rough; transparency, 3 fathoms; tide, low water; bar., 29·70. At finish—transparency, 3 fathoms; tide, flood.
					Plaice,	1	19	6	14	13	12		
					,,	14	11	...	...	...	...		
	W. 49·0	53·1	53·3 15 fath.		Lemon soles,	3	13	3	12	4	11		
					,, ,,	1	9	...	...	...	...		
					Common dabs,	2	10	5	8	10	7		
					,, ,,	3	6	...	...	...	...		
					Witch soles,	1	16	...	...	...	...		
					Long rough dabs,	1	13	1	11	6	9		
					,, ,,	7	8	5	6	...	...		
					Haddocks,	3	14	8	12	4	11		
					,,	1	9	13	5½	...	...		
					Cod,	1	24	3	13	2	10		
					,,	1	8½	...	...	...	...		
					Whitings,	7	8½	12	7½	8	6½		
					,,	16	5	...	...	...	...		
					Ling,	1	22	...	...	...	...		
					Common gurnards,	6	12½	9	9	9	6½		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No	Inches		
STATION VII. 3rd October 10.0 a.m. to noon.	W. 48·6	52·5	52·8 11 fath.		Gray skate,	1	18	1	13	...	...		At beginning—Wind W., force 3; cloudy and hazy; sea, heavy swell, E.; transparency, 2½ fathoms; tide, ebb; bar., 29·90. At finish—very hazy; sea, heavy roll from E.; transparency, 3 fathoms; tide, ebb.
					Thornback ray,	1	7	...	...	...	...		
					Plaice,	1	16	3	15	16	14		
					"	16	11	6	9	...	...		
	E. 51·0	52·6	53·0 17 fath.		Lemon soles,	1	11	...	...	...	...		
					Common dabs,	1	9½	4	8½	25	7		
					" "	7	6	...	...	...	...		
					Witch soles,	4	18	...	...	...	...		
					Long rough dabs,	5	9	31	8	14	6		
					Haddocks,	16	14	18	12	3	10		
					"	5	6	...	...	...	...		
					Cod,	1	11	3	9	...	...		
					Whitings,	5	9	10	8	8	7		
					"	2	6	...	...	...	...		
					Common gurnards,	1	15	2	13	...	...		
					Angler,	1	32	1	21	...	...		
STATION VIII. 2nd October 2.0 p.m. to 3.50 p.m.	E. 51·4	53·0	53·3 26 fath.		Gray skate,	1	15	1	8	...	...		At beginning—Wind N.E., force 6; cloudy; sea, very rough; transparency, 4 fathoms; tide, flood; bar., 29·96. At finish—Transparency, 3½ fathoms; tide, flood.
					Thornback ray,	1	27	1	24	...	...		
					Plaice,	1	17	1	12	...	...		
					Lemon soles,	1	14	1	14½	...	...		
	W. 53·0	52·8	53·0 20 fath.		Common dabs,	2	8½	1	10	5	7		
					Witch soles,	1	18	1	16	1	13		
					Long rough dabs,	1	13	4	9	11	8		
					" "	5	6½	...	...	...	...		
					Sail fluke,	1	16	...	...	...	...		
					Haddocks,	1	16	1	14	9	13		
					"	2	11	5	5	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VIII. 2nd October 2.0 p.m. to 3.50 p.m.— *continued.*					Cod, . . .	1	30	1	19	1	11		
					Whitings, . .	1	12½	1	10	4	9		
					,, . . .	6	7½	4	5	...	...		
					Common gurnards,	1	10	1	7½	...	...		
					Angler, . .	1	28	1	24	1	17		
STATION IX. 2nd October 11.30 a.m. to 1.30 p.m.	W. 50·1	53·1	53·3 29 fath.		Thornback ray, .	1	21	...	...	...	...		At beginning—Wind N.E., force 6; cloudy; sea, rough; transparency, 4 fathoms; tide, last hour ebb; bar., 29·96. At finish—Squally and showers; transparency, 4¼ fathoms; tide, flood.
					Plaice, . . .	1	22	2	17	8	16		
					,, . . .	10	13½	...	...	...	...		
					Common dabs, .	1	8½	...	...	...	...		
	E. 51·0	53·0	53·3 30 fath.		Witch soles, . .	2	17	...	...	...	...		
					Long rough dabs, .	1	11½	1	10	10	8½		
					,, ,, .	6	7	6	6	...	...		
					Haddocks, . .	2	14	1	11	4	6		
					Cod, . . .	1	42	1	22	1	18		
					,, . . .	1	11	2	9	...	...		
					Whitings, . .	1	15	1	14	5	12		
					,, . . .	3	10	9	9	4	8		
					,, . . .	2	5	...	...	...	...		
					Angler, . .	1	18	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.								Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.													
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.		
Station I. 9th Nov. 12.20 p.m. to 2.20 p.m.	E. 54·0	49·9	49·9 13½ fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; Infusoria, a. (*Ceratium tripos*). Bottom-net.—*Boreophausia raschii*, com.; *Calanus finmarchicus*, fr.; Amphipods, fr.; small Medusids, fr.; *Sagittæ*, com.	Gray skate,	1	10	...	...	...	...	...	...	*Pecten opercularis*, a.; *Nephrops norvegicus*, com.; *Portunus*, fr. (*P. holsatus*, mostly); *Pandalus annulicornis*, fr.; *Solaster papposa*, f.; *S. endeca*, f.; *Ophiothrix*, f.; *Actinoloba dianthus*, f.; *Flustra*, com.; *Hydrallmannia falcata*, com.; *Cancer pagurus*, f.; *Asterias* sp., f.	At beginning — Wind W., force 6; cloudy, fine; sea a little rough; tide about ½ flood; transparency, 2½ fathoms; bar., 30·01. At finish—Wind W., force 7; sea, rough; tide, 5 hours flood; transparency, 2 fathoms.
					Thornback ray,	1	38	2	18	1	17	3	14½		
					,, ,,	1	12	...	...	...	...	...	...		
					Plaice,	1	15	...	...	...	...	...	...		
	W. 53·3	49·6	50·0 8 fath.		Lemon soles,	6	14½	6	13	5	11½	2	10		
					,, ,,	2	7½	1	6½	...	...	...	...		
					Common dabs,	1	15	1	10¼	1	7	...	...		
					Long rough dabs,	1	14	2	12	14	10	11	9		
					,, ,,	11	8	5	7	4	6	1	5		
					,, ,,	1	2¼	...	...	...	...	...	...		
					Haddocks,	1	15½	1	12	...	...	...	...		
					Cod,	1	31	1	26	5	21	7	18		
					,,	3	16	12	13	12	12	3	10½		
					,,	1	9½	1	7	1	4½	...	...		
					Whitings,	2	19	2	7½	3	15	10	10½		
					,,	9	7½	8	5½	2	4	...	...		
					Angler,	1	28	1	22	3	17	2	15		
					Herring,	1	8¼	...	...	...	...	...	...		
					Pogge,	1	4½	...	...	...	...	...	...		
Station II. 8th Nov. 12.50 p.m. to 3.0 p.m.	E. 52·0	49·5	49·5 14 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; *Caligus*, sp., f.; *Infusoria*, a. Bottom-net.—*Boreophausia raschii*, fr.; *Calanus finmarchicus*, fr.; *Temora longicornis*,	Gray skate,	1	20	1	18½	2	14½	1	8	*Nephrops norvegicus*, fr.; *Solaster papposa*, f.; *S. endeca*, f.; *Cancer pagurus*, f.; *Portunus*, sp., f.; *Pecten opercularis*, a.;	At beginning — Wind W., force 4; overcast; sea moderate; tide, 4 hours flood; transparency, 2½ fathoms; bar., 30·07.
					Starry ray,	1	7¼	...	...	...	...	...	...		
					Thornback ray,	1	22	3	16	1	17	2	1½		
					Plaice,	1	14½	2	12	...	...	...	...		
	W. 57·4	49·6	49·8 12 fath.		Lemon soles,	1	13	...	...	...	...	...	...		
					Common dabs,	6	8	1	7	1	5	...	...		
					Long rough dabs,	5	10	14	8	7	6½	2	5½		
					Haddocks,	1	15	4	13½	1	10	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—I. FIRTH OF FORTH—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.								Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.													
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.		
STATION II. 8th Nov. 12.50 p.m. to 3.0 p.m. —*continued.*				fr.; *Caligus*, sp., f.; Amphipods, f.; *Tomopteris*, f.; *Sagittæ*, com.; small Medusids.	Cod,	1	36	1	24½	2	11½	2	9½	*Ophiothrix rosula*, f.; *Actinoloba dianthus*, *Alcyonium digitatum*, *Pandulus annulicornis*, *Flustra*, *Hydrallmannia falcata.*	At finish—Tide high water; transparency, 2½ fathoms.
					,,	2	6	...	...	...	...	...	...		
					Whitings,	1	10½	1	7½	3	6½	5	5½		
					,,	1	4	...	...	...	...	...	...		
					Common gurnard,	1	15½	...	...	...	...	...	...		
STATION III. 11th Nov., 1.55 p.m. to 3.55 p.m.	E. 50·5	49·0	49·3 7½ fath.	Surface-net.—A considerable quantity of fine mud-like material, comprising Infusoria and a few Larval Decapods. Bottom-net.—*Boreophausia raschii*, fr.; *Metopa alderi*, f.; *Hyperia galba*, f.; *Caligus*, sp.; *Calanus finmarchicus*, fr.; *Sagittæ*, com.; *Pleurobrachia*, fr.; *Thaumantias*, fr.	Thornback ray,	1	21	1	19	1	16	...	...	*Nephrops norvegicus*, com.; *Solaster papposa*, f.; *Pecten opercularis*, com.	At beginning—Wind W., force 2; a little hazy; mild; sea, smooth; tide, fully ½ hour flood; transparency, 1¾ fathoms; bar., 30·07. At finish—Tide, near high water; transparency, 1¾ fathoms.
					Lemon dabs,	1	14	...	...	...	...	...	...		
					Long rough dabs,	3	8	...	...	...	...	...	...		
	W. 50·7	49·0	49·4 8 fath.		Cod,	1	14	1	12	1	11	1	6		
					,,	2	5½	2	4	...	...	...	...		
					Whitings,	7	11	9	8½	3	7½	10	6		
					,,	5	5	...	...	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.								Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.													
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.		
Station IV. 12th Nov. 10.55 a.m. to 1.25 p.m.	E. 57·8	49·0	50·6 4 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; *Caligus*, f.; larval Decapods, f.; Infusoria, a. Bottom-net.—*Calanus finmarchicus*, f.; *Caligus*, sp., f.; *Boreophausia raschii*, f.; *Sagittæ*, fr.; small Medusids, fr.; (*Pleurobrachia* and others).	Plaice,	5	5½	43	13	81	12	60	10	*Pecten opercularis*, v.a.; *Portunus holsatus* fr.; *Portunus corrugatus*, fr.; *Nephrops norvegicus*, com.; *Carcinus mænas*, f.; *Solaster, papposa*, f.; *Asterias violacea*, f.; *Actinoloba dianthus*, f.; several pieces of a sponge (*Chalina* ?).	At beginning—Wind W.S.W., force 2–3; hazy, but fine; sea, smooth; tide about low water; transparency, 2 fathoms; bar., 30·04. At finish—Tide about 2½ hours flood; transparency, 1¾ fathoms.
					„	33	9	4	8	4	6½	...	...		
					Lemon sole,	1	10½	...	...	...	...	...	..		
					Common dabs,	1	13	2	12	2	11	8	10		
	W. 54·0	49·0	49·2 2½ fath.		„ „	6	8	10	7	5	6	2	4½		
					Flounders,	1	14	1	13	1	12	...	...		
					Long rough dabs,	2	10	1	9	...	...	...	...		
					Cod,	2	14	...	...	...	...	...	...		
					Whitings,	1	7½	1	6½	...	...	...	...		
Station V. 7th Nov. 9.30 a.m. to 11.30 a.m.	E. 53·6	50·0	50·2 23 fath.	Surface-net—*Calanus finmarchicus*, a.; *Dias longiremis*, a.; *Temora longicornis*, a.; young Decapods, f.; *Hyperia galba*, f.; *Infusoria*, a. Bottom-net — *Boreophausia raschii*, a.; *Atylus bispinosus*, fr.; *Hyperia galba*, fr.; *Calanus finmarchicus*, fr.; *Sagittæ*, a.; small Medusids, f.	Thornback ray,	1	19	1	17	1	13	...	...	*Nephrops norvegicus*, com.; *Fusus antiquus* 1; 1 large *Loligo vulgaris*; piece of seaweed with some Zoophytes attached.	At beginning—Wind W., force 6; dull; sea a little rough; tide fully 1 hour flood; transparency, 4¼ fathoms; bar. 29·91. At finish—Tide fully 3 hours flood; transparency, 4 fathoms.
					Lemon sole,	1	9½	...	...	...	...	...	...		
					Common dabs,	1	11	1	10	4	8½	2	7		
					„ „	2	6½	...	...	...	...	...	...		
	W. 54·4	50·0	50·5 29 fath.		Witch soles,	1	19	2	18	3	16	...	...		
					Long rough dabs,	2	10	7	9	7	8	11	7		
					„ „	6	6	1	5	...	...	...	...		
					Turbot,	1	23	...	...	...	...	...	...		
					Haddocks,	1	18	18	15½	34	14	15	13		
					„	2	11	3	6	...	...	...	...		
					Cod,	1	29	1	25	1	21	2	19		
					„	2	18	6	11½	1	10	...	...		
					Whitings,	4	13½	9	12	13	10	9	9		
					„	4	7	...	...	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station VI. 7th Nov. 12.23 p.m. to 1.15 p.m.	E. 53·9 W. 54·0	50·0 50·0	50·0 $13\frac{1}{2}$ fath. 49·9 14 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; young Decapods, f.; Infusoria, a. Bottom-net.— *Boreophausia raschii*, f.; *Mysis*, sp., f.; *Caligus*, sp., f.; *Calanus finmarchicus*, *Atylus bispinosus*, f.; *Hyperia galba*, f.; *Sagittæ*, a.; small Medusids, f. (*Pleurobrachia*, &c.).	Plaice,	3	19	1	20	2	18	8	16	Only one or two *Solaster endeca*, and *Portunus holsatus*.	At beginning—Wind W.; force 7–8; cloudy; sea, rough; tide, 4 hours flood; transparency, 2 fathoms; bar., 29·89. At finish — Tide, about 5 hours flood; transparency, $2\frac{1}{2}$ fathoms.
					„	15	14	18	13	11	12	6	11		
					Lemon soles,	1	16	1	14	6	13	...	...		
					Common dabs,	1	$10\frac{3}{4}$	2	10	3	$8\frac{1}{2}$	6	$7\frac{1}{2}$		
					„ „	1	$6\frac{1}{2}$	1	4	...	...	...	...		
					Long rough dabs,	2	$9\frac{3}{4}$	3	8	1	7	1	$5\frac{1}{2}$		
					Brill,	1	18	...	...	...	...	...	...		
					Haddocks,	2	14	1	12	...	...	...	...		
					Cod,	1	18	2	17	3	12	...	...		
					Whitings,	1	13	2	10	2	9	...	...		
Station VII. 7th Nov. 7.0 a.m. to 8.30 a.m.	W. 53·6 E. 53·6	47·5 48·5	48·1 7 fath. 50·0 24 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; Infusoria, a. Bottom-net. — *Boreophausia raschii*, fr.; *Mysis*, sp., fr.; *Erythrops goesii*, f.; Amphipods, com. (*Atylus bispinosus*, *Hyperia galba*, &c.); *Calanus finmarchicus*, fr.; *Caligus*, sp., f.; Cumacea, r.; small Medusids, fr.; *Sagittæ*, com.; post-larval herring, fr.	Plaice,	1	$11\frac{1}{2}$	...	...	...	...	...	...	*Solaster endeca*, f.; *Asterias rubens*, 1; and *Portunus holsatus*, r.; *Sabella* tube with contained Annelid.	At beginning—Wind W., force 5; cloudy; sea, moderate; tide, near low water; transparency, $1\frac{1}{2}$; bar., 29·90. At finish—Tide, a little after low water; transparency, $2\frac{1}{2}$ fathoms.
					Common dabs,	1	10	1	8	...	...	...	...		
					Long rough dabs,	1	8	1	9	1	$10\frac{1}{2}$	4	$6\frac{1}{2}$		
					„ „	1	5	...	...	...	...	...	...		
					Haddocks,	1	17	3	$6\frac{1}{2}$	...	...	...	...		
					Cod,	1	31	1	27	...	...	...	...		
					Whitings,	4	$9\frac{1}{2}$	1	8	3	7	4	6		
					„	4	5	...	...	...	...	...	...		
					Angler,	1	$13\frac{1}{2}$	...	...	...	...	...	...		
					Dragonet,	1	7	...	...	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station VIII. 6th Nov. 3.20 p.m. to 5.20 p.m.	E. 49·5	50·0	50·4 27 fath.	Surface-net.—*Dias longiremis*, a; *Temora longicornis*, a; Infusoria, a. Bottom-net. — *Boreophausia raschii*, fr.; *Mysis*, sp., fr.; *Erythrops goesii*, fr.; *Gastrosaccus spinifer*, f.; *Crangon*, sp., f.; *Calanus finmarchicus*, fr.; very young Decapods, f.; *Tomopteris*, f.; *Sagittæ*, a.; small Medusids, f.; 1 Herring (2½ inches); a few post-larval herring.	Grey skate,	1	19	2	17	1	14	1	11	*Nephrops norvegicus*, com.; *Cancer pagurus*, r.; *Solaster endeca*, f.; one or two pieces of *Hydrallmannia falcata*.	At beginning—Wind W., force 6–7; cloudy, fine; sea, a little rough; tide, about 2 hours flood; transparency, 4¼ fathoms; bar., 29·87. At finish—Wind W., force 5; tide, about 4 hours flood.
					Thornback ray,	1	18	1	17	...	...	...	...		
					Plaice,	1	20	1	14	...	...	...	...		
					Lemon sole,	1	13	...	...	...	...	...	...		
					Common dabs,	1	10	1	9	2	7	2	5½		
	W. 50·0	48·9	49·0 24 fath.		Long rough dabs,	1	8½	4	7½	8	6½	1	5½		
					Witch sole,	1	18	1	16	...	...	...	...		
					Haddocks,	6	13	4	12	1	9	14	6½		
					Cod,	1	40½	1	32	1	14	1	4		
					Whitings,	1	15½	4	13½	7	12	19	9		
					,,	9	8	1	6	...	...	...	...		
					Common gurnards,	1	12½	...	...	...	...	...	...		
					Angler,	1	27	1	22	1	18	...	...		
Station IX. 6th Nov. 12.45 p.m. to 2.45 p.m.	E. 51·3	50·0	50·4 27 fath.	Surface-net.—*Calanus finmarchicus*, a.; *Dias longiremis*, a.; *Temora longicornis*, a.; *Parathemisto oblivia*, f.; Infusoria, a. (*Ceratium tripos*, &c.); small Medusids, f. Bottom-net.—*Calanus finmarchicus*, com.; *Atylus bispinosus*, f.; *Caligus*, sp., f.; *Boreophausia raschii*, f.; *Mysis spiritus*, f.; young *Hippolyte*, *Hyas*, and other Decapods; *Sagittæ*, a.; young herring, f.	Plaice,	1	15	...	...	...	...	...	...	*Nephrops norvegicus*, f.; *Echinus esculentus*, r.; *Solaster papposa*, f.; *Tealia crassicornis*, f.; *Aurelia*, f.; a fragment or two of *Flustra*.	At beginning—Wind W., force 6; cloudy, fine; sea, a little rough; tide, near low water; transparency, 5 fathoms; bar., 29·88. At finish—Tide, a little after low water; transparency, 5 fathoms.
					Lemon soles,	1	17	1	14	1	13	2	11½		
					,, ,,	1	10½	...	...	...	...	...	...		
					Common dabs,	1	11	2	8	1	7	...	...		
					Long rough dabs,	7	7½	4	6½	1	5½	...	...		
	W. 51·6	50·0	50·2 29½ fath.		Haddocks,	1	16	4	13½	2	11½	5	6		
					Cod,	1	20	1	19	1	18	4	12		
					,,	1	11	2	10	...	...	...	...		
					Whitings,	2	13	10	10½	5	9	2	8		
					,,	3	7	2	6	...	...	...	...		
					Ling,	1	24	...	...	...	...	...	...		
					Common gurnard,	1	11	...	...	...	...	...	...		
					Brassie,	1	8	...	...	...	...	...	...		
					Angler,	1	33	...	...	...	...	...	...		
					Cat-fish,	1	19	...	...	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station I. 21st January 12.20 p.m. to 2.10 p.m.	E. 44·8 W. 44·8	42·9 42·0	43·1 16 fath. 43·0 8 fath.	Surface-net.—*Sagittæ*, a.; Medusids, f.; Schizopods, f. Bottom-net. — Very few organisms, except *Sagittæ*, a.	No fish in trawl-net. The trawl was proved to have been working properly by the polished condition of the trawl-iron when brought up.	... ...	... ...	... ...	... ...	... ...	... ...		At beginning — Wind N., force 4; clear; sea, rather rough; transparency, 3½ fathoms; tide, 1 hour flood; bar., 30·40. At finish—Cloudy, with some sunshine; transparency, 2¾ fathoms.
Station II. 22d January 9.50 a.m. to 11.50 a.m.	W. 40·0 E. 44·2	41·0 42·1	43·0 8 fath. 43·0 15 fath.	Surface-net.—*Sagittæ*, f.; Schizopods, f. Bottom-net.—*Sagittæ*, a.; *Tomopteris*, f.; Schizopods, f.; *Syngnathus acus*.	Long rough dabs, . Haddock, . . " . . Whitings, . .	1 1 1 1	8 18 12 9	... 5 1 ...	... 13½ 11½ ...	... 1 1 ...	... 12½ 14 ...		At beginning—Wind W., force 2; hazy, fine; sea, moderate; transparency, 2¾ fathoms; tide, 4 hours ebb; bar., 30·50. At finish—Transparency, 2¾ fathoms.
Station III. 21st January 2.30 p.m. to 4.40 p.m.	W. 44·8 E. 42·8	42·0 42·4	42·8 7 fath. 42·5 11 fath.	Surface-net.—Schizopods, f.; *Sagittæ*, f.; a large Medusid. Bottom-net.—Isopods, f.; *Caligus*, sp., f.; *Sagittæ*, a.; Medusids, f.	Plaice, . . . Common dabs, .	12 2	16 9	14 1	13 5	2 ...	11½ ...		At beginning—Wind N.E., force 4; clear; sea, moderate; transparency, 2½ fathoms; tide about low water; bar., 30·44. At finish.—Transparency, 1¾ fathoms.

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued*.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station IV. 22d January 7.20 a.m. to 9.30 a.m.	E. 36·8	42·2	43·0 10 fath.	Surface-net. — A few Medusids and *Sagittæ*. Bottom-net. — Medusids, a.; *Sagittæ*, a.; *Tomopteris*, f.; *Syngnathus acus*, 2.	Grey skate,	1	20	1	16	1	12½		At beginning — Wind N.W. force 3; hazy; sea, moderate; transparency, 2 fathoms; tide, ¼ ebb; bar., 30·50. At finish—Transparency, 2¾ fathoms.
					Plaice,	1	16	1	15	4	14		
					,,	1	12½	...	...	...	...		
					Haddocks,	1	24½	1	19	...	...		
	W. 38·0	41·0	42·8 6 fath.		Cod,	1	28	1	31½	1	37		
Station V. 22d January 12 noon to 2.0 p.m.	N. 44·2	42·1	43·0 13 fath.	Surface-net.—Medusids, f.; *Sagittæ*, f. Bottom-net.—*Caligus*, sp., r.; *Sagittæ*, a.; Medusids, a.	Plaice,	1	17	...	...	...	...		At beginning — Wind W., force 3; fine but hazy; sea, moderate; transparency, 2¾ fathoms; tide, low water; bar., 30·52. At finish—Transparency, 3¼ fathoms.
					Lemon soles,	1	11	...	...	...	..		
					Common dabs,	1	10½	1	6½	1	8		
					Turbot,	1	17	...	...	...	...		
	S. 46·0	42·8	43·3 16 fath.		Haddocks,	1	12	...	...	...	...		
					Cod,	1	31	...	...	...	...		
Station I. 19th March 12.10 p.m. to 2.10 p.m.	W. 41·0	40·3	40·1 5 fath.	Surface-net. — Larval Decapods, fr.; *Idotea marina*, f.; *Calanus finmarchicus*, f.; *Sagittæ*, f.	Starry ray,	1	10½	...	...	...	..		At beginning — Wind S.E., force 4; hazy, like rain; sea, moderate; tide, flood; transparency, 3 fathoms; bar., 29·39. At finish—Transparency, 3¼ fathoms.
					Plaice,	27	13½	23	12	18	11		
					,,	14	9	1	6	...	...		
					Common dabs,	8	11	9	9	5	6½		
	E. 40·0	40·2	40·4 8 fath.		Flounders,	1	15	2	12	9	8½		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station II. 18th March 11.45 a.m. to 2.5 p.m.	E. 39·2	40·2	40·0 13 fath.	Surface-net.—Nil. Bottom-net. — A few *Sagittæ* only.	Plaice, . . .	24	14	22	13	5	12		At beginning—Wind S.E., force 4; dull, inclining to rain; sea, rough; tide, flood; transparency, 3 fathoms; bar., 29·85. At finish—Wind N.E., force 1; sea, smooth; tide, flood.
					,, . . .	8	10	1	9	1	4¾		
					Lemon soles, . .	1	13	...	...	...	...		
					Common dabs, .	3	10	1	11½	1	8½		
	W. 41·4	40·6	40·2 7 fath.		,, ,, .	3	8	3	6½	...	...		
					Flounders, . .	1	12½	2	10½	2	10		
					,, . . .	1	9	1	7½	...	...		
Station III. 19th March 9.40 a.m. to 11.50 a.m.	E. 40·5	40·1	40·0 10 fath.	Surface-net. — *Idotea marina*, fr.; *Parathemisto oblivia*, r.; other Amphipods, f.; *Eurydice pulchra*, f.; *Calanus finmarchicus*, f. Bottom-net. — *Dias longiremis*, f.; *Temora longicornis*, f.; *Pseudocuma cercaria*, r.	Grey skate, . .	1	17¾	2	7	...	...		At beginning — Wind E.S.E., force 2; hazy, like rain; sea, smooth; tide, low water; transparency, 3 fathoms; bar., 25·49. At finish—Wind S.E., force 4; tide, flood; transparency, 3 fathoms.
					Plaice, . . .	1	17	7	15	11	14		
					,, . . .	21	13	11	12	12	11		
					,, . . .	1	9½	...	...	...	...		
	W. 41·7	40·4	40·3 5 fath.		Common dabs, .	1	4⅞	...	...	...	...		
					Flounders, . .	1	10½	1	7½	...	...		
					Long rough dabs, .	1	11½	1	9½	...	...		
					Haddocks, . .	1	15½	...	...	...	...		
					Cod, . . .	4	32	1	25	...	...		
Station IV. 18th March 2.25 p.m. to 4.40 p.m.	W. 41·0	40·5	40·0 7 fath.	Surface-net. — Contained nothing but some floating rubbish. Bottom-net. — *Boreophausia raschii*, f.; *Sagittæ*, f.	Plaice, . . .	49	15	44	12	42	10		At beginning—Wind E. by N., force 2; a little hazy; sea, smooth; tide, flood; transparency, 3 fathoms; bar., 29·76. At finish—Tide, ebb; transparency, 2 fathoms.
					,, . . .	1	8½	3	6	...	...		
					Common dabs, .	1	12½	...	...	...	...		
					Flounders, . .	4	13½	8	10	5	7½		
	E. 40·5	40·4	40·2 6½ fath.		Brill, . . .	1	9¼	...	...	...	...		
					Cod, . . .	1	30½	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station V. 19th March 7.25 a.m. to 9.20 a.m.	N. 40·0 S. 40·5	40·1 40·2	40·0 8½ fath. 40·1 10 fath.	Surface-net. — Contained nothing. Bottom-net. — *Dias longiremis*, com.; *Temora longicornis*, fr.; *Calanus finmarchicus*, fr.; young Cumaceæ, f.; larval Ophiuroids, f.; *Sagittæ*, f,; larval fish, f.	Plaice,	4	14	3	12½	3	11		At beginning — Wind E.S.E., force 4; hazy, like rain; sea, moderate; tide, ebb; transparency, 1 fathom; bar., 29·49. At finish—Wind E.S.E., force 2; sea, smooth; tide, low water; transparency, 3 fathoms.
					,,	1	8½	...	...	...	...		
					Common dabs,	3	11	8	10	3	9		
					,, ,,	9	7	3	6	...	...		
					Flounders,	1	15¼	1	10¼	4	9		
					,,	3	7½	...	...	...	...		
					Haddocks,	1	10	...	...	...	...		
					Common gurnards,	1	14	...	...	...	...		
					Lumpsucker,	1	18	...	...	...	...		
Station I. 18th April 4.0 p.m. to 6.10 p.m.	E. 47·0 W. 47·2	43·0 43·0	41·8 12 fath. 41·6 8 fath.		Thornback ray,	1	15	...	...	...	...		At beginning — Wind W., force 7; clear; sea, moderate; transparency, 2 fathoms; bar., 29·84. At finish -Transparency, 1¾ fathoms.
					Plaice,	1	26	8	14½	12	12½		
					,,	16	10	...	...	...	...		
					Common dabs,	4	11	1	9	4	7		
					Flounders,	2	10	...	...	...	...		
					Turbot,	1	15	...	...	...	...		
					Common gurnards,	15	14½	3	12	1	10		
Station II. 19th April 7.0 a.m. to 9.0 a.m.	W. 48·2 E. 49·0	42·6 42·2	41·7 6 fath. 41·1 11 fath.		Thornback ray,	1	21	3	15½	...	...		At beginning — Wind W., force 3; cloudy; sea, slight; transparency, 2 fathoms; bar., 29·84. At finish—Wind W., force 6; clear; sea, moderate; transparency, 2¼ fathoms.
					Plaice,	1	19	31	16	35	12		
					,,	4	10½	12	9	2	6½		
					Lemon sole,	1	9½	...	...	...	...		
					Common dabs	4	10½	8	8½	7	7		
					,, ,,	2	5	...	...	...	...		
					Whitings,	1	10	2	8½	...	...		
					Common gurnards,	2	11½	2	13	1	10½		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather and other Observations.
Station III. 19th April 2.40 p.m. to 4.50 p.m.	W. 51·4	42·5	41·7 7 fath.		Gray skate,	1	20	...	...	...	...		At beginning—Wind W., force 6; cloudy; sea, moderate; transparency, 1½ fathoms; bar., 29·84. At finish — Sea rough; transparency, 1½ fathoms.
					Thornback ray,	1	16	1	14½	...	...		
					Plaice,	31	15½	17	13½	20	10½		
					"	2	8	...	...	...	...		
	E. 51·2	42·1	41·0 13 fath.		Common dabs,	2	13	2	10	8	9		
					" "	15	8½	10	6½	6	5½		
					Long rough dabs,	1	11	...	...	...	...		
					Flounders,	3	13	6	9½	7	7½		
					Common gurnards,	4	15½	3	11	...	...		
Station IV. 19th April 12.10 p.m. to 2.20 p.m.	E. 48·8	43·0	41·1 9 faths.		Thornback ray,	1	19½	...	...	...	...		At beginning—Wind W., force 6; overcast; sea, rough; transparency, 1½ fathoms; bar., 29·84; At finish — As above; bar., 29·84.
					Plaice,	64	14	76	12	63	11		
					"	34	10	18	9	9	6½		
					Common dabs,	1	11	3	9	...	...		
	W. 51·8	42·5	41·8 6 faths.		Flounders,	2	11½	3	9	5	7½		
					Common gurnards,	1	13½	1	11	1	15		
Station V. 19th April 9.30 a.m. to 11.30 a.m.	S. 49·0	42·2	41·1 12 faths.		Starry ray,	1	13	...	...	...	...		At beginning — Wind W., force 6; cloudy; sea, rough; transparency, 2¼ fathoms; bar., 29·84. At finish—Transparency, 1½ fathoms.
					Plaice,	2	16½	3	15½	4	13½		
					"	2	12	...	...	...	...		
					Common dabs,	3	9½	2	8½	5	7½		
					" "	2	6	...	...	...	...		
	N. 48·5	43·0	41·0 12 faths.		Long rough dabs,	1	13½	2	8	1	7		
					Flounders,	1	14	2	11½	3	9		
					Haddocks,	3	12½	1	10	...	...		
					Whitings,	1	12	...	...	...	...		
					Common gurnards,	12	14½	9	11	6	9		
					" "	3	6½	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station I. 14th June 1.15 p.m. to 3.35 p.m.	W. 60·6	54·0	49·3 6 faths.	Surface-net. — *Anomalocera patersonii*, a.; *Centropages hamatus*, f.; *Temora longicornis*, r.; *Calanus finmarchicus*, f; larval Decapods, fr.; young *Balani* (Ostracod-stage), fr.; Medusids, f.; (*Beroe*, &c.); fish ova, f. Bottom-net.— Copepoda, f.; young *Crangon*, r.; Medusids, f. (*Bolina*, *Beroe*); fish ova, f.	Thornback ray,	1	23	1	21	...	...		At beginning—Wind S.W. by S., force 4; dull, but fine; sea, slight; tide, about 4½ hours flow; transparency, 4½ fathoms; bar., 29·71. At finish—Wind S.W., force 3; sea, smooth; tide, flood; transparency, 4½ fathoms.
					Plaice,	1	24	2	15	23	14		
					„	20	13	19	12	5	11		
					„	12	10	1	9	13	8		
	E. 61·0	53·0	49·0 11 faths.		„	15	7	1	6½	...	...		
					Lemon soles,	1	8¾	...	...	...	...		
					Common dabs,	3	11	6	10	23	9		
					„ „	26	8	31	7	54	6		
					„ „	3	5	...	...	...	...		
					Long rough dabs,	1	11½	1	7½	...	...		
					Common gurnards,	1	16	2	13	2	12		
					„ „	1	11	31	10	42	9		
					„ „	12	7	3	6	...	...		
Station II. 14th June 11.17 a.m. to 1.5 p.m.	E. 55·8	54·4	48·9 11 fath.	Surface-net.—*Temora longicornis*, f.; *Calanus finmarchicus*, fr.; *Anomalocera patersonii*, r.; *Centropages hamatus*, r; larval Decapods, f.; larval Schizopods, f. *Balani* (Ostracod-stage), f.; Embryogastropods, f.; Medusids, f.; fish ova, fr. Bottom-net. — Larval decapods, f.; larval Schizopods, f.; *Evadne nordmanni*, f.; Embryo lamellibranchs, f.; Medusids, com. (*Bolina*, *Geryonopsis*).	Thornback ray,	1	18	2	16	1	13		At beginning—Wind S.S.E., force 3; dull, but fine; sea, smooth; tide, about low water; transparency, 3½ fathoms; bar., 29·73. At finish — Tide nearly 2 hours flood; transparency, 4½ fathoms.
					Sandy ray,	1	3¾	...	...	...	...		
					Plaice,	2	15	5	14	13	12½		
					„	12	11½	14	10½	15	9½		
	W. 58·7	53·1	49·2 6 fath.		„	1	8½	15	7½	3	6½		
					Common dabs,	4	11	9	10	12	9		
					„ „	12	8	54	7	50	6		
					„ „	3	5	...	...	...	...		
					Flounder,	1	8½	...	...	...	...		
					Turbot,	1	20	1	14½	...	...		
					Haddocks,	2	10	1	8	...	...		
					Whitings,	1	17	3	7	...	...		
					Common Gurnards,	4	11	7	10	17	9		
					„ „	37	8	9	7	8	6		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather and other Observation.
Station III. 14th June 8.55 a.m. to 10.55 p.m.	W. 59·4	54·0	49·5 4½ faths.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, com.; *Dias longiremis*, f.; *Centropages hamatus*, f.; *Anomalocera patersonii*, f.; larval Decapods (*Crangon* and Brachyurids); embryo Gastropods, fish ova, fr.; Bottom-net.—*Temora longicornis*, f.; *Calanus finmarchicus*, f.; larval Decapods, f.; *Balani* (Ostracod-stage), f.; Medusids, com.; fish ova, f.	Plaice,	2	15	5	13	9	12		At beginning—Wind W.S.W., force 2; fine, a little hazy; sea, smooth; tide, about 4 hours ebb; transparency, 4¼ fathoms; bar., 29·74. At finish—Wind S.S.E., force 2–3; tide, near low water; transparency, 4¼ fathoms.
					,,	11	11	60	10	26	8½		
					,,	10	7½	2	6	...	...		
					Common dabs,	1	14	1	13	1	11		
	E. 57·0	54·2	48·2 11 faths.		,, ,,	3	10	4	9	20	8		
					,, ,,	35	7	17	6	8	5½		
					Common gurnards,	1	13	2	12	3	11		
					,, ,,	1	10	10	9	11	8		
					,, ,,	4	7	2	6½	...	...		
					Father-lasher,	1	8	...	...	...	...		
Station IV. 13th June 5.5 p.m. to 7.10 p.m.	E. 57·0	54·2	49·4 6 faths.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; larval Decapods, f.; Medusids, f.; (*Pleurobrachia*, *Bolina*, *Aurelia*). Bottom-net.—*Calanus finmarchicus*, f *Temora longicornis*, f.; larval Decapods, fr.; *Balani*, f. (Ostracod-stage); Embryo Gastropods, r.; Medusids, com.; fish ova, f.	Grey skate,	1	13	...	...	...	...		At beginning—Wind. S.S.E., force 3–4; fine, a little hazy; sea, slight; tide, about 2½ hours ebb; transparency, 4½ fathoms; bar., 29·66. At finish—Wind S.W., force 5; tide, fully 4½ hours ebb; transparency, 4½ fathoms.
					Thornback ray,	1	9½	...	...	...	...		
					Plaice,	2	13	1	12	2	11		
					,,	34	10	63	9	90	8		
	W. 59·5	54·4	49·8 7 faths.		,,	55	7	24	6	...	...		
					Common dabs,		11	14	9	7	8		
					,, ,,		7	4	6	4	5		
					Flounders,		9	3	8	...	...		
					Common gurnards,	2	16	...	...	1	11		
					,, ,,	2	9½	1	7	...	...		
					Lump-sucker,	1	11	...	...	...	...		
					Butter fish,	1	7	1	4	1	3½		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air.	Temperature. Water.		Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION V. 13th June 2·25 p.m. to 4.30 p.m.	S. 56·6	53·7	50·6 13½ fath.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Anomalocera patersonii*, f.; *Evadne nordmanni*, f.; larval Decapods, f. (*Crangon* and Brachiurids); Medusids, f.; fish ova, f.; (Gurnards ?), young fish, and 5 small Lump-suckers. Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Verbius varians*; *Balani*, f. (Copepod and Nauplius stages); larval Decapods, f. (*Crangon*, Schizopods, Brachiurids); Medusids, com.; *Tomopteris*, r.; fish ova, f.	Thornback ray,	1	26	1	22	...	...		At beginning—Wind S.E. by S., force 3; fine, a little hazy; sea, smooth; tide, about flood; transparency, 5 fathoms; bar., 29·72. At finish — Sea, slight; tide, 2 hours ebb; transparency, 5 fathoms.
					Plaice,	22	14	13	13	26	11		
					"	45	10	28	9	...	...		
					Lemon soles,	1	12	...	...	...	...		
					Common dabs,	1	11	3	9	15	8½		
					" "	23	6½	29	6	4	5		
	N. 57·0	51·9	46·5 14 fath.		" "	1	4	1	3	...	...		
					Long rough dabs,	1	10½	1	10	1	9		
					" "	1	8	...	...	...	...		
					Haddocks,	1	12	1	11	2	10		
					"	1	9½	1	8½	1	7½		
					Whitings,	1	12	...	...	...	...		
					Common gurnards,	3	12	9	11	19	9		
					"	9	8	34	7	35	6		
					"	3	5½	...	...	...	...		
					Dragonet,	1	8	...	...	...	...		
STATION I. 16th August 2.30 p.m. to 4.40 p.m.	W. 61·0	57·2	56·9 6 fath.	Surface-net. —Medusids, fr. (*Bolina*, *Pleurobrachia*); one or two very small *Mytilus*. Bottom-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Dias*	Thornback ray,	1	23	1	20	2	16½	*Portunus holsatus*, fr.; 1 half-grown *Cancer pagurus*; *Asterias*, sp., f.; *Alcyonium digita-*	At beginning—Wind W.N.W., force 3; overcast; sea, smooth; tide, 2½ hours flood; transparency, 3½ fathoms; bar., 29·67
					" "	1	15	1	9½	...	...		
					Plaice,	5	15½	78	13½	58	12		
					"	136	10½	74	9	27	8		
	E. 57·6	56·7	55·7 11 fath.		Common dabs,	2	11	25	10	38	9		
					" "	29	8	58	7	45	5½		
					Flounders,	2	8	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION I. 16th August 2.30 p.m. to 4.40 p.m.—*continued.*				*longiremis*; *Caligus*, sp., f.; *Evadne nordmanni*, f.; larval Decapods (*Hippolyte*, *Portunus* ?); young Amphipods, f.; *Sagittæ*, com.; small Medusids, fr.; young Annelids, r.	Long rough dabs, .	1	9	...	...	...	...	*tum*, f.; *Aurelia*, f.; *Eudendrium*, *Sertularia*, and *Membranipora*; a little sea-weed.	At finish—Wind S.E., force 3; tide, ¾ flood; transparency, 4 fathoms.
					Whitings, . .	1	12	2	7½	...	...		
					Common gurnards,	1	15	1	14	4	12½		
					" "	3	11	11	8	38	7		
					Angler, . . .	1	14	1	12	...	...		
STATION II. 16th August 6.40 a.m. to 8.40 a.m.	W. 57·6	57·0	56·8 6½ fath.	Surface-net. — *Dias longiremis*, f.; larval Decapods, f.; *Pleurobrachia*, f. Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, fr.; *Dias longiremis*, fr.; larval Decapods, fr.; *Caligus*, r.; *Evadne nordmanni*, r.; very young *Mytilus* and *Littorina*; *Pseudocuma cercaria*, 1; *Pleurobrachia*, f.; *Thaumantias*, f.; one or two very young fish (herring? gurnard ?).	Thornback ray, .	1	19	1	14	...	...	A quantity of sea-weed (mostly *Laminaria*), a.; *Asterias rubens*, f.; *Portunus holsatus*, f.; *Hyas coarctatus*, f.; *Corystes cassivelaunus*, f.; and *Echinus miliaris*, f.; *Eupagurus bernhardus*, r.; *A cyonium digitatum*, f.; *Aphrodite aculeata*; *Flustra*, *Membranipora*; *Aurelia*, and *Cyanea*.	At beginning — Wind W., force 5; a little hazy, fine; sea, moderate; tide, a little after high water; transparency, 3½ fathoms; bar., 29·71. At finish — Weather becoming cloudy; tide, nearly ½ ebb; transparency, 4 fathoms.
					Plaice, . . .	8	16	20	14	77	12		
					" . . .	157	10	111	8	20	5½		
					Lemon soles, . .	1	10	...	...	...	...		
					Common dabs, .	11	11½	10	10	49	9		
	E. 58·0	56·4	56·0 12 fath.		" " .	138	8	57	6	48	5		
					Flounders, . .	1	10	...	...	...	...		
					Common gurnards,	3	14	2	9	9	8		
					" " .	4	7	...	...	...	...		
					Angler, . . .	2	18	2	15	1	13		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
Station III. 15th August 4.44 p.m. to 6.44 p.m.	E. 61·8 W. 62·0	59·0 58·0	56·0 13 fath. 56·8 8 fath.	Surface-net. — *Dias longiremis*, f.; larval Decapods, f.; *Pleurobrachia*, &c., f. Bottom-net. — Filled with sand and ruptured.	Plaice,	1	15	1	12	3	10	*Aurelia*, com.; *Cyanea*, r.; *Asterias rubens*, f.; *Ophioglypha lacertosa*, f.; *Portunus holsatus*, f.); *Aphrodite aculeata*, 1 (large); some *Laminaria*.	At beginning—Wind W., force 4; cloudy, with some sunshine; sea, moderate; tide, near high water; transparency, 3 fathoms; bar., 29·53. At finish—Wind W.N.W., force 4; tide, fully 1 hour ebb; transparency, 3 fathoms.
					"	2	9	...	...	...	...		
					Common dabs,	2	10	2	8	1	5		
Station IV. 16th August 12.5 p.m. o 2.5 p.m.	E. 57·8 W. 60·0	57·0 57·2	56·9 6 fath. 57·1 5 fath.	Surface-net. — *Mysis flexuosa*, fr.; *Atylus bispinosus*,1; *Thaumantias*, *Geryonopsis*, *Pleurobrachia*, fr. Bottom-net. — A quantity of sand; several *Cumæ* and Amphipods, and a few *Pleurobrachia*.	Thornback ray	3	18	1	21	1	20	*Portunus holsatus*, com.; *Asterias*, sp., f.; *Loligo vulgaris*, 1 (small); *Aurelia*, fr.; *Cyanea*, fr.; a small quantity of weed, chiefly *Laminaria*.	At beginning—Wind W.S.W., force 4–5; overcast, inclining to rain; sea, moderate; tide, low water; transparency, 4½ fathoms; bar., 29·71. At finish—Wind W.N.W., force 3; tide, about 2 hours; flood; bar., 29·68; transparency, 3 fathoms.
					" "	1	15	...	...	...	...		
					Plaice,	1	24	4	11	20	10		
					"	47	9	119	7	129	6		
					"	12	5	...	...	...	...		
					Common dabs	2	11	5	9	5	8		
					" "	27	7	4	6	...	...		
					Flounders,	2	12	5	11	12	10		
					"	18	9	1	8	1	6		
					Brill,	1	13	...	...	...	...		
					Common gurnards,	4	14	17	11	14	9		
					" "	27	8	17	7	...	...		
					Angler,	1	17	1	13	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION V. 16th August 9.5 a.m. to 11.0 a.m.	S. 58·5	56·2	55·9 12 fath.	Surface-net.—Larval Decapods, r.; very young Gastropods, r.; *Pleurobrachia*, f.; *Bolina*, f. Bottom-net.—*Temora longicornis*, f.; *Dias longiremis*, f.; larval Decapods, f. (*Crangon*); very young starfishes, fr.; larval Ascidians, f.; very young *Mytilus*, f.; *Tomopteris*, 6; *Pleurobrachia*, *Thaumantia*, *Beröe*; 1 very young *Motella mustela*.	Thornback ray,	1	21	1	18	1	16	A large quantity of seaweed; *Asterias*, sp., f.; *Portunus holsatus*, f.; *Aphrodite aculeata*, 1; *Eupagurus*, sp., f.; *Hyas coarctatus*, f.; *Corystes cassivelaunus*, f.; *Alcyonium digitatum*, f.; *Eudendrium*, *Tubularia*, *Membranipora*.	At beginning—Wind W., force 3–4; becoming overcast; sea, moderate; tide, about half ebb; transparency, 4½ fathoms; bar., 29·72. At finish—Tide, 5 hours ebb; transparency, 4½ fathoms.
					Plaice	8	15	16	14	61	12		
					,,	59	10½	1	9	...	...		
					Lemon sole,	1	13	...	...	...	...		
	N. 59·5	57·0	55·9 13 fath.		Common dabs,	34	8½	144	7	62	6		
					,, ,,	20	5	...	...	...	...		
					Long rough dabs,	1	13	1	12	3	11		
					,, ,,	3	9½	4	8	...	...		
					Common gurnards,	1	15	2	13½	1	12½		
					,, ,,	6	9½	9	8	6	7		
STATION I. 11th October 1.0 p.m. to 3.0 p.m.	W. 53·0	50·9	51·0 6 fath.		Thornback ray,	1	11	...	...	...	...	*Aurelia*, f.; *Portunus holsatus*, f.; *Cancer pagurus*, r; *Solaster papposa*, f.; *Arterias*, sp., f.; *Membranipora*, f.; *Sertularia*, f.	At beginning—Wind W., force 2; moderately clear and fine; sea, smooth; tide, flood; transparency, 4 fathoms; bar., 29·41. At finish—Wind S.E., force 2; transparency, 4 fathoms.
					Plaice,	1	16½	1	15½	3	13		
					,,	7	12	9	11	38	10		
	E. 54·4	52·0	51·4 12 fath.		,,	8	9	5	8	...	...		
					Common dabs,	2	12	1	11	3	10		
	—				,, ,,	2	9	8	8	1	6		
					Common gurnards,	3	12	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station II. 11th October 10.10 a.m. to	W. 50·0	50·0	51·0 5 fath.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; larval Brachyura, f.; Infusoria (*Ceratium*) and Diatoms, fr. Bottom-net.—*Calagus*, sp., r.; *Metopa alderi*, f.; *Calanus finmarchicus*, f.; *Pleurobrachia*, fr.	Thornback ray,	1	12	...	...	...	...	*Portunus holsatus*, f.; *Cancer pagurus*, f.; *Asterias rubens*, f.; some sea-weed.	At beginning—Wind W., force 3; a little hazy, fine; sea, slight; tide, near low water; transparency, 3½ fathoms; bar., 29·37. At finish—Tide flood; transparency, 3½ fathoms.
					Plaice,	1	17½	6	15½	18	13		
					"	25	12	25	11	31	10		
					"	22	9	23	8	2	6		
	E. 52·0	51·2	51·9		Lemon soles,	1	12	...	...	...	...		
					Common dabs,	11	11	4	10	9	9		
					" "	8	8	6	7	4	6		
					" "	2	5	...	...	...	...		
					Flounders,	1	10	...	...	...	...		
					Turbot,	2	13	...	...	...	...		
					Common gurnards,	3	14	3	13	4	11		
					" "	7	11	...	...	...	...		
Station III. 11th October 8.0 a.m. to 10.0 a.m.	E. 46·0	50·9	51·5 12 fath.	Surface-net.—*Temora longicornis*, f.; *Calanus finmarchicus*, f.; larval Brachyura, f.; Infusoria, fr. Bottom-net.—*Calanus finmarchicus*, r.; *Temora longicornis*, r.; *Gammorus*, sp., r.; young *Porcellana* and larval Crustacea, r.; *Pleurobrachia*, f. Very little in Tow-nets.	Thornback ray	2	14	1	7	...	...	*Portunus holsatus*, f.; *Eupagurus*, sp., f.; *Cancer pagurus*, f.; *Asterias*, f.; some sea-weed.	At beginning—Wind W.S.W., force 2; a little hazy, fine; sea, smooth; tide, ¾ ebb; transparency, 3 fathoms; bar., 29·35. At finish—Wind W., force 3; tide, low water; transparency, 3½ fathoms.
					Plaice,	7	14½	15	13	34	12		
					"	31	11	54	10	44	8½		
					"	5	7	...	...	...	...		
	W. 48·6	50·0	51·0 4 fath.		Lemon soles,	1	13½	...	...	...	...		
					Common dabs	3	12½	10	11	13	9½		
					" "	15	8	13	7	14	6		
					Flounders,	1	9	...	...	...	...		
					Turbot,	1	15	...	...	...	...		
					Whitings,	2	5	...	...	...	...		
					Common gurnards,	6	15½	6	14	4	12		
					Angler,	1	45	1	18	1	15		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION IV. 19th October 8.0 a.m. to 9.30 a.m.	E. 49·0 W. 51·0	50·2 50·5	50·4 6 fath. 51·0 5 fath.	Surface-net.— Larval Brachyura, f.; Infusoria, f. Bottom-net. — *Mysis spiritus*, f.; young *Gastrosaccus* and other Schizopods, f.; *Pseudocuma cercaria*, f.; *Dias longiremis*, f.; *Temora longicornis*, f.; Embryo Gastropods and Lamellibranchs, f.; (*Mytilus* and *Scrobicularia*); Amphipods, f.; *Sagittæ*, f.; *Pleurobrachia*, f.	Starry ray,	1	12	...	...	...	...	A very large mass of seaweed (*Laminaria*, &c.); a few sponges, Zoophytes (*Flustra*, *Sertularia*); *Portunus holsatus*, *Eupagurus*, sp., f.; *Gammarus*, sp., f.; *Asterias*, sp., f.; *Astropecten irregularis*, and *Cucumaria nigra*, 1.	At beginning—Wind S., force 3; cloudy; sea, moderate; tide, ebb; transparency, 2½ fathoms; bar., 29·01 At finish—tide, low water; transparency, 2½ fathoms.
					Thornback ray,	1	8½	...	...	...	...		
					Plaice,	2	11	2	10	2	9		
					Common dabs,	2	11	1	8	6	5½		
					" "	2	4½	1	3	1	2½		
					Black sole,	1	17½	...	...	...	...		
					Haddocks,	1	17½	...	...	...	...		
					Cod,	1	5½	2	4	2	3½		
					Whitings,	1	12	1	8	1	6		
					"	3	5	7	4	3	3½		
					Pogge,	2	4½	...	...	...	...		
					Butter-fish,	1	4½	1	3	...	...		
					Five-bearded rockling,	1	4	1	3½	...	...		
					Diminutive lump-sucker,	1	2	...	...	...	...		
STATION V. 9th October 1.30 p.m. to 3.30 p.m.	S. 45·5 N. 49·0	52·0 51·0	52·0 13 fath. 52·0	Surface-net. — Young Brachyurids (*Megalops* stage), f.; *Sagittæ*, f.; small *Pleurobrachia*, f. Bottom-net.—Diatoms and Infusoria only.	Starry ray,	1	7	...	...	...	...	*Asterias rubens*, fr. and *A. violacea*, fr.; *Cancer pagurus*, f.; *Portunus holsatus*, f.; *Astropecten irregularis*, f.; *Pecten opercularis*, f.; several	At beginning—Wind S., force 7; dull, showery; sea, rough; tide, near high water; transparency, 4 fathoms; bar., 28·68. At finish—Tide, ebb; transparency, 3½ fathoms.
					Thornback ray,	1	4	...	...	...	...		
					Plaice,	6	14	17	12	23	11		
					"	12	10	7	9	...	...		
					Lemon soles,	1	8	...	...	...	...		
					Common dabs,	5	11	5	10	21	9		
					" "	53	8	55	7	24	6		
					" "	17	5	...	...	...	...		
					Long rough dabs,	2	9½	1	7	...	...		
					Haddocks,	1	15	1	12	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
Station V. 9th October 1.30 p.m. to 3.30 p.m.—*continued.*					Whitings,	1	12	...	...	...	...	Zoophytes (*Thuiaria*, *Antennularia*, and *Sertularia*); a small quantity of *Laminaria*.	
					Common gurnards,	1	17	2	14	4	13		
					,, ,,	3	11	...	...	...	...		
					Angler,	1	15	1	13	...	...		
Station I. 14th Nov. 10.8 a.m. to noon.	W. 44·8	48·1	49·6 5 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; *Metopa alderi*, fr.; *Atylus bispinosus*, fr.; larval Decapods, fr.; *Tomopteris*, fr.; Infusoria, a. Bottom-net. — *Metopa alderi*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus*, sp., f.; small Medusids, f.	Starry ray,	1	5½	...	...	...	...	Very few organisms—*Portunus holsatus*, f.; 1 *Aurelia*, f.; sea-weed (*Chorda*).	At beginning—Wind W., force 2; very misty; sea, smooth; swell from S.E.; tide, fully ½ ebb.; transparency, 4¼ fathoms; bar., 29·93. At finish—Tide, near low water; transparency, 4½ fathoms.
					Plaice,	1	18	11	14½	42	13		
					,,	49	11	32	10	13	9		
					Common dabs,	1	13½	1	11	10	10		
	E. 47·0	48·5	49·8 10½ fath.		,, ,,	8	9	6	8	1	6½		
					Long rough dabs,	1	11	...	...	...	...		
					Common gurnards,	3	14½	4	13	7	12		
					,, ,,	1	11	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY.—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic, Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.								Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.													
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.		
STATION II. 14th Nov. 8.15 a.m. to 10.0 a.m.	E. 45·5 W. 44·8	48·1 48·1	48·3 11 fath. 49·6 5 fath.	Surface-net. — *Dias longiremis*, fr.; *Temora longicornis*, fr.; *Metopa alderi*, fr.; *Atylus bispinosus*, fr.; larval Decapods, f.; *Tomopteris*, f.; Infusoria, a. Bottom-net.—*Gastrosaccus spinifer*, fr.; *Macropsis slabberi*, f.; *Mysis*, sp., f.; *Calanus*, f.; *Caligus*, sp., f.; *Sagittæ*, fr.; *Pleurobrachia*, fr.	Plaice, . . . ,, . . . Common dabs, ,, ,, Whitings, . . Common gurnards,	1 11 1 1 1 1	17½ 13 12 6 5 14	3 26 2 5 3 1	16 11 10 5 4 9	4 21 2	15 9 9	3 2 1	14 7 7	Only a small quantity of sea-weed and a few *Portunus holsatus.*	At beginning—Wind W.; force 2; very misty; sea, smooth; tide, about 2 hours ebb; transparency, 4½ fathoms; bar., 29·92. At finish—Tide, nearly 4 hours ebb; transparency, 4½ fathoms.
STATION III. 14th Nov. 6.12 a.m. to 9.50 a.m.	W. 44·0 E. 46·0	48·2 48·1	49·4 5½ fath. 48·5 11 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, com.; *Caligus*, f.; Amphipods, f. Bottom-net.—*Gastrosaccus spinifer*, f.; *Macropsis slabberi*, f.; *Mysis*, sp., f.; *Metopa alderi*, f.; *Calanus*, f.; *Caligus*, sp., f.; *Sagittæ*, *Pleurobrachia*, f.	Plaice, . . . ,, . . . ,, . . . Common dabs, Flounders, . Whitings, . . Common gurnards,	1 7 3 1 1 1 3	16 12 8 11 12½ 8 14	2 7 2 1 1 5 1	15 11 7 10 11 5½ 13	2 20 3 2 1	14 10 6 6 12	3 19 ... 2 2	13 9 ... 5 10	A very few *Portunus holsatus* and *Asterias*, and some sea-weed (*Laminaria* and *Ulvæ*).	At beginning—Wind W., force 2; hazy, fine; sea, smooth; tide, about high water; bar., 29·95. At finish—Tide, about 2 hours ebb; transparency, 4 fathoms.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—II. ST ANDREWS BAY—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.								Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.													
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.	No.	Ins.		
STATION IV. 13th Nov. 3.5 p.m. to 5.55 p.m.	E. 47·0 W. 43·5	48·8 48·5	49·4 8 fath. 49·3 3½ fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, a.; Infusoria, a. Bottom-net.—*Metopa alderi*, f.; *Hyperia galba*, f.; *Calanus*, f.; *Temora*, f.; *Sagittæ*, f.; small Medusids, f.	Plaice,	3	14½	11	13	145	11	107	9½	A few *Portunus holsatus* and *Asterias rubens*, and a quantity of *Laminaria*.	At beginning—Wind S.E., force 2; moderately clear; sea, smooth; tide, flood; transparency, 4 fathoms; bar., 29·98. At finish—Wind N.N.W., force, 2; very misty; tide, about ¾ flood.
					"	228	8	66	6½	6	4½	...	...		
					Common dabs,	2	10	1	8	2	6½	3	5½		
					Flounders,	1	15	1	12½	2	11½	5	10½		
					"	2	9½	1	8½	1	6½	...	...		
					Common gurnards,	2	3	1	15	...	...	...	...		
STATION V. 18th Nov. 12.55 p.m. to 2.55 p.m.	S. 48·3 N. 47·0	49·0 48·9	50·1 11 fath. 49·7 13 fath.	Surface-net. — *Dias longiremis*, a.; *Temora longicornis*, f.; Infusoria (*Ceratium*, &c.), a. Bottom-net.—*Caligus*, sp., f.; *Calanus*, f.; *Sagittæ*, f.; small Medusids, f.	Plaice,	1	17	1	16	2	14	5	13	One or two *Solaster papposa*; a few *Asterias*, sp.; and *Portunus*, sp.; one or two *Aphrodite*, and pieces of *Flustra*.	At beginning—Wind S.E., force 2; moderately clear; sea, smooth; tide, about low water; transparency, 4 fathoms; bar., 30·01. At finish—Tide, first of flood; transparency, 4 fathoms.
					"	2	11	1	7½	...	...	...	...		
					Common dabs,	2	12	3	11	6	10	6	8		
					" "	13	7	24	6	18	5	7	4		
					Long rough dabs,	1	9½	1	8½	...	...	...	...		
					Whitings,	1	9	1	8	8	5½	1	4		
					Common gurnards,	1	12	...	...	...	...	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—III. Montrose.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observation.
Station I. 19th June 7.27 a.m. to 9.37 p.m.	E. 52·6	50·8	49·3 17 fath.	Surface-net.—*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Anomalocera patersonii*, f.; *Evadne nordmanni*, r.; larval Decapods, f.; embryo Gastropods, f.; Ova (fish?), f.	Grey skate,	1	15	1	10	...	...		At beginning—Wind N.N.E., force 2; dull; sea, smooth; tide, flood; transparency, 3 fathoms; bar., 30·11. At finish—Wind E.N.E., force 2; tide, about 2 hours ebb; transparency, 3 fathoms.
					Thornback ray,	1	13½	1	12½	1	8		
					Plaice,	8	15	7	14	16	12		
					,,	14	11	2	10	6	8		
					,,	6	7	4	6	...	...		
					Common dabs,	1	11½	6	9½	17	8½		
					,, ,,	24	7	2	6	7	5		
					,, ,,	1	4	...	...	...	...		
	W. 53·3	50·3	50·0 7 fath.	Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, com.; young *Crangon*, r.; young Schizopods, r.; larval Ascidians, com.; Medusids, f.	Long rough dabs,	1	12½	2	10½	1	9½		
					,, ,,	1	9	1	7½	...	...		
					Turbot,	4	14½	1	15	...	...		
					Black sole,	1	10	...	...	...	...		
					Haddocks,	1	16	1	11½	...	...		
					Whitings,	1	12½	1	8½	...	...		
					Common gurnards,	1	11	5	10	13	9		
					,, ,,	16	8	12	7	1	6½		
					Angler,	1	24	1	22	1	13		
					,, ,,	1	12	...	...	...	...		
Station II. 19th June 10.35 a.m. to 11.5	W. 54·2	51·0	51·0 5 fath.	Surface-net. — *Temora longicornis*, com.; *Calanus finmarchicus*, f.; larval Decapods, fr.; *Balanus* (Ostracod-stage), f.; *Bolina*, f.; fish ova, fr.	Plaice,	3	15	2	13	2	12		At beginning—Wind E.N.E., force 3; moderately clear; sea, smooth; tide, about 3½ hours ebb; transparency, 2 fathoms; bar., 30·11. At finish—Tide, about 5 hours ebb; transparency, 3 fathoms.
					,,	7	11	14	10	5	8½		
					Common dabs,	1	9	1	8½	5	7		
					,, ,,	3	6	...	...	...	...		
					Long rough dabs,	1	12	2	9	...	...		
	E. 55·0	51·0	49·4 14 fath.	Bottom-net. — *Temora longicornis*, f.; *Calanus finmarchicus*, com.; *Centropages hamatus*, r.; larval Decapods, fr.; *Sagittæ*, fr.; Medusids, f.; embryo Gastropods, f.; fish ova, f.	Haddocks,	8	13	2	11	1	7½		
					Whitings,	1	10	...	...	...	...		
					Common gurnards,	2	17	2	15	1	14		
					,, ,,	2	12	1	11	11	10		
					,, ,,	7	9	35	8	30	7		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—III. Montrose—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station I. 18th Sept. 7.30 a.m. to 9.45 p.m.	54·0	55·0	54·5 18 fath.	Bottom-net.—*Metopa alderi*, r.; *Caligus*, sp., r.; *Porcellana*, (juv.), r.; *Sagittæ*, f.; *Tomopteris*, f.; small Medusids, f.; herring fry, f.	Gray skate,	1	10½	...	...	...	...		At beginning—Wind S.W., force 7; cloudy; sea, very rough; transparency, 5 fathoms; tide, flood; bar., 29·92. At finish—Transparency, 4 fathoms; tide, about high water.
					Plaice,	1	26	6	14½	14	10½		
					,,	22	6½	...	...	...	...		
	56·0	55·0	55·0 7 fath.		Common dabs,	18	10½	51	8½	69	7		
					,, ,,	45	5	...	...	...	...		
					Long rough dabs,	1	12	1	7	...	...		
					Turbot,	1	17	...	...	...	...		
					Haddocks,	1	14½	1	13	...	...		
					Whitings,	1	9½	1	8½	2	7½		
					Common gurnards,	1	16	2	11	...	...		
Station II. 18th Sept. 11.30 a.m. to 12.40 p.m.	W. 57·0	55·1	55·3 5 fath.		Thornback ray,	1	12	...	...	...	...		At beginning—Wind S.W., force 8; cloudy; sea, very rough; transparency, 3 fathoms; tide, ebb; bar., 29·86. At finish—Transparency, 4 fathoms; tide, ½ ebb.
					Plaice,	1	18	7	15	24	11		
					,,	15	10	23	8	6	6		
	E. 57·4	55·2	55·6 14 fath.		Common dabs,	22	9	105	8	57	6½		
					,, ,,	38	5	...	...	...	...		
					Turbot,	1	18	...	...	...	...		
					Whitings,	2	10	2	8½	3	7½		
					Common gurnards,	1	15½	2	14½	10	12		
					,, ,,	2	7	1	5	...	...		
					Angler,	1	14½	1	11½	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—IV. ABERDEEN.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION I. 22nd June 8.0 a.m. to 9.25 a.m.	N. 55·4	52·0	51·4 13 fath.	Surface-net.—*Calanus, finmarchicus,* com.; *Pseudocalanus elongatus,* com.; *Temora longicornis,* fr.; *Hyperia galba,* f.; larval Decapods, f.; Medusids, f.; Gurnard (?) ova, f.; young Lumpsucker, 1; young Plaice, 1.	Plaice, . . .	1	18	1	15½	1	14½		At beginning — Wind N., force 4; clear, fine; sea, slight; tide about 5 hours flood; transparency, 3 fathoms; bar., 30·01. At finish—Wind N.N.E., force 4; tide, full flood; transparency, 2 fathoms.
					,, . . .	1	13½	8	11½	4	10		
					,, . . .	5	9	1	7½	2	6		
					Common dabs, .	1	13½	1	10	3	9		
					,, ,, .	3	8	5	7	3	5½		
					Haddocks, . .	1	12½	3	10½	1	8¾		
					,, . .	1	7	...	...	...	...		
					Whitings, . .	1	11	1	8⅛	1	6½		
					Common gurnards,	1	12	3	11	2	10		
					,, ,,	41	9	14	8	14	7		
	S. 60·6	52·2	52·1 6 fath.	Bottom-net.—*Calanus finmarchicus,* com.; *Dias longiremis,* com.; *Centropages,* sp., com.; *Temora longicornis,* fr.; *Boreophausia raschii,* r.; *Atelecyclus septemdentatus,* r.; young Caridæ, Schizopoda, and Cumacea, fr.; larval Decapods, f.; *Sagittæ,* f.; Medusids, r.; fish ova, f.	,, ,,	6	6½	...	...	...	...		
STATION II. 21st June 3.35 p.m. to 4.25 p.m.	W. 54·8	53·0	52·8 4 fath.	Surface-net.—*Calanus finmarchicus,* a.; *Hyperia galba,* f.; *Idotea emarginata,* 1; larval Decapods, f.; *Bolina,* f.; *Pleurobrachia,* f.; Gurnard ova, f.; one very young Gurnard.	Plaice, . . .	1	16	1	14½	1	13½		At beginning—Wind E. by S., force 2; cloudy, fine; sea, smooth; tide, nearly 2 hours flood;
					,, . . .	1	10½	...	...	...	...		
					Common dabs, .	1	11	1	6	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—IV. Aberdeen—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION II. 21st June 3.35 p.m. to 4.25 p.m.—*continued.*	E. 54·9	54·2	51·0 16 fath.	Bottom-net.—*Calanus finmarchicus*, a.; *Caligus*, sp., r.; *Hyperia galba*, r.; young *Boreophausia*, fr.; young Caridæ, fr.; larval Decapods, r.; young Starfish, r; *Sagittæ*, r.; *Bolina*, f.; fish ova, fr.									transparency, 2½ fathoms; bar., 30·02. At finish—Becoming hazy; tide, 2½ hours flood; transparency, 2¾ fathoms.
STATION III. 21st June 8.55 a.m. to 10.45 a.m.	W. 56·0	52·0	51·9 7 fath.	Surface-net.—*Calanus finmarchicus*, com.; *Dias longiremis*, f.; *Anomalocera patersonii*, f.; larval Decapods, fr.; *Balanus* (Ostracod-stage), f.; *Sagittæ*, com.; *Aurelia aurita*, 2; young Lumpsucker, 1; fish ova, com.	Grey skate,	1	14	...	...	...	...		At beginning—Wind N.E., force 2; a little hazy, but fine; sea, smooth; tide, 1 hour ebb; transparency, 3 fathoms; bar., 30·06. At finish—Tide, about ½ ebb; bar., 30·04; transparency, 4½ fathoms.
					Thornback ray,	1	23	...	...	...	...		
					Plaice,	7	15½	6	14½	6	13½		
					„	10	12½	8	11	4	10		
					„	3	9	1	7	1	6		
					Common dabs,	2	8	1	9	5	7		
					„ „	14	6½	6	5½	...	...		
					Long rough dabs,	2	10	3	8½	3	7½		
					„ „	1	7	...	...	...	...		
					Witch soles,	1	19	1	18	...	...		
	E. 54·1	51·6	51·0 15 fath.	Bottom-net.—Copepods, a. (chiefly *Calanus*); Amphipods, r.; larval Decapods, f.; embryo Gastropods, f.; *Sagittæ*, com.; *Bolina*, f.	Haddocks,	1	14½	3	13	1	12		
					„	3	11	1	10	1	7½		
					Whitings,	2	12	1	11	2	9½		
					Hake,	1	46	...	...	...	...		
					Common gurnards,	4	11	4	10	15	8½		
					„ „	5	7½	6	7	1	6½		
STATION IV. 21st June 11.5 a.m. to 12.30 p.m.	S. 54·0	52·0	51·5 8 fath.	Surface-net.—Copepods, r.; young Decapods and Schizopods, f.; *Sagittæ*, f.; Medusids, f.	Thornback ray,	1	15	...	...	...	...		At beginning—Wind N.E. by N., force 2; moderately clear, fine; sea, smooth; tide, ½ ebb;
					Plaice,	1	17	9	15	4	14		
					„	3	13	3	12	3	10½		
					„	2	9½	1	8	1	7		
					Common dabs,	1	12	2	10½	4	8		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—IV. Aberdeen—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station IV. 21st June 11.5 a.m. to 12.30 p.m. —*continued.*	N. 53·6	52·1	51·4 9½ fath.	Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, f.; *Dias longiremis*, f.; *Centropages hamatus*, f.; young Schizopods, f.; young Cumæ, f.; *Balanus* (Copepod-stage), fr.; embryo Gastropods, fr.; Diatoms, several attached to the shells of young *Balanus*; fish ova, fr.	Common dabs,	8	7	15	6	3	5½		transparency, 3 fathoms; bar., 30·04. At finish—Wind E.N.E., force 4; sea, slight; tide, about 4½ hours ebb; transparency, 3 fathoms.
					,, ,,	2	4	...	...	...	...		
					Long rough dabs,	1	7½	...	...	...	...		
					Haddocks,	1	24	1	16	1	15		
					,,	1	13	3	11	1	9		
					,,	2	7½	...	...	...	...		
					Whitings,	1	12	1	11	1	10		
					,,	2	9½	3	7	...	...		
					Common gurnards,	2	11	16	10	16	9		
					,, ,,	11	8	35	7	9	6		
Station V. 21st June 12.42 p.m.	S. 55·6	53·9	52·6 5 fath.	Surface-net. — Copepoda, f.; Gurnard ova, f.	Plaice,	12	15	1	16	10	13		At beginning—Wind E.N.E., force 4; moderately clear; sea, slight; tide, nearly 5 hours ebb; transparency, 2 fathoms; bar., 30·03. At finish—Tide a little after ebb; transparency, 2 fathoms.
					,,	3	12	2	11	7	10		
					,,	4	9	8	8	...	...		
to 2.22 p.m.	N. 53·8	53·0	51·8 8 fath.	Bottom-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, com.; *Dias longiremis*, com.; *Alteutha*, sp.; larval Decapods, f.; larval Schizopods, f.; larval Cumæ, f.; Amphipods, f.; young *Idotea*, r.; young Brittle-starfish, f.; *Sagittæ*, f.; Medusids, r.; young Lumpsuckers, f.; fish ova, r.	Common dabs,	3	11	32	9½	51	8		
					,, ,,	61	7	59	6	7	5		
					Flounders,	1	10¾	1	9¼	...	...		
					Turbot,	1	24	1	22	1	17½		
					,,	1	15½	...	...	...	...		
					Haddocks,	1	18	...	...	...	...		
					Common gurnards,	1	13	1	11	4	10		
					,, ,,	23	9	25	8	4	7		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—IV. ABERDEEN—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION VI. 20th June 2.10 p.m. to 4.5 p.m.	N. 55·4	51·6	49·6 13 fath.	Surface-net. — Copepods, a.; (*Calanus* mostly, *Anomalocera*, very few); *Hyperia galba*, r.); larval Decapods, fr., *Sagittæ*, f.; Gurnard ova, f.	Grey skate,	1	18	...	...	...	...		At beginning—Wind, N.E., force 3; moderately clear; sea, moderate; tide, fully 1 hour flood; transparency, $4\frac{1}{2}$ fathoms; bar., 30·10. At finish—Tide, 3 hours flood; transparency, $4\frac{1}{2}$ fathoms.
					Sandy ray,	1	$11\frac{3}{8}$	...	...	...	...		
					Plaice,	2	$17\frac{1}{2}$	2	16	8	15		
					,,	8	$13\frac{1}{2}$	2	13	3	$11\frac{1}{2}$		
					Common dabs,	2	$9\frac{3}{4}$	2	$7\frac{1}{2}$	2	$5\frac{3}{4}$		
					Sail fluke,	1	18	...	...	...	...		
					Haddocks,	1	11	1	$14\frac{1}{2}$	...	...		
	S. 55·7	51·2	50·2 18 fath.	Bottom-net. — Copepods, f.; (*Calanus* chiefly), *Hyperia galba*, f.; *Bolina*, f.	Common gurnards,	1	11	3	10	9	9		
					,, ,,	9	8	5	7	...	...		
					Angler,	1	27	...	...	...	...		
STATION VII. 20th June 11.45 a.m. to 1.55 p.m.	E. 54·7	51·4	50·9 27 fath.	Surface-net.—*Calanus finmarchicus*, com.; *Dias longiremis*, f.; *Harpacticus chelifer*, r.; *Amathilla sabina*, r.; *Idotea marginata*, r.; larval Decapods, f.; *Sagittæ*, a.; Medusids, f.; fish ova, f.; young *Gadus*, sp., r.	Plaice,	1	$23\frac{1}{2}$	1	18	4	$16\frac{1}{2}$		At beginning—Wind N.E., force 3; cloudy, but fine; sea, moderate; tide, 5 hours ebb; transparency, $4\frac{1}{2}$ fathoms; bar., 30·10. At finish—Tide, fully 1 hour flood; transparency, $4\frac{1}{2}$ fathoms.
					,,	9	15	8	$13\frac{1}{2}$	2	$12\frac{1}{2}$		
					,,	1	11	1	$8\frac{1}{2}$	...	...		
					Lemon sole,	1	$12\frac{3}{4}$	...	...	...	...		
					Common dabs,	2	$8\frac{1}{2}$	2	$7\frac{1}{2}$	4	$6\frac{1}{2}$		
					,, ,,	2	6	1	$5\frac{1}{2}$	...	...		
					Haddocks,	2	18	1	$12\frac{3}{4}$	1	11		
					Cod,	1	$16\frac{1}{2}$	...	...	...	...		
					Whitings,	5	$12\frac{1}{2}$	5	$11\frac{1}{2}$	4	$10\frac{1}{2}$		
					,,	1	19	...	...	...	...		
	W. 55·4	51·6	49·8 22 fath.	Bottom-net. — Copepods, a. (*Calanus* mostly); Amphipods, fr.; Decapods, f.; (*Hippolyte*) Schizopods, f.; (*Mysis*); *Sagittæ*, a.; young round fish, r.	Common gurnards,	1	$13\frac{1}{2}$	4	11	11	10		
					,, ,,	13	9	5	8	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—IV. ABERDEEN—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION I. 21st Sept. 10.30 a.m. to 12.35 p.m.	N. 48·0	53·6	54·1 9 fath.		Plaice,	14	15	15	13	9	10		At beginning—Wind N.W., force 8; clouds and sunshine; sea, moderate (inshore); transparency, 4½ fathoms; tide, flood; bar., 29·34. At finish—Transparency, 4½ fathoms; tide, ebb.
					,,	4	9	...	..	...	...		
					Common dabs,	11	10	15	8	5	5½		
					Whitings,	2	12	4	9	8	7		
	S. 49·2	53·8	54·0 8 fath.		,,	2	5	...	...	...	...		
					Common gurnards,	3	12	4	10	...	...		
					Angler,	1	18	...	...	...	...		
STATION II. 21st Sept. 9.0 a.m. to 10.20 a.m.	E. 46·2	54·2	54·4 18 fath.		Plaice,	5	15	7	13	1	10		At beginning—Wind N.W., force 8; clouds and sunshine; sea, rough; transparency, 6 fathoms; tide, flood; bar., 29·36. At finish—transparency, 4 fathoms.
					Common dabs,	1	9½	17	8½	9	7		
					,, ,,	15	6	22	5	...	...		
					Long rough dabs,	1	12	8	9½	5	8½		
	W. 48.0	53·6	54·0 7 fath.		Turbot,	2	18	...	...	...	...		
					Haddocks,	1	16	3	14	1	11		
					,,	1	9½	...	...	...	...		
					Whitings,	2	8½	...	...	...	...		
					Common gurnards,	9	10½	8	9½	1	7		
STATION III. 24th Sept. 11.30 a.m. to 1.15 p.m.	N. 48·0	51·1	52·6 16 fath.		Plaice,	6	16½	19	14½	22	12		At beginning—Wind, N.W., force 6; clouds and sunshine; sea, moderate; transparency, 2½ fathoms;
					,,	13	10	12	8	2	6		
					Common dabs,	2	12	1	10	20	9		
					,, ,,	18	7½	36	6	8	5		
					Long rough dabs,	5	9½	3	8½	...	...		
					Flounders,	1	11	5	9½	5	7		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—IV. ABERDEEN—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION III. 24th Sept. 11.30 a.m. to 1.15 p.m.—*continued.*					Haddocks,	6	18	19	15	31	13		tide, flood; bar., 29·60. At finish—Cloudy and squally; transparency, 3 fathoms.
					"	12	11	1	8½	...	...		
					Cod,	1	11	...	...	...	...		
					Whitings,	1	15	47	13	19	10		
					"	12	8	1	4	...	...		
					Common gurnards,	2	13	15	10	4	8		
					" "	2	6	...	...	...	...		
STATION IV. 24th Sept. 9.15 a.m. to 11.15 a.m.	N. 45·2	48·2	52·8 12 fath.		Plaice,	7	17	9	15	28	10		At beginning —Wind N.W., force 5; clear weather; sea, moderate; transparency, 3 fathoms; tide, flood; bar., 29·60. At finish—Transparency, 2 fathoms.
					"	71	9	48	7	7	5		
					Common dabs,	1	14	4	9	28	8		
					" "	8	6½	13	5	...	...		
	S. 48·0		7 fath.		Flounders,	5	10	29	9	28	8		
					"	10	7	...	...	...	...		
					Haddocks,	1	17	6	16	16	13		
					Whitings,	1	18	6	15½	28	12		
					"	15	10	24	8	4	7		
					Cod,	1	11	...	...	...	...		
STATION V. 9th Sept. 12.10 p.m. to 2.20 p.m.	S 49·0	54·3	54·5 7½ fath.		Plaice,	1	20	1	17	7	16		At beginning—Wind N.W., force 6 to 7; cloudy; sea, moderate; transparency, 4 fathoms; tide, ebb; bar., 29·28. At finish—Transparency, 4 fathoms.
					"	4	14	15	12	11	10		
					"	14	9	2	7	...	...		
					Common dabs,	2	12	6	10	35	8½		
	N 49·0	54·4	54·6		" "	47	7	43	5½	12	4½		
					Flounders,	5	9	...	...	...	...		
					Turbot,	1	24	1	22	1	21		
					"	1	20	1	16	...	...		
					Common gurnards,	1	9	...	...	...	...		
					Angler,	1	37	1	34	1	17		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—IV. ABERDEEN—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather and other Observations.
STATION VI. 20th Sept. 9.30 a.m. to 11.40 a.m.	S. 47·0	54·5	54·6 17 fath.		Thornback ray,	1	8	...	...	...	...		At beginning—Wind N.W., force 7 to 8; cloudy; sea, rough; transparency, 6 fathoms; tide, high water; bar., 29·28. At finish—Transparency 6 fathoms; tide, ebb.
					Plaice,	4	16	1	12	...	...		
					Common dabs,	1	11	6	10	12	8½		
					” ”	6	7	26	6	16	5		
	N. 49·0	54·5	54·6 14 fath.		Long rough dabs,	4	9	2	8	...	...		
					Turbot,	1	18	...	...	...	...		
					Haddock,	1	11	...	...	...	...		
					Whiting,	1	8	...	...	...	...		
					Gurnards,	3	11	10	9	1	6		
STATION VII. 9th Sept. 10.0 a.m. to 12.30 p.m.	57·6	55·0	54·8 30 fath.		Thornback ray,	1	12	...	...	...	...		At beginning—Wind S.W., force 6; cloudy; sea, rough; transparency, 7 fathoms; tide, ebb; bar., 29·30. At finish—Wind W.N.W., 7; cloudy and squalls; transparency, 6 fathoms.
					Plaice,	1	18	10	15½	19	12		
					”	13	10	18	8½	...	...		
					Common dabs,	3	10½	36	9½	42	7½		
	53·4	55·0	54·8 28 fath.		” ”	52	5½	5	4½	...	...		
					Long rough dabs,	2	11	4	8	3	6		
					Flounders,	1	8½	...	..	...	...		
					Turbot,	2	20	1	1	...	..		
					Haddocks,	1	14	1	12	1	10		
					Whitings,	1	15	1	12	2	9		
					Common gurnards,	2	13½	2	12	11	9½		
					” ”	3	8½	...	...	...	...		
					Angler,	1	42	1	13	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—V. Moray Firth.

Station, Date, and Time Trawl down.	Temperature: Air. Dry Bulb.	Temperature: Water. Surface.	Temperature: Water. Bottom.	Pelagic, Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station I. 26th June 1.25 p.m. to 3.25 p.m.	W. 59·0	59·8	55·0 10 fath.	Surface-net.—*Calanus finmarchicus*, a.; larval Schizopods and Decapods, f.; *Hyperia galba*, r.; *Bolina*, *Beröe*, f.; one very young *Motella*, sp.; ova, f.; some Gurnard ova.	Thornback ray,	1	22	...	...	...	...		At beginning—Wind E., force 3; a little hazy, fine; sea, smooth; tide, about 3 hours ebb; transparency, 4 fathoms; bar., 29·89. At finish—Tide, about 5 hours ebb; transparency, 5¼ fathoms.
					Plaice,	1	24	1	22	4	20		
					,,	4	18½	5	17½	6	16½		
					,,	5	15½	5	13½	2	11½		
					,,	1	10	1	8	1	6		
					Common dabs,	1	12	2	11	2	9		
					,, ,,	3	8	2	7½	3	6½		
					,, ,,	1	5	...	...	...	...		
		58·0	56·8 8 fath.	Bottom-net. — Copepoda, a., (*Calanus*, chiefly); young Schizopods and Carida, a.; *Hyperia galba*, f.; Medusids, a.; small Anemones (?), com. (apparently associating with the Medusids); fish ova, f.	Turbot,	1	17½	...	...	...	...		
					Haddocks,	2	21	1	18	2	17		
					,,	2	16	5	14	1	13		
					,,	2	12	...	...	...	...		
					Common gurnards,	1	14	1	13	3	11		
					,, ,,	5	10	7	8½	4	7		
					,, ,,	1	6½	...	...	...	...		
					Angler,	1	48	...	...	...	...		
Station II. 26th June 10.10 a.m. to 12.40 p.m.	W. 65·0	58·8	56·8 8 fath.	Surface-net. — Copepoda, a good many (chiefly Calanus, very few *Anomalocera*, and one *Thalestris*, sp.); larval Decapods, f.; one *Boreophausia* (young); *Hyperia galba*, f.; *Idotea*, sp., one; Medusids, fr.; young Gadidæ (Lythe ?), nine or ten; ova, f.	Sandy ray,	1	15	...	...	...	...		At beginning—Wind E., force 1; a little hazy, fine; sea, smooth; tide, about 5 hours flood; transparency, 4 fathoms; bar., 29·93. At finish—Wind E., force 3; sea, smooth; tide, fully 1 hour ebb; transparency, 4 fathoms.
					Plaice,	1	24	6	21	1	18		
					,,	4	16½	4	15	5	13		
					,,	2	12	14	10	8	9		
					,,	7	7	3	6¼	1	5		
					Common dabs,	2	10	2	9	2	8		
					,, ,,	9	7	15	6	6	5		
					,, ,,	1	4	1	2¼	...	...		
					Haddocks,	1	19	1	17½	5	16		
					,,	4	15	5	14	3	13		
					,,	2	11	2	9	...	...		
					Cod,	1	12	1	10½	...	...		

TABLE C.—Record of Observations made on Board the 'Garland' during 1889.—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Oyservations.
STATION II. 26th June 10.10 a.m. to 12.40 p.m.—*continued.*	E. 65·0	60·0	49·0 13 fath.	Bottom-net.—*Calanus finmarchicus*, fr.; *Hyperia galba*, fr.; small Medusids, a.; small Anemones (?), com. (apparently associating with the Medusids).	Lythe,	1	28	...	...	...	...		
					Common gurnards,	1	12½	1	10½	2	9		
					,, ,,	2	8	1	7	3	6½		
STATION III. 1st July 9.55 a.m. to 11.25 a.m.	E. 58·9	57·8	55·7 11 fath.	Surface-net. — Copepods, f.; larval Decapods and *Caprella*, sp., f.; *Sarsia*, com.; *Pleurobrachia*, com.; with Anemone associates.	Thornback ray,	1	23	1	21	...	...	A quantity of sea-weed (*Laminaria*, &c.); a few Zoophytes (*Antennarai*); *Strongylocentrotus drohachiensis*, fr.; and *Echinus esculentus*, fr.; *Portunus holsatus*, fr.; several clusters of *Mytilus modiolus*.	At beginning—Wind W.S.W., force 4; cloudy, fair; sea, moderate; tide, about ½ flood; transparency, 3 fathoms; bar., 30·26. At finish—Tide, fully 4 hours flood; transparency, 2¾ fathoms.
					Plaice,	1	23	1	21	1	17		
					,,	11	14	25	13	49	12		
					,,	35	10	12	9	1	7½		
					Lemon soles,	3	13	2	12	1	10½		
					,, ,,	1	11½	2	9	1	7½		
	W. 60·3	58·7	57·4 7 fath.	Bottom-net. — Copepods, f. (*Dias*); embryo Lamellibranchs and Gastropods, f.; young *Gammarus*, sp., f.; *Caprella*, sp., r.; *Paradoxostoma*, r.; *Evadne nordmanni*; Diatoms, f.; recently hatched round fish, f.	Common dabs,	1	8½	2	6½	...	...		
					Cod,	1	10	1	9	1	8		
					Whitings,	1	7	...	...	...	...		
					Gurnards,	1	9½	1	9	...	...		
					Angler,	2	28	...	...	...	...		
STATION IV. 27th June 3.15 p.m. to 5.20 p.m.	N. 60·7	57·0	52·0 11½ fath.	Surface-net. — Copepoda, f.; (*Calanus*, *Anomalocera*, *Dias*); 1 *Aurelia*; 1 *Bolina*; 1 *Cyanea*; fish ova, f.; 1 very small fish (Gurnard?).	Plaice,	1	25	1	24	3	21		At beginning—Wind S.E., force 3; moderately clear, fine; sea, slight; tide, nearly 4 hours ebb; transparency,
					,,	2	18½	1	17	4	16		
					,,	8	14	6	13	2	12½		
					,,	3	10	1	9	3	6½		
					Lemon soles,	1	15	...	...	...	...		
					Common dabs,	1	11	2	9	4	8		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—V. MORAY FIRTH—*continued*.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION IV. 27th June 3.15 p.m. to 5.20 p.m.—*continued*.	S. 61·0	57·8	54·1 9½ fath.	Bottom-net. — Small Medusids, a.; with a few Anemones (?) associates.	Common soles,	18	7	3	6	2	4½		5½ fathoms; bar., 29·92. At finish—Tide, ebb; transparency, 4 fathoms.
					,, ,,	1	4	...	...	...	...		
					Haddocks,	1	20½	1	17	1	16		
					,,	13	13	1	12	...	...		
					Common gurnards,	1	15½	2	12	2	11		
					,, ,,	12	10	8	8	7	7		
					,, ,,	8	6	...	...	...	...		
STATION V. 27th June 12.10 p.m. to 2.25 p.m.	W. 60·8	57·2	51·9 12 fath.	Surface-net. — *Anomalocera patersonii*, f.; two small *Aurelia*; fish ova, f.	Plaice,	2	23	3	20	3	18		At beginning — Wind N.W., force 2; a little cloudy, fine; sea, smooth; tide, a little after flood; transparency, 7¼ fathoms; bar., 29·93. At finish—Wind S.E., force 3; sea, slight; transparency, 6 fathoms.
					,,	2	17	1	15	1	12		
					,,	1	8	...	...	..	...		
					Lemon soles,	1	18	1	15	1	9		
	E. 60·8	57·2	50·0 18 fath.	Bottom-net. — Medusids (small), a.; with a few small Anemones? and three young Gurnards.	Common dabs,	1	16½	4	9	9	8		
					,, ,,	11	7	6	6	2	5		
					Haddocks,	1	19	1	18	1	15		
					,,	1	13½	2	12	...	...		
					Common gurnards,	1	15	2	14	1	13		
					,, ,,	1	11	7	9	4	8		
					,, ,,	7	6½	...	...	...	...		
					Angler,	1	22	...	...	...	...		
STATION VI. 27th June. 10.0 a.m. to 1.40 a.m.	E. 55·4	56·2	52·4 18 fath.	Surface-net. — Copepoda, f.; Medusids, f.; fish ova, f.	Plaice,	1	26	1	24	2	10½	A great number of *Aurelia*.	At beginning — Wind N.W., force 3; cloudy; sea, smooth; tide, 4½ hours flood; transparency, 5 fath.; bar., 29·90. At finish—Tide, about flood; transparency, 5½ fath.
					,,	1	8	1	7½	...	...		
					Lemon soles,	1	18	1	7	...	...		
	W. 61·0	57·0	52·5 12 fath.	Bottom-net. — Small Medusids, a.; and some small Anemones.	Common dabs,	2	7½	7	6½	6	5½		
					Common gurnards,	2	18	1	16	2	15		
					,, ,,	5	14	1	13	1	12		
					,, ,,	5	10	6	9	1	8		
					,, ,,	3	7	1	6	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—VI. ORKNEY ISLANDS.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION I. 16th July 4.30 p.m. to 6.0 p.m.	E. 55·3	54·1	53·5 18 fath.	Surface-net.—*Calanus finmarchicus*, com.; *Temora longicornis*, com.; *Dias longiremis*, f.; *Centropages hamatus*, f.; *Evadne nordmanni*, f.; larval Decapods, fr., small Medusids, fr.; *Sagittæ*, f.	Thornback ray,	1	14¼	1	12	1	11	*Cucumaria nigra*, 8; *Ophiocoma nigra*, f.; *Echinus esculentus*, f.; *Pecten opercularis*, com.; several large Ascidians.	At beginning — Wind N.E., force 5; dull, inclining to rain; sea, moderate; tide, about 4½ hours ebb; transparency, 5½ fath.; bar., 29·70. At finish — Sea rough; tide, about low water; transparency, 5½ fath.
					Plaice,	1	17½	1	17	1	15½		
					,,	1	14½	1	12½	...	...		
					Lemon soles,	1	15	2	9½	1	9		
					,,	4	7	2	5½	...	...		
					Common dabs,	1	9	11	9	16	8		
					,,	18	7	1	4	...	...		
					Long rough dabs,	1	7	...	...	...	...		
	W. 54·0	54·1	52·7 21 fath.	Bottom-net. — Copepods, as at surface; larval Decapods, f.; *Evadne nordmanni*, f.; *Sagittæ*; small Medusids, com. (mostly *Pleurobrachia* and *Bolina*); very young *Gadus*, sp., f.	Haddocks,	1	15½	1	14½	1	11		
					Cod,	1	23	2	14½	1	13		
					,,	2	11	2	10	5	8		
					Common gurnards,	2	15½	2	13	1	11		
					,,	1	10	1	8½	5	8		
					Angler,	1	19½	...	...	...	...		
STATION II. 19th July. 11.23 a.m. to 12.15 p.m.	E. 53·7	53·1	52·4 18 fath.	Surface-net. — *Calanus finmarchicus*, f.; *Temora longicornis*, *Centropages*, sp., f.; *Anomalocera patersonii*, f.; *Evadne*, f.; *Bolina*, f. Bottom-net.—*Calanus*, f. *Temora*, f.; *Balani* (Copepod-stage), fr.; larval Brachyura and Carida, f.; *Pleurobrachia*, f.; *Bolina*, f.	Plaice,	1	17	1	16	1	8	*Echinus esculentus*, fr. Some sea-weed.	At beginning — Wind S.W., force 2; cloudy, but fine; sea, smooth; tide, about half flood; transparency, 5 fath.; bar., 29·60.
					Lemon soles,	1	10	...	...	...	...		
					Common dabs,	2	7	1	6½	...	...		
					Sail fluke,	1	10½	...	...	...	...		

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1889.—VI. ORKNEY ISLANDS—*continued.*

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION III. 17th July 23.20 p.m.	S. 51·0 N. 50·1	52·8 52·8	52·8 12 fath. 51·2 16 fath.	Surface-net.—*Calanus*, fr.; *Centropages*, f.; *Temora*, f.; larval Decapods, f.; *Sagittæ*, f. Bottom-net.—*Calanus*, *Temora*, *Thalestris*, sp.; *Hyperia galba*, f.; larval Decapods, f.; *Caligus*; one very small fish (young Gurnard?); fish ova, r.	Thornback ray, Plaice, " Common dabs, Haddocks, Cod, Common gurnards,	1 1 1 3 1 1 1	20½ 15 20½ 7 18½ 19 11	... 1 1 1	... 17 24 8	... 2 ... 1	... 18 ... 6	*Echinus esculentus*, a.; *Cucumaria nigra*, a.; *Porania pulvillis*, 2; *Chalina ocelata*, 1; some *Laminaria*.	At beginning—Wind N.N.E., force 6; cloudy; sea, moderate; tide, fully 1 hour ebb; transparency, 5 fath.; bar., 29·79. At finish—Tide, about 2 hours ebb; transparency, 5 fath.
STATION IV. 18th July. 12.35 p.m. to 2.30 p.m.	N. 51·3 S. 52·0	52·0 52·0	51·9 26 fath. 51·9	Surface-net. — Copepoda, f.; (*Calanus*, *Temora*, *Centropages*, and *Anomelocera*); larval Decapods, r.; 1 *Motella* (very young); fish ova, f. Bottom-net. — *Calanus*, f.; *Temora*, f.; larval Decapods, f.; larval Ascidians, f.; *Sagittæ*; Medusids, f.; *Cuma*, sp., 1; fragments of sea-weed; very young fishes (*Gadus*?).	Plaice, " Lemon soles, " " Common dabs, " Sail fluke, Haddocks, Common gurnards, Angler,	1 2 1 3 1 3 2 1 1 1 1	23 13 17½ 14 10 7½ 5 8 15 15 21	3 ... 2 3 ... 1 1 ... 1 1 ...	16 ... 16½ 13 ... 14 4½ ... 13 0 ...	4 ... 2 3 ... 3 ... ... 5 1 ...	14 ... 15 12 ... 7 ... ... 12 9½ ...	*Echinus esculentus*, fr.; *Stichaster roseus*, 1; *Cucumaria nigra*, 2; a quantity of *Laminaria*.	At beginning — Wind N., force 4; moderately clear; sea, moderate; tide, about 4 hours flood; transparency, 6 fath.; bar., 29·73. At finish — Tide, about high-water; transparency, 6 fath.

TABLE D.—ANSTRUTHER DISTRICT.—Buckhaven Haddock and Cod Line Fishing—Years 1888–89.

Months.	1888.								1889.							
	Number of Days Boats were out per Month.	Total Number of Shots per Month.	Haddocks and Whitings.		Number of Cod.	Average Number of Fish per Shot.			Number of Days Boats were out per Month.	Total Number of Shots per Month.	Haddocks and Whitings.		Number of Cod.	Average Number of Fish per Shot.		
						Haddocks and Whitings.		Cod.						Haddocks and Whitings.		Cod.
			100's of Large.	100's of Small.		Large.	Small.				100's of Large.	100's of Small.		Large.	Small.	
January,	24	243	64¼	455	153	33·8	239·6	0·62	24	206	178	119	435	110·6	73·9	2·11
February,	21	202	-	276½	93	-	175·2	0·46	19	247	217	152	227	112·3	78·7	0·91
March,	20	240	33⅛	283	167	17·6	150·9	0·69	25	514	401	308	284	99·8	76·7	0·55
April,	22	596	181	895	168	38·8	192·2	0·28	23	727	572	279	195	100·7	49·1	0·26
May,	25	566	87½	1257	106	19·7	284·2	0·18	27	656	473	415	111	92·2	80·9	0·16
June,	26	382	165	1166	99	55·2	390·7	0·25	25	253	155	240	85	78·4	101·1	0·33
July,	24	339	194	1014	71	73·2	382·8	0·20	26	267	213	172	84	102·1	82·4	0·31
August,	26	321	219	820	60	87·3	326·9	0·18	25	238	163	172	56	87·6	92·5	0·23
September,	25	504	325	1148	91	82·5	291·5	0·18	24	251	121	184	40	61·7	93·8	0·15
October,	25	983	764	1984	292	99·4	258·3	0·29	24	583	187	240	132	41·0	52·6	0·22
November,	16	458	261	279	352	72·9	77·9	0·76	23	357	82	99½	135	29·4	35·6	0·37
December,	25	714	422½	325½	852	75·7	58·3	1·19	21	236	67	44	335	36·3	23·8	0·41
Totals for Year,	279	5548	2716⅜	9903	2504	62·6	228·4	0·45	286	4535	2839	2424½	2119	80·1	68·4	0·46

Note.—'Large' fish are Haddocks only; 'Small' includes Whitings and (principally) Small Haddocks. One hundred fish is 32 warp or 128 fish. The total number of shots per month is ascertained by adding together the number of boats out each day.

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats during 1889, in the Leith, Anstruther, Montrose, Stonehaven, and Aberdeen Districts.

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s	cwt.	£
1889	**Leith District.**																								
Jan.	I. Net and line boats,	9884	15	–	–	1964	95	–	–	7260	363	14	6	–	103	20	195	1754	58	970	2049	–	336	114	9605
	II. Steam beam trawlers,	–	–	–	–	782	15	–	17	2 71	206	64	–	155	195	–	207	841	–	–	–	–	–	–	2829
	Total,	9884	15	–	–	2746	110	–	17	10,131	569	78	6	155	298	20	402	2595	58	970	2049	–	336	114	12,434
Feb.	I. Net and line boats,	3478	12	–	–	3264	118	–	23	13,542	537	19	10	–	442	3	138	174	44	1540	1961	–	89	157	9300
	II. Steam beam trawlers,	–	–	–	–	781	4	–	2	979	159	41	½	67	219	2	27	187	–	–	–	–	–	–	1148
	Total,	3478	12	–	–	4045	122	–	25	14,521	696	60	10½	67	661	5	165	361	44	1540	1961	–	89	157	10,448
March.	I. Net and line boats,	4896	–	4	–	2419	114	–	65	5480	416	16	27	–	377	5	79	369	62	1340	1850	–	122	133	6667
	II. Steam beam trawlers,	–	–	–	–	1185	27	–	25	2286	191	59	2	149	265	11	49	300	–	–	–	–	–	–	2358
	Total,	4896	–	4	–	3604	141	–	90	7766	607	75	29	149	642	16	128	669	62	1340	1850	–	122	133	9025
April.	I. Net and line boats,	402	–	4	–	11,818	708	1	176	3984	386	17	172	–	151	3	203	256	44	1794	1270	2·78	1616	108	13,20 9
	II. Steam beam trawlers,	–	–	–	–	995	33	–	22	2807	311	44	1	139	175	–	90	234	–	–	–	–	–	–	262 9
	Total,	402	–	–	–	12,813	741	1	198	6791	697	61	173	193	326	3	293	490	44	1794	1270	2·78	1616	108	15,838
May.	I. Net and line boats,	1137	–	–	–	10,767	446	2	646	2774	271	40	504	15	166	19	389	272	–	2044	684	10·75	1217	97	9359
	II. Steam beam trawlers,	–	–	–	–	566	32	–	15	1982	120	68	8	236	440	–	117	417	–	–	–	–	–	–	1920
	Total,	1137	–	–	–	11,333	478	2	661	4756	391	108	512	251	606	19	506	689	–	2044	684	10·75	1217	97	11,279

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued*.

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Leith District—*continued*.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s.	cwt.	£
1889 June.	I. Net and line boats,	1566	–	–	–	5929	220	–	1172	5417	325	$53\frac{1}{2}$	$167\frac{1}{2}$	15	250	–	276	211	–	1100	282	8·5	966	98	6472
	II. Steam beam trawlers,	–	–	–	–	942	59	–	21	4297	155	113	3	265	471	3	71	614	–	–	–	–	–	–	2538
	Total,	1566	–	–	–	6871	279	–	1193	9714	480	$166\frac{1}{2}$	$170\frac{1}{2}$	280	721	3	347	825	–	1100	282	8·5	966	98	9010
July.	I. Net and line boats,	2692	–	–	–	242	16	–	42	1203	265	1	3	–	308	–	28	88	10	770	265	2·25	304·5	99	2220
	II. Steam beam trawlers,	–	–	–	–	1095	68	–	26	7549	308	82	$2\frac{3}{4}$	129	298	2	265	1530	–	–	–	–	–	–	4975
	Total,	2692	–	–	–	1337	84	–	68	8752	573	83	$5\frac{3}{4}$	129	606	2	293	1618	10	770	265	2·25	304·5	99	7195
August.	I. Net and line boats,	7552	–	–	–	183	5	–	4	947	177	3	9	–	347	–	36	135	–	800	245	1·94	101·	160	2912
	II. Steam beam trawlers,	–	–	–	–	739	42	–	34	2746	255	79	2	239	522	–	112	667	–	–	–	–	–	–	3275
	Total,	7552	–	–	–	922	47	–	38	3693	432	82	11	239	869	–	148	802	–	800	245	1·94	101·	160	6187
Sept.	I. Net and line boats,	432	–	–	6	181	4	–	–	1450	226	1	–	2	360	–	17	104	–	10,326	695	5·0	141	175	2443
	II. Steam beam trawlers,	–	–	–	–	859	49	–	8	6106	322	133	3	284	1352	2	126	788	–	–	–	–	–	–	5769
	Total,	432	–	–	6	1040	53	–	8	7556	548	134	3	286	1712	2	143	892	–	10,326	695	5·0	141	175	8212
Oct.	I. Net and line boats,	–	–	–	–	468	9	–	4	3127	234	5	–	1	389	1	15	199	23	1706	1738	2·31	394	190	3279
	II. Steam beam trawlers,	–	–	–	–	590	46	–	20	2980	322	76	2	214	459	3	124	1410	–	–	–	–	–	–	3167
	Total,	–	–	–	–	1058	55	–	24	6107	566	81	2	215	848	4	139	1609	23	1706	1738	2·31	394	190	6446

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Leith District—*continued.*	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s.	cwt.	£
1889 Nov.	I. Net and line boats,	502	10	3	–	962	51	–	2	4345	292	5	3	1	310	105	153	825	33	1086	2145	2·56	662	143	4474
	II. Steam beam trawlers,	–	–	–	–	870	29	–	5	3581	378	90	1	230	417	2	141	1100	–	–	–	–	–	–	3204
	Total,	502	10	3	–	1832	80	–	7	7926	670	95	4	231	727	107	294	1925	33	1086	2145	2·56	662	143	7678
Dec.	I. Net and line boats,	2257	280	–	–	3733	299	–	69	5494	448	5	3	1	223	39	213	493	41	1289	2361	0·5	497	284	8074
	II. Steam beam trawlers,	–	–	–	–	900	25	–	5	955	261	39	–	132	546	2	32	543	–	–	–	–	–	–	2064
	Total,	2257	280	–	–	4633	324	–	74	6949	709	44	3	133	769	41	245	1036	41	1289	2361	0·5	497	284	10,138
Whole year.	I. Net and line boats,	34,798	317	11	6	41,930	2085	3	2203	55,023	3940	179½	904½	35	3426	195	1742	4880	315	24,765	15,545	36·59	6445·5	1758	78,014
	II. Steam beam trawlers,	–	–	–	–	10,304	429	–	200	39,639	2988	888	25¼	2239	5359	27	1361	8631	–	–	–	–	–	–	35,876
	Total,	34,798	317	11	6	52,234	2514	3	2403	94,662	6928	1067½	929¾	2274	8785	222	3103	13,511	315	24,765	15,545	36·59	6445·5	1758	113,890

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Anstruther District.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s.	cwt.	£
1889 January	By net and line boats,	18,345	600	3½	–	4391	151	–	124	1718	169	1	4	–	830	33	108	10	–	3085	100	·86	–	65	7655
February	„ „	30,660	80	1	–	5435	113	–	17	3752	255	3	15	–	858	3	53	54	–	1452	145	–	–	65	9998
March	„ „	8913	–	3	–	6045	365	–	92	4935	338	10	45	–	364½	4	203	6	–	1675	360	–	28·75	98	7392
April	„ „	99	–	–	–	3513	337	–	125	3328	269	13	45	–	169	–	335	6	–	2389	545	3·03	1502·50	65	4491
May	„ „	285	–	–	–	18,812	1687	20	1372	4047	391	85	346	–	95	–	1209	40	–	1743	245	14·53	2304·50	82	8435
June	„ „	109	–	–	–	5865	444	–	2170	2755	275	94	100	–	92	7	363	45	–	1704	–	5·50	856·50	70	3770
July	„ „	4860	–	–	–	255	–	–	–	1824	286	2	–	–	95	–	–	31	–	1097	–	7·28	310·00	18	2170
August	„ „	5776	–	–	–	244	–	–	–	1074	264	–	–	–	119	–	–	28	–	764	–	2·25	121·00	58	2109
September	„ „	213	–	35¾	–	189	–	–	–	1414	323	–	–	–	220	6	–	12	–	9204	110	24·00	52·00	45	2224
October	„ „	–	–	179	–	359	–	–	–	1479	342	–	–	–	155	28	–	29	–	2816	385	16·50	9·50	140	1896
November	„ „	51	120	31¼	–	945	–	–	–	2395	380	–	–	–	284	2	4	20	–	3543	240	12·00	1·75	90	2191
December	„ „	932	–	33	–	2237	12	–	30	3183	325	–	–	–	23½	29	22	34	–	4166	136	3·15	–	68	3265
Whole year	„ „	70,243	800	606½	–	48,290	3109	20	3930	31,904	3617	208	555	–	3305	112	2297	315	–	33,638	2266	89·10	5186·50	864	55,596

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s.	cwt.	£
1889	**Montrose District—**																								
Jan.	I. Net and line boats, .	1281	60	–	–	1111	49	–	22	10,243	432	3	1	–	101	19	16	1157	–	8200	–	–	–	97	5850
	II. Steam beam trawlers,	–	–	–	–	110	10	–	4	458	24	17	½	26	1170	–	9	95	–	–	–	–	–	–	1049
	Total, .	1281	60	–	–	1221	59	–	26	10,701	456	20	1½	26	1271	19	25	1252	–	8200	–	–	–	97	6899
Feb.	I. Net and line boats, .	636	–	–	–	640	21	–	8	14,038	360	2	2	–	334	11	5	1072	–	10,540	–	–	–	35	7286
	II. Steam beam trawlers,	–	–	–	–	142	10	–	5	480	50	8½	½	46	293	–	8	95	–	–	–	–	–	–	532
	Total, .	636	–	–	–	782	31	–	13	14,518	410	10½	2½	46	627	11	13	1167	–	10,540	–	–	–	35	7818
March.	I. Net and line boats, .	–	–	–	–	682	29	–	9	7879	265	–	–	–	535	6	16	737	–	6036	–	2·50	312·0	207	5102
	II. Steam beam trawlers,	–	–	–	–	285	10	–	5	970	35	8	1	36	227	–	14	117	–	–	–	–	–	–	801
	Total, .	–	–	–	–	967	39	–	14	8849	300	8	1	36	762	6	30	854	–	6036	–	2·50	312·0	207	5903
April.	I. Net and line boats, .	60	–	–	–	1812	57	–	60	8332	289	1	5	–	361	–	32	649	–	5723	–	9·40	1126·0	216	5817
	II. Steam beam trawlers,	–	–	–	–	290	8	–	4	595	29	9	1	46	117	–	13	113	–	–	–	–	–	–	567
	Total, .	60	–	–	–	2102	65	–	64	8927	318	10	6	46	478	–	45	762	–	5723	–	9·40	1126·0	216	6384
May.	I. Net and line boats, .	45	–	–	–	4842	303	–	452	10,437	464	16	47	–	217	2	388	1151	–	8867	–	15·90	1988·0	199	7433
	II. Steam beam trawlers,	–	–	–	–	66	6	–	–	640	14	23½	2	66	141	–	14	55	–	–	–	–	–	–	495
	Total, .	45	–	–	–	4908	309	–	452	11,077	478	39½	49	66	358	2	402	1206	–	8867	–	15·90	1988·0	199	7928

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Montrose District—*continued.*	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	00s	cwt.	cwt.	100s.	100s.	cwt.	£
1889 June.	I. Net and line boats,	39	–	–	–	2131	135	–	262	9137	1098	11	11	–	275	7	98	680	–	5936	–	11·86	1050·0	200	5306
	II. Steam beam trawlers,	–	–	–	–	65	6	–	11	568	20	19	1	81	166	–	10	116	–	–	–	–	–	–	504
	Total,	39	–	–	–	2196	141	–	273	9705	1118	30	12	81	441	7	108	796	–	5936	–	11·86	1050·0	200	5810
July.	I. Net and line boats,	54,884	–	–	–	204	8	–	–	1999	1021	–	–	–	130	7	20	221	–	2129	–	2·85	299·0	35	9704
	II. Steam beam trawlers,	–	–	–	–	114	6	–	16	1264	38	14	2	114	171	–	15	159	–	–	–	–	–	–	874
	Total,	54,884	–	–	–	318	14	–	16	3263	1059	14	2	114	301	7	35	380	–	2129	–	2·85	299·0	35	10,578
August.	I. Net and line boats,	73,088	–	–	5	72	10	–	4	963	560	½	–	–	112	7	9	165	–	1428	–	2·80	98·0	63	13,945
	II. Steam beam trawlers,	–	–	–	–	55	5	–	9	1315	22	44	1	89	489	–	43	263	–	–	–	–	–	–	1350
	Total,	73,088	–	–	5	127	15	–	13	2278	582	44½	1	89	601	7	52	428	–	1428	–	2·80	98·0	63	15,295
Sept.	I. Net and line boats,	3468	–	2	2	57	8	–	–	5091	1059	1	–	–	267	6	10	626	–	6755	–	6·40	50·0	54	4551
	II. Steam beam trawlers,	–	–	–	–	72	9	–	14	1685	55	27½	–	101	864	–	68	295	–	–	–	–	–	–	1798
	Total,	3468	–	2	2	129	17	–	14	6776	1114	28½	–	101	1131	6	78	921	–	6755	–	6·40	50·0	54	6349
Oct.	I. Net and line boats,	–	–	3	–	102	10	–	–	5160	834	1	–	–	213	1	9	679	–	6330	–	4·10	10·0	64	3860
	II. Steam beam trawlers,	–	–	–	–	105	9	–	8	1281	37	37½	–	138	717	–	50	303	–	–	–	–	–	–	1579
	Total,	–	–	3	–	207	19	–	8	6441	871	38½	–	138	930	1	59	982	–	6330	–	4·10	10·0	64	5439

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s.	cwt.	£
	Montrose District— *continued.*																								
1889 Nov.	I. Net and line boats,	–	–	1	–	486	23	–	5	9157	781	2	–	–	204	19	47	872	–	7695	–	1·20	–	90	5602
	II. Steam beam trawlers,	–	–	–	–	157	9	–	7	1348	35	52½	–	198	935	–	71	318	–	–	–	–	–	–	1811
	Total,	–	–	1	–	643	32	–	12	10,505	816	54½	–	198	1139	19	118	1190	–	7695	–	1·20	–	90	7413
Dec.	I. Net and line boats,	78	10	1	–	920	23	–	11	8587	1094	4½	2	–	225	45	21	1187	–	5628	–	0·60	–	298	6094
	II. Steam beam trawlers,	–	–	–	–	212	8	–	3	1128	46	40	2	108	566	2	33	531	–	–	–	–	–	–	1596
	Total,	78	10	1	–	1132	31	–	14	9715	1140	44½	4	108	791	47	54	1718	–	5628	–	0·60	–	298	7690
Whole year.	I. Net and line boats,	133,579	70	7	7	13,059	676	–	833	91,023	8257	42	68	–	2974	128	671	9196	–	75,267	–	57·61	4933	1558	80,550
	II. Steam beam trawlers,	–	–	–	–	1673	96	–	86	11,732	405	300½	11	1049	5856	2	348	2460	–	–	–	–	–	–	12,956
	Total,	133,579	70	7	7	14,732	772	–	919	102,755	8662	342½	79	1049	8830	130	1019	11,656	–	75,267	–	57·61	4933	1558	93,506

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Stonehaven District—	cwt.	cwt	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s.	100s	cwt.	£
1889 January	By net and line boats,	4309	–	–	–	1303	30	–	20	3148	138	3	4	–	76	39	24	97	–	–	–	–	–	20	2916
February	,, ,,	1507	–	–	–	422	4	–	–	3684	107	1	–	–	67	4	2	75	–	–	–	–	–	27	2215
March	,, ,,	–	–	–	–	409	8	–	–	2404	34	–	4	–	24	–	6	52	–	–	–	–	7	25	1258
April	,, ,,	274	–	–	–	1021	119	–	64	1366	16	4	18	–	17	–	90	57	–	–	–	1·25	320	106	1464
May	,, ,,	122	–	–	–	3132	250	–	350	2401	128	6	90	–	8	–	177	55	–	–	–	3·00	490	75	2287
June	,, ,,	1144	–	–	–	1672	128	–	206	2065	598	3	39	–	6	2	73	36	–	–	–	5·25	420	14	1908
July	,, ,,	22,946	–	–	–	35	–	–	4	236	335	–	–	–	6	–	–	15	–	–	–	1·00	67	–	3549
August	,, ,,	17,489	–	–	–	26	–	–	–	106	298	–	–	–	7	–	–	12	–	–	–	·60	74	15	1966
September	,, ,,	3640	–	–	–	90	–	–	–	1148	485	–	–	–	53	–	–	42	–	–	–	·25	70	60	1410
October	,, ,,	–	–	–	–	230	–	–	–	2521	807	–	–	–	48	–	–	67	–	–	–	·25	12	60	1379
November	,, ,,	–	–	–	–	474	–	–	–	3740	842	1	–	–	35	16	5	35	–	–	–	–	3	80	1667
December	,, ,,	145	–	–	–	1410	16	–	15	3287	469	1	1	–	28	73	31	44	–	–	–	–	–	60	2160
Whole year	,, ,,	51,576	–	–	–	10,224	555	–	659	26,106	4257	19	156	–	375	134	408	587	–	–	–	11·60	1463	542	24,179

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk. (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Aberdeen District.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s	100s.	cwt.	£
1889 Jan.	I. Net and line boats,	343	–	–	–	681	166	–	63	5216	562	6	2	–	8	11	87	291	–	–	–	–	–	–	3576
	II. Steam beam trawlers,	–	–	–	–	287	38	–	49	3521	21	200	–	241	4144	5	151	678	–	–	–	–	–	–	6193
	Total,	343	–	–	–	968	204	–	112	8737	583	206	2	241	4152	16	238	969	–	–	–	–	–	–	9769
Feb.	I. Net and line boats,	2257	–	–	–	1177	98	–	41	5549	87	4	22	–	–	4	63	183	–	–	–	·25	–	–	4066
	II. Steam beam trawlers,	–	–	–	–	318	36	–	28	3230	7	136	–	229	2904	3	100	573	–	–	–	–	–	–	5440
	Total,	2257	–	–	–	1495	134	–	69	8779	94	140	22	229	2904	7	163	756	–	–	–	·25	–	–	9506
March.	I. Net and line boats,	–	–	–	–	1143	259	–	53	3664	208	4	66	–	16	6	111	155	–	–	–	·25	–	–	2512
	II. Steam beam trawlers,	–	–	–	–	1146	31	–	37	7886	49	163	3	518	2159	3	106	768	–	–	–	–	–	–	7250
	Total,	–	–	–	–	2289	290	–	90	11,550	257	167	69	518	2175	9	217	923	–	–	–	·25	–	–	9762
April.	I. Net and line boats,	464	–	–	–	3211	950	4	249	3183	240	6	296	–	3	3	493	159	–	–	–	1·50	13·0	–	4333
	II. Steam beam trawlers,	–	–	–	–	1090	40	–	57	5752	160	350	7	865	1481	3	141	825	–	–	–	–	–	–	7397
	Total,	464	–	–	–	4301	990	4	306	8935	400	356	303	865	1484	6	634	984	–	–	–	1·50	13·0	–	11,730
May.	I. Net and line boats,	552	–	–	–	7250	1436	37	1556	6992	982	19	878	–	4	6	1121	363	–	–	–	3·50	44·0	–	7455
	II. Steam beam trawlers,	–	–	–	–	583	24	–	46	2864	116	614	7	1200	1945	3	121	862	–	–	–	–	–	–	6766
	Total,	552	–	–	–	7833	1460	37	1602	9856	1098	633	885	1200	1949	9	1242	1225	–	–	–	3·50	44·0	–	14,221

TABLE E.—Showing Fish Landed by Net and Line Boats and by Steam Beam Trawl Boats—*continued.*

Date.	District.	Herring.	Sprat.	Sparling.	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
	Aberdeen District—*continued.*	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s	100s.	cwt.	£
1889 June.	I. Net and line boats, .	2940	–	–	–	2961	520	8	1489	6040	2537	13	379	–	3	–	443	204	–	–	–	1·0	18·25	–	5007
	II. Steam beam trawlers,	–	–	–	–	520	19	–	297	3554	45	194	1	1313	1638	–	125	1627	–	–	–	–	–	–	5944
	Total, .	2940	–	–	–	3481	539	8	1786	9594	2582	207	380	1313	1641	–	568	1831	–	–	–	1·0	18·25	–	10,951
July.	I. Net and line boats, .	174,384	–	–	–	181	29	–	44	1362	1197	5	151	–	2	–	43	25	–	–	–	·60	15·0	–	21,987
	II. Steam beam trawlers,	–	–	–	–	794	1	–	331	4803	–	250	–	968	2217	–	125	1919	–	–	–	–	–	–	8055
	Total, .	174,384	–	–	–	975	30	–	375	6165	1197	255	151	968	2219	–	168	1944	–	–	–	·60	15·0	–	30,042
August.	I. Net and line boats, .	174,304	–	–	–	33	35	–	9	657	1189	8	185	–	24	–	22	–	–	–	–	–	40·0	–	29,531
	II. Steam beam trawlers,	–	–	–	–	532	–	–	147	7725	1	431	5	963	1622	–	6	726	–	–	–	–	–	–	9283
	Total, .	174,304	–	–	–	565	35	–	156	8382	1190	439	190	963	1646	–	28	726	–	–	–	–	40·0	–	38,814
Sept.	I. Net and line boats, .	20,676	–	–	–	35	50	–	–	2015	1454	1	188	–	34	–	4	–	–	–	–	–	37·15	–	5269
	II. Steam beam trawlers,	–	–	–	–	553	32	–	72	8192	32	410	–	1131	1539	–	4	1914	–	–	–	–	–	–	10,941
	Total, .	20,676	–	–	–	588	82	–	72	10,207	1486	411	188	1131	1573	–	8	1914	–	–	–	–	37·15	–	16,210
Oct.	I. Net and line boats, .	–	–	–	–	582	89	–	3	3204	1298	1	33	–	47	7	298	14	–	–	–	–	28·00	–	2924
	II. Steam beam trawlers,	–	–	–	–	604	10	–	23	8693	43	297	–	799	2174	–	41	1813	–	–	–	–	–	–	11,895
	Total, .	–	–	–	–	1186	99	–	26	11,897	1341	298	33	799	2221	7	339	1827	–	–	–	–	28·00	–	14,819

TABLE E.—SHOWING FISH LANDED BY NET AND LINE BOATS AND BY STEAM BEAM TRAWL BOATS—*continued.*

Date.	Districts.	Herring.	Sprat.	Sparling	Mackerel.	Cod.	Ling.	Torsk (Tusk).	Saithe (Coalfish).	Haddock.	Whiting.	Turbot.	Halibut.	Sole (Lemon Sole).	Flounder, Plaice, Brill.	Eel.	Skate.	Other kinds of White Fish.	Oysters.	Mussels.	Clams.	Lobsters.	Crabs.	Other kinds of Shell Fish.	Total Value.
		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	100s	cwt.	cwt.	100s	100s.	cwt.	£
1889 Nov.	**Aberdeen District**—*continued.*																								
	I. Net and line boats, .	–	–	–	–	996	146	–	–	3915	1797	–	–	–	35	22	366	6	–	–	–	–	–	–	3243
	II. Steam beam trawlers,	–	–	–	–	596	6	–	6	6882	–	325	–	972	2123	–	–	1404	–	–	–	–	–	–	8516
	Total, .	–	–	–	–	1592	152	–	6	10,797	1797	325	–	972	2158	22	366	1410	–	–	–	–	–	–	11,759
Dec.	I. Net and line boats, .	20	–	–	–	1368	145	–	86	3175	962	–	–	–	3	2	173	175	–	–	–	–	–	–	3557
	II. Steam beam trawlers,	–	–	–	–	923	10	–	25	6151	3	290	–	551	4730	–	–	1897	–	–	–	–	–	–	10,972
	Total, .	20	–	–	–	2291	155	–	111	9326	965	290	–	551	4733	2	173	2072	–	–	–	–	–	–	14,529
Whole year.	I. Net and line boats, .	375,940	–	–	–	19,618	3923	49	3593	44,972	12,513	67	2200	–	179	61	3224	1575	–	–	–	7·10	19·540	–	93,460
	II. Steam beam trawlers,	–	–	–	–	7946	247	–	1118	69,253	477	3660	23	9750	28,676	17	920	15,006	–	–	–	–	–	–	98,652
	Total, .	375,940	–	–	–	27,564	4170	49	4711	114,225	12,990	3727	2223	9750	28,855	78	4144	16,581	–	–	–	7·10	195·40	–	192,112

TABLE F.—SHOWING THE QUANTITIES MONTHLY OF LARGE AND SMALL FISH LANDED IN THE LEITH AND ABERDEEN DISTRICTS BY BEAM TRAWLERS AND LINE FISHERMEN IN 1889.

Month.	Stations.	Cod (Large).	Cod (Small).	Haddock (Large).	Whiting (Large).	Haddock and Whiting (Small).	Turbot (Large).	Turbot (Small).	Halibut (Large).	Halibut (Small).	Lemon Sole, Flounder, Plaice, Brill (Large).	Lemon Sole, Flounder, Plaice, Brill (Small).	Other kinds of White Fish (Large).	Other kinds of White Fish (Small).
	LEITH.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Mar.	I. Beam trawl,	1126	59	1994	134	349	52	7	2	...	375	39	361	51
	II. Line, extra-territorial,	1137	240	2806	202	328	15	1	23	2	166	55	373	38
	III. Line, territorial,	813	229	2101	164	276	...	...	2	...	121	35	213	44
Apr.	I. Beam trawl,	846	149	2454	262	402	40	4	1	...	265	49	305	74
	II. Line, extra-territorial,	9639	1309	2173	174	362	15	2	163	9	39	6	1065	73
	III. Line, territorial,	692	178	1300	163	198	...	...	...	...	92	14	184	25
May	I. Beam trawl,	467	99	498	90	1514	62	6	7	1	609	67	526	55
	II. Line, extra-territorial,	9683	549	427	100	1281	35	5	439	65	60	5	1473	94
	III. Line, territorial,	489	46	266	105	866	...	...	...	...	98	18	190	17
June	I. Beam trawl,	849	93	1433	52	2967	104	9	3	...	663	73	285	482
	II. Line, extra-territorial,	5477	198	1628	75	3429	48½	5	157½	10	34	8	1864	...
	III. Line, territorial,	170	84	163	27	420	...	...	...	...	203	20	83	47
July	I. Beam trawl,	1040	55	2517	102	5238	74	8	2¾	...	407	20	1298	593
	II. Line or net, extra-territorial,	124	13	210	42	509	1	...	3	...	55	27	68	16
	III. Line or net, territorial,	93	12	193	45	469	...	...	...	...	149	77	68	22
Aug.	I. Trawl,	667	72	1373	127	1501	71	8	2	...	696	65	778	77
	II. Line, extra-territorial,	57	5	111	4	116	3	...	6	1	...	...	54	30
	III. Line, intra-territorial,	106	15	361	84	448	...	...	...	...	265	95	73	23

TABLE F.—Showing the Quantities Monthly of Large and Small Fish Landed in the Leith and Aberdeen Districts by Beam Trawlers and Line Fishermen in 1889—*continued.*

Month.	Stations.	Cod (Large).	Cod (Small).	Haddock (Large).	Whiting (Large).	Haddock and Whiting (Small).	Turbot (Large).	Turbot (Small).	Halibut (Large).	Halibut (Small).	Lemon Sole, Flounder, Plaice, Brill (Small).	Lemon Sole, Flounder, Plaice, Brill (Large).	Other kinds of White Fish (Large).	Other kinds of White Fish (Small).
	LEITH—*continued.*	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Sept.	I. Beam trawl,	772	87	5496	250	682	118	15	3	...	1474	162	595	278
	II. Line or net, extra-territorial,	...	...	...	...	...	...	...	...	...	...	...	...	...
	III. Line or net, territorial,	136	47	1076	94	507	1	...	...	...	282	81	69	56
Oct.	I. Beam trawl,	550	40	2235	194	873	69	7	1	1	505	168	924	679
	II. Line, extra-territorial.	226	74	1651	102	615	3	...	...	...	192	61	109	80
	III. Line, intra-territorial,	134	34	655	59	279	1	1	...	...	105	32	20	19
Nov.	I. Beam trawl,	785	85	3224	281	454	80	10	1	...	583	64	694	583
	II. Line, extra-territorial,	347	39	1677	92	456	2	1	3	...	75	9	280	207
	III. Line, intra-territorial,	439	137	1809	126	477	2	...	...	...	204	23	402	245
Dec.	I. Beam trawl,	810	90	1091	208	417	104	14	...	...	594	84	329	278
	II. Line, extra-territorial,	805	714	4133	367	1073	4	1	3	...	64	5	752	282
	III. Line, intra-territorial,	150	44	258	36	64	...	...	...	...	134	20	53	26
	I.	8012	829	22,315	1700	14,397	774	88	22¾	2	6171	791	6095	3150
	II.	29,495	3141	14,816	1158	8169	126½	15	797½	87	685	176	6002	820
	III.	3222	826	8182	903	4004	4	1	2	...	1653	415	1355	524

TABLE F.—SHOWING THE QUANTITIES MONTHLY OF LARGE AND SMALL FISH LANDED IN THE LEITH AND ABERDEEN DISTRICTS BY BEAM TRAWLERS AND LINE FISHERMEN IN 1889—*continued.*

Month.	Stations.	Cod (Large).	Cod (Small).	Haddock (Large).	Whiting (Large).	Haddock and Whiting (Small).	Turbot (Large).	Turbot (Small).	Halibut (Large).	Halibut (Small).	Lemon Sole, Flounder, Plaice, Brill (Large).	Lemon Sole, Flounder, Plaice, Brill (Small).	Other kinds of White Fish (Large).	Other kinds of White Fish (Small).
	ABERDEEN.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Jan.	I. Beam trawl,	287	330	1755	21	1766	...	...	...	...	4385	...	...	...
	II. Line,	626	236	2345	394	799	...	...	...	...	...	...	...	...
Feb.	I. Beam trawl,	318	304	1687	7	1550	...	...	...	...	3005	125	...	...
	II. Line,	1160	159	2696	72	775	...	...	...	...	...	...	...	...
Mar.	I. Beam trawl,	1146	367	4530	37	3368	...	...	..	...	2592	85	...	...
	II. Line,	1122	151	1476	94	1111	...	...	...	...	...	16	...	...
April	I. Beam trawl,	1090	373	2675	119	3118	...	...	...	...	2251	115	...	...
	II. Line,	3191	133	1294	144	1029	...	..	...	...	...	...	...	...
May	I. Beam trawl,	583	462	1070	78	1832	...	...	...	...	2960	185	...	...
	II. Line,	7216	357	3617	570	3896	...	...	...	...	...	...	...	...
June	I. Beam trawl,	520	592	1880	31	1688	...	...	...	...	2692	259	...	...
	II. Line,	2912	202	2836	1668	2901	...	...	...	...	...	...	...	...
July	I. Beam trawl,	794	788	2094	...	2709	...	...	...	...	3080	105	...	...
	II. Line,	149	19	445½	768	716½	...	...	...	...	...	...	...	...
Aug.	I. Beam trawl,	532	726	4024	...	3702	...	...	...	...	2463	122	...	...
	II. Line,	33	...	338	776	344	...	...	...	...	...	...	...	...

TABLE F.—Showing the Quantities Monthly of Large and Small Fish Landed in the Leith and Aberdeen Districts by Beam Trawlers and Line Fishermen in 1889—*continued.*

Month.	Stations.	Cod (Large).	Cod (Small).	Haddock (Large).	Whiting (Large).	Haddock and Whiting (Small).	Turbot (Large).	Turbot (Small).	Halibut (Large).	Halibut (Small).	Lemon Sole, Flounder, Plaice, Brill (Large).	Lemon Sole, Flounder, Plaice, Brill (Small).	Other kinds of White Fish (Large).	Other kinds of White Fish (Small).
	ABERDEEN—*continued.*	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
Sept.	I. Beam trawl, . . .	553	867	4082	32	4110	...	...	...	...	2670	...	...	...
	II. Line, ...	33	...	879	797	682	...	...	...	...	...	...	...	...
Oct.	I. Beam trawl, . . .	604	724	5036	32	3668	...	...	...	...	2959	14	...	...
	II. Line, ...	570	...	1453	727	749	...	...	...	...	...	...	...	...
Nov.	I. Beam trawl, . . .	596	691	4359	...	2523	...	...	...	...	3077	18	...	...
	II. Line, ...	941	6	1637	1105	1094	...	...	...	...	...	...	...	...
Dec.	I. Beam trawl, . . .	923	823	3668	3	2483	...	...	...	...	5221	60	...	...
	II. Line, ...	1305	120	1317	646	528	...	...	...	...	...	...	...	...
	Beam, . .	7946	7047	36,860	360	32,517	...	...	...	...	37,355	1018	...	...
	Line, . .	19,258	1383	20,333½	7,761	14,624½	...	...	...	...	...	16	...	...

TABLE G.—SHOWING THE MONTHLY TAKES OF LINE AND NET BOATS FROM INSHORE GROUNDS IN THE LEITH, ANSTRUTHER, MONTROSE, AND STONEHAVEN DISTRICTS.

LEITH DISTRICT.

Month and Number of Days Fishing.	Place where Landed.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.*
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (22)	North Berwick,	325	2·16	73	0·48	62	0·41	...	...	...	...	9	0·06	10	0·06	150	16 to 28 ft.	...	...	M., H.
Feb. (18)	"	30	0·35	10	0·11	108	1·27	2	0·02	...	...	...	...	...	...	85	16 to 28 ft.	...	...	M., H.
Mar. (7)	"	...	...	2	0·08	32	1·28	2	0·08	...	...	...	...	...	...	25	16 to 28 ft.	...	...	M.
Apr. (22)	"	...	...	11	0·06	161	1·00	49	0·30	...	...	...	...	...	...	161	16 to 28 ft.	...	...	M.
May (27)	"	...	...	27	0·08	183	0·59	53	0·17	18	0·05	...	...	...	...	307	15 to 28 ft.	...	...	M.
June (25)	"	...	...	42	0·12	213	0·64	81	0·24	43	0·13	18	0·05	...	...	329	16 to 28 ft.	...	...	M.
July (26)	"	...	...	34½	0·1	164½	0·5	130½	0·4	30½	0·09	6½	0·01	...	...	326	16 to 28 ft.	...	...	M.
Aug. (22)	"	28	0·11	20	0·08	125	0·52	66½	0·23	18½	0·07	1	0·00	...	...	237	16 to 28 ft.	4	28 ft.	M.
Sept. (21)	"	...	...	15	0·081	106	0·579	36	0·196	15½	0·084	...	...	...	...	183	16 to 28 ft.	...	...	M.
Oct. (18)	"	...	...	20½	0·366	46	0·821	½	0·080	6	0·107	...	...	...	...	56	16 to 24 ft.	...	...	M.
Nov. (16)	"	...	...	17	0·320	19	0·358	1½	0·028	...	...	...	...	...	...	53	16 to 22 ft.	...	...	M.
Dec. (22)	"	...	...	20½	0·25	31	0·37	9¼	0·11	6	0·07	...	...	...	...	82	16 to 22 ft.	...	...	M., Cl.
Total	for year .	383	0·19	292½	0·14	1250½	0·62	431¼	0·21	137½	0·06	34½	0·01	10	0·005	1994				

* *Abbreviations.*—M., mussels, Cl., clams, L., lugworm, H., herrings, Lt., limpet, C., cuttlefish, Spr., sprats, Cr., crabs, S., sand-eels, Sa. sea-anemones, Lv., liver.

TABLE G.—Leith District—*continued.*

Month and Number of Days Fishing.	Place where Landed.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bai used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Cwts.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (26)	Cockenzie and Portseton,	...	...	548	1·81	330	1·09	...	...	...	...	...	...	...	...	302	Yawls.	...	...	Cl.
Feb. (21)	" .	...	...	542	1·90	288	1·00	...	...	...	...	...	...	...	...	280	Yawls. 24 to 30 ft.	...	...	Cl.
Mar. (23)	" .	...	...	378	1·21	369	1·18	...	...	...	...	...	...	...	...	311	Yawls.	...	...	Cl.
Apr. (25)	" .	...	...	313	0·94	354	1·07	...	...	...	...	...	...	...	...	330	Yawls.	...	...	Cl.
May (27)	" .	...	...	132	0·73	218	1·21	...	...	18	0·10	...	...	...	...	179	Yawls.	...	...	Cl.
June (23)	" .	...	...	26	0·188	131	0·949	...	...	77	0·557	...	...	...	...	138	...	42	...	Cl., L.
July (26)	" .	...	...	31	0·19	173	1·10	1	·00	93	0·59	...	...	...	...	156	Yawls.	...	...	Cl., L.
Aug. (25)	" .	...	...	33	0·22	166	1·11	...	...	63	0·42	...	...	...	...	149	Yawls.	...	...	Cl., L.
Sept. (25)	" .	...	...	47	0·19	314	1·23	...	...	78½	0·31	...	...	...	...	247	Yawls.	...	...	Cl., L.
Oct. (26)	" .	...	...	319	0·565	623	1·104	...	...	112	0·198	...	...	...	...	564	...	355	...	Cl.
Nov. (25)	" .	...	...	443	0·815	446½	0·822	...	...	63	0·11	...	...	...	...	543	...	543	...	Cl.
Dec. (25	" .	...	...	388	1·57	235	0·95	...	...	41	0·16	...	...	...	...	246	...	...	...	Cl.
Total	for year .	...	...	3200	0·92	3647½	1·05	1	0·00	545½	0·15	...	...	...	...	3445				

TABLE G.—LEITH DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Cwts.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (24)	Fisherrow, .	588	4·98	186	1·57	3	0·02	...		73	0·61	10	0·08	11	0·09	118	22 to 58 ft.	91	50 to 58 ft.	M.
Feb. (20)	,, .	90	1·11	33	0·40	127	1·56	9	0·11	...		...		300 crabs.		81	22 to 58 ft.	77	50 to 58 ft.	M.
Mar. (20)	,, .	...		21	0·25	84	1·02	12	0·14	205	2·49	...		1	0·01	82	22 to 58 ft.	109	50 to 58 ft.	M.
Apr. (19)	,, .	...		36	0·43	134	1·61	24	0·28	76	0·91	...		1700 crabs.		83	22 to 49 ft.	24	49 to 58 ft.	M., L.
May (20)	,, .	...		28	0·31	88	0·97	23	0·25	56	0·62	...		3400 crobs.		90	22 to 39 ft.	68	41 to 58 ft.	M.
June (20)	,, .	...		15	0·27	43	0·78	7	0·12	57	1·03	...		1800 crabs.		55	22 to 33 ft.	49	41 to 58 ft.	M.
July (16)	,, .	...		4	0·17	35	1·52	4	0·17	50	2·17	...		...		23	22 to 33 ft.	8	41 ft.	M.
Aug. (16)	,, .	...		4	0·09	36	0·85	8	0·19	158	3·76	...		...		42	22 to 33 ft.	8	41 ft.	M.
Sept. (13)	,, .	...		...		21	0·52	5	0·12	120	3·00	...		...		40	22 to 33 ft.	21	41 to 56 ft.	M.
Oct. (19)	,, .	3	0·04	3	0·04	16	0·25	3	0·04	196	3·11	...		...		63	22 to 56 ft.	49	41 to 58 ft.	M.
Nov. (22)	,, .	122	1·06	157	1·36	12	0·10	1	0·008	17	0·14	16	0·13	6	0·05	115	22 to 58 ft.	80	41 to 58 ft.	M., H.
Dec. (21)	,, .	355	2·19	205	1·26	19	0·11	3	0·01	...		21	0·12	6	0·03	162	22 to 58 ft.	95	41 to 58 ft.	M., H.
Total	for year .	1158	1·21	692	0·72	618	0·64	99	0·1	1008	1·05	47	0·04	24	0·02	954				

TABLE G.—Leith District—*continued.*

Month and Number of Days Fishing.	Place where Landed.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (27)	Newhaven, .	1256	1·12	1308	1·17	11	0·009	4¾	0·004	3½	0·004	126	0·11	167	0·15	1113	25 to 30 ft.	42	Large boats	M. H. C. Cl.
Feb. (23)	„	276½	0·73	1751	4·65	368	0·97	35¾	0·09	31¼	0·08	92	0·24	440	1·17	376	25 to 30 ft.	84	Large boats	M. H. C. Cl.
Mar. (24)	„	35½	0·10	1323	3·78	519	1·48	55	0.15	37¼	0·10	132½	0·37	528	1·50	350	25 to 30 ft.	148	Large boats	M. H. Cl.
April (24)	„	...	...	17	0·10	105	0·62	14	0·08	12	0·07	176 doz. crabs		87¼	0·52	166	25 to 30 ft.	148	Large boats	M. H. Cl.
May (27)	„	...	...	12	0·06	50	0·27	5½	0·03	12	0·06	3½ skate 451 doz. crabs		9½	0·05	182	25 to 30 ft.	322	Large boats	M. H. Cl. L.
June (24)	„	...	...	...	...	...	...	...	...	33	0·23	65	0·45	389 doz. crabs		143	25 to 30 ft.	183	Large boats	M. H. L.
July (26)	„	...	...	...	...	7½	0·06	2¾	0·02	39¼	0·28	18	0·14	199 doz. crabs 60 doz. crabs		121	25 to 30 ft.	43	Large boats	M. H. Cl. L.
Aug. (20)	„	...	...	...	...	...	...	...	...	23¼	0·40	...	...	...	...	58	25 to 30 ft.	29	Large boats	M. H. Cl. L.
Sept. (5)	„	...	...	...	...	...	...	...	...	3	0·60	...	...	3½	0·70	5	25 to 30 ft.	7	Large boats	M. Cl. L.
Oct. (8)	„	3	0·23	19	1·46	...	...	...	...	...	...	2	0·15	2	0·05	13	25 to 45 ft.	69	42 to 50 ft.	M. Cl. L.
Nov. (23)	„	105	0·24	116	0·26	...	...	...	...	...	...	11½	0·02	22	0·05	430	25 to 42 ft.	111	42 to 50 ft.	M. H. Cl.
Dec. (26)	„	317½	0·36	1128	1·28	...	...	...	...	...	...	82	0·09	217	0·24	877	25 to 50 ft.	84	42 to 50 ft.	M. H. Cl.
Total	for year .	1993½	0·51	5674	1·47	1060½	0·27	117¾	0·03	194½	0·05	532½	0·13	1476¼	0·38	3834				

TABLE G.—ANTSRUTHER DISTRICT.

Month and Number of Days Fishing.	Place where Landed.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Water.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (24)	Largo,	54	0·19	53	0·19	148	0·53	...	...	5	0·01	..	...	...	...	278	15 to 25 ft.	...	...	M. L.
Feb. (23)	"	4	0·01	45	0·20	84	0·37	22	0·09	240	1·07	...	...	...	...	224	15 to 25 ft.	...	...	M. L.
Mar. (25)	"	...	...	54	0·17	150	0·47	30	0·09	165	0·52	...	...	...	...	315	15 to 25 ft.	2	25	M. L.
Apr. (22)	"	...	...	26	0·15	127	0·75	21	0·12	44	0·26	...	...	...	...	168	15 to 25 ft.	4	48 to 55 ft.	M. L.
May (27)	"	...	...	19	0·09	118	0·60	21	0·10	7	0·03	...	...	...	...	194	15 to 25 ft.	...	...	M. L.
June (25)	"	...	...	12	0·10	35	0·31	26	0·23	2	0·01	...	...	...	...	111	15 to 24 ft.	...	...	M. L.
July (27)	"	...	...	6½	0·13	42	0·89	...	...	...	...	...	...	...	...	47	14 to 18 ft.	...	...	M. L.
Aug. (24)	"	...	...	10½	0·33	17	0·54	...	...	...	...	...	...	...	...	31	14 to 18 ft.	...	...	M. L.
Sept. (25)	"	...	...	16	0·12	30½	0·22	...	...	78	0·58	...	...	...	...	133	14 to 25 ft.	...	...	M. L.
Oct. (23)	"	...	...	36	0·19	38	0·20	3	0·01	30½	0·16	...	...	...	...	181	15 to 25 ft.	...	...	M. L.
Nov. (23)	"	...	...	32	0·17	41	0·22	...	...	71	0·39	...	...	...	...	181	15 to 24 ft.	...	...	M. L.
Dec. (21)	"	4½	0·03	63½	0·51	51	0·41	...	...	4	0·03	...	...	...	...	124	24 ft.	...	...	M. L.
Total	for year	62½	0·03	373½	0·18	881½	0·44	123	0·06	646½	0·32	...	...	...	...	1987				

TABLE G.—ANSTRUTHER DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (23)	Elie and Earlsferry,	15½	0·26	40½	0·53	54	0·71	...	...	15½	0·26	...	...	...	...	75	16 to 23 ft.	...	...	M. L.
Feb. (23)	,,	...	...	61½	0·60	45	0·44	...	...	70	0·68	...	...	...	...	102	15 to 25 ft.	...	...	M. L.
Mar. (26)	,,	...	...	38½	0·35	80¾	0·74	...	...	34½	0·30	...	...	...	...	108	16 to 23 ft.	...	...	M. L.
Apr. (23)	,,	...	...	19	0·20	69½	0·76	30	0·32	10	0·10	...	...	...	...	91	16 to 23 ft.	...	...	M. L.
May (26)	,,	...	...	11½	0·11	31½	0·30	28	0·26	...	...	...	...	14	0·13	104	15 to 16 ft.	...	...	M. L. S.
June (25)	,,	...	...	20½	0·20	42¼	0·42	22½	0·22	...	...	...	...	20¼	0·20	100	15 to 18 ft.	...	...	M. L. S.
July (27)	,,	...	...	26½	0·25	52	0·50	42½	0·40	...	...	...	...	4	0·03	104	16 to 18 ft.	...	...	M. L. S.
Aug. (26)	,,	...	...	20	0·19	30	0·29	18	0·17	8½	0·08	...	...	...	...	101	15 to 16 ft.	...	...	M. L.
Sept. (24)	,,	...	...	25	0·27	38	0·41	22	0·23	...	...	...	...	...	...	92	15 to 18 ft.	...	...	M. L.
Oct. (23)	,,	...	...	22½	0·26	32	0·38	15½	0·18	...	...	...	...	...	...	84	16 to 23 ft.	...	...	M. L.
Nov. (26)	,,	...	...	26½	0·25	30	0·28	13¼	0·12	3½	0·03	...	...	...	...	104	16 to 23 ft.	...	...	M. L.
Dec. (23)	,,	3½	0·03	35½	0·40	31½	0·35	5½	0·06	...	...	...	...	...	...	88	16 to 23 ft.	...	...	M. L.
Total	for year	19	0·01	347½	0·30	536½	0·46	197¼	0·17	142	0·12	...	...	38¼	0·03	1153				

TABLE G.—ANSTRUTHER DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (26)	St Monance,	715	1·52	1199	2·55	297	0·63	82	0·17	...	...	...	...	...	...	154 316	Yawls. Large.	...	...	H.
Feb. (24)	,,	926	1·84	1810	3·61	992	1·98	102	0·20	...	...	...	...	...	...	207 294	Yawls. Large.	22	25 to 28 ft.	H. Cl.
Mar. (25)	,,	299	0·66	2377	5·29	1529	3·40	189	0·42	...	...	39	0·08	179	0·39	302 147	Yawls. Large.	39	48 to 58 ft.	M. H. Cl.
Apr. (22)	,,	...	...	169	0·49	899	2·64	115	0·33	...	...	...	...	...	...	340	23 to 28 ft.	64	52 to 58 ft.	M. H. Cl.
May (27)	,,	...	...	132	0·50	381	1·45	103	0·39	...	...	...	...	...	...	261	25 to 28 ft.	82	48 to 58 ft.	H. Cl. S.
June (25)	,,	...	...	112	0·50	363	1·64	129	0·58	...	...	...	...	...	...	220	25 to 28 ft.	51	48 to 58 ft.	M. H. L. S.
July (27)	,,	...	...	82	0·54	208	1·37	101	0·66	...	...	...	...	...	...	151	21 to 28 ft.	38	42 to 57 ft.	M. H. S.
Aug. (27)	,,	5	0·02	123	0·69	238	1·35	95	0·53	...	...	...	...	...	...	176	21 to 28 ft.	71	48 to 78 ft.	M. H.
Sept. (24)	,,	...	...	63	0·43	184	1·27	56	0·38	...	...	...	...	...	...	144	21 to 28 ft.	...	...	M.
Oct. (23)	,,	...	...	148	0·57	276½	1·07	65	0·25	...	...	...	...	...	...	249 8	Yawls. Large.	...	...	M. Cl. C. Cr.
Nov. (25)	,	...	...	728	2·43	219	0·73	37	0·12	...	...	...	...	...	...	205 94	Yawls. Large.	...	...	M. H. Cl. C. Spr.
Dec. (26)	,,	193	0·35	1406	2·56	415	0·75	68	0·12	...	...	...	...	...	...	253 315	Yawls. Large.	...	...	M. H. Cl. Spr.
Total	for year	2138	0·55	8349	2·17	6001½	1·56	1142	0·29	...	...	39	0·01	179	0·04	3836				

TABLE G.—ANSTRUTHER DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (25)	Pittenweem, .	204	1·18	60	0·34	164	0·95	23	0·12	...	...	...	...	...	...	99 73	Yawls. Large.	...	...	M. H.
Feb. (21)	"	433	2·05	25	0·11	241	1·14	31	0·14	...	...	...	...	...	...	115 96	Yawls. Large.	...	...	M. H.
Mar. (21)	"	...	...	371	2·34	54	0·34	...	...	...	...	...	...	...	...	158	25 ft.	15	43 to 48 ft.	M. Lt.
Apr. (18)	"	...	...	3	0·02	178	1·29	36	0·26	...	...	...	...	...	...	137	25 ft.	...	...	M. Lt.
May (22)	"	...	...	132	0·81	25	0·15	...	...	...	...	...	...	...	...	162	25 ft.	...	...	M. Lt. S.
June (19)	"	...	...	...	...	121	1·07	28	0·24	...	...	...	...	...	...	113	25 ft.	...	...	M. H. S.
July (24)	"	...	...	...	...	119	1·07	29	0·26	...	...	...	...	...	...	109	25 ft.	12	48 ft.	M. Lt. S.
Aug. (24)	"	...	...	...	...	140	1·20	27	0·23	...	...	...	...	...	...	116	25 ft.	12	48 ft.	M.
Sept. (22)	"	...	...	...	...	118	1·20	18	0·18	...	...	...	...	...	...	98	25 ft.	...	...	M.
Oct. (18)	"	...	...	...	...	165	0·94	31	0·17	...	...	...	...	...	...	174	25 ft.	...	...	M. Lt.
Nov. (19)	"	...	...	...	...	158	0·94	26	0·15	...	...	...	...	...	...	168	25 ft.	24	48 ft.	M. Lt. Spr.
Dec. (15)	"	...	...	...	...	135	1·22	23	0·20	...	...	2	0·01	...	..	110	25 ft.	79	48 to 54 ft.	M. Lt.
Total	for year .	637	0·36	591	0·34	1618	0·93	272	0·15	...	...	2	0·00	...	...	1728				

TABLE G.—ANSTRUTHER DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (9)	Anstruther,	4812	3·43	1719	1·22	38	0·02	4	0·002	...	...	...	...	124	0·08	42 1358	Yawls. Large.	58	46 to 58 ft.	M. H.
Feb. (22)	,,	3545	4·14	878	1·02	144¾	0·16	...	...	...	...	...	...	...	...	57 798	Yawls. Large.	880	36 to 58 ft.	M. H. Cl.
Mar. (22)		...	...	17¼	0·23	237	3·20	3	0·04	...	...	...	...	...	...	74	24 to 28 ft.	561	36 to 58 ft.	M. Cl.
Apr. (2)	,	...	...	1	0·14	8½	1·21	...	...	...	...	...	...	...	...	7	24 to 28 ft.	116	45 to 58 ft.	M.
May	,		No	fishing	in	territorial	w	aters.		...	...	...	...	...	...	...	...	286	46 to 58 ft.	...
June	,		,,	,,		,,		,,		...	...	...	...	...	...	...	...	111	46 to 58 ft.	...
July (14)	,,	16	1·14	3½	0·25	16¼	1·16	3¾	0·26	...	...	...	...	...	...	14	24 to 28 ft.	81	40 to 56 ft.	M. Lt.
Aug. (19)	,,	373	3·96	1½	0·01	10¼	0·10	1¼	0·01	...	...	...	...	...	...	94	25 to 50 ft.	195	30 to 58 ft.	M.
Sept. (14)	,,	...	...	¾	0·03	30¾	1·28	4½	0·18	...	...	...	...	...	...	24	23 to 28 ft.	8	28 to 50 ft.	M.
Oct. (16)	,,	...	...	4¾	0·09	51½	1·03	4¾	0·09	...	...	...	...	...	...	50	23 to 28 ft.	4	46 ft.	M. Lt.
ov. (16)	,,	...	...	16¾	0·33	37¾	0·74	1¾	0·03	...	..	...	...	...	...	50	23 to 28 ft.	7	46 ft.	M.
Dec. (21)	,,	93	0·28	486	1·50	23	0·07	...	...	...	...	17	0·05	48	0·14	30 292	Yawls. Large.	71	46 to 58 ft.	M. H.
Total	for year	8839	3·05	3128½	1·08	597¾	0·20	23	0·00	...	...	17	0·00	172	0·05	2890				

TABLE G.—ANSTRUTHER DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Area restricted from Trawling.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (23)	Anstruther, .	44	0·28	28½	1·85	106½	0·70	...	...	...	...	...	...	38	0·25	152	28 to 40 ft.	...	...	M. H. C.
Feb. (17)	,,	124	0·65	296	1·56	246	1·30	...	...	...	...	...	...	54	0·28	189	28 to 41 ft.	...	...	M. H. Lt.
Mar. (17)	,,	...	...	510	2·50	434	2·11	6½	0·03	16	0·07	...	...	...	...	205	18 to 30 ft.	...	...	M. H. Lt.
Apr. (22)	,,	...	...	336	0·68	49½	0·10	...	...	...	...	...	...	...	...	487	17 to 28 ft.	...	...	M. Lt.
May (24)	,,	...	...	177	0·40	83	0·19	...	...	...	...	...	...	...	...	434	17 to 28 ft.	...	...	M. Lt. Cr.
June (22)	,,	5	0·03	58½	0·35	36½	0·22	...	...	...	...	...	...	3½	0·02	165	15 to 28 ft.	...	...	M. Lt. Cr. S. C.
July (26)	,,	...	...	75	0·44	83½	0·49	45½	0·27	...	...	...	...	26½	0·15	168	15 to 28 ft.	...	...	M. Lt. S. L.
Aug. (25)	,,	36	0·19	66½	0·36	54	0·29	32½	0·17	...	...	...	...	32	0·17	184	15 to 28 ft.	...	...	M. Lt. L.
Sept. (22)	,,	4	0·03	48	0·39	47½	0·39	19½	0·16	...	...	...	...	12½	0·10	121	15 to 28 ft.	...	...	M. Lt. S.
Oct. (22)	,,	...	...	64½	0·54	52½	0·44	...	..	...	...	...	...	30	0·25	119	15 to 30 ft.	27	28 to 40 ft.	M. H. Lt. C.
Nov. (21)	,	...	...	63	0·57	42	0·38	...	...	...	...	...	...	22	0·20	109	15 to 28 ft.	9	28 to 40 ft.	M. H. Lt. C.
Dec. (20)	,,	...	...	93	1·05	55	0·62	..	...	...	...	...	...	29	0·32	88	15 to 28 ft.	31	28 to 34 ft.	M. Lt. C.
Total	for year .	213	0·08	1816	0·75	1290	0·53	104	0·04	16	0·00	...	...	247½	0·10	2421				

TABLE G.—Anstruther District—*continued.*

Month and Number of Days Fishing.	Place where Landed	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Cwts.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (23)	St Andrews,	...	...	96	0·35	5	0·01	...	...	789	2·94	...	...	...	...	268	15 to 45 ft.	144	30 to 45 ft.	M. L. Sa.
Feb. (18)	,,	...	...	4	0·02	...	...	...	...	490	2·66	...	...	...	...	184	15 to 45 ft.	161	30 to 45 ft.	M. L.
Mar. (19)	,,	...	...	...	...	...	...	...	...	115	1·32	...	...	...	...	87	20 to 30 ft.	249	30 to 45 ft.	M. L.
Apr. (10)	,,	...	...	...	...	...	...	...	...	107	2·37	...	...	...	...	45	20 to 30 ft.	189	30 to 56 ft.	M. L.
May (20)	,,	...	...	...	...	196	2·15	...	...	85	0·93	...	...	...	...	91	20 to 30 ft.	236	30 to 56 ft.	M. L.
June (25)	,,	...	...	...	...	308	2·16	...	...	92	0·64	...	...	...	...	142	20 to 30 ft.	184	36 to 56 ft.	M. L.
July (26)	,,	...	...	...	...	275	1·89	...	...	95	0·65	...	...	...	...	145	20 to 30 ft.	112	36 to 45 ft.	M. L.
Aug. (22)	,,	...	...	...	...	40	0·36	...	...	110	0·99	...	...	...	...	111	16 to 30 ft.	57	36 to 44 ft.	M. L.
Sept. (23)	,,	...	...	...	...	91	0·66	...	...	126	0·92	...	...	...	...	136	20 to 30 ft.	115	36 to 54 ft.	M. L.
Oct. (16)	,,	...	...	7	0·07	38	0·41	...	...	92	1·01	...	...	...	...	91	20 to 30 ft.	162	36 to 45 ft.	M. Sa.
Nov. (22)	,,	...	...	18	0·24	116	1·56	...	...	29	0·39	...	...	...	...	74	20 to 30 ft.	251	36 to 45 ft.	M. Sa.
Dec. (18)	,,	...	...	...	...	176	2·22	...	...	6	0·07	...	...	...	...	79	25 to 30 ft.	260	30 to 45 ft.	M.
Total	for year .	...	...	125	0·08	1245	0·87	...	...	2136	1·47	...	...	...	...	1453				

TABLE G.—MONTROSE DISTRICT.

Months and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (6)	Broughty Ferry,	...	...	43	2·86	25½	1·70	3½	0·23	19¾	1·31	...	...	6	0·40	15	38 to 49 ft.	143	30 to 55 ft.	M. L.
Feb. (13)	„	...	...	4	0·97	4	0·97	½	0·01	153	3·73	...	...	1½	0·03	41	28 to 42 ft.	210	30 to 55 ft.	M. L.
Mar. (14)	„	...	...	34	0·36	...	...	...	...	303	3·29	...	...	28¾	0·49	92	18 to 40 ft.	113	28 to 55 ft.	M. L.
Apr. (12)	„	...	...	62	0·70	36	0·40	5½	0·06	327½	3·72	...	...	23¾	0·26	88	18 to 40 ft.	122	38 to 55 ft.	M. L.
May (19)	„	...	...	49	0·62	94½	1·21	12¼	0·15	63¼	0·81	...	...	23	0·29	78	18 to 38 ft.	202	30 to 55 ft.	M. L.
June (16)	„	...	...	5	0·12	22½	9·57	1¼	0·03	49	1·25	...	...	12	0·30	39	18 to 28 ft.	224	30 to 55 ft.	M. L.
July (11)	„	...	...	1	0·04	4½	0·18	...	...	31	1·24	...	...	12¾	0·51	25	18 to 20 ft.	56	30 to 38 ft.	M. L.
Aug. (19)	„	...	...	...	..	3	0·06	¼	0·005	61½	1·30	...	...	28¼	0·61	47	18 to 30 ft.	58	28 to 30 ft.	M. L.
Sept. (16)	„	...	...	1	0·03	1½	0·05	½	0·01	37½	1·38	...	...	10	0·37	27	18 to 28 ft.	155	27 to 55 ft.	M. L.
Oct. (7)	„	...	...	...	...	4	0·28	½	0·03	25½	1·82	...	...	4½	0·32	14	18 to 20 ft.	127	30 to 55 ft.	M. L.
Nov. (1)	„	...	...	...	...	...	...	...	...	½	·5	...	...	...	...	1	20 ft.	25	...	M. L.
Dec. (12)	„	...	...	8	0·38	29	1·38	9	0·42	8½	0·40	...	...	10½	0·50	21	18 to 23 ft.	208	30 to 54 ft.	M. L.
Total	for year	...	...	207	0·42	224½	0·46	33¼	0·06	1080	2·21	...	...	161	0·33	488				

TABLE G.—MONTROSE DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (15)	Arbroath,	74	1·15	90	1·40	16	0·25	...	...	...	...	...	...	78	1·21	64	...	...	...	M. H.
Feb. (14)	"	23	3·83	39	6·50	59	9·83	...	...	...	...	...	...	23	3·83	60	18 to 30 ft.	...	...	M.
Mar. (15)	"	...	...	24	0·55	25	0·58	...	...	1	0·02	...	...	14	0·32	43	18 to 30 ft.	...	...	M
Apr. (14)	"	...	...	29	...	43	0·97	...	...	...	...	...	...	13	0·29	44	18 to 30 ft.	...	...	M.
May (20)	"	...	...	26	0·38	43	0·63	...	...	...	...	...	...	5	0·07	68	18 to 30 ft.	...	...	M.
June (21)	"	...	...	75	0·91	16	0·19	...	...	...	...	...	...	35	0·42	82	18 to 30 ft.	...	...	M.
July (21)	"	...	...	46½	7·75	35	5·83	2	0·03	...	...	...	...	3	0·05	60	18 to 30 ft.	...	...	M.
Aug. (15)	"	...	...	10	2·50	21	5·25	...	...	...	...	...	...	4	0·10	40	18 to 30 ft.	372	30 to 50 ft.	M.
Sept. (22)	"	...	...	20	0·37	36	0·67	6	0·11	...	...	...	...	4	0·07	53	18 to 30 ft.	315	30 to 50 ft.	M.
Oct. (12)	"	...	...	11	0·52	20	0·95	1	0·04	...	...	...	...	6	0·28	21	18 to 30 ft.	392	30 to 50 ft.	M.
Nov. (19)	"	...	...	32	0·84	10	0·26	...	...	...	...	...	...	45	1·18	38	18 to 30 ft.	292	30 to 50 ft.	M.
Dec. (21)	"	16½	0·41	441	11·02	10	0·25	...	...	...	...	3	0·07	24	0·60	40	18 to 30 ft.	514	30 to 50 ft.	M. H.
Total	for year	113½	0·10	843½	1·37	334	0·54	9	0·01	1	0·00	3	0·00	254	0·41	613				

TABLE G.—MONTROSE DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (1)	Auchmithie,	...		...		...		...		...		...		25	2·77	9	18 ft.	65	18 to 28 ft.	M.
Feb. (1)	"	...		...		5	0·45	...		...		...		25	2·27	11	18 ft.	88	18 to 28 ft.	M.
Mar. (9)	"	...		...		79	1·08	...		...		...		71	0·97	73	18 ft.	90	18 to 28 ft.	M.
Apr. (3)	"	...		20	0·68	50	1·72	...		...		...		10	0·34	29	18 ft.	99	18 to 28 ft.	M.
May (3)	"	...		15	1·00	37	2·46	...		...		...		2	0·13	15	18 ft.	142	18 to 28 ft.	M.
June (2)	"	...		6	0·54	24	2·17	2	0·18	...		...		...		11	18 ft.	175	18 to 28 ft.	M.
July (1)	"	...		1	0·33	6	2·00	1	0·33	...		...		...		3	18 ft.	100	18 ft.	M.
Aug. (1)	"	...		6	1·00	12	2·00	...		...		...		...		6	18 ft.	77	18 to 28 ft.	M.
Sept. (1)	"	...		2	0·66	...		...		...		...		...		3	18 ft.	37	18 ft.	M.
Oct. (2)	"	...		8	0·88	17	1·88	2	0·22	...		...		...		9	18 ft.	112	18 to 28 ft.	M.
Nov. (4)	"	...		...		32	4·57	15	2·14	...		...		...		7	18 ft.	154	18 to 28 ft.	M.
Dec. (6)	"	...		19	0·63	45	1·50	19	0·63	234	0·09	...		8	0·26	30	18 to 20 ft.	143	18 to 28 ft.	M.
Total	for year	...	...	77	0·37	307	1·49	39	0·18	234	1·13	...	...	141	0·68	206				

TABLE G.—MONTROSE DISTRICT—*continued.*

Month and Number of Days Fishing.	Place where Landed.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Sand Eels.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (16)	Montrose and Ferryden,	...		132	0·83	233	1·47	10	0·06	3	0·01	...		80½	0·50	158	18 to 45 ft.	717	30 to 54 ft.	M. H. L.
Feb. (16)	,,	...		141	0·46	1308	4·33	5	0·01	½	0·001	...		87	0·28	302	18 to 54 ft.	575	30 to 54 ft.	M.
Mar. (12)	,,	...		121	1·53	140	1·77	9½	0·12	4¼	0·05	...		32	0·40	79	18 to 54 ft.	477	18 to 54 ft.	M.
Apr. (6)	,,	...		27	1·17	25	1·08	1¾	0·076	2½	0·10	...		7½	0·32	23	18 to 30 ft.	441	18 to 54 ft.	M.
May (18)	,,	...		88	1·07	86½	1·05	15¼	0·18	8¼	0.01	¼	0·003	24	0·29	82	18 to 30 ft.	452	18 to 54 ft.	M.
June (19)	,,	...		73	0·85	80	0·94	39¼	0·46	4	0·04	...		24½	0·28	85	18 to 30 ft.	239	30 to 54 ft	M.
July (20)	,,	...		67	0·78	77½	0·91	64	0·75	6¼	0·07	...		25¼	0·29	85	18 to 30 ft.	163	30 to 54 ft.	M.
Aug. (16)	,,	...		27	0·42	39½	0·62	49½	0·78	7½	0·11	¼	0·003	21	0·33	63	18 ft.	116	18 to 35 ft.	M.
Sept. (19)	,,	...		36	0·37	85½	0·90	62½	0·65	28	0·29	...		27½	0·28	95	18 to 30 ft.	412	18 to 54 ft.	M.
Oct. (16)	,,	...		34	0·23	91½	0·63	44	0·30	22	0·15	¾	0·005	31	0·18	143	18 to 54 ft.	422	18 to 54 ft.	M.
Nov. (20)	,,	...		105	0·51	303	1·77	69	0·40	31	0·18	...		74	0·43	171	18 to 35 ft.	721	18 to 54 ft.	M.
Dec. (19)	,,	...		140	1·25	178	1·58	69	0·61	11	0·09	...		75	0·66	112	18 to 40 ft.	918	18 to 54 ft.	M. C.
Total	for year	...	...	991	0·71	2647½	1·89	438¾	0·31	128¼	0·09	1¼	0·00	509¼	0·36	1398				

TABLE G.—MONTROSE DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (21)	Johnshaven, .	233	1.35	1297	7·54	1501	0·87	3	0·01	...		...		150	0·87	172	18 to 34 ft.	219	22 to 35 ft.	M. H.
Feb. (21)	„ .	44	0·29	567	3·85	204	1·38	3	0·02	...		4½	0·03	60	0·40	147	18 to 28 ft.	235	22 to 35 ft.	...
Mar. (20)	„ .	...		479	4·93	32	0·32	...		4	0·04	...		87	0·89	97	18 to 22 ft.	189	22 to 35 ft.	...
Apr. (16)	„ .	...		10	0·12	68	0·83	...		...		...		25	0·30	81	18 to 25 ft.	39	22 to 45 ft.	...
May (18)	„ .	...		6	0·05	81	0·74	...		...		...		19	0·17	108	14 to 22 ft.	78	22 to 50 ft.	...
June (23)	„ .	...		...		49	0·40	127	1·04	...		...		6	0·04	122	14 to 18 ft.	54	22 to 45 ft.	...
July (24)	„ .	...		...		12	0·09	243	1·85	...		...		...		131	14 to 18 ft.	...	...	...
Aug. (20)	„ .	...		...		14	0·18	87	1·12	...		...		3	0·03	77	14 to 22 ft.	...	...	...
Sept. (20)	„ .	...		...		69	0·73	65	0·69	...		...		20	0·21	94	14 to 22 ft.	125	22 to 35 ft.	...
Oct. (14)	„ .	...		10	0·13	59	0·80	36	0·49	3	0·04	...		23	0·31	73	18 to 22 ft.	174	22 to 35 ft.	...
Nov. (18)	„ .	...		97	1·40	34	0·49	31	0·44	...		...		26	0·37	69	14 to 22 ft.	276	22 to 35 ft.	...
Dec. (21)	„ .	3	0·02	498	3·77	136	1·03	34	0·25	2	0·01	...		90	0·68	132	18 to 30 ft.	284	22 to 38 ft.	M. H.
Total	for year .	280	0·21	2964	2·27	2259	1·73	629	0·48	9	0·00	4½	0·00	509	0·39	1303				

TABLE G.—MONTROSE DISTRICT—*continued.*

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
		Crans.	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
1889. Jan. (17)	Gourdon, .	120½	0·26	1490	3·31	862½	1·91	8	0·01	5	0·01	3½	0·007	254	0·56	450	18 to 26 ft.	318	26 to 36 ft.	M. H.
Feb. (20)	,, .	25	0·04	769	1·49	2185	4·24	10	0·01	...		...		168	0·32	515	18 to 26 ft.	418	26 to 36 ft.	M. H.
Mar. (16)	.	...		520	1·25	1242	3·00	51	0·12	...		...		283	0·68	413	16 to 26 ft.	326	18 to 36 ft.	M.
Apr. (15)	,, .	...		341	0·91	441	1·18	25½	0·06	3½	0·09	...		120½	0·32	371	16 to 18 ft.	310	26 to 53 ft.	M. Lt.
May (23)	,, .	...		427	0·79	636	1·18	28½	0·05	7	0·01	...		187½	0·34	537	16 to 18 ft.	...	26 to 53 ft.	M. Lt.
June (25)	,, .	5	0·007	392	0·61	657	1·03	260	0·40	36	0·05	...		195	0·30	636	16 to 18 ft.	...	26 to 53 ft.	M. Lt.
July (24)	,, .	...		158	0·39	234	0·58	595	1·49	24	0·06	...		84	0·21	398	16 to 18 ft.	...	...	M. Lt.
Aug. (19)	,, .	...		56	0·15	162	0·43	342	0·91	18	0·04	...		32	0·08	372	16 to 18 ft.	...	...	M. Lt.
Sept. (22)	,, .	...		107	0·16	1093	1·69	448	0·69	47	0·07	...		292	0·45	640	16 to 30 ft.	503	26 to 50 ft.	M.
Oct. (16)	,, .	...		122	0·22	718	1·30	390	0·70	18	0·03	...		229	0·41	552	20 to 32 ft.	160	32 to 38 ft.	M. Lt.
Nov. (22)	,, .	...		901	1·30	1019	1·47	112	0·16	46½	0·06	...		239½	0·34	689	26 to 28 ft.	164	28 to 38 ft.	M. H. Lt.
Dec. (21)	,, .	...		2430	5·61	758	1·75	113	0·26	54	0·12	43	0·09	180	0·41	433	22 to 28 ft.	344	22 to 38 ft.	M. Lt.
Total	for year .	150½	0·02	7713	1·18	10007½	1·66	2383	0·39	259	0·04	46½	0·00	2264½	0·37	6006				

TABLE G.—STONEHAVEN DISTRICT.

Month and Number of Days Fishing.	PLACE WHERE LANDED.	Quantity of Net and Line Fish caught within the Territorial Waters.														Number of Trips and Size of Boats Fishing.				Kind of Bait used.
		Herring.		Cod.		Haddock.		Whiting.		Soles, Dabs, and Flounders.		Skate and Turbot.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.		
1889.		*Crans.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*	
Jan. (21)	Shieldhill to Skateraw	3853	3·67	658	0·62	968	0·92	31	0·02	14	0·01	9	0·008	99	0·09	1049	18 to 40 ft.	634	18 to 40 ft.	M. H. Lv.
Feb. (20)	"	1638	2·10	267	0·34	1587	2·03	58	0·07	20	0·02	...	...	61	0·07	779	18 to 41 ft.	491	18 to 41 ft.	M. H. Lv.
Mar. (17)	"	...	...	142½	0·29	1075	2·21	20	0·04	15½	0·03	...	...	18	0·03	486	16 to 40 ft.	600	16 to 40 ft.	M. Lv.
Apr. (16)	"	...	...	127	0·25	859	1·70	8	0·01	6	0·01	...	...	8	0·01	505	16 to 26 ft.	285	16 to 61 ft.	M. H. Lt. Lv.
May (26)	"	...	...	141	0·22	801	1·27	87	0·13	11	0·01	...	...	21	0·03	629	16 to 26 ft.	269	16 to 61 ft.	M. H. Lt. Lv.
June (25)	"	...	...	118	0·15	1044	1·39	559	0·75	18	0·02	...	...	15	0·01	751	16 to 26 ft.	267	40 to 58 ft.	M. H. Lt. Lv.
July (23)	"	76	0·22	41	0·11	264	0·76	365	1·06	7	0·02	...	...	8	0·02	343	16 to 48 ft.	715	40 to 58 ft.	M. H. Lt.
Aug. (23)	"	...	...	16	0·05	103	0·37	294	1·06	6	0·02	...	...	11	0·03	277	14 to 26 ft.	958	40 to 61 ft.	M. H.
Sept. (24)	"	...	...	63	0·13	515	1·10	330	0·70	20	0·04	...	...	19	0·04	466	18 to 40 ft.	475	20 to 40 ft.	M. H. Lt. Lv.
Oct. (25)	"	...	...	125	0·18	611	0·89	465	0·68	26	0·03	...	...	28	0·04	683	16 to 40 ft.	1039	18 to 40 ft.	M. Lt. Lv.
Nov. (24)	"	...	...	203	0·45	380	0·85	274	0·61	27	0·06	5	0·01	18	0·04	444	16 to 40 ft.	912	18 to 40 ft.	M. Lt. Lv.
Dec. (25)	"	32	0·04	1148	1·47	1074	1·38	316	0·40	25	0·03	36	0·04	155	0·19	777	16 to 40 ft.	563	18 to 40 ft.	M. H. Lt. Lv.
Total	for year	5599	0·77	3049½	0·42	9281	1·29	2807	0·39	195½	0·02	50	0·00	461	0·06	7189				

TABLE H.—Showing the Quantities of Fish captured by Line Fishermen in the Territorial Waters, with the Average per 'shot' in 1888 and 1889.

DISTRICT.	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles, Flounders and Drabs.		Skate and Turbot.		Other White Fish.		Total Fish.		Total Trips.
	1888.																
Leith,	2,753	0·26	8,324¾	0·78	10,950¾	1·02	911½	0·08	2,524¼	0·23	381¾	0·03	91½	0·009	25,937½	2·434	10,655
Anstruther,	12,173¾	0·81	8,369½	0·56	14,220¼	0·95	2,224½	0·14	4,428	0·29	25¼	0·001	723½	0·04	42,164¾	2·834	14,876
Montrose,	196½	0·01	11,496	1·04	18,934½	1·72	2,360½	0·21	1,696¾	0·15	68¾	0·006	6,090¾	0·55	40,844¾	3·712	11,003
Stonehaven,	2,618	0·40	1,400	0·21	10,520	1·60	2,067¼	0·31	284	0·04	13	0·001	1,289¼	0·19	18,191½	2·780	6,543
Total,	17,741¼	0·411	29,590¼	0·686	54,625½	1·268	7,563¾	0·175	8,933	0·207	488¾	0·011	8,195	0·190	127,137½	2·951	43,077
	1889.																
Leith,	3,534½	0·34	9,858½	0·96	6,576½	0·64	649	0·06	1,885½	0·18	614	0·06	1,510¼	0·14	24,628¼	2·408	10,227
Anstruther,	11,908½	0·76	14,730½	0·95	12,170¼	0·81	1,861¼	0·12	2,979½	0·19	198	0·01	457¾	0·02	44,305¾	2·897	15,468
Montrose,	1,894	0·189	12,777½	1·27	15,779½	1·57	3,532	0·15	1,711¼	0·17	55¼	0·005	3,838¾	0·38	39,588¼	3·953	10,014
Stonehaven,	5,599	0·77	3,049½	0·42	9,281	1·29	2,807	0·39	195½	0·02	50	0·00	461	0·06	21,443	2·982	7,189
Total,	22,936	0·502	40,416	0·941	43,807¼	1·021	8,849¼	0·206	6,771¾	0·157	917¼	0·021	6,267¾	0·146	129,965¼	3·029	42,898

Note.—The Decimal figures in the second columns give the average cwts. per 'shot.'

TABLE I.—Showing the Monthly Amounts in cwts. of Round and Flat Fish landed by Line Fishermen and Beam Trawlers on the East Coast of Scotland during 1889.

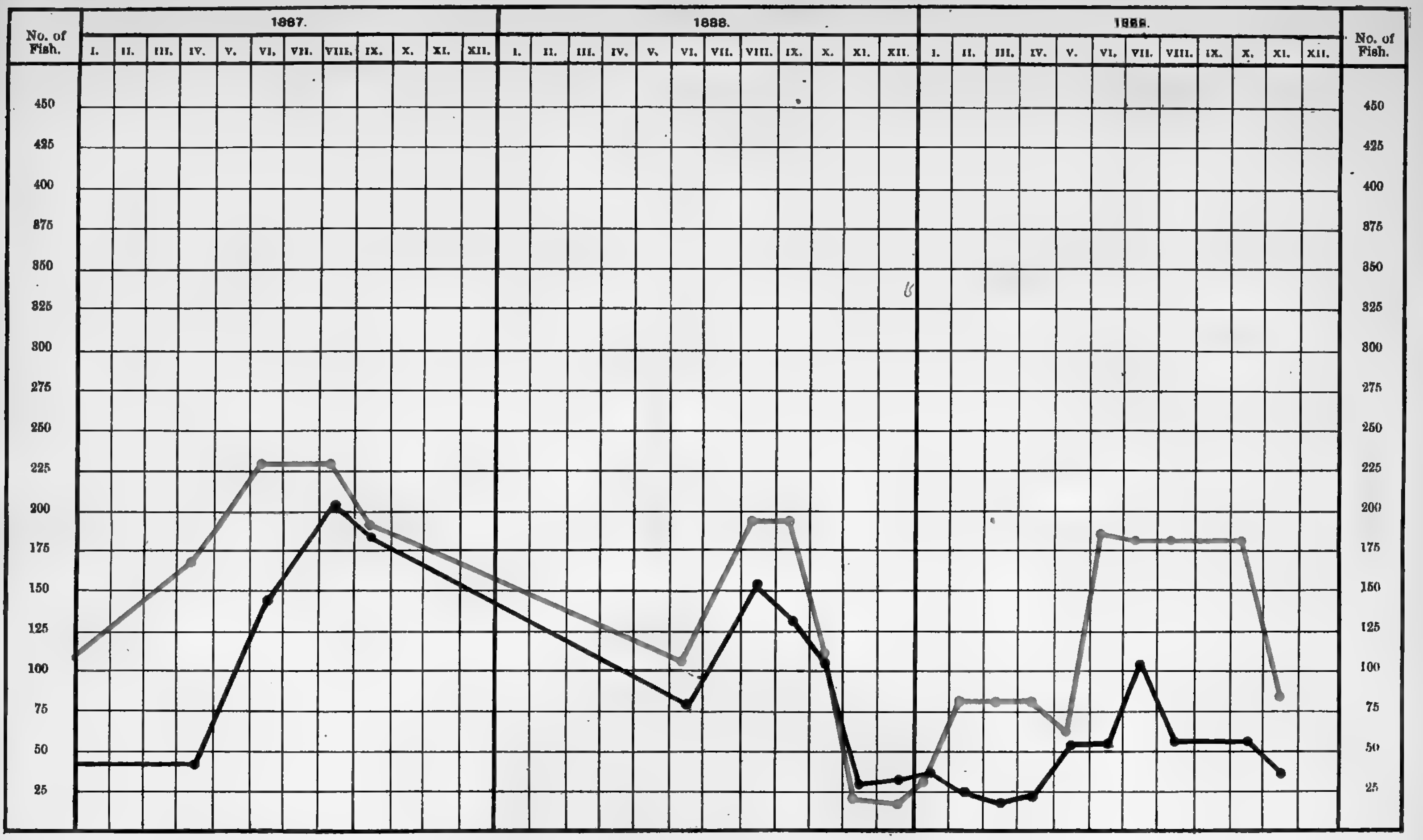
	Northern Section (from Aberdeen northwards).				Southern Section (south of Aberdeen).				Whole East Coast.			
	Round Fish.		Flat Fish.		Round Fish.		Flat Fish.		Round Fish.		Flat Fish.	
	Line.	Beam Trawl.	Line.	Beam Trawl.	Line.	Beam Trawl.	Line.	Beam Trawl.	Line.	Beam Trawl.	Line.	Beam Trawl.
January,	87,809¼	4,849	3,387¾	5,330	43,339	5,433	1,518	843½	131,148¼	10,282	4,905¾	6,173½
February,	81,092	4,494	2,479	3,473	53,209	2,896	1,975	710½	134,301	7,390	4,454	4,183½
March,	74,632	10,180	4,022	3,052	39,462	5,447	1,727½	810	114,094	15,627	5,749½	3,862
April,	52,429	7,999	5,763½	2,943	44,433	5,441	1,649	635	96,862	13,440	7,412½	3,578
May,	66,272	4,498	10,373¾	3,887	70,200	3,913	3,815½	1,115½	136,472	8,411	14,189¼	5,002½
June,	42,604	6,062	2,721¼	3,271	43,836	6,877	1,938	1,200	86,440	12,939	4,659¼	4,471
July,	15,664	7,848	910	3,560	8,607	5,175	608	1,082¾	24,271	13,023	1,518	4,642¾
August,	12,123	9,131	712	3,027	5,393	6,152	647½	1,620	17,516	15,283	1,359½	4,647
September,	27,907	10,795	712¼	3,084	12,916	10,264	937½	2,962½	40,823	21,059	1,649¾	6,046½
October,	60,804	11,186	1,562½	3,411	22,668	7,114	849	1,817½	83,472	18,300	2,411½	5,228½
November,	60,485	8,934	1,670⅓	3,460	33,180	7,835	1,079	2,135½	93,665	16,769	2,749½	5,595½
December,	58,427¾	9,174	1,988	5,667	39,958	5,121	824	1,498	98,385¾	14,295	2,812¼	7,165
Totals,	640,249	95,150	36,302⅓	44,165	417,201	71,668	17,568	16,430¾	1,057,450	166,818	53,870¾	60,595¾

PLATE I.

CHART showing the Results of the "Garland's" Trawlings.

The red line gives the average per "shot" of flat fish; the black line gives the average per "shot" of round fish.

I. FIRTH OF FORTH—CLOSED AREA.



II. ST. ANDREWS BAY—CLOSED AREA.

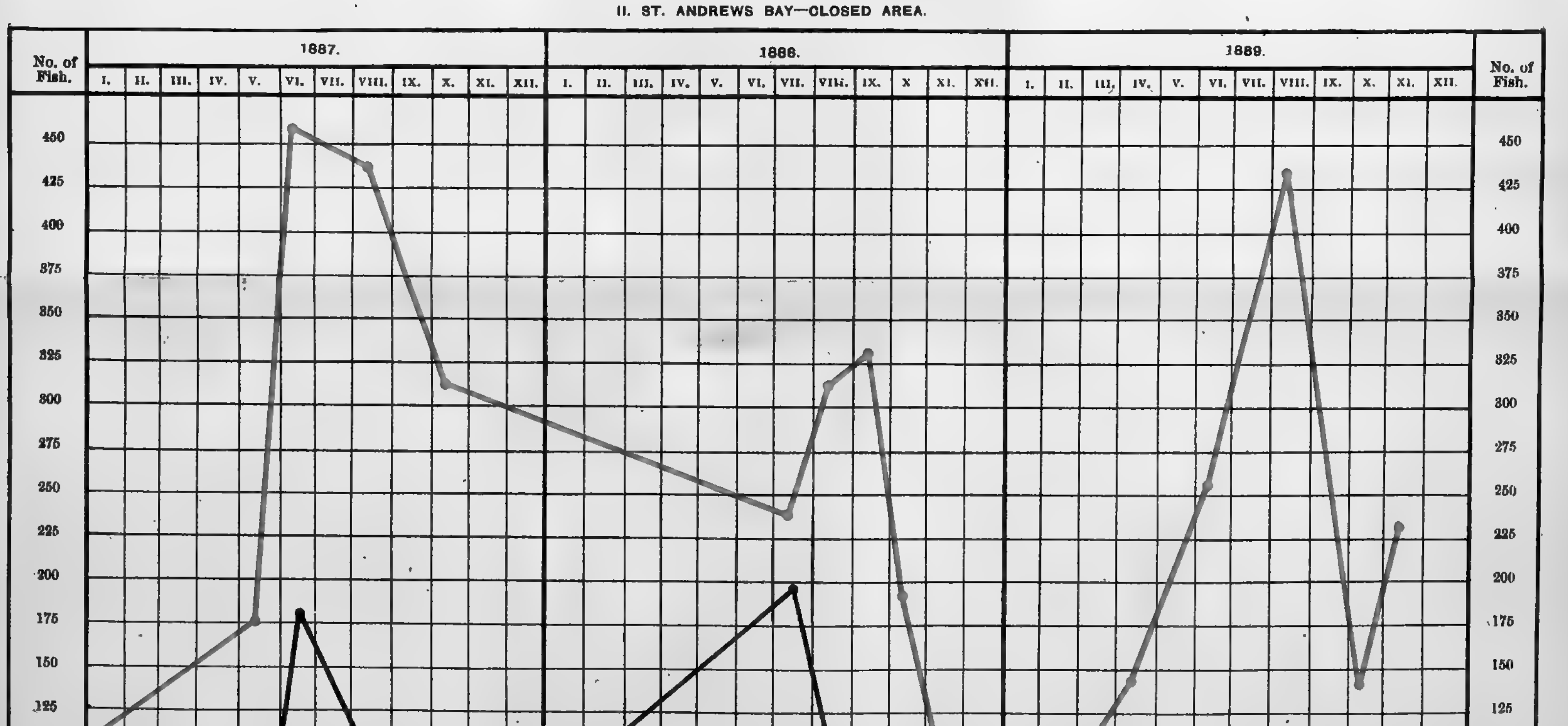


CHART showing the relative Monthly Quantities of Fish (exclusive of Herring, Sprats, and Mackerel) landed by Line Fishermen and Beam Trawlers along the East Coast of Scotland in 1889.

N.B.—The black lines represent fish caught by line; the red lines those caught by steam beam trawl. The thick lines indicate round fish; the thin lines flat fish. The arrows at the sides indicate the monthly averages.

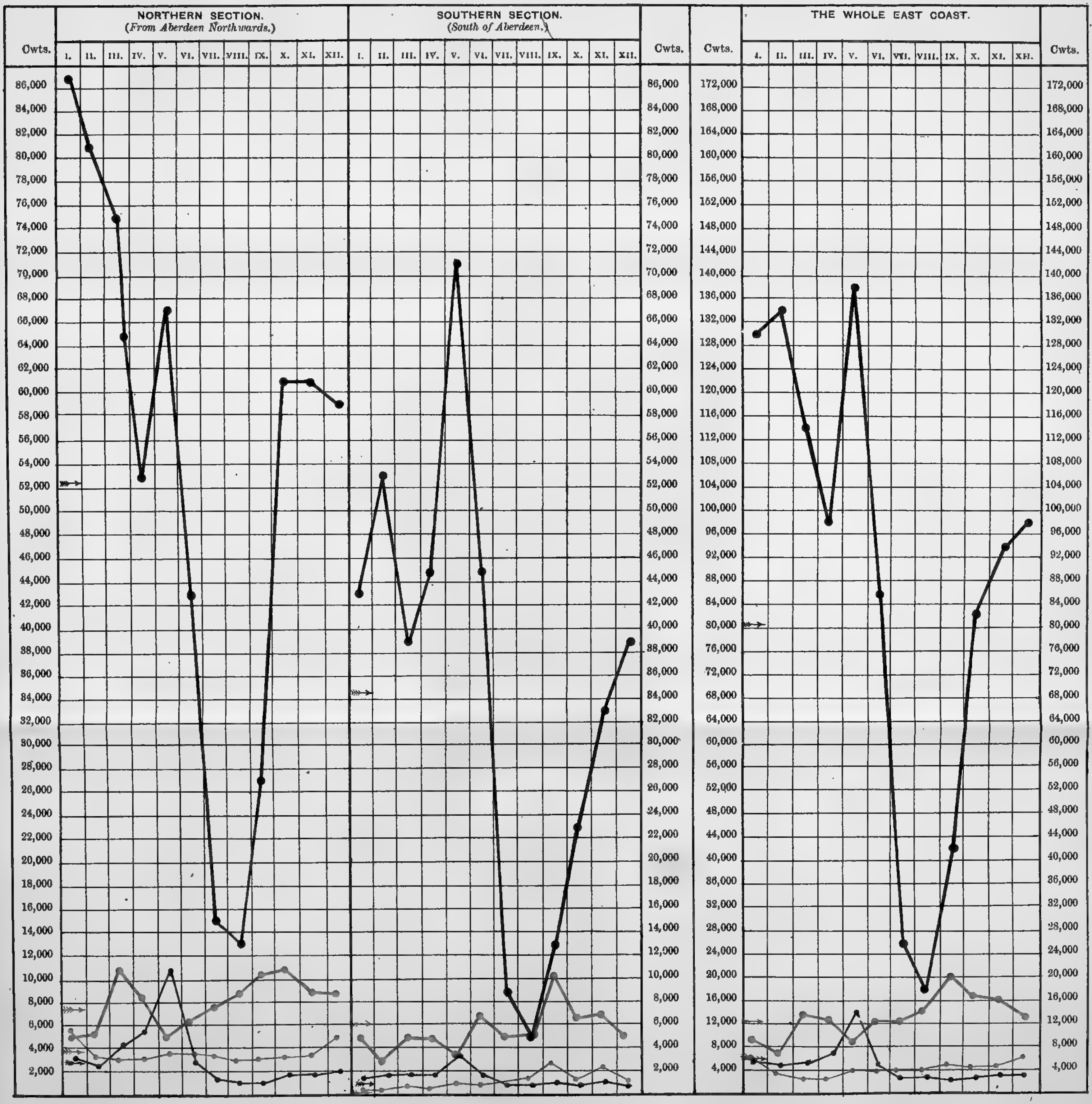


CHART shewing the chief Trawling Stations of the "Garland" on the East Coast.

PLATE III.

II.—THE DISTRIBUTION OF IMMATURE SEA FISH, AND THEIR CAPTURE BY VARIOUS MODES OF FISHING. By Dr T. Wemyss Fulton, Secretary for Scientific Investigations.

I. INTRODUCTORY.

There are few questions connected with the prosecution of sea fisheries of greater immediate interest than that relating to the capture of immature fish. It is a subject related more or less to almost every mode of fishing; and it is the subject about which cluster most of the objections urged against certain of these modes, such as beam trawling, shrimping, and the use of the bag-net and seine. The complaint of the wasteful destruction of young fish is a very old one. At the present time it has assumed especial importance in connection with beam trawling; and an International Conference, under the auspices of the National Sea Fisheries Protection Association, has been called to meet in London in July to consider the subject.

Careful investigations have recently been made by the Fishery Board, by means of the steamer 'Garland,' into the distribution and capture of immature fish on the East Coast of Scotland. Before describing these investigations and the results that have been obtained, it may be well to glance at the history of the question.

1. Previous Legislation.

Complaints as to the wasteful destruction of the fry and brood of fish have been made from very early times, and a number of Acts of Parliament have been passed dealing with the matter. As was to be expected, the earlier Acts related exclusively to river and lake fisheries. Thus, in the reign of Edward I., it was made penal to destroy young salmon 'from the midst of *April* to the Nativity of St. *John Baptist*.' *

In the reign of Richard II. this clause was re-enacted, with the addition that 'no Fisher or Garth-man, nor any other' was to be allowed to use nets called 'Stalkers, nor other nets or engines whatsoever they be 'by the which the Fry or the Breed of the Salmons, Lampreys, *or any other Fish*, may in any wise be taken or destroyed.'†

In the reign of Edward III. a petition was made to Parliament in the session 1376–77, stating that the abundance of fish in creeks and havens had been greatly diminished by the employment of a trawl-net (called *Wondyrchoum*‡), which captured all small fish that entered it, and also destroyed the spawn and brood of fish.

The first Act of Parliament I have found to specifically deal with the wasteful capture of immature sea fish, was passed in the reign of Henry VII.§ This Act states that while 'dyvers statutes and

Edward I. c. 47 (1284).

† 13 Richard II., c. 19 (1389–90).

‡ It might be supposed that this net was not identical with the modern beam trawl, but was in reality like the *Wonderkuil*, at present used in the Zuider-see, and which is slung between two boats which run before the wind; but in the petition it is said to be made after the fashion of a drag for oysters.

§ Henry VII. c. 21 (1488–89).

'ordenaunces' have been made for the preservation of the fry and brood of fish in the rivers of England, none had been made 'for savynge and 'kepynge of frye and brood of Fysshe resortyng out of the See and Salt-waters in to Havens and Crekes wythin the sayd Reame,' and is passed for the preservation of such fry in the Nasse and Haven of Orforde in Suffolk (Orfordness). It appears from this Act that the fry were destroyed not by the beam trawl, but by stow-nets or bag-nets, and that they were used for manure, &c. 'In late dayes,' the Act quaintly continues, 'for a 'singuler covetyse and lucre certeyne persones have used to set and 'ordeyne certeyne botes called Stallbotes festened with ankers, havyng 'wyth theym suche maner unresonable nettes and engynes,' that all kinds of fry and brood are destroyed—'Wyth whiche frye and broode the said 'persones wythe parte thereof fede their hogges, and the residue they put 'and ley it in grete pyttes in to the grounde, which elles wolde torn to 'such perelous infeccion of eyre that noo persone thider resortyng sholde 'it abyde or suffre.'* The ground for interference with this bag-net fishing was that it 'causeth grete scarcite of Fysshe in that countrees '(Norfolk and Suffolk) where afore this tyme were wounte to be grete 'plente.' The penalty was £10 for every offence, and the justices of the peace were empowered to inquire and examine into the kinds of nets and engines used. In 1491 this Act was confirmed by parliament, on the ground that the supply of fish had been increased by its operation.

In the above Act no fish are specified, and no attempt is made to define what fry or brood is. In an Act passed during the reign of Elizabeth, however, a minimum size is fixed for certain fish.† This Act was for the preservation of the 'spawn, fry, and young breed of Eels, Salmons, Pikes,' and of all other river fish, with which 'in divers places they feed Swine 'and Dogs,' 'and otherwise, lamentable and horrible to be reported, destroy 'the same, to the great Hindrance and Decay of the Commonwealth.' By this Act no one was allowed after 1st June to kill a pike under 10 inches, a salmon under 16 inches, a trout under 8 inches, or a barbel under 12 inches; the use of all engines except a trammel with a mesh of at least 2½ inches broad was prohibited. In the reign of James, and in subsequent periods in the seventeenth century, many petitions were presented and bills introduced for the purpose of dealing with the wasteful capture of small fish, and severe measures were enforced for the suppression of the employment of nets with illegal size of mesh. The first Act in which I have found a definition of undersized sea fish attempted, was passed in 1714 during the reign of George I.‡ Clause 4 of this Act states that, 'of late years the Breed and Fry of 'Seafish has been greatly prejudiced and destroyed by the using of Nets of 'too small Size or Mesh;' and makes any person liable to a penalty of £20 who shall use 'at Sea, upon the Coast of that Part of Great Britain 'called England, any Traul-net, Drag-net, or Set-net whatsoever for the 'catching of any kind of Fish (except Herrings, Pilchards, Sprats, or 'Lavidnian) which hath any Mesh or Moke of less Size than three inches 'and a half at least from knot to knot.' This Act prohibits the sale of certain kinds of fish under a fixed size, and is interesting as showing the opinions held at the beginning of last century as to what immature fish are. Clause 7 prohibits the bringing ashore, sale, offering, or exposing for sale or barter, of 'any unsizeable fish,' that is to say under the

* This fishery is at the present day called in Holland the Staalboomen-visscherij, and the produce in the Zuider-see is largly used as food for ducks, &c., and as manure (*vide* Dr Hoek's *Rapport over Ankerkuil- en Staalboomen- visscherij*, Leiden, 1888.)

† 1 Elizabeth, c. 17 (1558-9).

‡ 1 George I., st. 2, c. 18 (1714-16).

following sizes, measured 'from the Eyes to the utmost Extent of the 'Tail (*viz.*) every Bret or Turbet, sixteen inches; every Brill or Pearl, 'fourteen inches; every Codlin, twelve inches; every Whiting, six inches; 'every Bass and Mullet, twelve inches; every Sole, eight inches; every 'Place or Dab, eight inches; and every Flounder, seven inches.' The penalties were forfeiture of the fish to the poor of the parish and the payment of a fine of twenty shillings; in default of which the offender was to be 'severely whipped and kept to hard labour for a space of' at least six days.

All the above Acts, so far as they relate to sea fisheries, have been repealed. At the present time there is no restriction as to the size of mesh used or the size of sea fish taken, except in the case of herring nets on the coast of Scotland, and the enactment is quite obsolete.

2. Recent Inquiries.

In recent times various Commissions have been appointed by Government to inquire, directly or indirectly, into the capture and destruction of immature sea fish by various modes of fishing. The most extensive of these was that held by the 'Commissioners appointed to inquire into the Sea 'Fisheries of the United Kingdom,' whose report was issued in 1866.* One of the points upon which inquiry was to be made was—'Whether 'any of the methods of catching fish in use in Sea-Fisheries involves a 'wasteful destruction of fish or spawn, and, if so, whether it is probable 'that any legislative restriction upon such method of fishing would result 'in an increase of the supply of fish.' The Commissioners visited various parts of the coast and heard evidence, and found generally that while beam trawling, shrimping, the use of seine and circle-nets, and of stow-nets, and weirs involve the capture of a certain very variable proportion of small fish, there was no good grounds to believe that this destruction of small fish had diminished the supply of saleable fish. The Commission, however, admitted that, with respect to inshore fisheries, 'it is undoubtedly 'possible, that by the use of improved engines, the destruction of fry 'might reach such a pitch as to bear a large, instead of, as at present, 'an insignificant ratio to the destruction affected by the natural enemies 'of fish, and by conditions unfavourable to their existence.' And that, if such a state of things were satisfactorily proved to exist, 'the best 'remedial measure would be to place a restriction upon the size of the 'fish permitted to be brought ashore, and to subject the possessor of fish 'below a certain specified size to penalties; but to avoid interfering 'with the implements of fishermen, or with their methods of fishing.' It is very doubtful, however, if the enforcement of a regulation of this character alone would do much good. It would prevent the sale, but permit the capture and destruction of immature fish; since a large proportion of those obtained in beam trawling, and many also in shrimp trawling, probably do not live when returned to the sea.

The conclusions of this Commission (and indeed of all previous and most subsequent Commissions), were almost wholly reached by sifting the opinions of various classes of fishermen and others who appeared before them,—of 'assertions that can be neither proved nor disproved,' and of 'evidence of the most conflicting character.' The Commissioners pointed out that enough was not known 'of the number, the mode of 'multiplication, or of the conditions of existence in any locality of any 'given kind of fish,' to enable them 'to form the slightest estimate as to

* Report of the Commissioners appointed to inquire into the Sea Fisheries of the United Kingdom, vol. i.; the Report and Appendix, 1866.

'the effect which will be produced upon the number of that fish by a 'given amount of destruction of its young.'

The Commissioners (Mr Frank Buckland and Sir Spencer Walpole) appointed to inquire into the Sea Fisheries of England and Wales, reported in 1879, that 'there are no reasons for thinking that the destruc'tion of immature fish, which is undoubtedly going on, is wasteful in 'the sense that it is diminishing the future supply of mature fish.'* I am not satisfied, however, with the arguments by which this conclusion was supported. Too much stress was laid on those derived from the whitebait and herring fisheries.

In the inquiry made by the Government Commissioners in 1884 into beam trawling, scientific investigations were for the first time systematically employed in connection with the question of the destruction of immature fish. This branch of the inquiry fell into the highly competent hands of Professor M'Intosh, F.R.S., who, for the greater portion of a year, accompanied steam trawlers working off the east coast of Scotland. Professor M'Intosh made careful observations as to the results of ninety-three hauls of the trawl-net, the contents being in each case registered; and he brought to bear upon the inquiry a wide and varied knowledge of fisheries. The results of these observations are referred to below, but I may say here, that since no standard of size could be then laid down for the specimens classed by Professor M'Intosh as immature, and since the great majority of those so classed consisted of common dabs and long rough dabs—which reach maturity while still very small—it appears to me that many of the fish classed by Professor M'Intosh as immature, were in reality adult; and, conversely, that many excluded from the class of immature fish were immature. Thus, for instance, not a single immature cod is mentioned. This Commission reported as follows:—'We are of opinion that, while at times a considerable number 'of immature fish may be taken in the trawl-net, these, generally speaking, 'are not of the more valuable kinds of food fishes, and that there is no 'evidence of any unnecessary or wasteful destruction of immature food 'fishes by the use of the beam-trawl.' †

The investigations undertaken by the Fishery Board as to immature fish have mainly consisted in the determination of—

1. What an immature fish is.
2. The distribution of immature fish in inshore and offshore waters at different times of the year.
3. The capture of immature fish by different modes of fishing.

II. DEFINITION OF IMMATURE FISH.

Before describing the results of the inquiry into the distribution and capture of immature fish, it is necessary first of all to define what an immature fish is. Hitherto no scientific standard has been laid down for the discrimination of immature from adult fish according to their length; although arbitrary standards have been adopted, as in the Act of 1714. But it is absolutely essential, if this question is to be treated rationally, and in order that any legislative regulations on the subject that may be made may be productive of good and not of harm, that the maximum size of immature individuals of each kind of fish should be scientifically determined. To the popular mind an immature fish is a small fish,

* Report on the Sea Fisheries of England and Wales, p. xxii, 1879.

† Report of the Commissioners appointed to inquire and report upon the complaints that have been made by Line and Drift Net Fishermen of Injuries sustained by them in their Calling, owing to the use of the Trawl Net and Beam Trawl, in the Territorial Waters of the United Kingdom, p. xxxi, 1885.

and nothing more; but, strictly, the use of the term 'immature' should be confined to the condition of the reproductive organ—the milt or roe—since no individual of a species can be considered 'mature' until it is able to reproduce its kind. There is another sense in which the word 'immature' is used in the case of fish, namely, to indicate the condition of the reproductive organ at a period remote from the time of spawning. Thus, for example, a haddock examined in October will be found to have the reproductive organ small and ill-developed, quite irrespective of the size of the fish, and in one sense such a specimen might be called immature, although it had spawned in the previous March. I am aware that other factors besides the biological one, such, for instance, as the economic one relating to saleable and unsaleable fish, have been associated with the question of immature fish. I shall refer to these in the sequel. I propose to restrict the term 'immature' to young fish which have never developed ripe milt or roe—which have not yet become adult; and this must be kept carefully in view. It will be found that in this sense the maximum size of immature individuals of different species of fish (or, what is the same thing, the minimum size of mature individuals) varies immensely. An immature fish may be a large fish, and a mature fish may be very small.

The limit of size which divides an immature from an adult specimen of any fish has not previously been determined, or indeed attempted. No doubt this is owing to the fact that the investigation is more difficult, and involves more labour than one might anticipate. As a rule, fish spawn for a comparatively brief period each year, and it is not always easy to obtain ripe specimens in sufficient numbers.

In order to determine this fundamental point, I have had nearly 13,000 food fishes, belonging to all the important species examined at all times of the year, each fish being carefully measured, and the condition of the reproductive organ registered.* Of this number 756 were found ripe, and 1426 nearly ripe, and I have taken the minimum length of these specimens as mainly indicating the limit of size between maturity and immaturity. The results in regard to the ripe fish are set forth in Table I.; those regarding the 'nearly ripe' in Table II.

TABLE I.—The Maximum and Minimum Lengths (in inches) of Ripe Fish.†

Name of Fish.	Largest.	Smallest.	Difference between Largest and Smallest.	Average Size.	Number Ripe.	Number Examined.
Plaice,	28	13	15	20·7	157	2212
Lemon sole,	18	8½	9½	14·9	56	863
Common dab,	14	5½	8½	8·5	108	2061
Long rough dab,	15½	6½	9	9·1	115	1488
Flounder,	16½	7	9½	10·1	82	217
Witch sole,	19½	14	5½	17·3	14	223
Little sole,	4½	3¾	¾	4·0	5	38
Turbot,	28	23	5	25·2	4	68
Haddock,	23	12	11	16·1	20	1375
Whiting,	17½	9	8½	12·6	54	1318
Cod,	39	26	13	32·6	8	957
Gurnard,	18	8½	9½	12·4	124	1299
Cat-fish,	42	27	15	34·8	9	59

* This has been mainly done by Mr Thomas Scott, F.L.S., one of the naturalists of the Fishery Board, and partly by Mr Peter Jamieson, assistant naturalist.

† In all cases the extreme length is given, from the tip of the snout to the tip of the tail.

TABLE II.—The Maximum and Minimum Lengths (in inches) of Nearly Ripe Fish.

Name of Fish.	Largest.	Smallest.	Difference between Largest and Smallest.	Average Size.	Number nearly Ripe.	Number Examined.
Plaice,	26½	12	14½	19·5	83	2212
Lemon sole,	18	7½	10½	13·2	64	863
Common dab,	13½	5	8½	8·6	286	2061
Long rough dab,	14	5½	8½	8·3	400	1488
Flounder,	15½	7½	8	10·7	66	217
Witch sole,	19	11½	7½	16·3	41	223
Little sole,	5	3	2	3·8	15	38
Turbot,	26	18	8	20·6	6	68
Brill,	23½	20	3½	21·7	2	23
Sail fluke,	15	10	5	12·4	4	16
Haddock,	23	10	13	15·5	67	1375
Whiting,	21	8	13	13·1	111	1318
Cod,	44	20	24	34·0	53	975
Gurnard,	17	8½	8½	12·4	225	1299
Cat-fish,	27	24	3	25·3	3	59

These Tables show that the range of length of mature individuals of the same kind of fish is very great, and also that the range of length of *immature* specimens of *different* species is very great. Thus Table I. shows that the smallest ripe turbot obtained was 23 inches, the smallest ripe plaice 13 inches, the smallest ripe little sole 3¾ inches, and the smallest ripe dab 6½ inches. The proportions of ripe specimens obtained also varied considerably. (*Vide* Report on the Spawning of Fishes, p. 257).

The difference in size between the largest and smallest ripe specimens is very marked in some cases. For instance, the largest fully ripe plaice was 28 inches long, and the smallest only 13, or less than half the size. The smaller specimens were invariably males, the smallest ripe female being 20 inches in length. The average length of mature males was only 16·7 inches, while that of mature females was no less than 24 inches. The males of all the other species mentioned in the Tables, with the exception of cod and haddock, are smaller than the females. This subject is dealt with in my Report on the Proportional Numbers and Sizes of the Sexes among Marine Fishes (*vide*, p. 348). It will be observed from the Tables that the difference between minimum and maximum sizes increases generally in proportion to the number obtained. I have little doubt that, when I have collected sufficient data, I shall be able to formulate a law by which, given the average size of a species (adult and immature), it may be possible to indicate the approximate size which marks off immature individuals from adult.

In some cases in the above Tables, such as plaice, common dabs, long rough dabs, and gurnards, the figures may be accepted as indicating with some exactitude the demarcation between immature and possibly adult fish.* In some other cases the number of ripe individuals is too small to afford a basis for generalisation; but by taking into consideration the sizes of those *nearly mature* (Table II.) a fairly accurate average may be obtained. Chiefly from these two Tables, but also from a consideration of all the evidence before me, I have drawn up Table III., which shows the lengths of the *smallest ripe individuals* of the species named. Thus fish under the sizes given will be here classed as *immature* fish.

* I say 'possibly adult,' because in the same shoal, specimens having the roe or milt not fully developed may be found of a larger size than fully ripe individuals.

TABLE III.—Showing the Limit of Size between Mature and Immature Fish.

Flat Fish.	Inches.	Round Fish.	Inches.
Plaice, ... (*Pleuronectes platessa*).	12	Haddock, ... (*Gadus æglefinus*).	10
Lemon sole, ... (*Pleuronectes microcephalus*).	8	Cod, ... (*Gadus morrhua*).	20
		Whiting, ... (*Gadus merlangus*).	8
Common dab, ... (*Pleuronectes limanda*).	6	Gurnard, ... (*Trigla gurnardus*).	8
Flounder, ... (*Pleuronectes flesus*).	7	Cat-fish, ... (*Anarrhichas lupus*).	20 (?)
Witch sole, ... (*Pleuronectes cynoglossus*).	12		
Long rough dab, . . . (*Hippoglossoides limandoides*)	6		
Little sole, ... (*Solea minuta*).	$3\frac{1}{2}$		
Turbot, ... (*Rhombus maximus*).	18		
Brill, ... (*Rhombus lævis*).	16		
Sail Fluke, ... (*Arnoglossus megastoma*).	9		

At a conference of those engaged in the English East Coast fishing trade, recently held in Hull,* it was agreed that the term immature fish should be interpreted to mean 'a sole which measures less than 10 inches, 'a turbot or a brill which measures less than 12 inches, and a plaice which 'measures less than 12 inches.' I have not at present sufficient information about the English sole to enable me to determine the maximum size of immature individuals; but there can be little doubt that the size adopted for turbot and brill will exclude many immature specimens.

III. THE DISTRIBUTION OF IMMATURE FISH IN IN-SHORE AND OFF-SHORE WATERS.

In connection with the capture of immature fish by various modes of fishing, and with any legislative enactments relating thereto, it is important to determine the proportional abundance of the various kinds of immature flat fish and round fish at various distances from shore and in different depths of water. Where are young fish chiefly found? The general belief is that young fishes specially haunt the shallow waters adjacent to the shore; but it will be found that the young, and particularly the fry, of different kinds have very different habits in this respect.

* *Fish Trades Gazette*, May 10, 1890, p. 9.

It has now been demonstrated that the eggs of almost all food-fishes (except those of the herring) are pelagic, and float at or near the surface of the sea, where they are hatched. This is the case with the ova of plaice, dabs, soles, turbot, brill, whiting, cod, ling, haddock, gurnard, &c. I have also shown that the old idea held by Buckland and others, that sea-fishes come into bays and estuaries to spawn is erroneous. A few unimportant species, such as the common dab and the long rough dab, and to some extent the flounder and gurnard, spawn partly in the territorial waters; the great majority, as plaice, lemon soles, turbot, brill, cod, whiting, haddock, &c., spawn at distances more or less remote from shore. The floating eggs and the newly-hatched embryos are, however, carried in a large number of cases by the currents towards the shore; hence many young fishes may be found in great numbers in the waters around the coast, where they obtain abundance of food and shelter. Many others are carried seawards; and there is little doubt that the young of those which spawn at considerable distances from shore, such as the ling and turbot, are chiefly to be found in the offshore waters. By the use of the tow-nets it has been shown that the ova of haddock, cod, ling, and plaice may be got up to thirty miles from shore; the ova of the turbot have been found fifty miles off. Off the mouth of the Firth of Forth pelagic ova are frequently collected in large numbers, mainly those of the cod, haddock, whiting, lemon sole, and dabs.

In order to determine the relative distribution of immature fish, special observations have been made on board the steamer 'Garland,' by the employment of a specially constructed fine-meshed trawl-net, resembling generally the net used in the shrimp fishing in the Solway Firth. This net is 32 feet long, the cod-end being 8 feet in length; it is fixed to an 18-feet beam. The largest meshes are one inch, and the smallest half an inch, so that it is well adapted to capture very small fish. The observations have been made chiefly in the Firth of Forth and St Andrews Bay; but also at other parts of the east coast, namely, off Montrose and the Aberdeenshire coast, in the Moray Firth, and at the Orkney Islands. Hauls were also made at offshore fishing grounds, at distances from shore of from ten to twenty-two miles, and in water up to above fifty fathoms in depth.

The total number of fish captured was 42,088, belonging to about forty species. Excluding at present those species which are of no economic importance, and those of which the number obtained is small, the total number of immature cod, ling, haddock, whiting, gurnard, plaice, lemon sole, flounder, common dab, long rough dab, &c., obtained was 33,297 out of a total of 34,803 of these kinds captured. The data are therefore pretty extensive; and as this is the first time an attempt has been made to accurately investigate the distribution of immature fish, they will repay careful consideration.

In Table IV. I have tabulated the immature adult specimens according to their sizes, a thick line being drawn between the adult and the immature. It will be noticed how various was the proportion between the adult and the young in the different species. This, together with other facts, shows that the habitat and habits of young fishes vary very much, for the trawl, of course, can only work on a limited portion of the sea bottom. Nevertheless, it is curious that while 1118 immature plaice were caught, and only 119 adults, the immature lemon soles numbered less than half of the adults. Again, only 451 immature haddocks were captured, as compared with 124 adults; while there were 26,179 immature whitings, and only 296 adults. The immense number of very small whitings caught (the majority under four inches in length)

TABLE IV.—Showing the Numbers of the more important kinds of Fish Captured, arranged according to Sizes.

Note.—The thick line separates the adult from the immature.

Fish.	Size in Inches.																				Totals.		Grand Total.
	Above 20	20	18	17	16	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Under 1	Adults.	Immature.	
Cod,	12	..	10	7	...	16	25	...	11	...	13	40	29	49	57	72	45	68	...	...	12	442	454
Ling,	...	...	...	...	...	...	...	1	...	...	...	...	1	1	...	...	...	...	..	...	...	3	3
Cat-fish,	6	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	2	8
Turbot,	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	4
Brill,	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Plaice,	4	...	2	7	28	...	78	98	288	176	80	153	78	155	26	22	42	...	...	...	119	1118	1237
Witch sole,	...	...	...	...	5	2	...	...	1	...	1	...	...	...	...	...	...	...	...	...	7	2	9
Haddock,	...	...	...	...	8	44	...	72	...	38	3	6	19	39	153	158	22	6	4	3	124	451	575
Lemon sole,	...	...	...	...	...	...	1	70	...	41	19	17	10	10	5	11	7	4	...	...	131	64	195
Flounder,	...	...	...	...	...	1	...	...	1	1	2	3	4	...	...	...	...	...	...	...	8	4	12
Whiting,	...	...	...	...	1	23	...	25	35	35	177	286	364	1419	6765	14516	2694	117	...	...	296	26,179	26,475
Gurnard,	...	...	...	...	...	8	...	38	24	40	41	50	61	67	25	7	25	5	...	...	151	240	391
Common dab,	...	...	...	...	...	...	2	...	37	20	58	95	110	169	344	235	288	440	348	...	332	1824	2156
Long rough dab,	...	...	...	...	...	...	...	4	...	13	44	91	149	252	268	132	501	1501	247	...	301	2901	3202
Little sole,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	18	54	8	...	...	19	62	81
Totals,	22	1	12	14	47	95	106	308	397	364	438	741	825	2161	7644	15171	3678	2149	599	3	1507	33,296	34,803

was due to the presence of a vast shoal of them in the Firth of Forth in the autumn of 1889 (see p. 175).

I have been at pains to tabulate, in Tables V. and VI., the proportions of immature flat fish and round fish found at various depths and at various distances from shore. The results are of much interest and in some ways surprising. Considering, first, all the immature fish, of whatever species, it will be seen that the largest proportion was obtained at a distance of from 3 to 6 miles from shore (496 per shot), and the next largest proportion at a distance of from 6 to 12 miles (482 per shot). Within a distance of 1 mile from shore the proportion was only 87·4 per shot; from 12 to 18 miles the immature fish averaged 90·6 per shot; and at 22 miles only 16·0. It therefore appears that, while immature fish are found at considerable distances from the shore, they chiefly frequent a zone just beyond the three-mile limit. Within the three-mile limit the average number caught per shot was 141·7, while beyond the three-mile limit it was as much as 447. It must be remembered that these figures deal mainly with the Firth of Forth. The abundance of immature specimens at any given distance from shore varies also with the depth, and especially with the kind of fish. In Table VI. the average per shot in different depths is shown. The greatest proportion were obtained from water between twenty-five and thirty fathoms deep. Both in shallow water and in deep water the relative amounts were less.

Flat-Fish.

The total number of flat-fish caught in the special net was 6897, of which 5979 were immature and 918 of adult size. Immature flat-fish were found both near the shore and at all distances examined (up to 22 miles). They were also found in shallow water and in water 53 fathoms in depth, although in very different proportions. If we consider, first, the proportional abundance of young flat-fish, according to the distance from shore, it will be found (Table V.) that the largest number were obtained between six and twelve miles off, but they consisted chiefly of the commoner and less valuable kinds, namely, common dabs and, especially, long rough dabs. The average abundance in the territorial waters was also great, but in this case it was due to the presence of young plaice and common dabs. Immature flat-fish are rather more abundant beyond than within the three-mile limit, owing to the greater number of long rough dabs.

Having made these general observations, I shall now describe in detail the distribution of the young of the different kinds.

Plaice (*Pleuronectes platessa*).

Of 1237 plaice captured 1118 were immature. The distribution of immature plaice is very regular by far the largest number being got near the shore, and fewer and fewer the further from the shore. As a rule, except in certain localities in the neighbourhood of their spawning grounds, few very large plaice are got in territorial waters on the East Coast, and never in a ripe condition. They apparently never spawn within the territorial waters. Table V. shows how regularly the numbers of immature plaice increase as the shore is approached. At distances under one mile the average number per shot was 33·4; between one and three miles 10·1; between three and six miles 2·9; between six and twelve miles 1·6; and between twelve and eighteen miles 0·0. The average number per shot within the three-mile limit was 21·4, while it was only

TABLE V.—Showing the Distribution of Immature Fish, according to the Distance from Shore ; also the Relative Abundance within the Three-Mile Limit and Beyond.

Note.—The figures represent the average number per 'shot' of the trawl-net.

Distance from Shore in Miles.	Plaice.	Lemon Sole.	Common Dabs.	Long Rough Dabs.	Cod.	Haddocks.	Whiting.	Gurnard.	Total for Flat Fish.	Total for Round Fish.	Grand Average.
Under 1 . .	33·4	0·4	28·8	1·9	2·1	0·0	16·1	4·7	64·5	22·9	87·4
1 to 3 .	10·0	0·3	18·5	3·6	3·4	0·7	152·0	4·5	32·5	160·5	193·1
3 to 6 .	2·9	0·9	10·7	46·8	6·2	6·2	421·3	1·0	61·3	434·7	496·0
6 to 12 .	1·6	0·1	22·6	67·8	3·3	12·8	373·1	0·5	92·3	389·8	482·1
12 to 18 .	0·0	0·8	39·0	24·0	3·6	2·0	19·2	2·0	63·8	26·8	90·6
At 22 . .	0·3	0·0	11·0	1·1	0·6	0·6	1·0	0·9	13·0	3·0	16·0
Total for three-mile limit, .	21·4	0·3	23·5	2·8	2·7	0·3	85·9	4·3	48·1	93·6	141·7
Total for waters beyond, .	2·5	0·8	14·6	45·5	5·5	6·3	370·6	1·0	63·5	383·5	447·0

2·5 beyond. The same result appears when the depth of water is considered, by far the larger proportions being obtained in the shallower waters. Thus, in depths under five fathoms, the average number per shot was 26·7 ; in from five to ten fathoms 20 ; in from ten to fifteen fathoms 2·8 ; in from twenty-five to thirty fathoms 0·3. No other flat-fish shows the same regularity in the distribution of the young, and so far as plaice is concerned, the territorial waters may justly be described as a 'nursery.' It will be seen from Table IV. that the greater number of the immature plaice caught were fairly large sized specimens, nearly eighty per cent. being above six inches in length, and none under three inches. Had smaller individuals been present, it is difficult to understand how they could have escaped capture, since above two thousand dabs under three inches were caught in the same hauls. The very small plaice remain close in-shore, and gradually pass out into deeper water as they increase in size. The greater number of the small specimens caught were got on sandy ground in shallow water, as close in-shore as it was safe for the 'Garland' to go. On the margin of the shore in such localities very small plaice, about an inch long, may be caught in a hand-net in June and July. All those under six inches were obtained in May and June, in water only a few fathoms deep, and were clearly those spawned in previous years. The proportion of immature to adult plaice in the territorial waters is least in December, January, and February.

It is worth remarking here that, while the results of the 'Garland's' Trawling Experiments in 1889 do not show that an increase of flat-fish generally has taken place in the area from which beam trawling is prohibited, they show that plaice have increased in numbers, both in the closed area and in the adjacent area where trawling goes on. It seems reasonable to suppose that, by the protection of the young plaice in the territorial waters, the numbers on both the in-shore and off-shore grounds are being increased. It has been ascertained by the experiments which the Scientific Department of the Board have made on the migration of fishes (p. 353) that plaice of at least twelve and thirteen inches in length probably do not migrate at the spawning time from the territorial waters to the off-shore grounds where the adults spawn. This confirms the results of the examination of the reproductive organs as to the diagnosis of immature plaice.

Lemon Sole (*Pleuronectes microcephalus*).

Of 195 lemon soles obtained, 131 were adult and only 64 immature. This number is not large enough for any certain conclusions. The greater number of the immature specimens were obtained just beyond the three-mile limit, and in moderate depths. The average for the waters within three miles from shore was 0·3 per shot; 0·8, or more than double, for the waters beyond. The largest average per shot was 0·9 at from three to six miles from shore. In regard to depth, immature individuals were obtained up to thirty fathoms, the largest proportion being found between fifteen and twenty fathoms.

As in the case of the plaice, the majority of the immature specimens were fairly large, about half of them being above 6 inches in length. In the case of the lemon sole, however, the smallest specimens were obtained in water above ten fathoms deep, three of the four specimens two inches in length being caught in March and May in about twenty fathoms. At Smith Bank, the great spawning ground in the Moray Firth, where few immature fish are obtained, a few lemon soles of four and a half inches were caught. The lemon sole spawns mainly in June, and generally at some distance from shore.

TABLE VI.—Showing the Distribution of Immature Fish according to the Depth of Water.

Note—The figures give the average number per 'shot' of the trawl-net.

Depth in Fathoms.	Plaice.	Lemon Soles.	Common Dabs.	Long Rough Dabs.	Cod.	Haddock.	Whiting.	Gurnard.	Total for Flat Fish.	Total for Round Fish.	Grand Total.
1 to 5 . .	26·7	0·1	23·7	0·8	2·9	...	29·1	4·0	51·4	36·1	87·5
5 to 10 . .	20·0	0·6	15·9	7·8	3·2	...	156·9	2·8	44·8	162·8	207·6
10 to 15 . .	2·8	0·8	26·5	13·3	5·5	2·2	200·0	3·0	43·5	211·2	254·7
15 to 20 . .	3·8	1·2	13·8	56·0	6·8	6·0	492·7	1·8	74·8	507·3	582·1
20 to 25 . .	0·9	0·7	24·7	75·8	2·0	3·8	178·1	1·4	102·1	185·3	287·4
25 to 30 . .	0·3	0·2	2·2	45·2	7·0	19·0	841·7	0·6	47·8	868·4	916·2
30 to 35 . .	0·7	...	8·6	107·3	...	9·3	50·0	1·0	116·6	60·3	176·0
50 to 55 . .	...	...	...	49·0	7·5	0·5	33·0	...	49·0	41·0	90·0

Common Dab (*Pleuronectes limanda*).

Of the 2156 specimens of the common dab obtained, 332 were of adult size and 1824 were immature. The distribution of the young individuals of this species presents a curious contrast to that of the young of the long rough dab. Immature common dabs are found pretty generally distributed both in the in-shore and off-shore waters, and in depths to about twenty-five fathoms; but they are proportionally more numerous in the territorial than in the extra-territorial waters. The average number per shot of the trawl was 23·5 within three miles from shore, and 14·6 in the waters beyond. The in-shore waters may therefore be said to be nurseries for this flat-fish—but not to the same exclusive extent as in the case of the plaice. The average number of immature individuals per shot was 28·8 at distances under one mile from shore, and 18·5 at distances of from one to three miles. The young were proportionally more numerous at distances between twelve and eighteen miles, where the average per shot was 39·0. Even on ground twenty-two miles from land they were relatively very numerous. In regard to depth, the distribution is pretty equal up to twenty-five fathoms. In deeper water immature specimens appear to be comparatively scarce, although a considerable number between two and three inches in length were taken on Smith Bank.

Considerably more than half of the young dabs were under three inches in length, 348 of these being about or a little over one inch long. These very small specimens were got in deep as well as in shallow water, chiefly in May, February, and March; and they appear to occur in patches or 'nurseries.' In one haul in eighteen fathoms, four miles from shore, 77 between one and two inches long were captured in May; and in another haul in March in fifteen fathoms, five miles from shore, 97. On the other hand, in May, 83 were caught in one haul in water under four fathoms deep and less than a mile from shore. Eighteen specimens between two and three inches long were caught in June twenty-two miles from land.

These facts as to the distribution of immature common dabs agree with what we know of their spawning habits, for this is one of the few fishes which spawns in territorial as well as in extra-territorial waters. The immature forms seem to be reared almost anywhere.

Long Rough Dab (*Hippoglossoides limandoides*).

The number of long rough dabs obtained was 3202, of which 301 were of adult size and 2901 immature. The distribution of the young individuals of this species differs much from that of the young of the common dab, and contrasts markedly with that of immature plaice. The great proportion of young long rough dabs are found in off-shore waters, an average of only 2·8 per shot being caught within the three-mile limit, as against 45·5 per shot beyond. There is a gradual increase in their numbers up to a distance of twelve miles from shore. Similarly, the greatest number was obtained in deep water (thirty to thirty-five fathoms). It was the only young flat-fish obtained in the deep water of the Moray Firth—fifty to fifty-five fathoms.

Nearly eighty per cent. of the immature long rough dabs were under three inches in length, no less than 1501, or considerably over half of these obtained, being about two inches long; the greater number of the very small specimens were obtained in deep water in September, February, March, and April, scarcely any being from water of less depth than twelve fathoms, and the majority from water about twenty fathoms deep.

For instance, 173 little long rough dabs, from one inch to an inch and a half in length, were obtained in May, in one haul in twenty fathoms, four miles from shore; and 61, equally small, in September, in twenty fathoms, at six miles from shore. In October, 250 under two and a half inches in length were taken in a haul in twenty-four fathoms, at the mouth of the Forth, five miles from shore. Ten miles from shore, 165, between two and three inches long, were captured in May, in one haul. Specimens under three inches long were got in fifty fathoms, twelve miles off.

It may be therefore said that the immature long rough dabs show a converse distribution to the young plaice. They are comparatively scarce within the three-mile limit, especially near shore, and exist in numbers in the deep off-shore waters.

Turbot (*Rhombus maximus*).

The evidence as to the distribution of immature turbot is chiefly of a negative character. Only four specimens, each about sixteen inches long, were obtained by the special net, and they were caught in about four fathoms of water about a mile from shore. I have carefully examined the records of the 'Garland's' trawling work for the past two years, in order to ascertain as much as possible about the distribution of immature turbot. The total number of turbot obtained during the ordinary trawling operations of the 'Garland' in 1888 and 1889 was 56, which shows how scarce this fish, once abundant in the Firth of Forth, is becoming. The largest specimen was twenty-eight inches long, and the smallest nine and a quarter inches (in St Andrews Bay), the next smallest being thirteen inches. The total number under eighteen inches in length, and therefore presumably immature, was thirty-one, most of them ranging about fifteen or sixteen inches. Most of the smaller specimens were got near the shore in St Andrews Bay, in water under ten fathoms deep. In the Firth of Forth turbot were obtained only near its mouth. It is a curious circumstance that no very small turbot have ever been obtained by the 'Garland.' The special fine-meshed trawl-net, and the ordinary trawl-net, which retains large numbers of immature plaice and dabs, have been very extensively employed in the territorial water, and only one turbot under thirteen inches has been captured. Where are the young turbot between three and twelve inches? Professor M'Intosh records the capture of one specimen, five and a half inches long, by a salmon stake-net near St Andrews; but I think it will be found, on the East Coast of Scotland at least, that the great majority of young turbot are on the off-shore grounds. It will be seen from my report on the Spawning and the Spawning Places of Marine Food Fishes (p. 257) that the turbot spawns at great distances from the coast. The eggs of the turbot are pelagic, and float at the surface of the sea, but none have been obtained in the tow-nets of the 'Garland' near shore. According to Professor M'Intosh, the young fish—up to at least an inch in length—are likewise pelagic * (thus differing from nearly all other flat-fishes at this size) and may be carried long distances by marine currents, but few, I think, reach the sandy beaches. It has been sometimes stated before the Commissions on fishery questions that thousands of young turbot may be found at some places in the shallow waters and pools on the beach, and that they are largely destroyed by shrimp fishers. This statement appears to stand in need of confirmation, for it is easy for the uninitiated to mistake the young of a very common species for the young of the turbot or brill. Buckland, however, states that he has seen 'turbot, brill, plaice, and soles, not much, if at all, larger than 'a thumb-nail' in such situations.

* *Report of Commission on Trawling*, 1885, p. 60.

Brill (*Rhombus lævis*).

The evidence as to immature brill is also negative. Only one specimen was obtained in the special net, and it was twenty inches long. During the past two years the 'Garland,' which works chiefly in the territorial waters, has captured seventeen specimens of this fish. The smallest was nine and a quarter inches in length, and was taken in comparatively shallow water in St Andrews Bay in March. Ten specimens were obtained by trawlers while Mr Scott was on board, the smallest, which was eight inches in length, was caught in deep water twenty-five miles from land. The largest specimen obtained by the 'Garland' was twenty-four inches long. One, twenty-three inches in length, was fonnd to be ripe in May at the mouth of the Forth, within two miles from shore, so that spawning may occasionally occur in territorial waters. There is little doubt, however, that brill spawn chiefly at considerable distances from shore, and it is probable that the young are chiefly to be found there. If small brill frequented the territoral waters to any extent, some would have been caught in the 'Garland's' trawl. Only two of the larger sized immature individuals were caught in territorial waters; one of these was thirteen inches, and the other sixteen and a half inches in length. Professor M'Intosh mentions* that the smallest specimens landed by local trawlers, who fish in St Andrews Bay, were about ten inches in length.

Other Flat-Fish.

Immature individuals of other flat-fish were obtained in numbers too few to enable anything definite to be said as to their distribution. These were flounder (*Pleuronectes flesus*), witch sole (*P. cynoglossus*), little sole (*Solea lutea*), and sail fluke (*Arnoglossus megastoma*). No flounders were captured under seven inches in length; the four immature individuals were found in shallow water close in-shore. The two immature witch soles were obtained in a depth of twenty fathoms, ten miles from land. The little soles were all captured in the Moray Firth, mostly at Smith Bank, in the off-shore waters; a few were, however, obtained from the in-shore grounds. This species is chiefly interesting from the fact that it may reach maturity and spawn when only a little over three inches in length. Adult specimens would undoubtedly be popularly classed as 'immature fish.'

Skate.

Sixty-three specimens of skates and rays were obtained in the special net, and 433 in the ordinary trawling operations of the 'Garland' in 1888 and 1889, but small specimens were scarce.

It would appear, from an examination of the records, that immature skates and rays are found almost equally in-shore and off-shore. In the case of the thornback (*Raia clavata*), they are rather more abundant in deep off-shore water. The smallest thornback ray obtained was three inches broad; of the two specimens of this size, one was got near shore, and the other ten miles off. Nearly all the very small thornbacks got in the Firth of Forth were caught near its mouth. The smallest starry ray (*Raia radiata*) was three and a half inches, and it was obtained eight miles from shore. The smallest gray skate (*Raia batis*) was six and a half inches, caught within four miles from shore. The smallest speci-

* *Op. cit.*, p. 361.

men of the sandy ray (*Raia circularis*) was three and three-quarter inches broad, and was got in shallow water in St Andrews Bay. It is probable that very young skates and rays frequent rocky bottoms, where they are born and where the trawl cannot work. No 'purse' has ever been got in the trawl-net. The number of skates and rays is rather increasing than diminishing.

Round Fishes.

The total number of round fishes captured was 27,906, of which 589 were of adult size and 27,317 immature. As has been said, the great number of immature round fish was due to the presence of a vast shoal of small whitings in the Firth of Forth in the autumn of 1889. The distribution of the immature round fish, according to the depth of water and the distance from shore, is shown in Tables V. and VI. They were found in the deepest water examined and in the shallowest, and at all distances up to twenty-two miles from shore. As in the case of immature flat-fish, but to a more marked degree, the proportional abundance within three miles from shore is less than in the waters beyond; but it would appear that they are relatively less numerous than young flat-fish (chiefly dabs), when the distance from shore is above twelve miles or thereabout. The average number of immature round fish per shot within three miles from shore was 93·6, while beyond that limit it was 383·5. The greatest number were taken between three and six miles off (434·7 per shot). At distances less than a mile comparatively few were obtained (22·9 per shot). At twenty-two miles from land, where there were a considerable number of immature flat-fish (dabs), no immature cod, haddock, or whiting, and only a few immature gurnard, were captured. The same result is brought out when the depth of water is considered. Comparatively few were obtained in the shallower or deeper waters, the greater number frequenting water of from twenty-five to thirty fathoms deep. There appear to be considerable differences in the habits of the young round fishes, *e.g.*, cod and haddock, especially when only a few inches in length; and this subject is well worthy of further inquiry.

Cod (*Gadus morrhua*).

The number of cod captured by the net was 454. Of this number 12 were of adult size and no less than 442 were immature (under twenty inches). The immature cod were found to be most abundant at distances between three and six miles from shore, but they were fairly numerous within three miles off. The average number per shot of the net was 2·7 within three miles, and 5·5 in the waters beyond—a much larger proportion for the former than in the case of haddocks and whiting. Young cod also frequent quite shallow waters. By looking down the column in Table VI. it will be seen that they gradually increase in abundance from close in-shore up to between three and six miles off, and then diminish in numbers. In regard to the depths of water, the same regularity is not apparent. Immature cod were obtained in all depths up to fifty-five fathoms; the greatest number were obtained in water of from ten to twenty fathoms deep. In the two hauls made in July, in above fifty fathoms (twelve miles from shore), fifteen young cod under three inches in length were captured. Table IV. shows that the larger proportions of the immature cod were under five inches in length, 62 measuring only two inches. Young cod under three inches were obtained in February, March, April, June, July, and October. Most of the specimens under four inches long were found in comparatively shallow in-shore waters. In one haul, in July, about a mile and a half from shore in the Moray Firth, 52 young cod under three and a half inches were caught, twenty-eight of them ranging between $1\frac{3}{4}$ and $2\frac{1}{4}$ inches. On the other hand, at Smith Bank, twelve miles off the shore, in twenty fathoms, a few young cod from one inch to one and a half inches were captured in May. In 1889 in the ordinary trawling operations of the 'Garland,' 694 immature cod were captured, the majority being obtained within three to six miles from shore.

Very young cod may be obtained in great numbers quite close in-shore on rocky ground among seaweed, especially during summer and autumn.

Haddock (*Gadus æglefinus*).

The young haddock seems to have different habits from the young whiting and cod, and to frequent different ground, most of them being got in deepish water at a distance from shore. Of 575 haddocks obtained, 451 were immature, and 124 of adult size. The average number of immature individuals per shot within three miles from shore was only 0·3; while beyond the three-mile limit they were twenty times as abundant, the average being 6·3 per shot. None were got in water under ten fathoms in depth; the great majority were captured in depths between twenty-five and thirty fathoms. Immature haddocks therefore are not numerous in the territorial waters. They are not apparently found, like the young cod, among the tangles at low water. Of the 451 immature specimens, 347, or seventy-seven per cent. were under five inches in length; 22 were under three inches, and seven one inch or under.* The seven of or under one inch in length were captured in one haul in the Moray Firth in July, fifteen miles from shore, and in water thirty fathoms deep, on ground where a large shoal of haddocks were discovered spawning at the end of March. In July the territorial waters in the Moray Firth were also examined, but not a single young haddock was obtained in any of the several hauls made. If it were the habit of the young haddock to frequent the territorial waters, one would have expected to discover individuals derived from the shoals which spawned some twelve miles off in March. The great majority of those four and five inches long were caught in water of between twenty and thirty fathoms depth, and from four to ten miles from shore. It is noteworthy that very few specimens were captured between six and ten inches in length. Only four between these sizes were obtained during May, July, September, and October; while 345 smaller specimens and 155 larger were caught during the same months. In February, March, and April, however, individuals under five inches were very rare, and those between six and ten inches much more common. Nearly all the specimens under five inches in length were captured in September, at the mouth of the Firth of Forth and up to ten miles outside it. Larval and post-larval stages of the haddocks have not yet been detected in tow-net collections. Professor M'Intosh, our greatest authority, states † that no young haddocks have hitherto come under notice until they were over two inches in length. It would appear, therefore, that the pelagic life of the haddock is limited, and that they soon seek the bottom, and, probably, chiefly rocky ground (where the trawl cannot be used) some distance from shore.

* These very small specimens were unfortunately not preserved.

† 'The Development and Life-History of the Teleostean and other Food Fishes,' *Trans. Roy. Soc., Edin.*, vol. xxv. pt. iii., No. 19, 1890.

WHITING (*Gadus merlangus*).

The observations regarding the distribution of immature whitings are of much interest. Altogether 26,475 whitings were obtained, of which 296 had reached adult size, and no less than 26,179 were immature. In the autumn of last year the 'Garland' discovered the presence in the Firth of Forth of a vast shoal of young whitings, mostly ranging in size from three to five inches, as many as 3606 immature individuals being captured in one haul of the net. This shoal was pretty equally distributed over the bottom of the firth, except in the shallow waters close to the shore, where comparatively few were obtained. It extended, one might say, like a sheet from Oxcar lighthouse to some eight miles beyond the Isle of May, a distance of thirty-six miles. Twenty miles off May Island not a single immature specimen was obtained while this shoal was present in the firth. The great proportion were obtained between Inchkeith and May Island, in water of from fifteen to thirty fathoms. I have calculated the number present in this shoal, based upon the number obtained in about thirty hauls of the net, and the area of the bottom where they were found, and the result is certainly astonishing, showing that above 230,000,000 of immature whitings were present in the Firth of Forth and neighbouring waters in September 1889. It shows to what an extent the territorial waters may serve as a nursery for the whiting. As has been said, comparatively few were found in the shallow water or close in-shore (Tables V. and VI.). The average number per shot at distances within a mile off the shore was 16·1; at distances up to three miles 85·9; from three to six miles 421·3; from six to twelve miles 373·1; and from twelve to eighteen miles 19·2. The largest number was obtained in water of from twenty-five to thirty fathoms deep, the average number per haul being 841·7; comparatively few were got under five fathoms depth.

In the preceding May immature whitings were fairly numerous in the Firth of Forth, but the majority of these were over five inches in length, and very few were under three inches. Over ninety per cent. of those composing the shoal in September, on the other hand, were under five inches in length. The smallest specimens obtained were two inches long. In September the in-shore grounds off the Aberdeenshire coast were also examined, but very few immature whitings were obtained. In October there was an obvious diminution in their numbers in the Firth of Forth. In February, March, and April of the present year (1890) while young whitings were fairly numerous, especially near the mouth of the firth, they were very much less abundant than during last September, and the majority of them were five or six inches long. It would appear that the shoal gradually dispersed at the beginning of winter. In regard to the origin of this immense shoal, it must be borne in mind that the whiting spawns in March, April, May, and June, and a pelagic specimen one inch long has been captured by the tow-net in September.* The observations in the preceding May showed that there were few very small whiting in the Firth of Forth at that time. It is difficult to understand how the great shoal of September could be caused by an incursion from off-shore of fish spawned the previous season. The young whiting may have come from rocky places, and been recruited by those spawned in the neighbourhood of the Firth of Forth from three to six months before.

* Report on the Pelagic Fauna, by Professor M'Intosh. *Seventh Annual Report, Fishery Board*, Part III., p. 308, 1889.

Gurnard (*Trigla gurnardus*).

The number of gurnards captured was 391, of which 151 were adult, and 240 immature. The greater number were taken in shallow water (under five fathoms) near the shore, but specimens seven inches long were found in water over thirty fathoms deep and twenty-two miles from land. Only about twenty-seven per cent. of those obtained were under five inches in length, twenty-five specimens were three inches, and five two inches long. Most of these very small specimens were found in shallow water, but a few were taken in deep water at a distance from shore. The greater number were captured in May and June. Of those at or under three inches, the majority were taken in May and June. Two of the five under two inches were obtained in March and the rest in May. These must have been spawned in the previous season. The gurnard spawns on the East Coast of Scotland from January to August, but mainly in June, and both in the territorial and off-shore waters. Its floating ova are not infrequent in the Firth of Forth and St Andrews Bay, and they have been obtained in the tow-net as far off as 65 miles from shore.

Ling (*Molva vulgaris*).

Only three immature ling were obtained. They were seven and twelve inches long, and were captured in deep water at the mouth of the Forth in September. While very young ling seem to be sometimes got among the tangle in shallow water, the presence of immature forms in the territorial waters may be considered uncommon. This agrees with what we know of the spawning habits of this fish. They spawn chiefly in April, May and June, at distances varying from 10 to 170 miles from shore. The floating eggs have been obtained twenty-five miles from shore. Very small pelagic specimens are occasionally caught in the tow-net.

Saithe or Coal-fish (*Gadus virens*).

Only ten immature specimens were captured. They were all obtained in July in water under six fathoms deep, near the shore, in the Moray Firth. The smallest specimen was one inch long, and the largest four and a half inches. It is known that, at certain parts of the coast, young coal-fish swarm around the shores, especially on rocky tangle-covered ground, but few are captured by the trawl.

Other Fishes.

Above 7000 other fish were obtained besides those enumerated above.

Eight specimens of the cat-fish (*Anarrhichas lupus*) were caught in the special net, and fifteen in the ordinary net. The smallest specimen was fourteen inches in length obtained in May at the mouth of the Forth. The largest specimen measured forty inches. Specimens of from twenty-seven to thirty-seven inches long were found mature or partly spent in the Firth of Forth in February.

Twenty-eight specimens of the frog-fish or angler (*Lophius piscatorius*) —one of the greatest enemies of the food-fishes—were captured in the special net and a very large number in the ordinary net. There were very few small specimens among them. One specimen measured five and a half inches, and was caught in twelve fathoms three miles from shore. Three specimens were nine inches long; a considerable number were from fifteen to twenty inches, but the greater number were above twenty inches, some being over four feet. Considering the abundance of the adults, it is remarkable so few small frog-fishes are caught in the trawl-net. It is probable that this is due to a difference of habit between the adults and the young, the smaller individuals frequenting rocky in-shore ground, where young cod, coal-fish, &c., abound. When a little larger they will not be much attacked by predaceous fishes.

Only one immature hake (*Merluccius vulgaris*) was obtained. It was four inches long, and was taken at the mouth of the Forth in May, in fourteen fathoms of water. It is not a common fish in the neighbourhood of the Firth of Forth.

One specimen of the John dory (*Zeus faber*), three inches in length, was caught in the Firth of Forth in ten fathoms in September.

Thirty-one specimens of the sand-eel (*Ammodytes lanceolatus*) were obtained. Ten were under four inches in length—mostly caught in about fifteen fathoms; one was eleven inches long.

Sixty-five specimens of the dragonet (*Callionymus lyra*) were captured. Forty-one were under six inches in length, nineteen under five inches, and two under four. A few of the smaller were obtained in shallow in-shore water; the majority were taken in about fourteen fathoms at the mouth of the Forth in May.

Of the Pogge (*Agonus cataphractus*) 168 specimens were caught; of these 102 were under two inches. The smallest specimens were obtained both in deep and shallow water, in-shore and off-shore, in February, March, May, June, and July. Small specimens of the rocklings, brassie, hag-fish, pipe-fish, *Lumpenus*, &c., were also captured.

In July, in the Moray Firth, in a depth of fifty-three fathoms twelve miles from shore, twenty-one hag-fishes (*Myxine glutinosa*) were obtained. Eight of these were eleven inches long, and nine ten inches. The two smallest were seven inches.

Of more interest are the herrings and sprats. Altogether 5011 young herring were captured in the special net. The largest caught in the trawl was seven inches long (two in May) and the smallest two inches. In September, in Aberlady Bay, in water under four fathoms, 2294 young herring between two and three inches long were captured in a single haul. In May also, in shallow water near Portobello, 185 were caught in one haul. In March 180 and in April 778 were taken in single hauls near the same place. In March 1042 were taken in one haul near Oxcars, in water of about seven fathoms depth. Although the herring is a pelagic fish, and pelagic in its young stages, it appears to be a bottom-feeder at certain periods of its life.

911 sprats were taken in the trawl, most of them about three inches long. Like the herring, they were chiefly found in shallow water in-shore, in March, April, May, June, and October.

Comparison between the Territorial and Extra-Territorial Waters.

From what has been detailed above as to the distribution of immature fish, it is obvious that the territorial waters and the waters immediately adjacent form to a large extent nurseries for them. They contain the seed for future harvests. It is clear, however, that the in-shore grounds on the East Coast, at all events, do not act as nurseries to the young of all fish. The young of turbot, brill, ling, and, curiously enough, haddock appear to be practically absent from them. On the other hand, immature plaice and common dabs, whiting and cod abound. The case of plaice is interesting. We already know a great deal regarding the habits of this important food-fish—its spawning and spawning grounds, its food, &c. (*vide*, pp. 230, 260); and it has now been seen that the territorial waters are the great nursery for its young.

I have made a careful analysis of the observations at grounds off-shore, which shows the comparative paucity of immature fish in these regions. Altogether thirty-three hauls were made at distances of between eight and twenty-two miles off, and in water varying from twenty-seven to fifty-three fathoms. The average number of immature fish per shot is as follows:—Plaice, 0·1; common dabs, 9·0; long rough dabs, 21·0; cod, 0·8; haddock, 2·8; whiting, 32·5. The large average for whiting was caused by the fringe of the shoal present in the Forth in September. The results at Smith Bank, where shoals of plaice, cod, haddock, little soles, &c., spawn in succession in spring, are of much interest. This bank lies at a distance of about sixteen miles from shore in water twenty fathoms deep. Twelve hauls of the special net were made in May, June, and July, and the total number of immature fish captured was 231, or an average of only nineteen per shot of the net. Thirty-eight were round fish (cod, whiting, and gurnard) and 193 flat fish, comprising lemon soles, common dabs, and long rough dabs, but almost entirely common dabs, and not a single immature plaice. A considerable number of adult plaice, lemon soles, haddock, whiting, &c., were obtained. Smith Bank, therefore, although a great spawning ground, is remarkably destitute of immature fish.

Another bank examined lies about twenty-two miles east of May Island, opposite the mouth of the Firth of Forth, in about twenty-four fathoms of water. Six hauls were made here in June, September, and October, and although adult plaice, lemon soles, dabs, cod, haddock, &c., were obtained, there were very few immature specimens, only 96 being captured, which gives an average of 16 per shot. Immature cod, haddock, and whiting were present only in October, and immature gurnard also in June and September, the average per shot being only three. The average for flat-fish was thirteen, and they consisted almost entirely of dabs. Between this bank and May Island eight hauls were made. Immature fish were relatively more numerous than further off, the average for young flat-fish being 55·2, and for young round fish 132·5. Three immature (but large-sized) plaice were obtained, and two young lemon soles, but the great majority were dabs, especially long rough dabs.

Four hauls were made in May and July in deep water—up to fifty-five fathoms—in the Moray Firth, twelve miles from land. The only adult flat-fish obtained at this depth were common and long rough dabs, and one witch sole. The only immature flat-fish were long rough dabs, of which there were seventy-three, the smallest being three inches in length, obtained in July. There were also fifteen young cod; the smallest, two and a half inches in length, was caught in July. There was only one immature haddock, two and a quarter inches long, in May; and fifty young whiting, the smallest being five inches in length. In the same neighbourhood, but in water twenty-eight fathoms deep, from eleven to fifteen miles from shore, four hauls were made in July, for comparison with those made in deep water. Only thirty-seven immature fish were taken. The flat-fish consisted almost entirely of long rough dabs, the smallest of which was four inches long. There were also three common dabs, the smallest being two and a half inches in length. There were no immature plaice. There were also two young cod, six young whiting, and nine young haddocks. The smallest cod was two inches long and the smallest whiting four inches. All the haddocks were tiny, two were one and a quarter inches, two one and one-eighth of an inch, and three only three-quarters of an inch. These are, I believe, the smallest haddocks yet obtained anywhere.*

* *Vide* footnote, p. 18. There is some doubt about the specific diagnosis of these young gadoids.

IV. THE CAPTURE OF IMMATURE FISH BY VARIOUS MODES OF FISHING.

The chief modes of fishing with which the capture and destruction of immature sea fishes have been associated are beam or otter trawling, shrimp fishing, seine-net fishing, stow-net or bag-net fishing, and the fishing with kettle-nets and weir-nets. It has also been stated that line fishermen land large quantities of immature fish.

I. Beam-Trawling.

The complaint that this mode of fishing destroys vast quantities of immature fish is of old standing, and most of the legislative enactments which have been passed on the subject have been directed against it. In the Report of the Commissioners in 1866, already referred to, it is stated that they are satisfied that while 'trawling in the open sea involves the capture 'of a certain very variable proportion of immature fish,' it was not 'waste-'fully destructive.' Nothing definite is said as to their capture in bays and estuaries, except that 'there is reason to think that, in bays, the trawl brings up a larger proportion of small fish than when used in the open sea.' The first scientific inquiry on the subject was made by Professor M'Intosh in connection with the Trawling Commission of 1884. A full account of his investigations is given in Appendix A of the Commissioners' Report.

The general conclusions arrived at by Professor M'Intosh were that the trawlers did not kill a very large proportion of immature fish, and that what they did kill was mainly the common dab and the long rough dab; and that line fishermen killed a larger number of immature round fish than did the trawlers.

I have analysed the results obtained by the 'Garland' while carrying on the trawling experiments, but the number of immature fish obtained by it is probably greater in proportion than would be obtained by an ordinary large trawler, from the fact that the net used has a smaller mesh. The ordinary net of the 'Garland' is 51 feet long, and it is attached to a 25 feet beam. The largest meshes are 3 inches from knot to knot, and the smallest $1\frac{1}{2}$ inches in the cod end. The size of the mesh in the net used by steam trawlers varies. In those made use of in Professor M'Intosh's inquiry, the mesh towards the beam was $2\frac{1}{2}$ or 3 inches from knot to knot, and $1\frac{1}{2}$ at the cod end. In recent years the mesh has been enlarged. On the East coast of Scotland it is usually from 6 inches on the square to $3\frac{3}{4}$ at the cod end. I am informed by Mr A. W. Maconochie that the meshes run from 4 inches down to $1\frac{1}{2}$ inches at Lowestoft; and that the Grimsby smacks, which fish in the more distant parts of the North Sea, use nets with meshes from 6 inches down to 3 inches at the cod end; while the smaller class of vessels use a mesh of from $5\frac{1}{2}$ to $2\frac{1}{2}$ inches.

In 1889 the ordinary net of the 'Garland' was shot above 150 times at the trawling stations in the Firth of Forth and St Andrews Bay. The total number of plaice, lemon sole, dabs, haddock, cod, &c., obtained was 20,254, of which 13,837 were of adult size and 6417 were immature. Of the total, 14,684 were flat-fish and 5570 round fish. Of the flat-fish, 9801 were of adult size and 4883 immature; that is to say, among flat-fishes one immature specimen was captured for every two adults. Of the round fish, 4036 were adult and 1534 immature; or, in other words, about two immature round fishes were captured for every five adults. These results are shown in the following Table :—

	Grand Total.		Flat-Fish.		Round Fish.	
	Flat-Fish.	Round Fish.	Mature.	Immature.	Mature.	Immature.
Firth of Forth,	8396	4826	6652	1744	3517	1309
St Andrews Bay,	6288	744	3149	3139	519	225
Totals,	14,684	5570	9801	4883	4036	1534

The proportion of immature to adult round fish in the comparatively shallow waters of St Andrews Bay was slightly less than in the Firth of Forth; while the proportion of immature to adult flat-fish was about four times greater—the immature being almost equal in numbers to those of adult size. The very large proportion of immature to adult flat-fish is due to what has been stated under the section on distribution, namely, the great preponderance of immature plaice in the territorial waters where the 'Garland' was chiefly employed. Thus, of the total of 4883 immature flat-fish, no less than 4433 were immature plaice, as is shown in the adjoining Table.

	Plaice.		Lemon Sole.		Common Dab.		Long Rough Dab.		Flounder.		Witch Sole.		Turbot.		Brill.	
	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.
Firth of Forth, .	2297	1534	932	37	1823	106	1448	52	42	7	99	3	6	4	5	1
St Andrews Bay, .	1311	2899	10	...	1706	211	...	...	121	24	...	...	1	5	...	2
	3608	4433	942	37	3529	317	1448	52	163	31	99	3	7	9	5	3

The number of immature specimens of other flat-fish is comparatively small. The proportion of immature to mature dabs contrasts markedly with the results obtained by Professor M'Intosh in 1884; but in that case immaturity could not be determined by the Professor strictly in relation to a fixed size, but rather by the judgment of the eye. Two of the Forth trawling stations lie beyond the mouth of the firth, one about six miles and the other about ten miles from shore. When the numbers obtained at these two stations are contrasted with the numbers obtained at the stations within the territorial waters, a striking difference is brought out. Seventy hauls were made at the latter stations, and twenty at the off-shore stations. In order to make the comparison complete, I have therefore multiplied the numbers actually obtained at the off-shore stations by three and a half, with the following results:—

	Plaice.		Lemon Sole.		Common Dab.		Long Rough Dab.		Flounder.		Witch Sole.		Turbot.		Brill.	
	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.
Stations in Firth, .	2222	1523	881	36	1601	198	1144	35	40	7	46	...	6	4	5	1
Stations in Off-shore Waters, .	262	38	178	4	777	28	1064	59	7	...	185	10	...	...	...	...

The proportion of immature to adult plaice captured on the off-shore grounds is very much less. In the territorial waters of the Forth the proportion was about two immature to three adults; in the off-shore waters about one immature to seven adults. The proportion of immature lemon soles to adults was about half what it is in the territorial waters. The proportion of immature common dabs was also much less, but the proportion of immature long rough dabs was much greater. The smallest immature plaice captured on the off-shore grounds was nine and a half inches in length. In the stations within the Forth proper the smallest was six inches, but there were very few caught of that size. In the territorial waters the smallest lemon sole caught was six inches long, the smallest flounder six inches, the smallest long rough dab three and a half inches, and the smallest common dab three inches—but very few dabs were under five and a half inches. It may be said that this net very rarely captured flat-fish under six inches. In St Andrews Bay, the smallest plaice obtained was four inches and three-quarters in length; one common dab only two and a half inches long was caught. As an example of the abundance of immature plaice in the territorial waters of St Andrews Bay, the results of one haul in about five fathoms in November may be mentioned. Altogether 566 plaice were captured, of which 552 were immature. There were 145 eleven inches in length; 107 nine and a half inches; 228 eight inches; 66 six and a half inches, and 6 four and a half inches. The largest obtained was fourteen inches and a half long. The greatest proportion of immature to adult plaice occurred in St Andrews Bay in summer and autumn. In the three months, January, March, and April combined, the proportion was 573 adults to 288 immature; in June 139 adults to 583 immature; in August 334 adults to 921 immature; in October 151 adults to 355 immature; and in November 114 adults to 752 immature.

The details of the 1534 immature round fishes taken by the beam-trawl are given in the following Table:—

	Cod.		Haddock.		Whiting.		Gurnard.		Cat-fish.		Ling.	
	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.	Mat.	Im.
Firth of Forth, .	182	689	1352	94	1032	321	916	199	31	5	4	1
St Andrews Bay,	10	5	30	3	14	39	465	198	...	...	...	...
Totals,	192	694	1382	97	1046	360	1381	377	31	5	4	1

The proportion of immature haddocks captured was not very large (under seven per cent.); that of whiting was larger, being about one to every three adults; while nearly four immature cod were caught for every adult. Sixty-five of the ninety-four immature haddocks caught at the Forth stations were obtained at the off-shore grounds, chiefly in September, October, and November; the others being got at the mouth of the Forth. On the other hand, only thirty-six of the immature cod were off-shore, the great majority being caught well up the firth. The majority of the immature whitings were also caught in the firth proper, mainly from August to November.

The smallest cod taken in the net was four inches and a half long, in November; there were a few at six and seven inches, and a considerable number at nine and ten inches. The smallest haddock was four inches in length. Six of this size were captured at the off-shore stations in

August. There were several five and six inches long, and many more eight and nine inches. The smallest whiting taken was three and a half inches long, but there were only two or three at this size. A large number were six and seven inches long. The smallest gurnard was four inches, taken in August; there were many about six and seven inches. The gurnard is rarely taken in the trawl in winter or spring. Its first appearance was in April, the numbers rapidly increased from June to August, and it had practically disappeared in November.

From what has been said, it is obvious that the use of a beam-trawl with a mesh similar to that of the 'Garland's' net captures a large number of immature fish, especially plaice and cod. It may be said generally that it will capture the great majority of flat-fishes above six inches in length, and large numbers of round fishes above six or seven inches, and a few of both much below that size. Further, if employed in the territorial waters, it will capture far larger quantities of immature fish—especially plaice and lemon sole, dabs, flounder, cod, and whiting—than if used off-shore.

There are two important practical points in this connection in regard to which the observations on board the 'Garland' are of value. The first concerns the relation of size of mesh to the capture of immature fish; the second refers to the condition of vitality of the immature fish after the contents of the net are emptied on deck—that is to say, to their destruction as well as their capture.

Mesh of Net.

It has not unfrequently been stated that the mere enlargement of the mesh of the trawl-net has little effect on the proportion of small fish taken. It is contended that contraction of the meshes from the strain on the net and the accummulation of sea-weed, &c., bar the escape of small fish. But that the enlargement of the mesh undoubtedly allows small fish to escape in great numbers may be at once seen from a comparison of the results of the employment of the small-meshed net (p. 163, *et seq.*) and the ordinary trawl-net on board the 'Garland.' The two nets were used on exactly the same grounds and during the same months of the same year, and the proportion of immature fish captured in the small-meshed net was about twenty-two to one adult, and in the ordinary net rather less than one immature to three adults. In the Firth of Forth, in September 1889, the small-meshed net captured thousands of immature whitings at a single haul (*vide*, p. 175). The ordinary net working amidst this shoal captured only fifty-eight immature whitings in a whole month, although the beam of the net was seven feet longer. Similarly, very few of the smaller immature specimens of other food-fishes were taken by the ordinary trawl-net, while large numbers were captured by the small-meshed net (p. 165). The sizes of the smallest specimens captured by each net are shown in the accompanying Table.

	Size of Mesh in Cod End.	Plaice.	Lemon Sole.	Common Dab.	Long Rough Dab.	Flounder.	Witch Sole.	Cod.	Haddock.	Whiting.	Gurnard.
		in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Ordinary net, .	$1\frac{1}{2}$ inches, .	$4\frac{3}{4}$	6	$2\frac{1}{2}$	$3\frac{1}{2}$	6	...	$4\frac{1}{2}$	4	$3\frac{1}{2}$	4
Special net, .	$\frac{1}{2}$ inch, .	3	4	1	1	·7	...	2	$\frac{3}{4}$	2	2

The Vitality of the Fish.

The question whether the immature fish brought up in the trawl-net retain sufficient vitality to enable them to live if returned to the sea is one of very great importance. Professor M'Intosh, in his observations in 1884, paid special attention to this. He states generally that the proportion of the living to the dead varies according to the nature of the ground, the length of time the trawl has been down, and the condition of the weather and the sea. On clean sandy or hard bottoms nearly all were living; on muddy bottoms nearly all were dead. Most of his remarks, however, refer to the fish generally, adult and immature; and they may be briefly epitomised. The trawl was generally kept down for between five and six hours, occasionally above seven hours, frequently two or three hours. All the skates and rays were alive; cod were almost always alive, if large, some small codling were dead; of haddocks, about a third of the large ones were alive, the smaller appear to have been mostly dead; most of the whitings—in some cases all—were dead; most of the ling were alive; most of the common dabs and long rough dabs were dead; turbot were as a rule 'active;' the brill were all alive; plaice were usually all alive; as were also the soles and lemon dabs. In cases where the trawl was down beween two and three hours on clean ground the fish were all alive.

On board the 'Garland' the net is very rarely kept down more than two hours and a half, and most of the fish are alive, the whitings succumbing first. In order to test the effect on the vitality of the fish of keeping the net down longer, a haul was made for four hours in from 8 to 20 fathoms. The condition of the fish as to vitality is shown in the following Table:—

Kind of Fish.	Living.		Dead.	
	Number.	Size in Inches.	Number.	Size in Inches.
Plaice, ...	114	12 –13½	4	15½
,, ...	41	10½–11	...	...
,, ...	6	9	...	...
,, ...	7	8	...	...
,, ...	1	6	...	...
Common Dabs, .	6	9–11	19	7
,, ,, . .	32	7– 8	7	6
Lemon Soles, . .	25	10	42	11–14
,, ,, . .	7	9	1	7
Long Rough Dabs,	...	...	11	8 –10
,, ,, .	...	...	11	6½– 7
Flounders, . .	1	7	1	11
Cod, . . .	...	...	1	39
,, ...	...	...	3	23
,, ...	...	...	1	17
,, ...	...	...	26	11–16
,, ...	...	...	1	9
Haddocks, . .	...	...	3	11–12
Whitings, . .	...	...	4	14–16
,, ...	...	...	14	10–11½
,, ...	...	...	6	9–10
Gurnard, . .	...	...	4	13–15
,, ...	...	...	23	10–11
,, ...	...	...	31	8
,, ...	...	...	10	7
Herring, . .	...	...	1	
Sprat, . . .	...	...	1	4
Angler, . . .	...	...	2	28–3
Cat-fish, . . .	...	...	2	34–39
,, ...	...	...	1	16½

Of 470 fish taken, nearly half died while their condition was being recorded. All the round fish, large and small, rapidly succumbed. Ninety-six out of 240 flat-fish also perished, especially the dabs and lemon soles. The plaice showed remarkable vitality, only 4 dying. It is noteworthy that it was not always the immature specimens which succumbed first. Thus fifty-four immature plaice and one immature flounder were living, while four adult plaice and one adult flounder were dead. The only immature flat-fish which was dead was one lemon sole.

The bottom where this haul was made consisted of mud and shells, and it was therefore unfavourable. But Mr Thomas Scott, F.L.S., who conducted the experiment, states:—'Very few, if any, of the fish were dead when the trawl was hauled up, but many died very soon,' as the record was being made. It would appear, therefore, that many of the fish that escape death in the trawl die rapidly while lying on the deck. What is their chance of vitality if returned at once to the sea? The experiments which the Board have carried on as to the migratory movements of fish probably throws some light upon this question. About 1000 fish caught in the trawl after its being down from one to two and a half hours have been labelled with brass labels and replaced in the sea (*vide*, p. 353). Of 333 plaice labelled, 8 are known to have been recaptured alive months afterwards; of 33 cod and codling, 3 have been recaptured; of 43 lemon soles and of 220 dabs, none have been retaken. It is probable that a large number of dabs succumbed after being replaced in the sea. Comparatively few haddock and whiting were lively enough to label.

The importance of the above observations is related to this question:—If any regulations be made for beam-trawlers to return immature fish to the sea, are the fish likely to live or to perish? As the beam-trawl is now worked most of them would, I think, almost certainly perish.

Besides the observations made by Professor M'Intosh, referred to above, there is very little scientific evidence as to the immature fish captured by beam-trawlers in their ordinary operations. I instructed Mr T. Scott, F.L.S., while on board steam-trawlers for scientific purposes, to measure the smallest fish obtained by the trawl; but from the rapidity with which the operations of sorting out the fish, &c., are performed, this was found to be impracticable. However, while on board the 'Southesk,' which belongs to Messrs Johnston & Sons, Montrose, and works almost entirely off-shore, he kept notes as far as possible. In March 1889, 1310 haddocks were got in one haul in the Moray Firth. 'The average size of these fish was 16 inches, and very few were as small as $10\frac{1}{2}$ inches.' These fish, however, belonged to a spawning shoal, and few immature individuals would be present. The smallest round fishes recorded during this voyage in the Moray Firth were cod, 12 inches; whiting, $6\frac{1}{2}$ inches ('exceptional, very few so small'); haddocks, $9\frac{1}{2}$ inches; gurnard, $8\frac{3}{4}$ inches. The smallest flat-fishes were:—Plaice, 6 inches (one specimen); common dab and long rough dab, 6 inches; lemon sole, 10 inches; witch sole, $8\frac{1}{2}$ inches. In April, twenty miles from Montrose, the smallest haddock recorded was 12 inches, the smallest cod 12 inches, the smallest whiting 9 inches, the smallest witch sole 12 inches, the smallest lemon sole 11 inches, and the smallest dabs $6\frac{1}{2}$ inches. From the abundance of dabs, the size of the smallest caught may be taken as a test of the capacity of the net to allow small fish to escape. It would therefore appear, from the rather imperfect evidence obtained, that the net of at all events the 'Southesk' steam-trawler only occasionally captures fish under six inches in length.

The evidence in regard to the capture of immature fish by the beam-trawl may be thus formulated:—

1. That, especially in inshore waters, immature flat-fish and round-fish may be captured in large numbers by the beam-trawl.

2. That relatively more immature flat-fish than immature round-fish are taken.

3. That, on the East Coast of Scotland, immature flat-fishes of all kinds are caught by the beam-trawl; but especially, in regard to absolute numbers, immature plaice and dabs, and in regard to relative proportion of immature to adults (a most vital point), chiefly plaice, flounder, lemon sole, turbot, and brill.

4. That very large numbers of immature cod are captured, especially inshore; also considerable quantities of immature whitings and gurnards, and fewer immature haddocks.

5. That the ordinary trawl-net used by large beam-trawlers, probably, in ordinary circumstances, captures very few fish under 6 inches in length.

6. That the size of the mesh of the trawl-net, *per se*, exerts a most important influence on the proportion of immature fish captured.

7. That the majority of the immature fish captured by the beam-trawl, as now used, would probably perish if returned to the sea.

2. Shrimp Fishing.

Much complaint has also been made against the various modes of shrimp fishing, as highly destructive to immature fish. This mode of fishing is carried on usually in very shallow water close to the beach, where small flat-fish abound; and I think it is admitted on all hands that large quantities of these fish and of immature round fish are taken in shrimp-nets. It is said, however, that the great majority of these immature fish do not belong to the valuable kinds, and that they are returned to the water alive.

Shrimp fishing is much more common in England than in Scotland. In England it is largely practised at various parts of the coast both by hand or push-nets, and by beam-trawls, which in some places are dragged in shallow water by horses. Shrimps are also caught in bag-nets or stow-nets. In Scotland, the only place where shrimp fishing is carried on is in the Solway Firth, where about sixty boats are engaged in it. The net used is a beam-trawl, with a beam of about 20 feet in length, and the small meshes of the net are about ½ inch from knot to knot.

The Fishery Board last year sent one of the naturalists (Dr J. H. Fullarton) to inspect the Solway shrimp fishing, and the small fish, &c., taken in several hauls of the shrimp-nets were subsequently sent to me by one of the fishermen, and were tabulated by Mr Peter Jamieson. The small fish in five successive hauls are here shown.

Date. 1889.	Depth of Water in Feet.	Sole.		Plaice.		Flounder.		Common Dab.		Whiting and Cod.		Pogge.		Sting-fish.	
		No.	Size in Ins.	No.	Size in Ins.	No.	Size in Ins.	No.	Size in Ins.	No.	Size in Ins.	No.	Size in Ins.	No.	Size in Ins.
June 6	8–10	4	3–6	7	3½–6	1	5½	...	...	2	3¾–6	16	3½–6	3	2¾–3
,, 11	3–12	7	2¾–5	62	2–5½	1	3⅞	1	4½	4	2	19	2–4	9	2 –3
,, 20	10–15	...	...	14	2½–6¼	1	6¾	2	5¾	...	...	50	2½–4¾	23	2½–3½
,, 27	10–12	...	...	20	2–6¼	...	...	...	...	1	2¼	5	3–4	3	2½
July 10	8–10	...	...	75	2–4	2	5¼	...	...	44	2½–3½	5	3–3½	2	3
	Total, .	11	2¾–5	176	2–6¼	5	5¼–6¾	3	4½–5¾	61	2–6	95	2–6	40	2 –3½

Besides the fish enumerated, there were also a few pipe fish, herring (2½ inches), sprats (3¾ inches), crabs, young cuttlefish, young mussels, &c. It is clear from this table that the shrimp trawl-net captures considerable numbers of very immature fish. In fact, in this respect it is comparable to the special small-meshed net used on board the 'Garland' in the experiments on the distribution of immature fish. The Solway shrimp-net, however, working close in-shore in a few feet of water, captures young plaice, &c., in greater numbers, for they are more abundant in the shallow water. It is noteworthy that more young soles (*Solea vulgaris*) were taken than young dabs or flounder, some of them only two and three-quarter inches in length. This fish is rare on the East Coast. The young plaice numbered 178, or an average of nearly thirty-six per haul, the largest being six and a quarter inches and the smallest two inches.

There is no doubt that when the number of boats and nets used in shrimping around the coast is considered, the capture of very small immature fish, especially flat-fish, by them must be enormous. There are probably at least 2000 trawl-nets used (frequently two and even four by a boat), besides a large number of push-nets, ground seines, &c. Mr A. W. Maconochie informs me that the shrimp trawls used in the Grimsby district have meshes from one inch at the beam to half an inch at the cod. But much smaller meshes are elsewhere used, running from five-eighths to a quarter of an inch. The shrimp trawl is kept down a very short time (usually from fifteen minutes to a little over an hour), and a number of hauls may be made in a day. The immature fish enumerated in the above table might all have been easily got in the course of a forenoon. If we suppose that each of the trawl-nets around the coast takes an equal number, we shall find that the shrimpers capture daily fully 400,000 immature flat-fish, probably over half a million. It is beyond doubt, at all events, that enormous numbers of very immature flat-fish are taken in shrimp fishing, and that the great majority are worthless as food. A very important question to determine, therefore, is :—Does this mode of fishing involve the *destruction* as well as the *capture* of large quantities of immature flat-fish? This is in reality the crucial question ; and it is to be regretted there is very little accurate evidence relating to it. From the fact that the trawl-net is kept down so short a time, and that it is almost invariably used on a clean bottom, it may be inferred that very few of the immature fish are dead when the net is hauled, and that if they were *at once* returned to the sea a large proportion would live. But this is not always done; at the best there is often much delay, and with impaired vitality the chances of the young fish surviving are greatly lessened. The general practice is to riddle the shrimps (the gauge of the riddle varying very much in different places) and to return the small shrimps and fish to the sea. But the riddling is not always done immediately the net is hauled ; often not, indeed, until the shrimps are taken ashore, and sometimes not until they are boiled.

In France a committee was recently appointed to investigate the relation of shrimp fishing to the capture of immature fish. This committee last year reported to the Minister of Marine, on behalf of the Consultative Committee on Marine Fisheries.* They state that the shrimp trawl destroys great quantities of immature fish, especially flat-fish, and that its excessive use at certain parts of the coast has been followed by a marked decline in the productiveness of inshore fishing. They further state that even although the young fish are returned immediately to the sea they do not survive their rough usage (*froissements*) and perish. The prohibition of this mode of fishing is strongly urged, and the employment of an ingenious trap recommended. This trap, which has

* *Rapport adressé au Ministre de la Marine au nom du Comité Consultatif des Pêches maritimes sur la vulgarisation de l'emploi d'Engins pour la pêche de la chevrette,* par MM. Giard et Roussin.

been in use since 1861 in some places, is made on the principle of a lobster-pot, consisting of a barrel-shaped frame, 75 centimetres (about 30 inches) long, and covered with netting having meshes 10 millimetres (nearly two-fifths of an inch) wide. There are openings at each end, and bait is suspended within. A hundred boats at Croisie, each attending to from 25 to 30 traps, land on an average 80,000 kilogrammes of shrimps annually, between 1st May and 31st October, valued at 220,000 francs. If this system, which is entirely innocent of the destruction of immature fish, has been so successful in France, it should be tried in this country; and I hope to make experiments with it in the Solway.

It has been shown above that shrimp-trawling involves the capture of very large quantities of immature flat-fish, and the possible destruction of considerable numbers. Before, however, any attempt is made to deal with this mode of fishing by enactment, it would be prudent to have a thorough inquiry made into it. The main points to be determined are (1) what are the quantities of immature fish captured, especially of the more valuable flat-fishes, such as soles, plaice, turbot, and brill; (2) what is the proportion of those captured which are destroyed by the ordinary practice, and how may this destruction be avoided. The inquiry would involve experimental observations as to the vitality of the immature fish captured, at intervals after capture, and when returned to the sea. I hope to undertake an inquiry of this nature in the ensuing season.

3. Line Fishing.

It is frequently stated that line fishermen land large quantities of immature round fish, especially during certain months of the year. The inquiries made by the Fishery Board into this subject have been by (1) the collection of special statistics as to the fish landed in certain districts; (2) experiments in line fishing on board the 'Garland' (during my inquiry into the value of different baits). In the statistical inquiry the fish were not measured, but were classed into 'large,' 'small,' &c., by the fishery correspondents. These terms are capable, no doubt, of latitude in interpretation; but the statistics referring, as they do, to very large quantities over considerable areas, are of value. In order to bring the terms into relation with the sizes of immature and adult fish, I give the following Table, prepared by one of our most experienced fishery officers, Mr John Murray, of the number of inches which divides large from small:—

Ling,	35	Halibut,	36
Hake,	24	Brill,	12
Saithe,	24	Lemon sole,	11
Haddock,	10	Plaice,	11
Whiting,	12	Witches,	11
Cod,	24	Skate,	35
Turbot,	17		

The statistics available are (1) those of the Buckhaven cod and haddock fishery for the past six years; (2) those showing the fish landed during 1889 in the Leith, Anstruther, and Aberdeen districts; (3) those kept by the fishermen of certain boats fishing on the East Coast.

The Buckhaven statistics show the monthly quantities of cod and of large haddocks and small haddocks and whitings landed since 1884. In the six years, 1884–89, 33,288 shots were made; the following Table gives the *average number* per shot of large haddocks on the one hand, and of small haddocks and whitings on the other.

	Average number of large haddocks per shot.	Average number of small haddocks and whitings per shot.
1884 . . .	22·1	38·3
1885 . . .	23·4	221·5
1886 . . .	31·8	147·0
1887 . . .	42·8	208·9
1888 . . .	62·6	228·4
1889 . . .	80·1	68·4

Thus, according to these statistics the number of small haddocks and of whitings captured by hook and line greatly exceeds the number of large haddocks taken. We have seen that the maximum size of immature haddocks is about ten inches (p. 163), and that the limit of size of the 'small' haddocks referred to above is also estimated at ten inches. If the term 'small' were interpreted rigidly according to this standard, the Table would show that line fishermen capture very large quantities of immature haddocks. But the Table includes whitings of all sizes, as well as small haddocks; and reasons will be given later, which indicate that the haddocks classed as 'small' include large numbers of small adults as well as immature.

The same result is brought out when the special statistics kept by the fishermen themselves are examined.* For instance, one boat in the Aberdeen district landed 205 scores of very small haddocks, during the last fifteen days of July; 357 scores in August, 659 in September, 763 in October, and 120 scores in the first two days of November. Thus, a single boat, within a period of sixteen weeks, captured considerably above 20,000 small haddocks. This boat also landed in six days, nearly 4000 very small whitings, and another boat landed as much as twelve cwts. of very small haddocks on a single day. It has been estimated that at

District.	Large Cod.	Small Cod.	Large Haddocks.	Large Whitings.	Small Haddocks and Whitings.	Large Turbot.	Small Turbot.	Large Halibut.	Small Halibut.	Large Lemon Sole, Flounder, Plaice and Brill.	Small Lemon Sole, Flounder, Plaice and Brill.	Other Fish (large).	Other Fish (small).
Leith.	cwts.	cwts.	cwts.	cwts.	cwts.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
1. Territorial, .	3,222	826	8,182	903	4,004	4	1	2	...	1,653	415	1,355	524
2. Extra - Territorial, . .	29,495	3,141	14,816	1,158	8,169	126	15	797	87	685	176	6,002	820
	32,717	3,967	22,998	2,061	12,173	130	16	799	87	2,338	591	7,357	1344
Anstruther.													
1. Territorial, .	11,158	4,717	10,889	889	5,978	3	1	7	2	2,144	572	537	228
2. Extra - Territorial, . .	40,558	2,884	12,629	1,034	3,786	167	39	403	149	...	...	5,360	802
	51,716	7,601	23,518	1,923	9,764	170	40	410	151	2,144	572	5,897	1030
Aberdeen.													
Territorial and Extra-Territorial,	19,258	1,383	20,333	7,761	14,624	...	...	...	...	...	16	...	...
Grand Total, .	103691	12,951	66,849	11,745	36,561	300	56	1200	238	4482	1179	13,254	2374

* *Vide* Sixth Annual Report, pp. 45, 46, 1888.

Aberdeen in 1887, line fishermen landed 20,425 small haddocks and small whitings as compared with 16,485 large haddocks and whitings. Other statistics also show that large numbers of small round fish are taken by hook and line. The totals in 1889 in three districts are given in the table on the opposite page, the fish caught in the territorial waters being distinguished from those caught outside. Although the actual numbers of small round fish set forth in these returns is great, it is very small if the proportion between large fish and small fish is considered. The statistics of the absolute and relative amount of small fish caught by hook and line vary in different years, in different districts, and for different kinds of fish. It must not be assumed that this statistical division into 'large' and 'small' represents mature and immature fish.

The 'Garland's' Experiments.

The experiments in line fishing carried on on board the 'Garland' were conducted with great care, each fish obtained being measured and the length recorded. The line used had 1800 hooks baited with a great variety of bait,* and was shot on twenty-seven occasions from August to March, in water of from 6 to 30 fathoms, and at various distances from shore. 2046 fish were obtained, namely, 745 haddocks, 639 cod, 260 whitings, 1 ling, 1 saithe, 19 gurnards, 1 dragonet, 374 common dabs, 4 plaice, 1 lemon dab, and 1 brassie (*Gadus luscus*). Omitting the less common forms the proportion of immature to mature fish was as follows :—

	Mature.	Immature.
Haddock, ...	676	67
Cod, ...	34	605
Whiting, ...	229	31
Common Dab, ...	374	0
Gurnard, ...	19	0
	1332	705

It will be seen that the proportion of immature haddocks and whitings obtained was small, being about nine per cent. for the haddocks, and about eleven per cent. for the whitings. On the other hand the proportion of immature cod captured was very large, only about five per cent. having reached a size at which reproduction was possible. It is remarkable that not a single flat-fish under six inches was caught. All the 374 specimens of the common dab were six inches or more in length, and therefore fall into the category of adult fish, although a few were six and a half inches and seven inches long. The general average was between eight and nine inches. The four plaice and the one lemon sole were adult.

A large proportion of the haddocks and whitings were very close to the minimum size of maturity; many of these may never have spawned. There is little doubt that in the statistical returns, referred to above, a large proportion of these would be classed as 'small' fish. Most of the immature haddocks were taken in about twenty fathoms near May Island. Some of the cod captured were very small; there were a large number at nine and ten inches, several at six inches, and one as small as four and a half inches in length.

The general results of the inquiry into the quantities of immature fish captured by line fishing may be thus summarised :—

1. Considerable quantities of immature round fish, especially cod, and at some seasons, haddocks and whitings, are taken by hook and line; but except in the case of cod the proportion of immature to adults is not great.

* *Vide* Report on Bait Experiments, Seventh Annual Report, part iii. p. 352, 1889.

2. Comparatively few immature flat-fish are caught by hook and line and those are mainly the commoner and less valuable kinds.

4. Stow-net or Bag-net Fishing.

This method of fishing is largely practised in estuaries for whitebait, sprats, sparling, shrimps, &c., and undoubtedly captures large quantities of immature fish. Whitebait consists in Scotland almost entirely of young sprats and herrings, the proportions varying at different seasons. From the great size of the net and the small mesh, almost everything that is carried into it by the current is retained. The most elaborate inquiry into the capture of young fish by the bag-net was made a few years ago by Mr Bottemanne and Dr P. P. C. Hoek, the scientific adviser on fisheries to the Dutch Government.* In certain parts of Holland bag-net fishing is extensively carried on, the nets being much larger than the stow-net used on the Thames. The fish which were captured by these nets during Dr Hoek's inquiry, included flounder, plaice, sole, herring, sprat, shad, eel, lamprey, sparling, dace, perch, &c., but no young whitings, cod, or haddocks were taken, owing apparently to the brackishness of the water. The contents of the net were carefully examined on eighty occasions, between March 1886 and June 1887. The very small unsaleable fishes consisted mostly of young shad, herring, sprat, eels, gobies, &c.; but large numbers of very small flounders were captured. In one shot in March, these small unsaleable flounders numbered between 7000 and 8000. Few young plaice were taken. In June there was a 'handful,' the largest measuring 80 millimetres in length. A few young soles were also caught in June; but from the brackish nature of the water the two latter fish are very scarce. Nearly all the fish, and all the young fish, are dead when the net is hauled. In Holland, and also in Germany,† bag-net fishing is largely resorted to for catching a mixture of all sorts of young fish ('nest,' 'grus'). They are used for bait for eels, and also to feed hens, ducks, and swine. The conclusion of the Dutch report above referred to is that the bag-net fishing is prejudicial to the abundance of fish in the river; but that from the condition of the river and its bank it is impossible to catch the fish by other engines. It is not proposed to prohibit the fishing, but to limit the number of nets (which can easily be done, as the water is rented in lots from Government), and to strictly enforce the close time from 1st April to 1st June. Dr Hoek looks upon the Zuider Zee as a great spawning place for certain fish, and as a great nursery for the young; and he aims at the ideal of abolishing all modes of fishing which cause great destruction of immature fish.

While bag-net fishing undoubtedly involves the capture of immature fish in immense quantites, it would appear that these are not to any large extent the young of cod, haddock, whiting, or flat-fish, with the exception of flounders in certain places.

5. Weirs and Ground Seines, &c.

Fixed nets or weirs on the shore—salmon stake-nets, &c., and the ground seine, are all said to be very destructive to young fish. The evidence given before the various Royal Commissions shows that large numbers are thus taken; but no scientific inquiry has been made into the subject. Professor M'Intosh mentions that young turbot have been captured in the salmon stake-nets at St Andrews.

* *Rapport over Ankerkuil- en Staalboomen-Visscherij op het Hollandsch Diep en Haringvliet*, Lieden, 1888.

† Prof. Metzger, Ueber Steerthamenfischerei in der Elbe, Weser und Ems, *op. cit.*, p. 257.

V. SUMMARY.

1. It has been shown that the complaints as to the destruction of immature fish by trawling and bag-net fishing are many centuries old, that many enactments have been promulgated in connection therewith, and that at present there are no restrictions in Britain as to the capture of immature sea fish, except, perhaps, by the exclusion of beam trawling from the territorial waters of Scotland.

2. I have also shown that an immature fish may be large or small, and that the maximum size of immature fishes varies very much in different species; for instance, from $3\frac{1}{2}$ inches in the little sole to about 18 inches in the turbot, and 20 inches in the cod; and I have given a table showing the largest size of immature individuals of the important food fishes.

3. The distribution of immature fish has been explained in relation to the distance from shore and to the depth of water. Their distribution varies according to the species. I have proved that the territorial waters, and especially those portions near shore, where the bottom is sandy, serve as nurseries for plaice, and that immature plaice are practically absent beyond the territorial waters. Very young lemon soles, flounders, dabs, cod, and whiting, frequent the inshore waters; whiting sometimes in vast shoals. Very young cod, and also common dabs, may exist in numbers at a distance from shore. Immature long rough dabs and haddocks are there most abundant. There is no evidence that very small turbot, brill, or ling, frequent the territorial waters at the parts of the East Coast where the observations were made; although fairly large, but immature, turbot and brill are found in the territorial waters. At off-shore fishing grounds there is a paucity of immature fish, except dabs and occasionally haddocks.

4. *Beam Trawl.*—I have shown that the beam trawl, with a mesh of three inches towards the beam, and a mesh of an inch and a half at the cod end, is capable of capturing large numbers of immature flat-fish and round-fish; and that immature plaice and cod especially, are taken in inshore waters in very large numbers with such a net. In the net used by the best class of beam trawlers, considerable numbers are also taken, although the evidence is not as definite or extensive on this head as one would desire; few of these seem to be under six inches in length.

The size of the mesh, *per se*, exerts a most important influence on the proportion of immature fish obtained.

The majority of the immature fish taken by the beam trawl as now used would probably not survive if returned to the sea.

Shrimp fishing involves the capture of very large numbers of immature flat-fishes, probably 400,000 in a single day's fishing all round the coast; these are especially plaice, but also soles, flounders, and dabs; a considerable proportion of these are destroyed.

Line fishing involves the capture of a considerable, but not excessive, quantity of immature round-fishes, especially cod; but comparatively a very small proportion of immature flat-fish.

Bag-nets capture immense quantities of young herrings and sprats (whitebait), &c., but relatively few flat-fishes.

Weirs, Seines, &c., capture in some places immense numbers of immature fish, which are largely destroyed.

VI. CONCLUSIONS AND RECOMMENDATIONS.

In considering the facts given above as to the capture of immature fish, there are several preliminary matters which require attention.

The application of the term Immature.

In the first place one must be clear as to what is meant by the term 'immature.' It is generally restricted to small fish and fry, and to edible fish which are too small to be saleable. This idea is erroneous. There are two aspects in which the question has been considered; the biological aspect, in relation to the reproduction of the fish, and the economic aspect in relation to whether the fish are saleable or unsaleable as food. These aspects have been often confounded and confused. But it is very desirable to keep them clearly defined; for many adult individuals of several of the edible fishes, such as dabs, are practically unsaleable, while many immature specimens of other kinds are eminently saleable, *e.g.*, turbot, brill, plaice, cod, &c. It is better to restrict the application of the term immature to what it means literally, viz., a fish which has never developed ripe milt or roe—which has never exercised the function of reproduction. The term 'undersized' might be applied to immature fish below a certain size. For instance, cod between one inch and twenty inches are immature; but no one, probably, will advocate that the sale of all cod under twenty inches should be prohibited, although some, like the government of George the First, might advocate the prohibition of their sale when under, say, twelve inches. In that case, cod under twelve inches would be 'undersized.'

The distinction between different species of Fish.

Another point is the necessity, when discussing the desirability of interference with the capture or sale of immature fish, of carefully distinguishing between one kind of fish and another. Neglect of this truth has led to many strange conclusions. There is no doubt that certain food-fishes can suffer enormous destruction of their young by man, without the number of adults taken being sensibly diminished. Millions of immature herrings are captured annually by bag-nets and cotton surface drift-nets, without the catch of adults in succeeding years being much, if at all, reduced. Millions of immature cod are also annually captured around our coasts, and their capture is not apparently followed by detrimental results. It is different with certain flat-fish, such as turbot, brill, sole, and plaice. It is generally acknowledged that the admitted falling off in the number of these fish is due largely to the destruction of their young. Mere fecundity *per se* has nothing to do with it—although it is an argument which has been frequently used by Royal Commissioners and others. The female herring produces an average number of about 20,000 to 30,000 eggs only, and the cod about 3,000,000. The turbot produces about 10,000,000; the sole about 200,000 and the plaice about 150,000. Yet the herring can suffer, as we have seen, enormous destruction of its young. The cardinal principle which should guide action in this matter is the relative abundance of the adults. The rarer a species the more liable it is to extinction. If any food-fish is proved to be diminishing in numbers for a period of years, and if the average size of the fish captured is also diminishing, then that fish requires protection; it is an indication that the adults are being fished out and the non-producing young drawn upon. If it is shown that immature individuals are destroyed in large numbers, their destruction should, if possible, and as far as possible, be prevented. Several fisheries have gone through these stages of diminution in the numbers of adults, and general diminution in size; notably the lobster fisheries, especially in Canada, Newfoundland, Norway, and to some extent in Scotland.

There is no doubt that hitherto in dealing with this question, too little discrimination has been made between the destruction of the young of the different kinds of fishes. One of the chief arguments used by the Royal Commissioners of 1866 and 1879, and by Professor Huxley, Mr Buckland, Mr Shaw-Lefevre, and others, is that since the admittedly enormous destruction of immature herrings, by man, their enemies, and physical causes has not seriously affected the numbers of adult herrings captured by the herring boats, it would be idle to interfere with the destruction of the young of other kinds of fish. No doubt when the Report of the Commissioners was issued in 1866 the evidence of the diminution of any particular fishery was not satisfactory, and our knowledge of the spawning, habits, &c., of the food-fishes was very much less than what it is now. The Commissioners say:*—'It is assumed 'that any destruction of fry effected by man bears a large ratio to the 'destruction resulting from other causes, an assumption which in several 'cases is, certainly, and in most is, probably, altogether erroneous. Nor do 'we know enough of the number, the mode of multiplication, or of the 'conditions of existence in any locality of any given kind of fish, to be able 'to form the slightest estimate as to the effect which will be produced upon 'the number of that fish by a given amount of destruction of its young.' Our knowledge, however, has been greatly increased since 1866; and, while it is not possible to give with accuracy the proportion of young that may with impunity be destroyed in any one case, we now know that the destruction of immature turbot, sole, brill, and plaice, should as far as possible be prevented. The arguments used by Mr Buckland and Sir Spencer Walpole in their Report of 1879 are of the same character, with especial reference to the abundance of herrings, despite the destruction of the young. Illustrations are drawn from the destruction of wheat in the manufacture of bread, the eating of eggs and of lambs. It is obvious, however, that in the one case we know how many grains of wheat, how many eggs, and how many lambs must not be destroyed, and take care that the requisite number is preserved to keep up the supply; and although it is gravely stated that 'fish are more prolific 'than wheat,' it does not follow that in all cases the requisite number of young fish are left in the sea to keep up the supply. The necessity, above referred to, of carefully discriminating between the destruction of the young of the various kinds of fish, is also shown by the argument based on the capture of whitebait; *e.g.*, 'if the sale of small fish be prohibited, 'the law must either apply, or not apply, to the sale of whitebait. If it be 'intended to prohibit the sale of whitebait, no further observations seem to 'be necessary; but if, for the reasons which we have already given [the 'abundance of herring, &c.], whitebait are still to continue a legal article of 'food, we can see no reason whatever for interfering with the sale of other 'small fish.'† Mr Shaw-Lefevre, who was one of the Commissioners in '1865, has expressed a similar opinion. He says‡ 'The destruction of 'whitebait, however, is so great, that in comparison with it the destruction 'of all other small fish sinks into insignificance, and it would seem absurd 'to take steps to prohibit the capture of other immature fish, while the 'capture of whitebait is permitted.' Such reasoning, however, is away from the point, and ignores the natural distinctions between the life-conditions of one species and another. Rats and mice, for instance, are trapped and destroyed in every possible way by man: yet the race survives. But if the same licence were allowed in the destruction of sheep or deer, these

* *Op. cit.*, p. xxvi.
† *Report on the Sea Fisheries of England and Wales*, p. xxii, 1879.
‡ *The Fisheries Exhibition Literature*, vol. iv. p. 97, 1884.

animals would rapidly be exterminated. Another argument liable to abuse is this : the ratio of the destruction of immature fish by man bears a small proportion to the ratio of destruction by natural means, and, therefore, can do no harm. But the destruction of the young by natural causes is provided for by nature in the fecundity of the species ; for the degree of fertility in a species is as much adapted to the conditions of its existence as is the structure of its jaws. We have not sufficient knowledge to enable us to state what proportion the ratio of destruction by man bears to the ratio of destruction by natural causes. In some cases it is almost certainly slight and does not go beyond the margin of waste which nature allows. In other cases there is little doubt that, although relatively small, it is sufficiently large to disturb the balance, and to decrease the number of adults. Each case must be considered separately.

As has been said, there does not appear to be satisfactory evidence that the capture of immature herring, cod, haddock, and most other round fish, has had detrimental results. But there is now a concensus of opinion that the supply of most of the valuable flat-fish, such as turbot, brill, soles and plaice, has fallen of, in spite of increased efforts to catch them ; and it has also been shown that the young are destroyed in large numbers. The statistics for past years show that the supply of these fishes has diminished.

I shall therefore not deal here with the question of the destruction of immature round-fish, but shall limit consideration to the destruction of immature flat-fish by shrimping and beam trawling.

Shrimping.

There is ample evidence that shrimping, and especially shrimp-trawling, involves the capture of immense numbers of young flat-fish, and the destruction of large numbers. The shrimp fisherman works in the zone where very young flat-fish abound, and by the present mode of fishing in catching the shrimps he must perforce catch the young flat-fish. If it were possible to substitute the method used in some places in France, and recommended by the French Committee, of using baited traps instead of nets (*vide* p. 186), the capture of young flat-fishes would be entirely avoided.

But how can their destruction by the present methods be dealt with ? There is no question here of mesh of net or of avoidance of nurseries of young fish. The only satisfactory way of dealing with the subject is to ensure that the young fish be returned to the sea alive and vigorous. The French Committee state that in France the fish when returned perish ; but I have little doubt their destruction may be avoided, (1) by hauling the net within a given time ; (2) by replacing them in the sea within a given time after the net has been hauled. We have not yet, however, sufficient knowledge to fix with any precision at all the length of time that might be allowed in either case. The vitality of the various species of young flat-fishes varies very much, and a length of time which might ensure the survival of one kind might be fatal to another.*

Another point of importance which should be determined before any

* I am aware, as Buckland points out, that there may be practical difficulties in the way of always enforcing such regulations. In shrimping by night, which is practised in some places, the men are cautious of handling the shrimps in the dark for fear of being wounded by the sting-fish (*Trachinus vipera*). Then there is the difficulty of managing the ship and trawl in foul weather, and at the same time picking out the young fish. But in the great majority of cases the regulation could be carried out without hardship or risk.

regulative measure is proposed, is the proportional abundance on the shrimping grounds of the young of the various kinds of flat-fishes. Scientific reasons are given below which render it doubtful whether it is wise to attempt to preserve the young of the almost valueless dabs from destruction; but there can be no question at all as to the wisdom of preserving the young of the more valuable flat-fish—turbot, soles, brill, plaice, &c. It has been shown where young plaice and young soles abound, possibly young turbot and brill are present in large numbers in many similar localities, although I do not think the scientific evidence in favour of this view is as yet conclusive. It is a subject for inquiry, for the flat-fish nurseries at different parts of the coast differ in the proportion of the fish composing them. It is very desirable that a careful scientific inquiry should be made into the capture and destruction of young fish by shrimp-nets, seines, weirs, and fixed nets around the shores.

Beam-trawling.

The capture of immature flat-fish by beam-trawlers stands on a different footing. In dealing with this question I shall consider (1) the actual capture of immature flat-fish by beam-trawling; (2) whether and to what extent this is detrimental, and (3) how it may be avoided. It has been shown by the investigations detailed in this paper that trawlers capture large quantities of immature flat-fish; although almost certainly not so many very small ones as do shrimp fishers. The trawlers themselves admit that they kill large quantities of young fish; and they desire to avoid it. One trawler has stated that he has seen 1000 vessels in the North Sea getting at the rate of two or three tons of immature fish, night after night for two or three weeks. * No doubt this picture is largely exaggerated. The question as to the extent to which the capture of immature fish is prejudicial, is difficult and complex. I have shown (p. 163) that a plaice under twelve inches, a turbot under about eighteen inches, a haddock under ten inches, and a cod under twenty inches are immature, and have not performed the function of reproduction. That is the biological statement of the case. But beyond that there is the economic side which must necessarily be the final appeal; for the object is how to obtain year after year the largest possible harvest of food from the sea without endangering future supplies. There is no question that a large number of *immature* fish (such as those named) are eminently saleable and wholesome, and in point of fact they now furnish an important article of diet. The great problem is to determine for each kind of fish the size which may be allowed to be caught and the size which should not. In the case of round-fish there is little difficulty; they are abundant, the very young specimens escape capture by hook and by trawl, and the supplies are not falling off. In the case of the more valuable flat-fish one principle can be laid down; that the destruction of young individuals which are unsaleable, or so small from the economic point of view as to be of comparatively little value, should be prevented in every way possible. No one will dissent from that. But is it expedient to recommend that, say, all turbot under about eighteen inches, brill under about sixteen inches, and plaice under twelve inches, should be preserved? It must be remembered that an immature individual approaching sexual maturity is of much more value to the species than several which are less developed Thus more harm will probably accrue by the destruction of one turbot at sixteen or seventeen inches than by the destruction of a dozen at

* Nat. Sea Fisheries Protect. Assoc., Report of Proceedings at the Conference of Representatives of the Sea Fishing Industry, p. 37, 1889.

nine or ten inches, or of a thousand at one inch; its natural chances of survival to the reproductive stage being so much greater. It is possible that in the case of the turbot, brill, and sole, there has been overfishing (or the capture of too many adults) as well as destruction of the young. But in that case there is all the more need for the protection of immature individuals.

Passing now to the problem of how the capture and destruction of immature specimens may be prevented, it will be found to be exceedingly difficult of solution. It might be easy enough to interdict the sale of fish under a certain size as recommended by the Commission in 1866 under certain contingencies (*vide* p. 159). But this will be productive of positive harm, unless it can be also ensured that the fish under the prohibited size are either not captured at all, or if, are returned to the sea in such a condition as will enable them to live. In the case of line fishing there would be less difficulty, for the fish are nearly always active and vigorous when the line is hauled, and the immature forms would almost all live if at once returned to the sea. But how is it to be carried out in beam-trawling?

If immature flat-fish were special in their distribution—if their nurseries could be defined as apart from the habitats of the adults—the problem could be easily solved by the prohibition of beam-trawling in those areas. But it cannot be said that the young of the valuable flat-fishes have a special distribution apart from the adults, except to a certain extent in the case of plaice. I have shown that immature plaice abound in the territorial waters and are rare offshore (unless perhaps at certain banks, like the Dogger). Adult plaice are found scattered about in the territorial waters—in some localities, as the Pentland Firth, they are said to spawn there—but, relatively to the young, they are far more abundant offshore. I believe that the prohibition of beam-trawling in territorial waters would go a long way to protect immature plaice. The trawling experiments of the 'Garland' have shown that while nearly all fish have diminished during the last two years in the territorial waters of the East Coast, where trawling is prohibited, plaice alone have increased. But it is certainly different with immature turbot and brill, and probably also with soles. Young turbot and brill are probably at least as abundant at distances from shore as in the territorial waters (*vide* pp. 171, 172), and it would be impossible to protect them by prohibition of trawling within defined areas—without at the same time preventing the capture of adults. Soles are rare on the East Coast; but from the evidence obtained I think it will be found that the distribution of the young at present caught by the trawl is not specially in territorial waters or definable areas.

On the other hand, if all immature fish were equal in size it would be possible to prevent the capture of the great majority by simply enlarging the mesh of the net (*vide* p. 182). But a serious difficulty arises from the fact that the largest immature individuals of different species have very different sizes (p. 163). A mesh which would allow all immature plaice, witch soles, flounders, lemon soles, and probably soles (*Solea vulgaris*), to escape, and at the same time be capable of capturing the adults, would capture large numbers of immature turbot and brill. A mesh which would allow the escape of all immature lemon soles, flounders, dabs, &c., would capture large quantities of immature plaice, soles, turbot, brill, &c. Similarly, a mesh which would allow all immature turbot and brill to escape, would not retain many fully adult plaice, soles, flounders, &c.—and it would probably not be worth fishing with it. If a size of mesh were fixed which would permit the escape of all flat-fish under, say, 8 inches, many immature forms would not be caught (*vide* Table III. p. 163), and this considered alone would be an advantage. The size of mesh necessary could be determined by a few experiments. It is questionable, however, if the benefit accruing from the adoption of such a mesh would not be more than counter-balanced by certain disadvantages. The mesh would capture the smallest adults of most flat-fishes, but it would allow many adults of the comparatively valueless flat-fishes, as the common dab, long rough dab, &c., to escape. These fishes are abundant on the Scottish coast, and it is shown by Mr Ramsay Smith in the Report on the Food of Fishes (p. 230) that they live to a large extent on the same food as soles, plaice, and haddock. Would it be, on the whole, beneficial to put a premium on the multiplication of these fishes—which occupy ground and consume food capable of rearing multitudes of other more valuable fishes in order to preserve from capture a considerable proportion of immature plaice and soles, and a moderate proportion of turbot and brill? It is a subject for further inquiry.

It is, I think, obvious that limitation of the size of the mesh will not alone solve the problem.

Another measure advocated is, as in shrimp-trawling, while allowing the *capture* of immature individuals, to pick them out and return them to the sea, when the net is hauled. As trawling is at present carried on, it is doubtful if such procedure would be of much advantage. When a net is down five, six, or seven hours the probability is that at all events most of the immature flat-fish in it are either dead before they are brought to deck, or are so much impaired in vitality that they will die before they can be picked out or after they are returned to the sea. Our knowledge on this point is not however very exact. Professor M'Intosh* states that, during the experiments in connection with the Trawling Commission of 1884, the turbot were 'as a rule active when freed from the trawl' and that 'all the brill and soles were alive and in fine condition.' He describes the sole as 'one of the most tenacious amongst flat-fishes.' He also points out that no fish was so hardy as the plaice. From an examination of the records made by Professor M'Intosh, it appears that when the net was hauled all the turbot, brill, and soles were alive. Turbot, brill, and plaice were living after the net had been down as long as seven hours and twenty minutes on a sandy bottom; all the soles when the net had been down for five hours even on a muddy bottom. Some plaice were dead after the net was down for four hours on a muddy bottom. Dabs succumbed much more rapidly. The vitality of immature fish appeared to be much less—but turbot, brill, and soles are not included in this class. No turbot, brill, or soles were caught during the experiment made on board the 'Garland' (*vide* p. 183), but some of the plaice died before their condition could be recorded; and it is doubtful how many would have lived if they had been returned to the sea. In this connection the routine operations on board a trawler must be borne in mind.

It appears to me very necessary, at all events, that further experiments should be made before it can be assumed that even moderately sized immature turbot, brill, and soles will live *when returned to the sea*, after the net has been down a few hours. It would be a mere waste to return such fish to the sea unless it were certain they would live.

From what I have stated in this Report as to the distribution, capture, and destruction of immature fish, and from general considerations, I think that certain principles may be laid down, and certain recommendations made.

* *Op. cit.*, p. 358.

1. That the destruction of all immature fish which are not saleable should be prevented, in all cases possible.

In the case of shrimp fishing, and the fishing by fixed engines along the shore, an inquiry should be made as to (*a*) the amounts and proportions of the various kinds of immature fish captured; (*b*) as to the length of time shrimp-nets may be down without the vitality of the young flat-fish taken in them being seriously impaired; (*c*) as to the length of time which may be allowed to elapse between the removal of the young flat-fish from the sea, and their being returned to it vigorous enough to live. I am convinced that annually many millions of the young of valuable flat-fishes are wastefully destroyed by shrimp-nets along the shore; and that it is quite possible to devise a remedy without imposing hardship on the shrimp fishers.

Ordinary beam-trawl nets should possess a mesh which is large enough to allow all flat-fish under six inches in length to escape.

2. That where it can be shown that immature flat-fish of the valuable kinds have a special or localised distribution, apart from the adults, or where their preponderance is excessive, beam trawling should be partially or entirely prohibited in such nursery areas, unless it can be shown that the disadvantages are greater than the advantages.

As yet the only authenticated case of such nurseries being fairly well defined occurs with plaice, the young of which is practically confined to the territorial waters.

3. That, from the biological point of view, the killing of all turbot under eighteen inches; brill under sixteen inches; plaice under twelve inches; witch soles under twelve inches; lemon soles under eight inches, and all immature black or English soles, should if possible be prevented. And that no measures should be taken to protect the young of the almost valueless and largely competing dabs.*

The difficulty is to carry out such a principle in practice. The sale of the fish may be prevented, but not their capture, and merely to prohibit their sale would be worse than useless. It cannot be carried out by dealing with the mesh of the trawl-net alone. Experiments should be first made to determine the degree of vitality of the various kinds of fish under the sizes named, after the net has been down for a varying number of hours; and also the length of time the fish can lie on deck and live when returned to the sea. All that is required is a large tub of sea-water on board.† Should it be clearly demonstrated that the immature fish named would live when returned to the sea after the lapse of a time approximate to what now occurs in the practice of beam trawling, the enforcement of a regulation embodying the above principle would be highly serviceable. Certain practical difficulties could be overcome with a little care. Any regulations should be international.

4. In declining fisheries the mere protection of immature individuals has not been effective; it has been found necessary to supplement restriction by artificial cultivation.

* It will be seen from my Notes on Contemporary Fishery Investigations (p. 359), that the sale of young individuals of certain sea fish has been interdicted in Italy since 1877, and in Denmark since 1888; and that the subject is engaging close attention in Holland, France, Belgium, and Spain. The sizes fixed upon in Denmark and Italy, however, like the sizes adopted in the Act of George I., are more or less arbitrary, and do not in reality agree with the distinction between mature and immature individuals.

† Such experiments are now being arranged for on board the 'Garland.'

This has been very clearly demonstrated by the history of the lobster or oyster fisheries in Norway, Canada, Newfoundland, the United States, Holland, and France. Restriction to the verge of prohibition has failed; and artificial culture has been resorted to. If it were possible for trawlers and fishermen to artificially fertilise the ova of ripe soles, turbot, brill, and plaice, and return the eggs to the sea, undoubted benefit would accrue, for the waste of spawn is enormous.*

Hatcheries for sea fish have been established in the United States, Norway, Newfoundland, and at Grimsby, and it is proposed to erect one in Canada. If similar hatcheries were established on our coasts millions of young turbot, soles, &c., could be planted on proper ground every year.

With this view the Fishery Board have recently requested Professor M'Intosh to undertake an investigation into the hatching and development of the turbot and lemon sole.

* All that is requisite is a jar of sea-water, into which the eggs are run by gentle pressure on the female; a little milt is then added, and the contents gently stirred with the hand. After standing for a short time the contents should be flung into the sea.

Record of some of the Observations made in 1889 on Board the 'Garland' at various parts of the East Coast of Scotland, as to the Distribution of Immature Fish in Inshore and Offshore Waters.

Note.—E., before the figures denoting temperature, means east end of station; W., west end; S., south end; and N., north end.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
21 miles east of May Island. 5th June. 3.35 p.m. to 4.50 p.m.	W. 58·0	54·2	4·5 24 fath.	Surface-net.—A considerable number of Copepods (*Calanus* and *Anomalocera*), *Sagittæ*, f.	Starry ray,	1	$11\frac{1}{2}$	...	...	...	...	*Spatangus purpureus*, over 400 *Echinus esculentus*, *Flustra* sp. and *Tubularia indivisa*.	At beginning—Wind, E., force, 2: fine, clear; sea, smooth; transparency, $5\frac{1}{4}$ faths.; tide, about high water; bar., 30·34.
					Common dabs,	2	6	12	5	3	$3\frac{1}{2}$		
					,,	18	2-3	...	...	...	...		
					Long rough dabs,	1	8	3	6	...	...		
					Common gurnards,	1	$8\frac{1}{2}$	...	...	...	...		
Liston's Bank. 17th Sept. 2 p.m. to 3 p.m.	N. 57 5	56·0	55·2 24 fath.		Plaice,	1	16	1	$13\frac{1}{2}$	1	$10\frac{1}{2}$		At beginning—Wind, S.S.W., force, 7; cloudy; sea, rough; transparency, $4\frac{1}{2}$ fathoms; tide, first hour flood; bar., 29·98. At finish—Wind, S.S.W.; force 6; overcast.
					Common dabs,	1	13	...	...	...	...		
					,, ,,	1	$8\frac{1}{2}$	3	$7\frac{1}{2}$	5	$6\frac{1}{2}$		
					,, ,,	7	$5\frac{1}{2}$	6	$4\frac{1}{2}$	2	4		
					Long rough dabs,	1	9	1	6	1	5		
					Common gurnards,	2	8	1	7	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.		
FIRTH OF FORTH. 3 to 6 miles west of May Island. 17th October 1889, 2.25 p.m. to 3.45 p.m.	W. 49·0	52·0	51·8 26 fath.	Surface-net.—A considerable number of Copepods (*Dias, Temora*, &c.), *Sagittæ*, f.; small Medusids and very young Decapod Crustacea, fr. Bottom-net.—A great many Copepods (common sp., *e.g. Calanus*), a., *Tomopteris*, fr., Amphipods, f.	Plaice, . . .	2	14¼	...	...	...	...	*Nephrops*, c.; *Pandalus annulicornis*, fr.; *Aurelia* and *Cyanea*, f.	At finish—Wind W.N.W., force 2; weather, very hazy, inclining to rain; sea, smooth; tide, ; transparency, 4¾ fathoms; bar., 29·61.
					Long rough dabs, .	3	7½	1	7	6	6¼		
					" "	7	5	250	2½–1¾	...	...		
					Cod, . . .	9½	1	...	...	...	...		
					Whitings, . .	1	14	1	11	1	9¼		
					" . . .	3	8½	63	5½	187	5		
					"	59	4	43	3	7	2¼		
					Lumpenus lampetriformis, . .	1	6	...	...	...	...		
STATION I. 14th May 1889, 2 p.m. to 3.30 p.m.	W. 46·0	47·8	46·8 15 fath.	Surface-net. — Fish eggs, c.; Copepods (*Calanus* and *Temora*), c.; *Sagittæ*, f. Bottom tow-net. — Fish eggs, f.; *Calanidæ* and Medusids, c.	Starry ray, . .	1	6½	...	...	...	...		Observations taken at 1.55 p.m.—Wind east, force, 4; sky, overcast; sea, smooth; tide, about 2 hours ebb; transparency, 2 fathoms; bar., 29·71.
					Plaice, . . .	18	14	11	11	5	9		
					Lemon dabs, . .	3	13	3	9½	1	8½		
					" " . .	1	4½	...	...	...	...		
					Common dabs, .	11	8	9	6½	16	4½		
					" " . .	5	4	23	3½	38	2½		
					" " . .	77	2–1½	...	...	...	...		
					Long rough dabs, .	3	8	3	7	...	...		
					Cod, . . .	1	7	1	5½	1	4		
					Haddocks, . .	1	11	1	10	...	...		
					Whitings, . .	2	8½	12	6	4	4		
					Common gurnards,	1	11	4	8½	5	7½		
					" " .	7	6	3	3	...	...		
					Dragonet, . .	1	7	2	6	1	5		
					Cat-fish, . .	1	36	1	27	...	...		

Record of some of the Observations made in 1889 on Board the 'Garland' as to the Distribution of Immature Fish.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
Station II. 14th May 11.50 to 12.50 p.m.	E. 46·0	46·9	44·5 15 fath.	Surface tow-net. — Number of fish eggs, c.; Calanidæ, c. Bottom tow-net. — *Sagittæ*, c.; Calanidæ, fr.; Medusids (small), f.	Grey skate,	2	14½	...	...	...	...		Observations taken at 11.45 a.m.—Wind east, force 3; weather, sky overcast; sea, smooth; tide, about flood; transparency, 2¼ fathoms; bar., 29·72.
					Plaice,	1	14½	4	12	6	11		
					"	3	9	1	8	...	...		
					Lemon dabs,	8	12½	6	11	5	8½		
					" "	2	7	1	2¾	...	...		
					Common dabs,	5	9	7	7	3	5½		
					" "	1	3½	...	...	...	...		
					Long rough dabs,	1	13	1	10	19	8		
					" "	13	7	3	6½	7	5½		
					" "	14	5	28	4	71	3½		
					" "	59	3–2½	...	...	...	...		
					Haddocks,	1	11	1	10	...	...		
					Cod,	1	6½	1	10	1	21		
					Whitings,	1	10	1	9	3	8		
					"	3	7½	90	6	97	5		
					"	27	4	6	3	...	...		
					Common gurnards,	4	10	5	8	1	6½		
					Pogge,	1	5½	2	3½	...	...		
					Angler fish,	1	28	1	24	2	21		
					" "	1	11½	...	...	...	...		
					Herring,	1	4½	...	...	...	...		
					Lumpenus lampetriformis,	2	12	6	10	...	...		
Firth of Forth. 9th May 1889 Portobello west about ⅓ mile, steering eastward 12 noon to 1 p.m.	E. 52·0	49·3	46·9 4 fath.	Surface-net. — Larval Decapods, f.	Thornback ray,	1	12½	...	...	...	...		Observations taken at 12 noon—Wind E.N.E., force 3; weather a little hazy, but fine; sea, smooth; state of tide, 3 hours ebb; transparency, disk
					Plaice,	1	15½	7	13½	47	11		
					"	19	9	20	8	8	7		
					"	2	6	6	3	...	...		
					Common dabs,	1	10	14	9	7	8–1 at 11		
					" "	12	7	2	6	13	5		
					" "	17	4	2	3	24	2–2¼		
					Long rough dabs,	3	10	3	7½	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE in 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Ins.	No.	Ins.	No.	Ins.		
FIRTH OF FORTH. 9th May 1889 Portobello, west about ⅓ mile, steering eastward, 12 noon to 1 p.m. —*continued.*					Cod,	1	18	...	...	...	...		just lost sight of at 1 fathom; bar., 29·71.
					Whitings,	1	8	4	6½	71	5½		
					"	27	4	5	3½	...	...		
					Common gurnards,	1	11½	1	7½	3	6		
					Angler,	1	23½	...	...	...	...		
					Father-lasher,	1	9¾	1	7	1	3½		
					Pogge,	1	4½	1	3	...	...		
					Sprat,	1	5	...	...	...	...		
					Herring,	1	7	80	5	44	4		
					"	7	3	24	2½	30	2		
					Zoarces vivipara,	1	9	...	...	...	...		
15th May 1889 Aberlady Bay, trawled westward across the bay 1.10 p.m. to 2.15 p.m.	E. 49·0	47·9	46·8 5½ fath.	Surface tow-net.—Floating eggs and *Calanus*, f. Bottom tow-net.—Copepods and Amphipods, fr.; Mysidæ including *Siriella armata* (two specimens), f.; and some Zoophytes.	Thorny ray,	1	25	5	17	1	14		Taken at 1.5 p.m.—Wind, E. N. E, force 4; sky overcast; sea moderate; transparency, 1¾ fathom; tide about flood; barometer, 29·72.
					"	5	12½	6	11½	3	7½		
					Plaice,	9	13	31	10	30	8½		
					"	22	7	104	6	9	5		
					"	11	4	29	3½	...	...		
					Lemon dabs,	1	12	...	...	...	...		
					Common dabs,	2	10	1	8½	2	7½		
					" "	8	6	7	5	1	4		
					" "	2	3½	2	3	10	2½–1¾		
					Founder,	1	11	1	9	2	8		
					" "	4	7	...	...	...	...		
					Whitings,	3	4½	...	...	...	...		
					Common gurnards,	1	12	2	8	1	6		
					"	1	4	3	3½	...	...		
					Pogge,	1	3½	6	2–2½	...	...		
					Freckled goby,	6	2–2½	...	...	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
STATION VII. 17th May 1889, 7.40 to 7.50 a.m.	W. 45·0	47·7	44·8 10 fath.	Surface-net. — Copepods, fr.; *Sagittæ* and *Tomopteris*, f. Tow-net at 8 faths.—Copepods, fr.; *Sagittæ*, fr.; Medusids, and *Balani* (free swimming stage), fr.; and young fish, f.	Starry ray,	1	11	...	...	...	...		Taken at 7·40 a.m. Wind, E. by N., force, 3; weather rather hazy and damp; sea smooth; tide, about 4 hours ebb; transparency, 3 fathoms; barometer, 29·95.
					Plaice,	4	16	1	7	...	...		
					Common dabs,	5	7	10	6	2	5		
					" "	7	4½	3	4	5	3		
					" "	81	1½–2½	...	...	...	...		
					Lemon soles,	1	12½	3	11½	2	9½		
					Long rough dabs,	3	12	5	7	4	5½		
					"	1	4	2	3	...	...		
					Haddocks,	3	10	...	...	...	...		
					Whitings,	2	9	10	7	53	5		
					"	14	4½	7	3½	...	...		
					Hake,	1	4	...	...	...	...		
					Common gurnards,	1	15	1	13	7	10½		
					"	8	8½	1	7	9	6		
					"	1	5½	1	3	...	...		
					Dragonet,	1	8½	3	7	4	6½		
					"	6	5	1	4½	...	...		
					Pogge,	2	4½	5	3½	2	3		
					"	1	2½						
					Cat-fish,	1	14	...	...	...	...		
STATION VIII. 16th May 1889, steered south-west 4.7 to 5.7 p.m.	N.E. 47·0	46·0	44·0 22 fath.	Tow-netting similar to Station IX. trawled shortly before this one.	Common dabs,	1	4½	1	5½	1	3		At beginning—Wind, E.; force, 3; weather, overcast, hazy; sea smooth; transparency, 3⅓ fathoms; tide, about 1 hour ebb; barometer, 29·90.
					" "	2	2½	1	2	...	...		
					Lemon soles,	1	3	...	...	...	...		
					Long rough dabs,	15	7	15	6	2	5		
					"	15	4	103	3½	16	3		
					Witch soles,	1	15½	1	11½	...	...		
					Haddocks,	1	12	6	10	1	6		
					Whitings,	3	8	56	6½	40	5		
					"	10	4	1	3½	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Ins.	No.	Ins.	No.	Ins.	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
					Common gurnards,	11	10	2	12	4	9		
					,, ,,	1 at 2	8	4	6	1	2½		
					Angler,	1	22	...	...	...	...		
					Pogge,	2	4½	2	3½	5	2½		
					Lumpenus lampetriformis,	1	10½	...	...	...	...		
STATION IX. 16th May 1889, 2.45 to 3.45 p.m. steered north.	S. 48·0	46·3	44·0 21½ fath.	Surface tow-net.—Fish ova and Calanidæ, f. Tow-net sunk to about 8 faths.—Calanidæ, fr.; and a number of young fish.	Starry ray,	1	2½	...	...	...	...		Taken at 2.45 p.m. — Wind, 3, force, 2; weather, overcast, hazy; sea smooth; transparency, 3 fathoms; tide, about flood; barometer, 29·90.
					Plaice,	1	21	1	17	...	...		
					Common dabs,	1	9½	1	7½	1	5½		
					,, ,,	1	5	1	3½	1	2½		
					Long rough dabs,	6	8	14	6½	14	5½		
					,, ,,	91	3½	24	3	...	...		
					Witch soles,	1	18½	1	17½	1	15¼		
					,, ,,	1	9½	...	...	...	...		
					Haddock,	2	9½	1	10½	...	...		
					Whitings,	1	10½	1	7½	19	6½		
					,,	11	5	2	4	...	...		
					Common gurnards,	2	14	3	9	1	11		
					,,	1	5½	...	...	...	...		
					Pogge,	2	3	2	2	...	...		
					Lumpenus lampetriformis,	2	9½	3	10½	3	12¼		
					Four bearded rockling,	1	9½	...	...	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
STATION I. 6th Sept. 1.30 p.m. to 3.0 p.m.	E. 54·5	56·0	55·0 15 fath.		Plaice, . . .	2	12	6	11	...	...		At beginning—Wind E., force 3; fog, sea slight; transparency, 3 fathoms; tide, ebb; bar., 30·20. At finish — No change.
					Lemon soles, . .	3	13½	1	10½	6	9½		
					,, ,, . .	2	8	...	...	...	...		
					Long rough dabs, .	13	9	17	7½	30	5		
					,, ,, .	6	4	8	2	...	...		
					Cod, . . .	3	10½	2	9	2	4½		
					Whitings, . .	11	8½	8	7½	361	5½		
					,, . . .	193	5	1094	4	43	3		
					Herring, . .	1	3	...	...	...	...		
STATION II. 6th Sept. 11.15 a.m. to 12.30 p.m.	E. 55·0	56·0	56·2 14 fath.		Plaice, . . .	7	13½	8	12	...	...		At beginning—Wind E.S.E., force 2; very hazy; sea smooth; transparency, 4½ fathoms; tide, flood; bar., 30·20. At finish — No change.
					Common dabs, .	11	8	6	7	5	6		
					,, ,, .	22	5	32	4½	29	4		
					,, ,, .	2	2	...	...	...	...		
					Lemon soles, . .	1	13½	2	11½	2	8½		
					Long rough dabs, .	2	9	4	7	5	5½		
					,, ,, .	2	4½	4	2	...	...		
					Haddocks, . .	6	5½	12	4½	7	3½		
					Cod, . . .	2	10½	3	9	...	...		
					Whitings, . .	2	8	6	7	231	4½		
					,, . . .	630	4	39	3	...	...		
					Common gurnards,	1	12	2	9½	3	8		
					Goby, . . .	1	2½	2	1½	...	...		
STATION V. 4th Sept. 3.40 p.m. to 5,0 p.m.	E. 53·4	55·8	56·0 22 fath.		Plaice, . . .	2	14	1	11	...	...		At beginning—Wind E., force 3; dense, fog; S.E. swell; transparency, 4 fathoms; tide,
					Lemon soles, . .	4	14	1	12	...	...		
					Long rough dabs, .	1	8	6	6	10	5		
					,, ,, .	5	4	103	2½	to	1½		
					Haddocks, . .	16	4	2	3	...	...		
					,, . . .	2	13½	3	12	19	5		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature.			Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate, Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
	Air.	Water.											
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
					Cod,	1	17	2	14½	2	10½		flood; bar., 30·10. At finish—A little less fog.
					,,	1	4	2	3	...	...		
					Whitings,	4	10	20	8	12	7		
					,,	219	5	348	4	59	3		
					Brassie,	1	7	...	...	...	...		
					Gurnard,	3	12	1	9	...	...		
					Plaice,	1	13	...	...	...	...		
STATION VIII. 4th Sept. 11.40 a.m. to 12.50 p.m.	W. 54·0	55·5	56·0 20 fath.		Common dabs,	8	7½	1	5½	5	4		At beginning—Wind E., force 2; very hazy, S.E. swell; transparency, 4 fathoms; tide, ebb; bar., 30·8. At finish—Weather thick.
					,, ,,	2	3	...	...	...	...		
					Long rough dabs,	2	7	2	6	2	5		
					,, ,,	61	2	to	1½	...	...		
					Haddocks,	17	5	25	4	...	...		
					Cod,	1	18	...	...	...	...		
					Whitings,	1	12	3	9½	7	8½		
					,,	6	7	228	5	401	4		
					,,	33	3	...	...	...	...		
					Common gurnard,	1	7½	...	...	...	...		
					Goby,	3	2	...	...	...	...		
					Plaice,	1	13	2	10	...	...		
STATION IX. 4th Sept. 1.30 p.m. to 2.40.	W. 54·0	55·6	56·0 29 faths.		Common dabs,	5	7½	4	6	8	5		At beginning—Wind E., force 2; S.E. swell; fog; transparency, 4½ fathoms; tide ebb; bar., 30·10. At finish—More fog.
					,, ,,	8	4	2	3½	...	...		
					Lemon soles,	1	12½	1	10	...	...		
					Long rough dabs,	11	8	5	6	1	5		
					Haddocks,	1	15	1	12½	2	10		
					,,	14	5½	12	4½	...	...		
					Whitings,	16	9	31	8	11	7		
					,,	42	4½	14	3½	...	...		
					Common gurnards,	1	7½	1	6½	...	...		
					Herring,	2	3	...	...	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish. No.	Inches	No.	Inches	No.	Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
MORAY FIRTH. Smith Bank, 5th July 1889. Steered S. 6.40 to 8 p.m.	N. 58·5	58·0	50·0 25 fath.	Surface-net. — Copepods (*Dias centropages*), r.; Larval Decapods, f.; Embryo Gastropods, f.; and fish ova (gurnard), f.; Schizopods, r. Tow-net at 10 fathoms. A few small Medusids and Larval Decapods. Bottom-net — Half filled with sand and ruptured.	Thornback ray,	1	14	1	11½	...	...	*Spatangus* and dead Mollusc shell, v.a.	At beginning—Wind E. by S., force 3; weather, a slight haze, no clouds, fine; sea, slight; tide, 2½ hours ebb; transparency, 7½ fathoms; bar., 30·10.
					Sand ray,	1	3	...	...	...	...		
					Common dabs,	2	6	5	5½	2	5		
					" "	5	4	1	3¾	14	3		
					" "	48	22½	..	...	...	...		
					Lemon soles,	1	8½	...	...	...	...		
					Long rough dabs,	1	5½	...	...	...	...		
					Little soles,	1	5	3	4½	2	4¼		
					" "	6	4	12	3¾	17	3½		
					" "	11	3	8	2¼	...	...		
					Common gurnards,	1	4½	...	...	...	...		
					Angler,	1	25	...	...	...	...		
					Pogge,	1	4½	2	3½	8	3		
					"	2	2½	1	2¼	...	...		
					Goby,	3	2	...	...	...	...		
MORAY FIRTH. Smith Bank, 5th July steered E. 9.25 to 10.35 p.m.	W. 57·0	57·8	50·0 21 fath.	Surface-net — Copepods, f.; 1 young Amphipod (*Atylus ?*); Larval Decapods, f.; Gastropods (Embryo) and small Medusids (young *Cyanea*) f.; 1 very young fish (Gurnard ?). Tow-net at 12–15 fathoms, some sand and a few larval Decapod crustacea.	Common dabs,	1	2¼	...	...	...	...	One *Spatangus*.	At beginning—Wind S.E. by E., force 3; weather, a slight haze, no clouds, fine; sea, slight; tide, 5½ hours ebb; transparency, 7½ fathoms; bar., 30·8.
					Cod,	1	7	...	...	...	...		
					Haddocks,	1	17	1	15	1	14		
					"	6	13	6	12	...	...		
					Whitings,	1	18	2	11½	6	9½		
					"	12	7½	5	6½	...	...		
					Common gurnards,	1	12½	5	9	1	10		
					"	2	8	1	7	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl down.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Size of Fish. No.	Size of Fish. Inches	Size of Fish. No.	Size of Fish. Inches	Size of Fish. No.	Size of Fish. Inches	Invertebrate Fauna, &c., brought up in Trawl Net.	Wind, Weather, and other Observations.
MORAY FIRTH. STATION I. 10th July 2.40 to 3.45 p.m.	W. 53·0	55·9	55·0 5 fath.	Surface-net — Copepods, r.; small Medusids (*Pleurobrachia, Thaumantias*), f.; *Actinia*, f.	Thornback ray,	1	26	...	...	...	...	A small quantity of weed with some *Caprellæ* and Amphipods adhering to it, and one or two *Pandalus annulicornis* and *Virbius varians*.	At beginning—Wind E., force 5; weather, overcast with rain; sea, moderate; transparency, 4½ fathoms; bar., 29·68.
					Plaice,	1	11½	...	...	...	...		
					Common dabs,	1	11½	2	6¼	2	5½		
					" "	1	5	2	4½	2	3½		
					" "	2	3	...	...	...	...		
					Cod,	1	8½	1	3½	8	3		
					"	15	2½	28	1¾–2¼	...	...		
					Coal fish,	1	4½	1	4	1	2¾		
					" "	1	2¼	1	1⅝	1	1⅜		
					Sand eels,	2	6½	...	...	...	...		
					Butter fish,	2	2	...	...	...	...		
MORAY FIRTH, Spey Bay, 11th July. (Between Port Gordon and mouth of Spey.) 9.15 to 11 p.m.	E. 51·5	57·0	56·9 6 faths.	Surface net.—Copepods (*Parapontella brevicornis, Centropages hamatus*), *Evadne*, r.; larval ascidians, r.; *Cratium fusus, Tintinus*, and other Infusorians, r.; a few young Amphipods.	Common dabs,	1	3¼	1	1¼	...	...		At beginning—Wind, E.N.E., force 2; weather, moderately clear, fine; sea, smooth, easterly swell; tide, about 4 hours flood; transparency, 4½ fathoms; bar., 29·91.
					Cod,	1	3	...	...	...	...		
					Coal fish,	2	3¼	1	3	1	1¾		
					Whiting,	1	2	...	...	...	...		
					Goby,	4	2	...	...	...	...		

RECORD OF SOME OF THE OBSERVATIONS MADE IN 1889 ON BOARD THE 'GARLAND' AS TO THE DISTRIBUTION OF IMMATURE FISH.

Station, Date, and Time Trawl Down.	Temperature. Air.	Temperature. Water.		Pelagic Fauna, Spawn, and young Fish.	Description of Take.	Number and Size of Fish.						Invertebrate Fauna, &c. brought up in Trawl Net.	Wind, Weather, and other Observations.
	Dry Bulb.	Surface.	Bottom.			No.	Inches	No.	Inches	No.	Inches		
MORAY FIRTH, 11th July Cullen, S.S.W., 11 miles, steered N.E., 4.45 to 5.50 p.m.	S.W. 52·8	54·1	51·0 53 fath.	Surface-net.—*Dias* and *Balani* (Ostracod-stage), r.; Larval decapods, c. Tow-net at 20 fathoms, *Calanus* and Larval Decapods, (*Macrura* and *Carida*), f.; Medusids (*Bolina, Thaumantias*), c.	Long rough dabs,	2	8¼	5	6½	8	5½	A few *Crangon Allmanni, Pandalus Annulicornis* and *brevirostris* and a quantity of small Medusids.	Observations taken at beginning of Trawl. Wind, N.E., force 2; weather a little cloudy, fine; sea, smooth, easterly swell; tide, about low water; transparency, 4¾ fathoms; bar., 29·88.
					,, ,,	3	5	20	4	6	3¼		
					Witch soles,	1	15	1	14	...	...		
					Cod,	1	3	3	2⅓	...	...		
					Haddocks,	1	13½	1	11½	1	2¼		
					Whitings,	1	14	1	12	2	10½		
					,,	5	9½	4	7½	20	6½		
					,,	4	5½	...	...	...	...		
					3-Bearded Rockling	1	9	1	8½	1	6		
					Hag,	5	11¼	4	10	...	...		
					Lumpenus lampetriformis,	1	8	...	...	...	...		
MORAY FIRTH, 11th July Lossiemouth S.S.W., 15-16 miles, steered S.S.E., 2.30 to 3.30 p.m.	N. 54·0	53·7	52·5 27 fath.	Surface-net — *Dias longiremus*, f.; several Larval Decapods and fish ova nearly hatching out, and small Medusids. Tow-net at—15 to 16 fathoms, *Calanus*, f.; Caridæ, fr.; a very young fish (Gurnard), a considerable number of Medusids (*Pleurobrachia, Bolina*, &c.)	Long rough dabs,	1	6½	2	5½	1	4¼	*Pecten opercularis*, c.—A few *Spatangus purpureus* f.; and 2 young *Loligo*. Dredge brought up *Echinocardium florescens*, c. *Spatangus purpureus*, f.; *Dentalium entalis*, f.; *Venus galina*, f.; *Mactra subtruncata*, f.; *Axinus cronlinensis*, f.	At beginning—Wind, N.E., force 3; weather, a little overcast—fine; sea, moderate, with easterly swell; tide, fully 3 hours ebb; bar., 29·89; transparency, 5 fathoms.
					Sail fluke,	1	15	...	...	...	...		
					Haddocks,	1	16½	1	12½	1	11½		
					,,	1	2⅛	2	1¼	2	1⅛		
					,,	3	¾	...	...	...	...		
					Whitings,	1	13	...	...	...	...		
					Common gurnards,	1	10	...	...	...	...		
					Hag,	1	10¾	...	...	...	...		

III.—THE COCKLE BEDS OF BARRA. By J. H. Fullarton, M.A., D.Sc. (Plate IV.)

1. Historical.

The history of the Barra Cockle Beds dates back to the sixteenth century. Dean Munro, in his *History of the Western Isles* (1540–1549), in describing the island of Barra, says—'Not far from the Isles 'Watersay (one of the islets belonging to Barray) towards the north by 'twa mile of sea, lyes the Isle of Barray, being seven mile in lengthe 'from the south-west to the north-eist and be north, and foure in 'breadthe from the south-eist to the north-west, ane fertill and fruitful 'isle in cornes. . . . . In the north end of this ile of Barray, there 'is ane rough heigh know, mayne grasse and greine round about it to 'the head, of the top of the quhilk ther is ane spring and fresh water 'well. This well truely springs up certain little round white things, 'less nor the quantity of confeit corne, lykest to the shape and figure 'of an little cokill, as it appeared to me. Out of this well runs ther 'an little strype downwith to the sea, and quher it entres into the sea 'ther is ane myle braid of sands quhilk ebbs ane myle callit the Fraymore 'of Kilbaray—that is, the grate Sandes of Barry. This ile is full of grate 'cokills, and alledgit by the ancient countrymen that the same cockles 'comes down out of the foresaid hill through the said strype, in the first 'small forme that we have spoken of, and after there coming down to the 'sandes growis grate cokills always. Ther is na fairer and more profitable 'sands for cokills in all the warld.' Martin, though a little more sceptical, writes in 1703 (*Western Isles of Scotland*)—'And they say that the well 'of Kilbar throws up embrioes of cockles, but I could not discern any 'in the Rivulet, the air being at that time foggy.'

This interesting piece of natural history is not quite so ridiculous as some of the stories attempted to be passsed for fact on the credulous public, such as the finding of a living frog embedded in the strata of the Coal Measures. Though the researches of Loven on the development of the cockle were then in the distant future, the Old Statistical Account (Sir John Sinclair's) in 1795 pointed out the fallacy of the origin of cockles from the 'animalculi' of the well, as Buchanan, following in his predecessors' footsteps, had alleged. This story was further discredited by James Macdonald, who wrote a *General View of the Agriculture of the Hebrides*, &c., in 1811. He says—'The story of the cockle embryos 'being carried down from a spring and along the course of a rivulet near 'Kilbar in Barray, we found to be merely a fancy of the Venerable Dean '(Munro), perhaps suggested by the patriotic vanity of the natives. 'The isle of Barray has indeed more cockles than any other island in 'proportion to its extent, and much benefit is derived from them, not 'only as food, but also as manure and cement, the shells being often 'exported to all the neighbouring districts for these purposes. Various 'other parts of the range of islands under review likewise contain vast 'quantities of cockles; and these shell-fish propagated their kind no 'doubt in the same manner here as in other parts of the world.'

Sir John Sinclair (1814), in his *General Report* (vol. iv. ch. i. Appendix No. 4), also tells of 'an astonishing quantity of shell-fish, 'especially of cockles, which are collected in hundreds of horse-loads at 'a time, as the people live much upon them in the summer season, and 'from the shells they also procure lime.'

In the New Statistical Account, the Rev. Alexander Nicholson, minister of the parish of Barra, tells that 'cockles are to be found '(1845) in the sands of Barray in such immense quantities that scores 'of horse-loads may be taken up during a single tide.'

These are some of the samples of the prominent position which the cockles of Barra held in the estimation of the writers on Barra between 1540 and 1845, and no account of the island is complete without a reference to the valuable cockle beds of Barra. While cockles are plentiful in such localities as Benbecula, Lewis, Easter Ross, St Andrews, and Solway in none of these can such quantities of fine cockles be obtained as in Barra.

2. The Cockle and its Habits.

The cockles — genus *Cardium*— have a wide geological range, extending from mesozoic times through Tertiary strata and into the seas of the present day. While the species that existed in Secondary and Earlier Tertiary ages present the characteristic features of the genus, individuals exhibiting the specific characters of *Cardium edule* are found in the Coralline Crag of the Pliocene, and in succeeding Pliocene strata down to the raised beaches that are so well developed on different parts of our shores. Jeffrey * has also chronicled the presence of fossils of *C. edule* from Upper Miocene strata near Antibes. Like its fellow Lamellibranch—the common mussel—the life of the species *C. edule* has been a long one, but its ancestral history is even longer than that of *Mytilus edulis*, which occurs only in the Upper Tertiaries.

Corresponding with this wide distribution in time, the common edible cockle, like the edible mussel, is found in the North Atlantic from the Polar circle to the waters of the Mediterranean, Möhr chronicling its occurrence in Iceland, and Forbes in the Ægean. It has also been found in the Canaries.

Some of the species of the genus *Cardium* are found at considerable depths, but the common cockle abounds in sandy beaches close inshore. It is found in beaches above low-water mark, and also in sandy bays a few fathoms in depth. While it flourishes best, and attains its greatest size in salt water, it is also present in the brackish water of estuaries. In the latter case, however, it exists as the smaller variety —*rusticum*—much smaller in size, and with a more delicate and wedge-shaped shell.

The ground in which cockles are found is sandy and soft, and the common cockle is generally buried from one to a few inches below the surface of the bank. If the sand is too soft and easily disturbed by the waves, the cockle is not able to maintain a vigorous foothold, whereas too hard ground presents an obstacle to its movements in the sand. While cockles herd together in great numbers, it is only in sheltered bays that they are obtained in sufficient numbers to make the gathering of them a commercial success. Where the sands are exposed to the full force of the Atlantic and North Sea waves, they are practically barren. Even storms in what are regarded as sheltered bays often cast ashore great quantities of cockles and their more seaward neighbours—razor-fish (*Solen*). The latter generally is found in the sand in a more or less vertical position, but the position of the cockle is not nearly so constant. If cockles are left on the surface of a sand bank, they bore their way obliquely downwards and have the beak of

* *British Conchology*, vol. ii. p. 287.

the two shells looking upwards and forwards. Their siphonal end—with the inhalent and exhalent openings—is therefore generally directed more or less upwards. On being touched they withdraw their siphons within the valves of the shell, which firmly interlock with each other, the prominent ridges of one edge of the shell fitting into and interlocking in the corresponding depressions in the edge of the other. The siphon tubes are short and conical, and diverge somewhat towards their free ends. At the opposite end from the siphons the foot is protruded, It is elbow-shaped, the distal end being pointed, and of a yellowish brown colour. Like the other Lamellibranchs which have the power of burrowing in sand or mud, by the alternate lengthening and thinning of the foot, on the one hand, and by the thickening and contracting from the point backward, on the other, the cockle is enabled gradually to work its way forward in the sand. The reverse or 'shoving' process permits its movement backwards.

While this is the method of movement of the adult cockle, the embryo leads a free pelagic life, swimming by the aid of the embryonic organs, which afterwards become aborted.

The thickness of the shell is extremely variable. In hard sandy beaches the shell is thick and globular in form, as it also is in exposed stretches of the coast; but where the ground is soft and more muddy the shell is slightly elongated posteriorly, and also thinner than the globular form. The thickness of shell and shape depend on the nature of the deposit in which the animal lives and on the forces that strike against the sandy beaches.

In large and globular-shaped specimens the beaks of the valves are so prominent, that by applying them back to back with the hinges at an angle of 90 degrees, one can open them by a corkscrew-like motion of the one on the other. In many cases, however, the shells are so soft that the beaks or umbones are worn away without the valves being divaricated. This softness is due to the composition of the shell, in which 'Dr Phipson has 'shown that they contain more than 90 per cent. of pure carbonate of lime.'* The great quantity of carbonate of lime in the inorganic constituents of the shells renders these admirable as a source of lime supply, which is easily obtained by calcining them. Tho Old Statistical Account says, 'the 'shell of the cockle makes the whitest, if not the strongest lime.'

3. The Barra Cockle Beds.

At the northern end of the Island of Barra, and facing the eastward, are the sand banks where the cockle is found. The sands are divided into three distinct portions—Traigh Mhor (in the Admiralty chart spelt Trigh Vore) being the most southerly, Kilbar Strand or Traigh Cille Bharra next, and Traigh Sghuir'aval (spelt in the Admiralty chart Trigh Scurrival) lying at the extreme south end of the peninsula of Eoligary. Traigh Mhor, the most important of the three, is divided from Kilbar Strand by the Island of Oronsay, and the latter from Traigh Sghuir'aval by the point that juts out nearly opposite Eoligary House towards the island of Fuday. Although there are great banks of sand on the west side of Barra, especially opposite Borve, and south and north of Grean Head, yet the exposure of these to the heavy seas of the Western Ocean prevents the cockle obtaining a foothold there. In the case of the sand banks of Traigh Mhor, Kilbar Strand, and Traigh Sghuir'aval, as these lie on the east side of Eoligary peninsula, they form good ground for cockles.

* Jeffrey, *loc. cit.*, p. 291.

The further protection afforded them by the islands and wash rocks of the Sound of Barra, in which they are situated, is also helpful. Traigh Mohr, which is the most extensive, is also the best protector. It is sheltered from south-easterly gales by the islands of Gighay and Hellisay, and by the rocks and islets running westwards from Hellisay to Grianameal. East and north-east winds are broken by the large island of Eriskay, by the Stack Islands, and by the wash rocks between the latter and the island of Fuday. From all other winds it is completely protected. Kilbar Strand is more exposed, especially to south-east winds, but the island of Fuday shelters it from the north-east. Traigh Sghuir'aval is the least sheltered of all. While Fuday Island protects it on the south-east, north to north-easterly seas from South Uist, and along the western side of South Uist, are only interrupted by the shallow banks lying at the western entrance to the Sound of Barra and to the north of Traigh Sghuir'aval. From high-water mark at the time of the greatest springs to low-water mark at the same season, the sand banks of Traigh Mohr are dry to the extent of almost a mile. Similarly at Traigh Sghuir'aval the tide ebbs for about half a mile, while at Kilbar Strand the distance is much less. The distance across Traigh Mhor from the Island of Oronsay to the rocks on the southern side of Traigh Mhor at low water is three quarters of a mile. The extent of sand banks dry at Traigh Mhor at lowest tides is about 320 acres, or about the same as is dry at the banks at Traigh Sghuir'aval and Kilbar Strand combined.

The banks of Traigh Mohr and Kilbar Strand are connected by the neck of sand which, as the tide recedes, dries between Oronsay and Eoligary, but Traigh Sghuir'aval is completely separated off from Kilbar Strand by the point of land about opposite Eoligary House.

Traigh Mohr is bluntly triangular, with the blunted apex pointing shorewards, the mark of low water forming the base of the triangle. Traigh Sghuir'aval is quadrangular, its long diameter being nearly south-south-east and north-north-west, while it is somewhat broader at its western shoreward side. It is fully two-thirds of a mile long, and the whole sand bank that ebbs dry contains upwards of 200 acres. As the geological formation of Barra is Laurentian gneiss, the sand bank, which is the product of denudation of gneissose rocks, is composed of particles of quartz felspar and mica—the predominating constituents of such rocks.

While the other two banks yield cockles, these are produced in greatest abundance on the beach at Traigh Mhor. But the whole of the sandy stretches of Traigh Mhor do not furnish an equal yield. The cockles are comparatively few in that part of the bank nearest high water, but from a quarter of a mile from high-water mark down to the low-water mark of neap tides they increase in numbers and size, and between the low-water mark of 'neaps' and the low-water mark of 'springs' they are most abundant. At the lowest of spring tides they occur alongside of a plentiful supply of *Solen siliqua*, which, like the cockles themselves, attain a giant size. I have found the cockle also to be abundant in the sand bank which stretches seawards, and is for a few hundred yards covered by not more than 2 or 3 feet of water at lowest 'springs.' More than 200 acres of Traigh Mohr are cockle-bearing, and the crop which this acreage is capable of producing is enormous. This extent may be considered as rich in cockles, and far surpasses anything that either of the other two baylets can show. So what is said has special reference to Traigh Mhor unless when otherwise mentioned. Having regard to the immense quantities of cockles in the banks, it is astonishing how few living forms are to be found upon the surface of the sand. The cockles are for the most part to be found 3 or 4 inches below the surface; and even the shells of dead cockles are quickly silted up and buried, particularly if the valves become separated from each other.

Cockles of every size, from the giant form of a little above 2 inches in diameter to the young form of about a quarter of an inch, are to be met with. Such large forms as the Barra cockle beds yield are seldom to be obtained elsewhere, and it would be difficult to find so many of these large forms anywhere at the expenditure of so little work as is required at Traigh Mhor.

The method adopted for securing the cockle is by means of raking. The rakes are much the same as the ordinary iron rakes used in gardens and for gravel walks, the teeth, however, of the cockle-rake being longer. The larger cockles, not being able to pass between the teeth of the rake, are brought to the surface along with the dead shells that have been silted and buried in the sand. But as the gatherers desire not only the largest sized forms, but even half-grown cockles, they are compelled to perform an operation akin to hoeing in order to obtain the latter. In this way, when many gatherers are at work at the season of low tides the strand presents a series of drills and furrows, which, however, are levelled in the course of a tide or two; and the beach presents the same even surface as it did before the gatherers' raking took place.

The season of cockle gathering lasts from the beginning of October till the end of April, but occasionally a few gatherers may be at work on the beds during the intervening months, particularly in May. The quantities, however, gathered during these months are so small that there may be said to be practically no cockle gathering taking place for five months of the year. Sir John Sinclair's Statistical Account states the season of cockle gathering for the use of the natives themselves to be May, June, July, and August; but the New Statistical Account says, 'they commence the use of them in times of scarcity in 'April, and continue the use of them till the beginning of August.' The *Ordnance Gazetteer* has evidently copied Sir John Sinclair's Statistical Account, for it gives the gathering time as in the latter, and also closely follows it in other particulars. Men, women, boys, and girls all take part in collecting the cockles, and they are accompanied to the strand by ponies and carts, or ponies furnished with panniers, for the transport of the bags of cockles to the port of shipment. The men are engaged in long-line and lobster fishing from February, and most of them begin herring fishing with the opening season in May. While the men are at the line and lobster fishing, gathering is done by the other members of the household; but when the herring season opens the women are employed at gutting and curing herrings, or at farming operations on their crofts. Agricultural pursuits occupy their time till the potatoes are dug, and some are also employed in kelp gathering and burning; but the population of Barra, when not engaged in these duties, betake themselves in large numbers to the strand.

4. Cockles as a Source of Food Supply.

For the past twelve years cockles have been exported in quantity from Barra, but previous to that the chief use of the cockle to the natives of Barra was as an article of food for home consumption. Whenever a population discovers that it can easily obtain what can as easily be converted into gold, there is a rush in most cases to convert the produce into cash, though the momentary rush may impoverish and lessen the supply. Unfortunately, the statistics of the export of cockles from Barra have only been obtained by the Fishery Board for the last few years, but these and the information otherwise obtainable show that the Barra people are like their neighbours in being desirous of reaping as rich a crop as possible with the least delay, without looking too closely at the effects produced by over-fishing on the crops of succeeding years.

The quantities exported since 1885 were as follows:—

1885, ...	9940 cwt.	1888, ...	2149 cwt.
1886, ...	8545 „	1889, ...	4880 „
1887, ...	3719 „		

The greatest quantity sent off in any month for which statistics are available was in March 1886, when 4000 cwts, or nearly one-half of the produce of the whole year, was despatched to market. Previous to that, however, as much as 100 tons were shipped in one day. However inadvisable such a large shipment to markets, now regulated largely by the laws of supply and demand, might be, it must be remembered that the facilities for transport were neither so rapid nor so frequent as the steam-boat services of the present time afford. When the export trade first began great quantities of large cockles could be obtained, and of course the time taken to fill a bag with an abundant supply of the larger cockles is proportionately less than that required to fill it with the smaller sizes. Now, as one native expresses it, few of the cockles get sufficient time to grow big. The cockles which are now sent to market range from about two inches to nearly an inch in diameter, and the tendency seems to be to send large and small alike, the latter size predominating. Of course, it may be a question whether a bag of small cockles will not fetch as much in the market as a bag of large cockles, seeing a bag of half-sized cockles will contain at least twice as many as a bag of large-sized ones. Even though the former should command a higher price than the latter, the question comes to be whether a greater number of bags may not be obtained from the banks, if the cockles are allowed to grow till fully mature in size, and whether the increased price from the larger number of bags will not in the end yield a larger revenue to the inhabitants of the island.

The markets supplied with Barra cockle are, among others, those of London, Liverpool, Manchester, Bristol, Sheffield, Bradford, Leicester, Leeds, Huddersfield, &c., the larger proportion going to Midland towns of England. They are despatched either by the mail steamer *via* Oban, or by direct steamers 'Dunara Castle' or 'Hebridean' *via* Glasgow. Each bag contains about one cwt., and the freight per bag is 3s. 7d. to Leicester and Bristol, 3s. 4d. to London, and 3s. 1d. to other towns mentioned.

Like other bivalves which can form a closed cavity by approximating their valves, the cockle has great vitality when removed from its natural habitat. If the weather be not too hot, it can live out of the sea for a good many days. It is thus admirably suitable for transmission for long distances, and in cold weather retains its vitality unimpaired for days after reaching southern markets. In hot weather they are apt to die, if two or three days on the journey to market.

Their value as food has been known and appreciated for two centuries and a half. Venner, writing (*Via recta ad Vitam longam*) in 1650, states:—'Cockles are not so noisome as muscles (mussels); they are of 'lighter concoction, and better nourishment, yet not laudable meat for 'such as lead studious or easy kind of life or have weak stomachs.' * Whether we agree or not with this ancient physiological statement, it is interesting to notice that the value of cockles as food has been appreciated for centuries in our own country. Cockles and mussels are a cheap food, and are within the means of the poorer classes of the community. What the oyster is to the upper classes and middle classes, they are to the lower classes. 'The poorer classes, who eat cockles in Lancashire and mussels 'in the Midland Counties, buy whelks and periwinkles in the London 'markets. †

While the epicure prefers to eat his shell-fish uncooked, in many places cockles are boiled; and Jeffrey ‡ seems to think that Æsop refers, in his fable when the son of the husbandman was apostrophising, 'O most wicked 'creatures, are you singing, while your houses are being burnt,' to the roasting of cockles. Fleming, in his *History of British Animals*, says 'cockles 'form a very palatable food, either raw or boiled, and are considered in 'highest season in the spring months.'

While Forbes and Hanley (*British Mollusca*, vol. ii.) descant on the cockle as most savoury food, few, who can afford to buy the more expensive oyster, will acquiesce in the judgment of those who prefer cockles to oysters, as they mention. These authors say—'Lieutenant Thomas 'informs us that in Sanda, among the Orkney Isles, during the late failure 'of the potato crop, many of the poorer people subsisted almost entirely 'on cockles.' No doubt, in various districts in the Highlands—in several places I have heard such stories from reliable witnesses—during seasons of scarcity in bygone times the population had largely to depend for sustenance on cockles, mussels, limpets, periwinkles, razor-fish, and edible seaweeds. Both Statistical Accounts dwell on the excellence of cockles as food, and tell how in times of scarcity the people consumed cockles from April to August. Such a diet is still preferable to the contents of the tow-net praised as 'food for the shipwrecked,' but they are certainly not obtainable by the crew of a raft in mid-ocean, as is the crustacean, cœlenterate and other pelagic life of the ocean. Besides being inferior to the oyster they are not superior in succulence to the fattened mussel, though the latter may not command such a price in the English market as the cockle.

Though generally eaten by themselves either raw or cooked, boiled or roasted, they are also used as an addition to sauce for fish, and the addition by many is regarded as enhancing the flavour of the sauce. They may also be pickled, and by some are eaten in this preserved condition; but, after all, the lover of molluscan food prefers them raw. In whichever way they are used, they form a very valuable article of food, and the income derived in some districts from their sale is very large. Spencer Walpole § says, 'the cockles which are gathered in 'Morecambe Bay are sold for at least £20,000 a year.' Whether this is the gross proceeds of the sale, without deduction of freight to market, or only the amount realised for cockles before transport from Morecambe, the sale from Barra beds cannot be expected to yield annually anything like even the sum netted by the cockle gatherers of Morecambe Bay. Messrs Buckland and Walpole, in their Report of 1879 of the Sea Fisheries of England and Wales, say that the value of this

* *Cf. International Fisheries Exhibition Literature*, vol. i. W. Stephen Mitchell, *On the Place of Fish in a Hard-Working Diet, with Notes on the Use of Fish in Former Times.*

† Spencer Walpole, *International Fisheries Exhibition Literature*, vol. i. p. 62.

‡ *Loc. cit.*, vol. ii. p. 290.

§ *Loc. cit.*, i. p. 47.

little mollusc to the Morecambe Bay fishermen cannot be less than £20,000 annually.

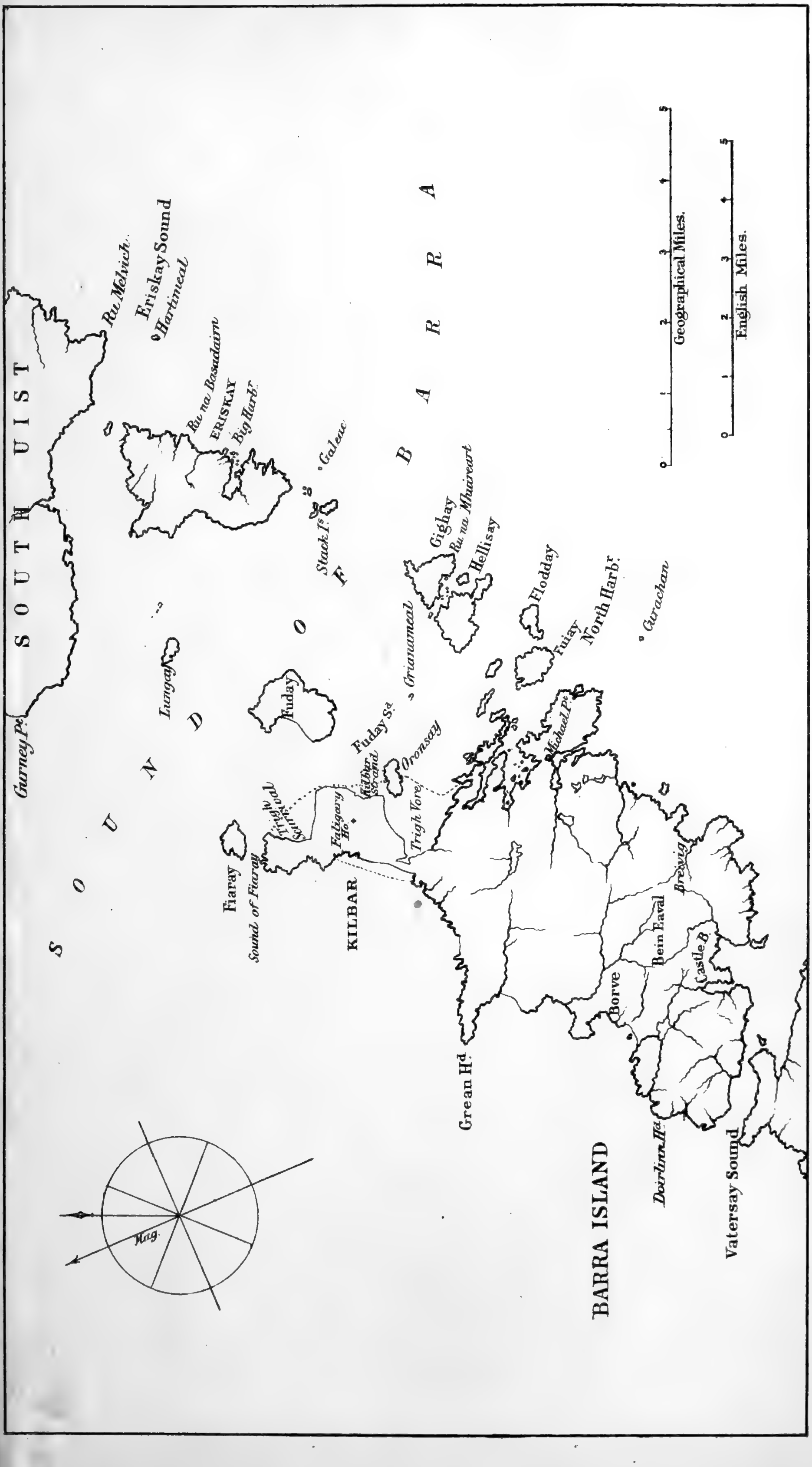
The value of the Barra cockles, nevertheless, if due attention is paid to the farming of the beds, will considerably help a population where a few pounds to each family equal a much higher sum in wealthier parts of the country. In the *Scotsman* of 8th January 1886, it is stated that 10,000 bags (10,000 cwt.) were shipped within three months from these beds. If this quantity be taken at the price put by Messrs Buckland and Walpole on Morecambe Bay cockles, it would represent a value of £2500; but unfortunately, after carriage is deducted, the natives of Barra don't realise so much per bag as this. The population of Barra in 1881 was 1887, or about 300 families. If an improved system of regulation takes the place of no regulation at all, with the increase of the productive value of the beds arising therefrom, a greater sum will be obtained for each family in the island. A competent authority, thoroughly acquainted with the cockle beds of Barra, estimates that they should yield £4000. Dividing this among 300 families, the earning of each family from the cockle beds alone will amount to £13 per annum. But as we may deduct at least one third off the number of families who will avail themselves of the Barra cockles as an additional source of revenue to the earnings of lobster, line and herring fishing, each family on this supposition should obtain £20 per annum from the sale of cockles. As the season for cockle gathering has hitherto extended from October to April, or about seven months, this would give fifty-seven shillings to each family per month.

After lobsters and fish, the cockle is the most important of the fisheries of Barra. While the cod and ling fishery is yet successfully prosecuted, the herring fishery of Castlebay and Lochboisdale has decreased in value, and the lobster fishings are on the decline. The fishermen have to go further to sea to set their lobster creels, and they have been meeting with so little success that they have not prosecuted it during the earlier months of the year, most of the lobster fishermen having to betake themselves to line fishing. It is therefore more than ever necessary that the cockle beds of Barra should be so worked that they produce the greatest revenue possible to the fishermen and crofters.

5. Conclusion.

That the supply of cockles has decreased is known to those acquainted with the Barra cockle beds. In two years at the end of last century the Old Satistical Account tells us that 'no less than one hundred to two 'hundred horse-loads of cockles were taken off the sands at low water every 'day of the spring tides during the months of May, June, July, and August.' In 1845 scores of horse-loads might be taken up during a single tide. Formerly a plentiful supply of large-sized cockles could be obtained from the sands; now the cockle-gatherers cannot collect as many half-sized specimens as they could once upon a time gather of the larger forms. The complaint is that the cockles are not allowed to remain till they attain a sufficient size, but that the sands are raked and re-raked, and as many half-sized ones as are turned up by the rakes are transferred by the gatherers to their bags. It is also alleged that, by constant raking, the small cockles are left on the surface of the sand, and are washed ashore during storms of east wind. This is no doubt partially true, but whether the great amount of damage that is alleged to be done in this way is actually done is open to doubt. The great

PLATE IV.


SOUTH UIST
SOUND OF BARRA
Gurney Pt.
Ru Melvich
Eriskay Sound
Hartimeal
Ru na Basadairn
ERISKAY
Big Harbr.
Galeac
Stack Is.
Lungay
Fuday
Fuday Sd.
Grianumeal
Gighay
Ru na Mhuireart
Hellisay
Flodday
Fuiay
North Harbr.
Guracham
Oronsay
Kilbar Strand
Trigh Vore
Trigh Scurrival
Faligary Ho.
Fiaray
Sound of Fiaray
KILBAR
Michael Pt.
Breyvig
Bein Eaval
Castle B.
Borve
Grean Hd.
Doirlinn Hd.
Vatersay Sound
BARRA ISLAND
Mag.
Geographical Miles.
English Miles.
0
1
2
3
4
5

expanse of sand banks, and the gentle shallowing of the bank, militates against such excessive damage in the case of the cockle, which can perform such an active burrowing movement by means of its foot. There is little doubt, however, about the other cause to which the decline is attributed, viz., the gathering of under-sized forms. Each gatherer tries with his or her neighbours to secure as many cockles as possible, the result being that as the supply of large forms decrease, smaller and smaller cockles are taken up. This has been admitted to me by gatherers, and one of the clergyman of the island, as well as the Board's officer at Castle Bay, Mr Duff, states that if regulations which will secure protection for the growth of the under-sized cockles are made, the natives would be thankful. The people wish to be protected against each other, so that if the Board's officer had power to seize immature sizes, much good would result.

Whatever regulations are enacted, they must always satisfy one condition, that they will benefit the people of Barra, and obtain for them an increased revenue from their valuable cockle beds. Such regulations as to size in the case of the oysters produced in the basin of Arcachon have helped to develop the oyster industry of that district, and Denmark, Holland, and Spain have issued regulations as to the minimum size of certain kinds of fish. The discussions which have taken and are taking place at fishery conferences and in fishing circles in England, in reference to the capture of under-sized fish, all lean towards declaring a size below which fish ought not to be taken. In Scotland we have a standard size below which lobsters are not to be sold; and Canada has been compelled, in the interests of the lobster fishery, to also fix a large regulation minimum size for lobsters.

Protective measures to prevent the further depletion of the cockle beds, and to increase their productiveness, may assume one of three forms, viz., either by what is analogous to the rotation of crops in the agricultural world, or by decreeing a size under which no cockles can be exported, or by having a close season. These are not necessarily alternative, but may be complementary. As regards a close season, this is practically in force already, in so far as the heat of summer prevents cockles being transported alive to market when that occupies more than a day or two. Cockles should not be despatched to market during the breeding season. If a minimum legal size in the case of the cockle were decreed, the difference in the size attainable between cockles found in estuaries and those found in pure sea water, where there is no river near, should be taken into account. While estuarine cockles do not exceed one inch and a half or one inch and four-fifths in length, cockles easily grow to a size of two inches in such favourable places as Barra. Besides actual measurement, a handier method would be to select the cockles by riddling, or a maximum number might be fixed which a measure of capacity like the gallon measure might contain. A third helpful method, which could be worked along with regulations as to close season and a minimum size, might be to allow only a portion of a bank to be open during the season for gathering. Any benefit which might be derived from the last might, however, be covered by the preceding suggestion as to a minimum size. This last regulation works well in the case of the natural banks of oysters which the French Government opens for a limited number of tides per annum to the mariners of the Maritime Conscription, for whose benefit they are entirely conserved.

By adopting some such regulations as those suggested, the cockle beds of Barra would, I believe, be as productive as they have ever been, and the chronic poverty of one of the distant Hebridean Isles would be in some degree removed.

IV.—OYSTER CULTURE IN FRANCE AND HOLLAND. By J. H. Fullarton, M.A., D.Sc.

The oyster fisheries of Scotland, which were once so productive, have now reached a very low ebb, the value of oysters taken in 1888 being only £742; and unless measures are adopted to arrest the decline of these fisheries and promote their artificial culture and rearing, as well as to afford adequate protection, we cannot expect to derive an increased revenue from a source whence it is quite possible to obtain an important increase. In other countries the oyster industry has passed through a similar stage. In France, Holland, and America the natural beds proved quite inadequate to meet the public demands, as they had been over-fished and depleted like those in Scotland. The destruction and depletion of the beds in these countries was not allowed to go on indefinitely, as has been the case in Scotland. Foreign Governments took up the subject before absolute destruction had taken place, and established oyster culture on an extensive scale. The results to them have been most satisfactory, and at the present day the yield of oysters is greater than it has ever been

With the object of becoming acquainted with the different methods I visited the chief oyster centres from the East Schelde in Holland to Arcachon in the south-west of France, and the main features of the system is set forth in this paper.

The breeding and rearing of oysters is carried on in France and Holland most successfully. In the Autumn of 1889 I visited the Dutch oyster 'parcs' in the East Schelde, and have to record my thanks for the facilities and kindness shown me by Dr Hoek, scientific adviser in fisheries of the Dutch Government, Mr C. J. Bottemanne, chief inspector of fisheries to the Zealand Fishery Board, and Dr de Leeuw of the Wemeldinge Oyster Company. Afterwards, I visited the chief French 'parcs,' from Arcachon northwards along the Atlantic coast to St. Malo and Cancale. M. Raveret-Wattel, secretary of the National Society of Acclimatisation of France, and Dr Brocchi whose scientific labours on oyster-culture on behalf of the French Ministry of Marine are witnessed by his various works on the subject, facilitated my visits to different parts of the French littoral, and greatly helped me, by advice and otherwise, in my examination of the latest developments and newest methods in oyster-culture. To them I have to express my appreciation of their kindness.

The French have led the way in oyster-culture, and the Dutch have shown themselves apt pupils of the French pioneers. According to Pliny, Sergius Orata, a contemporary of Lucius Crassus the orator, has the honour of being the father of oyster-culture; but modern oyster-culture dates back upwards of thirty years to the time of M. Coste, who, in his projects for resuscitating the declining oyster industry of France, was powerfully assisted by the late Emperor of the French. Had it not been for the ungrudging support of the French Government of that day, France would not likely now be deriving such great revenues as she does from the oyster parcs. M. Coste, of the Institute of France, an enthusiastic pisciculturist, may be called the father of modern oyster-culture. The oyster industry of France had been gradually declining towards the middle of the present century, and the first step towards reviving it may be fixed as the journey which M. Coste took, by command of the French emperor, to Lake Fusaro in Italy, where oyster-culture had been carried on for many years. M. Coste, having informed himself of the Italian method, took up the subject with great enthusiasm, and persuaded his sovereign to embark in the new enterprise of artificial cultivation and propagation of the oyster. After the lapse of thirty years it is possible to do justice to the labours of M. Coste, though, in the interval, his claims have not always received the acknowledgment they deserved. That he was no mere visionary dreamer, the present position of oyster-culture on the French littoral is ample evidence, and the returns which the French people have received and are receiving, fully justify the large national expenditure which the French Treasury incurred in starting oyster-culture. Mistakes were undoubtedly made, especially at St. Brieuc, in not paying sufficient attention to the forces of nature, but hitherto unparalleled successes, especially at Arcachon, were as surely attained. The successes attained entirely outweigh any mistakes which were made, and which are not unlikely to occur at the inception of any new enterprise like oyster-culture. In oyster-culture inattention to biological and physical conditions can only lead to mistakes, while a due observance of these will further the practical development of the artificial cultivation and propagation of the oyster, when these are attempted in a practical manner on more than merely a laboratory scale.

Questions of ownership of foreshore rights and rights to neighbouring bottom are comparatively simple in France and Holland. In the case of France the State is proprietor of all the foreshores and of the sea bottom within the territorial waters, and it does not divest itself of this right. Areas are let to capitalists and to fishermen, the State exacting a rental therefor, and granting certain privileges of fishing on natural banks to the seamen of its marine. In Holland there is a slight difference. The Government owns most of the oyster and mussel ground; but there are cases where it is difficult to say whether the Crown, as representative of the public, or the proprietor of the *ex adverso* land, is proprietor of the fishery banks. In one instance that came under my notice both the Crown and the proprietor laid claim to mussel fisheries, and the one was as disinclined as the other to submit the claim to the arbitration of a court of justice. The difficulty was removed—not solved—by the Crown offering on lease one part of the banks in dispute, while the adjoining proprietor made offer of another part of the same bank. Such disputes are few, as the executive government soon brushes alleged titles aside.

The Dutch oyster industry is under the administration of the Zealand Fishery Board, guided by Mr C. J. Bottemanne, chief inspector of fisheries. The fisheries of Holland, including the Zealand oyster fishery, are regulated by the executive, acting under the counsel of the accomplished zoologist, Dr Hoek, who devotes his whole time to the duties of his office, which is chief adviser on fisheries to the Dutch Government.

In France the Minister of Marine has the management of the fisheries, and has the assistance of M. Bouchon-Brandeley, chief inspector, and of Dr Brocchi, a zoologist, who has given the best account of the French system of cultivation and propagation of the oyster, both in its biological and practical aspects.

The system of letting the ground differs in the two countries, though in some respects it is similar. Before 1870 the oyster industry of Holland hardly existed, but in that year the Yerscke banks in the East Schelde were let to a society of fishermen for a period of 18 years, at an annual rental of £2250. The fishermen, however, were incapable of managing this new venture, and on their application they were relieved of their obligation, and the banks were let to a society of merchants at a rent £500 less than was paid by the fishermen. Now, these banks are let on lease, which expires in 1915, and the annual rental to the Dutch Treasury is £30,000. Dr Brocchi says, 'In 1877 ostreiculture received in this 'country (Holland) a new impulse by the appointment of an inspector-'general of fisheries, M. Bottemanne.' Possessed of a wise foresight, and indefatigable energy, the large revenues of the Dutch Government from the oyster and mussel fisheries are largely due to his intelligent management. Besides accompanying me in an examination of the banks in the steam-yacht of the Zealand Fishery Board, which is not unlike the 'Garland,' though a little smaller, he furnished me with plans, conditions of lease, and information on his whole management of the fisheries. The beds are parcelled out in rectangular lots of limited size—2 acres being the usual extent—and these are, on a fixed and advertised date, let by public auction for a limited number of years. The result of this system is an increasing revenue to the Dutch Treasury.

In France matters are somewhat different. The Naval Department, or Ministry of Marine, are charged not only with Admiralty duties, but also with the management of the fisheries. Though a foreigner at first sight may not be able to trace a close connection between the two, when the fact is noted that the Government of France takes a paternal interest in the condition of its maritine population, and must find conscripts to man its fleet, and when it is known that the fisheries are cultivated with this object, it is seen that there is reason for one department being at the same time the conscriptive authority and the means of helping time-expired conscripts to earn their bread without having to migrate or emigrate.

In parcelling out the oyster ground the French, like the Dutch, divide it off by means of stakes into lots of from half an acre upwards. These lots are either given to the conscripts who have served their time in the navy at a nominal rental, or they are let to ostreiculturists at 30 to 35 francs per hectare in Arcachon, and at 80 francs per hectare in the Morbihan. The rental is therefore about 10s. per acre at Arcachon, and about 25s. per acre in the Morbihan. In Holland leases are generally given for a period of fifteen years, though there are cases where the let is for thirty years, with certain breaks in the lease. Some of the mussel banks are let for five years only. In France, on the other hand, the tenure, though nominally a yearly one, is in practice longer, as, if the beds are well cultivated and to the approval of the maritime authorities, there is no disturbance of tenure.

When the Government in this way lets oyster beds and derives a revenue therefrom, it exercises a certain amount of protection, the lessees also guarding their own interests. In the case of the East Schelde, the controlling authority, the Zealand Fishery Board, possesses some five boats, which are used in the survey of the beds and in affording protection to the lessees, one of the boats at least being fitted with the electric light for night duties. In addition to this police patrol, the larger ostreiculturists have also boats and watchmen of their own. In France the *gardes-de-pêche* protect chiefly the Government oyster beds, which are reserved for the marine conscripts, but they and the servants of the ostreiculturists also watch the parcs of the capitalist. At Arcachon the bay is dotted over with *pontons*, species of arks, being in fact boats with houses built on them, which serve as watch-houses for the fishermen—*parquers*—of the proprietors of the parc.

The oyster which is cultivated in France and Holland is *Ostrea edulis*, the bivalve which existed once upon a time in such quantities in the lochs of the west of Scotland and in the Firth of Forth. But, besides this oyster, the French introduced the Portuguese oyster *Ostrea angulata* which is a much coarser species then the native French oyster, though perhaps a more prolific form. It maintains a vigorous development on the coast about the mouth of the Gironde, but it is not cultivated in the waters of the Morbihan. It is a diœcious form, while the common oyster is monœcious or hermaphrodite.

For convenience, the system of oyster cultivation may be treated under two divisions: 1. The Production of Oysters, 2. The Growth of Oysters.

The Production of Oysters.

The object of oyster-culture at this stage is to obtain the greatest possible quantity of spat in such a position that the young oysters can be readily transferred for purposes of growth from one locality to another.

Pisciculture has reached a high state of development, so far as artificial fertilisation is concerned. Artificial fecundation has made the stocking of depleted lakes and streams possible in this country, in America, and in other countries, but the biological conditions which it is necessary to observe prevent the same method being followed in the case of the oyster. In those molluscs where the young undergo development within the mantle chamber or the gills of the mother, no artificial medium has been found which can take the place of the fluid found within the maternal shell. Till this is done it will be idle to look for results in the fertilisation of the oyster after the same method as is adopted among teleosteans.

The eggs of *Ostrea edulis* are fertilised within the body of the animal, and the first stages in the life history of the young oyster are passed within the valves of the mother. After the young oyster attains a certain stage in its development it leaves its mother, and is carried along by the currents of water in the sea. It then gives up its pelagic existence and becomes moored to some solid substance in the water, where it remains fixed for the rest of its life, unless it is artificially removed. By nature the young oyster becomes attached by the apex or umbo of the concave valve to shells, stones, and other solids on the bottom of the neighbouring areas. Sometimes, especially where there are strong currents, the pelagic oyster may be carried long distances, but where the dispersive forces are not great it settles down in the neighbourhood to a fixed existence. It is at this stage that man can greatly assist by supplying fit resting places—collectors—for the spat.

For the collection of spat the first essential condition is the presence of a large number of mother-oysters. M. Coste's classical experiment kept this in view, and the French Government have continued his policy. Of the millions of millions of the free swimming spat only a small proportion becomes fixed and captured by man. The policy therefore of the French Government, in setting aside certain banks—*bancs reserves*—and of the *parquers* in keeping a large supply of mother-oysters in suitable localities for spatting purposes, assures, if the conditions are favourable, an abundant quantity of young oysters. The Dutch lessees also keep large stocks of oysters, and their collectors receive a supply of spat from the embryos set free from the breeding-oysters. Both French and Dutch ostreiculturists, who possess an experience of other than their own coasts, urge the necessity, if oysters are to be laid down in suitable localties in Scotland, that they should be laid down in quantity, and suggest millions instead of thousands, if oyster-culture is to be a success. One ostreiculturist whom I met near St. Malo, informed me that his firm had sold to M. Coste two and a half millions of oysters, which were planted in one bay, where there were previously natural banks.

Different forms of collectors have been employed at different times. In the infancy of oyster-culture bundles of twigs, anchored above the bottom, were the favourite collectors, but as the French perfected themselves in methods, new applicances were devised for the collection of the spat. Not only must the spat be collected by such appliances, but it must be collected in such a way that the removal of the young oysters can be easily accomplished without material loss. In the case of twigs, and also in the case of stones, which were used as collectors, the injury to and the destruction of the young oysters was very great. Tiles—ordinary roofing tiles—were employed, and when the young oysters were fit to be removed, they were either taken off by the aid of a knife to separate the attached valve of the shell from the tile, or the tile was cut into pieces by means of a pair of shears or sharp pincers. The better method—breaking the tile into pieces, with a young oyster attached to each piece—is continued in certain places to this day, the belief being that the piece of attached tile is an additional protection to the young and thin-shelled oyster against the ravages of the crab and other enemies. There is doubtless a certain amount of truth in this, but the protection afforded by the other appliances obviates the necessity of the process. The breaking of the tile into pieces is still to be seen, especially in the oyster parcs of the Morbihan.

The ordinary methods of collecting at present, both in France and Holland, is either by specially treated tiles, or by supplying quantities of cockle and other shells to the beds. These latter are called natural collectors, and are used especially in the district of Arcachon. While on the tile the oyster is an appendage, on the shell the oyster which is the appendage soon changes places, and the cockle or other shell becomes the appendage of the oyster. Empty shells are not always obtainable in sufficient quantity, but they are greatly desired in the centres of reproduction, as they form not only resting-places for the embryos, but they also supply lime to the water for secretion by the growing and shell-forming oysters.

The tiles, first tried as collectors in the establishment of Madame Felix at Regneville, were treated by a process devised by Dr Kemmerer in order that the *detroquage*, or removal of the oyster from the tile, might be facilitated, and the loss by breaking the slender shells of the oyster reduced to a minimum. The process is to dip the tiles into a solution of lime and water, and allow the tile so coated to dry, then pass the tile through a bath of hydraulic lime, mixed with sand, and chalk in some cases. In others the tiles are first "white-washed," then dried and coated with a thin covering of mortar. The first process permits the young oyster to be easily removed; removal can be performed by the finger-nail, but it is generally done by an instrument like a glazier's putty-knife. The coat of mortar is for the adherence of the spat. This is the typical method as performed at Arcachon. At Wemeldinge in Holland it differs slightly. There the mortar used is harder, being chiefly composed of hydraulic lime with a little sand and chalk, and so the removal is effected by cutting round about the individual young oysters and scraping them off. The principle is the same, but the details differ.

As to the localities suited for the production of spat the pre-requisite already mentioned is the presence of a large number of mother-oysters, but there are other things which must be taken into account before collectors are placed for the reception of spat. While reproduction is attended with best results in purely salt water, growth and fattening is greatly promoted where there is an addition of fresh water to the salt water of the sea. At Arcachon the water of the bay, which is connected with the Atlantic by a narrow mouth, and extends at high water to an area of nearly 40,000 acres and at low water about 12,000 acres, is salter than the ocean. It is here where the largest operations in artificial cultivation are carried on, and where perhaps the most advanced methods are pursued.

The saltness of the water, then, being helpful, the nature of the bottom may hinder or assist operations. The bottom should be sufficiently hard to prevent the tiles when laid in the water being silted up and covered with mud. Arcachon and the Morbihan form a great contrast in this respect. While the bottom at Arcachon is composed of gravel, sand, and mud, and presents a comparatively firm stratum, in the indentations of the Morbihan the bottom is of very soft mud, that would rapidly bury the tiles if they were placed upon it. In the East Schelde the conditions of bottom are more akin to what is found at Arcachon, and consequently the arrangement of the collectors is much the same.

Another condition which is essential to success is that the spot chosen for placing the collectors should be in a sheltered locality, and not exposed to the violence of the sea. At St. Brieuc the neglect of this condition caused a loss of oysters and collectors, and seemed almost to thwart the efforts which the French were making in the new enterprise of artificial cultivation.

The particular place for placing the collectors, in order that they may be clothed with a sufficient amount of spat, is where there is a gentle current and eddies carrying the embryos which have been set free from the mantle chamber of the mother. The embryos are thus brought in contact with the collectors and rest on them.

As to the time when the tiles should be placed in the water, that varies at different points, all agreeing, however, that not till the embryos have been liberated from the mother's shell should the tiles be placed in the water. The reason for this is obvious. If the tiles are deposited too soon, they become covered with dirt and overgrown with seaweed, ascidians, and polypes, and so do not offer a good situation for the young oyster to settle upon. The date at which they should be placed in the sea depends on the temperature of the water. When the temperature of the water has risen to 18° C. (64° Fahr.) the tiles are deposited. At Arcachon the tiles are deposited in the water from the 12th or 15th of June, or, in a cold season, as late as the beginning of July. In Brittany the water is not so warm, and so the tiles are not placed till sometime later, between the 25th June and the middle of July. In Holland they are deposited in June or July, the time depending on the season. The temperature-index is one way (the handiest in fact) of ascertaining the stage of development of the embryos; the other is to examine the female organs, carefully note their condition, and ascertain the time taken for the extruded egg to develop till it becomes a free swimming pelagic embryo.

The arrangement of the tiles differs at different places, as do also the size and the shape of the tiles. They are like ordinary roofing tiles, concave on one side and convex on the other. The tiles used at Arcachon are longer than those I have seen elsewhere. They are 20 inches long, 9 inches broad at the one end and 5 at the other. In Holland and in the Morbihan, while the tiles are slightly shorter, they are of equal breadth at either end. In placing them they are so arranged that currents and eddies are promoted between different tiles and different rows of tiles.

At Wemeldinge in Holland the tiles are laid down near the shore, outside of the dyke of the *polder*—*polder* is the land reclaimed from the sea—and are placed parallel to and against each other, the tiles in the row being placed obliquely to the bottom on which they lie. At Arcachon in France the tiles are deposited in rows, with their concave surfaces towards the bottom, each row of tiles being transverse to the one immediately above and below it. While, in the cases of some, especially the marines who hold parcs, the tiles are placed in this way on the ground, the ostreiculturist of capital does not lay the tiles on the ground, but places them in crate-like structures, the tiles being arranged after the same manner as those on the ground. This method prevents breakages, and facilitates the deposit and lifting of the collectors.

Neither of these methods—*dispositions des tuiles en ruches*—will suit the state of matters in the indentations or rivers of the Morbihan. The mud there is as soft as it is on the mussel beds of our coast, and another method of arranging the tiles had to be devised. M. Leroux in 1866 hit on a method whereby the tiles could be employed as collectors and still not be in contact with the bottom. It is known as the arrangement of the tiles in bouquets—*disposition des tuiles en bouquets*—and the lowest of the tiles is from 6 to 8 inches above the level of the mud. Tiles of about 13 inches are chosen, which are convex on the upper side and concave on the lower. At either end of each tile a hole is bored for the passage of a galvanised iron wire. There are two tiles running parallel in the lowest row, and placed transversely at either end to these are two other tiles, through which the four wires are passed. This transverse arrangement and stringing of tiles on four wires is continued till there are altogether ten or twelve tiles strung together. A pole several feet long is passed through the space in the centre of the arrangement parallel to the wires, and the four wires are fastened to the top of this pole. The four wires at the bottom are also bound to the pole, and the whole arrangement has been compared to a mushroom—*champignon*—where the pole represents the stalk and the tiles the umbrella of the mushroom. The pole, loaded with the ten or twelve tiles, is inserted in the mud till the lowest tile is at least six inches above the surface of the mud.

Besides the tiles and the shells, planks of wood in some places are employed as collectors of spat, but I have only seen them used by the peasants. They are coated with a mixture of similar composition to what is put on the tiles, and several of them are nailed together by small cross pieces, the whole being anchored some distance above the bottom of the collecting ground.

In some places the Portuguese oyster attaches itself to the rocks on the foreshores, and the peasants strip them off when this is possible by a chisel-like knife.

In Holland the tiles which are placed in the sea in June or July must be lifted under penalty of a heavy fine before the first of December. Some of the Dutch ostreiculturists remove the young oysters straightway from the tiles, but Dr. de Leeuw, who has been called the most scientific of Dutch ostreiculturists, transfers his tiles when lifted from the sea to the ponds which are constructed inside of the dyke in the *polder*. Others, however, remove the young oysters at once from the tiles and place them in cases in the *hospitaals*; but the Wemeldinge Oyster Company does not remove the oysters from the tiles till they are one year old.

In the Morbihan the president of the Society of Ostreiculturists—Mr Jardin—places his tiles in the sea between 15th June and 31st July, and does not lift them till 1st March, when the young oysters are removed from them. Others again allow them to remain on the tiles for a longer period, in some cases as many as eighteen months or even two years before they are removed. Those *parquers* who don't coat the tiles with mortar, remove the oysters—*huîtres à tesson*—therefrom by breaking the tiles at the end of the first year.

The young oysters which have been removed from the collectors are carefully nursed and tended from their enemies till they are protected by a thick shell, when they are transferred to the growing places. At the stage of removal from the tiles the young oysters, if not protected would become the prey of the star-fishes, the crabs, and the boring molluscs. To prevent the ravages of these enemies all ostreiculturists of any note adopt special measures. The young thin-shelled forms are transferred to cases or ambulances—*caisses ostréophiles*—which are set down in the water. These cases costfrom ten to fifteen francs, and were the invention of M. Michelet of Arcachon. They are formed of four pieces of wood—four to six inches broad—nailed together to form a framework, two to three feet broad and four to six feet long; to this framework is fixed a bottom of galvanised wire-cloth, and there is often a lid of the same material to close the case. Generally there are four legs on the case to permit of its standing a few inches above the ground.

The oysters remain for a longer or shorter time in these cases. They may be transferred to the *claires*, which at Arcachon average from 50 to 70 metres long by 10, 15, and even 30 metres broad. At Arcachon these *claires* are formed by being enclosed by walls of clay about a foot high. The clay face being secured either by boarding or by a breast-wall of heather on the outside. They remain in the *claires* till they are transferred to the fattening and growing grounds. Arcachon natives are sent to Marennes, and La Tremblade to be greened and fattened, and to Ile d'Oleron and other places to be fattened. The oysters of the second great centre of reproduction in France—the Morbihan, comprising Vannes, Auray, St. Philibert and La Trinité—are sent to the greening and fattening establishments at Marennes and La Tremblade, or to more northern places, such as Whitstable and the ports on the French side of the Channel. Of course, some of these are also made ready for the market near their birthplaces, but Arcachon and Brittany are essentially for the production of the spat.

In Holland great quantities of spat are produced in the East Schelde; many are fattened on the Yersche Banks, and many are exported to the fattening grounds of Essex and Belgium.

The Growth and Fattening of the Oyster.

The conditions necessary to growth and fattening differ somewhat from those required for breeding. While reproductive activity requires the water to be of high specific gravity, and a high temperature, if there is to be a large and plentiful supply of spat; oysters will flourish and fatten in waters that are neither so warm nor so exclusively salt. Mud, which has been seen to be so hurtful to young oysters may be exceedingly helpful to adult forms. In France especially, the oyster industry is divided into two very distinct branches, either of which, if carried out in an enterprising and intelligent manner, is successful. The French have for long perceived this, and many ostreiculturists devote themselves to one branch almost exclusively. If this fact had not been so often lost sight of, the ventures that have been made in England and in Ireland would not in so many instances have failed.

The chief fattening ground of France is situated to the north of the Gironde, in the Charénte Inferieure, in the districts of Marennes and La Tremblade. There are other localities in the north, especially along the shores of the English Channel, where fattening operations have also been and are most successful. The Dutch can fatten their oysters at Yersche, in the neighbourhood of the spatting ground. They send them to Ostend, Whitstable, and Colchester, where the different 'natives' are fattened. It will be sufficient, however, to describe the fattening operations at La Tremblade and Marennes. These two places are chiefly famous for the greening and fattening of the oyster; but on the north of the river Seudre, which separates La Tremblade from Marennes, and opposite Ile d'Oleron, the oyster can be fattened and still remain white.

The chief point to be noticed is that the oysters are transferred to a locality rich in food, and fulfilling other conditions of nutrition—to *parcs d'elevage.*

The oysters which it is not desired to green are laid down either on the banks of mud, or on the gravel and rocks close to land. These are laid down in the sea directly, but others are transferred to *parcs, viviers et depôts*—reservoirs—which are in direct connection with the sea at all times; but if it is sought to green the oysters, these are laid down in specially prepared *claires*, which are often some distance removed from the river Seudre, and have only connection with the sea at the times of 'springs.' The *claires* are the property of the proprietors of the neighbouring lands, and thus differ from the foreshore concessions or ordinary *parcs* let by the Government.

The greening *claires* are either high or low, situated according to their distance from the Seudre. They are bounded by banks of mud about a metre high, and they are provided with sluices to regulate the entrance and exit of water. Inside the bounding banks a ditch runs round the *claire*, and the bottom of the *claire* slopes from the centre downwards towards the ditch. Oysters which are placed in one of those specially prepared *claires* generally begin to green in about a fortnight, though some of them take longer. The labial palps, gills, and intestine become green-coloured from the presence of a diatom, *Navicula ostrearia*, and the green oysters are regarded by connoisseurs as special delicacies. While the greening is taking place the oyster fills up and fattens, becoming ready for the market in a comparatively short time.

The *claire* has to be prepared every year, and there are two steps in the preparation. They are dug, and the ground is cleared and hardened by evaporation. After the draining and hardening of the rounded surface, the ground cracks, and the process of *gralage* is completed. This process occupies six or eight weeks, and is succeeded by the second step. A small quantity of water is introduced, and ultimately the bottom is covered by a white, creamy effervescence—*humeur*. This completed, the *claire* is ready to receive the oysters, which have to be greened and fattened.

Oysters are received in March and April, and they are edible in September and October. The mortality is great, averaging about 20 per cent., but the proprietors, who buy oysters from the Morbihan and Arcachon at 15 to 25 francs per thousand, realise for them 30 to 90 francs, the average being from 40 to 50 francs per thousand.

The ground in the Morbihan is not only too soft for the laying of the tiles upon, necessitating the placing them *en bouquet* to receive the spat, but in places it is even too soft to lay down oysters for fattening. Dr Gressy, to render this soft ground suitable for placing oysters upon it, mixed the mud with gravel, and so hardened or macadamised the ground of the *parc*, thus reclaiming it and making it suitable for oyster *parcs*.

Conclusion.

It is exceedingly desirable that general information as to the best methods, or the methods which in other countries have yielded the best results, should be as widely made known as possible, especially among these meditating the starting of oyster culture on different parts of the Scottish seaboard. There is a pretty widely diffused notion that something might be done towards cultivating oysters in Scotland; and there can be no doubt that there are places in Scotland where oyster culture would have a reasonable prospect of success. This is especially true for those localities where oysters formerly existed in abundance, but even there close attention is an essential of success. It cannot be too much insisted on that there are two distinct branches of oyster culture, viz., the breeding and the feeding, requiring entirely different characters of water, ground, &c. Recently I saw tiles which had been laid down in a western loch, presumably for the purpose of catching the spat, which, however, had been laid down rather for giving a basis of attachment for *serpulæ* and barnacles. By the time the oysters will be ready to spat, if they do spat, the entire surface of the tiles will be in such a condition that there will be no room for the oyster spat. Tiles which are laid in the water five or six months before the oyster has been known in this country to throw its spat, can only be covered with mud and a variety of organisms, whose seasons of reproduction are much earlier, and whose young take up every foot of available space of such surface as clean tiles will present. The collectors—tiles or otherwise—should not be placed in the water until after examination, it has been found that the bulk of the oysters are ready to spat.

Besides a dissemination of accurate information as to the methods of oyster culture, a knowledge of the physical, biological, and other conditions of reputed oyster ground ought to be obtained. The Fishery Board is now engaged in this work, and several lochs on the West Coast of Scotland are being investigated with this object in view.

As to the branch of the oyster industry to which oyster cultivators might look for success, on the West Coast of Scotland in selected localities we could at least feed and fatten oysters. We have not sufficient information as to the spatting of the West Coast oyster, and we cannot rely on the waters of our coast being so warm as the French seas are. Yet even with our less warm waters, oysters have in recent years spatted in our seas. I have dredged oysters on the West Coast which ranged in age from two years upwards. Some were spatted as late as 1888, while many were produced in 1886, in one of our western lochs.

Attempts have been made at oyster culture in Scotland, but the best authorities agree that if oyster culture is to make permanent progress in this country, experimental operations should be conducted on a much more extensive scale than hitherto. Intending ostreicultruists should bear in mind that they can obtain a cheap supply of oysters, ranging in size from one inch to two and a half or even three inches, at a very reasonable figure, and that now when special steamers have been built for conveying oysters from France, the mortality in transport is reduced to a minimum. The proprietors of oyster-feeding parcs in France find that this industry gives a very large return, and if the same were attempted in Scotland, I have no doubt that lessees of suitable ground, might engage in this branch, *i.e.*, in oyster fattening, with reasonable prospects of success.

SECTION B.—BIOLOGICAL INVESTIGATIONS.

I.—ON THE FOOD OF FISHES. By W. Ramsay Smith, B.Sc.

The following pages embody the results of a second year's observations on the food of fishes, carried on chiefly by Mr Thomas Scott, F.L.S., on board the 'Garland.' Although the observations have not been made quite continuously during either year, the results already obtained give very decided indication of the lines along which investigations will have to be made, and promise to shed much light on the hitherto very obscure subject of the food of our commonest food fishes. The introductory remarks here made will be confined almost exclusively to the fish examined in the Forth and in St Andrews Bay, since the stations there furnish the best record of facts for comparison.

To begin with, one noteworthy fact is the similarity of this year's results to those of last year, as regards both the Firth of Forth and St Andrews Bay, wherever the numbers of fish examined have been sufficient to justify the expectation that the percentages recorded are trustworthy indications of the extent to which fishes feed on any particular genus or species of animals. Another fact is that the same kinds of fish feed most abundantly on similar food, say echinoderms, annelids, crustaceans, molluscs, fish, both in the Firth of Forth and in St Andrews Bay, although there may be variations in the relative numbers of the genera, and in the particular species, forming the bulk of their food; these variations being due to the differences in the faunas of the two localities, or to other causes at present unknown. A few notes on the food of some of the important fishes, based on the results of the two years' investigations of the Firth of Forth and St Andrews Bay, may be given.

Plaice.—The chief food of these consists of annelids, *Sabella*, *Priapulus*, *Nereis*, and *Sipunculus* being the commonest forms in the Firth of Forth in both years; and *Terebella*, *Phyllodoce*, and *Nereis* in St Andrews Bay. The large number of unidentified annelids found must, however, be borne in mind in this connection. Next in order, but to a slightly less extent, come molluscs, the most common forms being *Scrobicularia*, *Venus*, *Solen*, and *Mactra* in the Firth of Forth; and, in addition to these, *Nucula* in St Andrews Bay. Arthropods are much less important as food, especially in the Firth of Forth; but in St Andrews Bay *Ampelisca* and *Portunus* are fairly common. Fish forms almost no part of the food of plaice, except at Station VI. in the Firth of Forth, where sand-eels were largely eaten by plaice in 1888. Echinoderms seem to be of little importance as food to plaice.

Lemon Soles.—In the Firth of Forth these feed most largely on annelids, as do plaice, and on the same forms; but the place of molluscs is taken by arthropods, as next in importance in the diet of the lemon sole, molluscs, echinoderms, and fish being comparatively unimportant. In St Andrews Bay only a few lemon soles were examined, and they all contained annelids in both years.

Common Dabs.—The diet of these is more varied than that of the two forms already mentioned. In the Firth of Forth arthropods (consisting chiefly of hermit crabs), and in St Andrews Bay annelids (*Terebella*, *Arenicola*, *Phyllodoce*, and others) formed most of the food. Next in importance were echinoderms (*sand-stars*) in both localities. Annelids in the Firth of Forth are of nearly equal importance to arthropods in St Andrews Bay; molluscs and fish form about the same proportions at both places.

Long Rough Dabs.—These differ very much in their feeding from the fish already mentioned. In the Firth of Forth no other fish, with perhaps the solitary exception of the haddock, feeds so largely on echinoderms. Arthropods (especially *Crangon* and hermit crabs) form a somewhat larger proportion of their food; while annelids, molluscs and fish form a very small part indeed. In St Andrews Bay these fish seem to live almost exclusively on echinoderms, sand-stars being found in above 80 per cent. Arthropods (all *Crangon*) were found in from 7 to 15 per cent.; annelids and fish were rarely found, molluscs not at all.

Witch Soles.—In the Firth of Forth these fish feed very largely if not almost exclusively on annelids (especially *Sabella*). Arthropods (chiefly *Crangon* and *Ampelisca*) form a small part of their diet along with molluscs (*Scrobicularia*), while echinoderms and fish are found on very rare occasions. In St Andrews Bay no witch soles were examined.

Flounders.—Of these 39 specimens were examined in the two years in the Firth of Forth, but none contained any food. In St Andrews Bay they feed chiefly on annelids (*Terebella* and *Arenicola*), *Crangon*, *Eupagurus*, *Echinus*, *Solen*, and goby being the only other forms found.

Gurnards live both in the Forth and in St Andrews Bay on a very varied diet of arthropods (especially *Crangon*, *Pandalus*, *Portunus*, *Eupagurus*) and fish (herrings, sprats, sand-eels, whitings, dabs, pipe-fish, lump-suckers, pogge), with an occasional annelid or mollusc. Only in one instance were echinoderms (*Ophiura albida*) found out of 630 stomachs examined, 407 of which contained food.

Cod.—In the Firth of Forth these fish feed largely on a very varied assortment of arthropods and fish, molluscs and annelids forming subordinate articles of diet, and echinoderms being very rarely found. In St Andrews Bay only a few cod were examined; arthropods, annelids, and fish formed their sole food.

Haddocks.—In the Firth of Forth these fish are perhaps the most equal or indiscriminate feeders. Arthropods were found in 50 to 59 per cent. of stomachs containing food; echinoderms and annelids in from 20 to 26 per cent. In 1888 molluscs were found in 23 per cent., and fish in 14 per cent., while in 1889 molluscs were found in 53 per cent., and fish in only 3 per cent.; so that one might say that molluscs in this latter year took the place of fish in the dietary of the haddock. In St Andrews Bay not many haddocks were examined, but the absence of fish as an article of their diet is noteworthy.

Whitings.—In the Firth of Forth whitings feed chiefly on fish, and would seem to prefer this article of diet. Arthropods form a smaller part of their food. Molluscs and annelids would appear to be unimportant, and no echinoderm has been found in any of the stomachs examined. In St Andrews Bay only a few were examined.

Skate.—In the Firth of Forth arthropods (*Portunus*, *Pandalus*, *Crangon*, *Nephrops*) form the chief food of the skate. Fish come next in importance, and consist of herrings, whitings, and flat-fish. Molluscs and echinoderms are rare; annelids are not found. In St Andrews Bay the food is similar, except that molluscs are more common and annelids are represented.

Cat-fish.—In the Firth of Forth arthropods (*Eupagurus*, *Hyas*, *Portunus*, *Cancer*, *Nephrops*, *Crangon*, *Galathea*) were found in about 50 per cent.; sand-stars and molluscs (*Pecten*, *Buccinum*, *Cardium*) were found each in about 30 per cent.; annelids and fish as articles of food were merely represented.

Angler Fish.—Without doubt fish forms almost the sole article of diet of the angler. Whitings, herrings, sprats, skate, haddocks, cod, sand-eels, rockling, long rough dabs, and other flat-fish have all been found in the stomachs examined. Only one stomach of 33 containing food contained anything but fish, viz., an arthropod (*Eupagurus*).

The food of very young fish is a subject requiring much investigation. It is but slightly referred to in the following pages; two short paragraphs record all that has been done with regard to it.

A comparison of the food of the same kinds of fish at the outlying and the inshore stations would prove, as one can already see, very interesting and instructive; but such a comparison will be more confidently made when another year's observations of food are recorded, and a list is before one of the fauna brought up by the trawl-net and dredge at the various stations during the different months of the year. Then also would be the proper time to deal with the whole subject in a comprehensive manner, with the certainty that something at least is known of the habits and food of food-fishes, and the reasonable expectation that something may be done to preserve and improve the food supply of the more valuable fishes in different localities, and to prepare the way for the introduction of valuable fish, where now they are scarce.

I. FIRTH OF FORTH.

Plaice.

(*Pleuronectes platessa*).

Of 328 stomachs examined 57 were empty, and the contents of 7 were indistinguishable:* 264 contained matter that could be identified. The following notes refer to these 264:—

Echinoderms were found in 24 stomachs (9 %). They consisted of (1) *Ophiura*, at Station II., in two in May; at Station IV., in two in May and in one in March; at Station VI., in one in April, in two in May, in one in June, in three in February and in one in March; and at Station VII., in two in May and in one in June: (2) *Amphiura* (sp. *filiformis*), at Station VII., in two in June, in three in August and in one in March: (3) *Ophioglypha*, at Station IV., in two in August and at Station VI., in one in August: (4) *Echinocardium* (sp. *cordatus*), at Station VIII., in one in August: (5) *Asterias*, at Station III., in one in July.

Annelids were found in 167 stomachs (63 %). They consisted of (1) *Sabella*, at Station I., in two in June, in one in July and in two in March; at Station II., in two in June; at Station III., in one in July and in four in November; at Station IV., in one in August and in six in March; at Station V., in two in August and in two in March; at Station VI., in two in June; at Station VIII., in one in June, in one in July and in one in August; and at Station IX., in one in August and in one in November: (2) *Priapulus* (sp. *caudatus*), at Station I., in one in March; at Station II., in one in August; at Station III., in four in June; and at Station VIII., in two in August: (3) *Nereis*, at Station I., in one in June;

* Those recorded as 'indistinguishable' generally contained some pulp or mucus.

at Station II., in one in July; at Station III., in one in July; at Station IV., in one in August; at Station V., in one in June; and at Station VII., in one in August: (4) *Sipunculus*, at Station II., in one in June; at Station IV., in one in March; at Station VI., in one in June; and at Station VII., in one in June and in three in August: (5) *Arenicola*, at Station III., in one in June and in one in July; at Station IV., in one in June; and at Station VII., in one in August: (6) *Aphrodite*, at Station II., in one in July and in one in August; and at Station VII., in one in June and in one in March: (7) *Echiurus*, at Stations II. and III., in one in July; and at Station VII., in one in August. 106 stomachs contained annelids that could not be identified. The proportion of the stomachs in which annelids were found to the total number of stomachs containing distinguishable matter at the various stations is as follows:—Station I., 21 of 31; II., 16 of 32; III., 36 of 43; IV., 37 of 41; V., 7 of 27; VI., 13 of 43; VII., 16 of 21; VIII., 15 of 17; IX., 6 of 8. Similarly the proportion during the various months at all the stations is—April, 16 of 24; May, 32 of 45; June, 28 of 48; July, 18 of 41; August, 23 of 37; November, 11 of 15; February, 0 of 5; March, 39 of 47.

Arthropods were found in 21 stomachs (7 %). They consisted of (1) *Crangon*, at Station II., in six in July; and at Station V., in one in April: (2) *Eupagurus*, at Station I., in one in March; at Station II., in one in July; at Station IV., in one in March; and at Stations VI. and VII., in one in June: (3) hermit-crabs, at Station II., in one in May; and at Station VI., in one in August: (4) *Amphidotus*, at Station VI., in one in February: (5) *Ampelisca*, at Station VI., in one in August: (6) *Portunus*, at Station VII., in one in August; unidentified amphipods, at Station I., in one in March; and at Station IV., in one in May: (7) *Cyprina*, at Station VII., in one in August: and (8) unidentified decapods, at Station IV., in one in March.

Molluscs were found in 111 stomachs (42 %). They consisted of (1) *Scrobicularia*, at Station I., in two in May, in five in June, in three in July, in five in August and in four in March; at Station II., in four in April, in four in June and in five in March; at Station III., in three in June, in three in July and in two in August; at Station V., in four in May, in seven in July and in eight in August; at Station VI., in one in November; and at Station IX., in one in May, in two in August and in one in February: (2) *Venus* (sp. *galina*, *lincta*, and *fasciata*), at Station VI., in one in May, in one in June and in four in August; and at Station VIII., in two in August: (3) *Solen*, at Station II., in one in June and in one in August; at Station III., in three in June; at Station IV., in five in March; at Station V., in one in August; and at Station VII., in one in April: (4) *Mactra*, at Station III., in two in June; at Station V., in one in August; and at Station VI., in one in May, in one in June, in one in August and in one in November: (5) *Pecten* (sp. *tigrinus* and *striatus*), at Station IV., in two in March; and at Station VI., in three in June, in one in August, and in one in November: (6) unidentified lamellibranchs, at Station II., in three in August; and at Station VI., in one in May and in one in June: (7) *Cardium*, at Station V., in one in August; at Station VI., in one in April; and at Station VIII., in one in August: (8) *Nucula*, at Station VI., in one in May: (9) *Corbula gibba*, at Station VII., in one in August: (10) *Tapes virginica*, at Station VI., in one in June: (11) *Buccinum undatum*, at Station I., in one in July: (12) *Octopus*, at Station VI., in one in April.

Ascidians.—At Station VII., ascidians were found in two in August.

Fish were found only at Station VI. They consisted exclusively of sand-eels (*Ammodytes*), and were found in one in May, in four in August, and in one in November.

An *Anemone* was found at Station IV., in one in June.

Lemon Soles.

(*Pleuronectes microcephalus.*)

Of 239 stomachs examined 52 were empty, and the contents of 32 were indistinguishable: 155 contained matter that could be identified.

Echinoderms were found in 10 stomachs (6 %). They consisted of (1) *Holothuria*, at Station VII., in one in May and in one in August: (2) *Ophiura albida*, at Station IV., in one in June: (3) *Ophiothrix rosula*, at Station III., in one in August: (4) unidentified sand-stars, at Station I., in one in April; at Station IV., in one in August; and at Station VII., in two in May and in two in June.

Annelids were found in 105 stomachs (67 %). They consisted of (1) *Sabella*, at Station I., in one in June and in two in March; at Station II., in one in June and in three in July; at Station III., in two in August; at Station IV., in one in August; at Station V., in three in July and in five in August; at Station VI., in seven in August; at Station VIII., in one in August; and at Station IX., in two in June, in one in July and in two in November: (2) *Sipunculus*, at Station II., in three in July; and at Station V., in one in August: (3) *Priapulus*, at Station II., in one in June: (4) *Nereis*, at Station III., in one in July. 68 stomachs contained annelids that could not be identified. The proportion of the stomachs in which annelids were found to the total number of stomachs containing distinguishable matter at the various stations is as follows:—Station I., 10 of 21; II., 11 of 19; III., 19 of 29; IV., 4 of 9; V., 23 of 25; VI., 14 of 19; VII., 5 of 11; VIII., 3 of 6; IX., 11 of 17. The proportion during the various months at all the stations was—April, 15 of 18; May, 13 of 20; June, 23 of 32; July, 17 of 29; August, 16 of 38; November, 6 of 7; March, 10 of 12. *Lineus bilineatus* was found at Station V., in one in August.

Arthropods were found in 43 stomachs (27 %). They consisted of (1) hermit-crabs (chiefly *Eupagurus bernhardus* and *lævis*), at Station I., in four in August and in two in March; at Station II., in one in April, in three in July and in five in August; at Station III., in two in June, in one in August and in one in March; at Station V., in four in August and in one in March; at Station VI., in two in May and in one in August; at Station VII., in one in April, in one in May and in one in March; at Station VIII., in one in July, in two in August and in one in November; and at Station IX., in one in May and in one in June: (2) unidentified amphipods, at Station VIII., in one in May: (3) *Porcellana*, at Stations I. and III., in one in June: (4) *Portunus corrugatus*, at Stations I. and II., in one in July; and at Station III., in one in August: (5) *Crangon*, at Station IX., in one in November: (6) *Galathea*, at Station V., in one in June.

Molluscs were found in 12 stomachs (7 %). They consisted of (1) unidentified lamellibranchs, at Station III., in one in July; and at Station VI., in one in May and in three in August: (2) *Solen*, at Station VI., in one in April: (3) *Scrobicularia*, at Station I., in one in May: (4) *Chiton*, at Station IX., in one in November: (5) unidentified gastropods, at Station V., in one in August.

Ascidians were found at Station VI., in one in August.

Fish were found in 5 stomachs (3 %). They consisted of (1) gobies, at

Station IV., in one in June: (2) unidentified fish, at Station V., in one in August; and at Station VI., in two in May and in one in August.

Sea-anemones were found at Station IV., in one in August and at Station IX., in one in June.

Common Dabs.

(*Pleuronectes limanda*).

Of 315 stomachs examined 125 were empty, and the contents of 9 were indistinguishable: 181 contained matter that could be identified.

Echinoderms were found in 34 stomachs (18 %). They consisted of (1) *Ophiura* (sp. *albida*), at Station II., in one in March; and at Station IV., in three in June; at Station V., in three in August; at Station VI., in one in June and in one in March; and at Station VII., in one in March: (2) *Amphiura filiformis*, at Station V., in two in August; at Station VII., in two in May, in one in June, and in three in August; and at Station VIII., in one in August; (3) unidentified sand-stars, at Station I., in one in May; at Station III., in one in July; at Station VI., in one in April and in one in February; and at Station VII., in two in May: (4) *Ophioglypha*, at Station II., in one in August; and at Station VI., in five in August: (5) holothurians, at Station VII., in two in May: (6) *Ophiothrix*, at Station II., in one in March.

Annelids were found in 32 stomachs (17 %). They consisted of (1) *Sipunculus*, at Station I., in three in June; at Station II., in two in June and in one in July; and at Station VII., in three in August: (2) *Sabella*, at Station II., in one in July; at Station IV., in one in March; at Station V., in two in June; and at Station IX., in one in August: (3) *Polynöe*, at Station VI., in one in August; at Station VII., in one in August; and at Station IX., in one in August: (4) *Terebella*, at Station VII., in one in June: (5) *Priapulus*, at Station II., in one in August: (6) unidentified annelids, at Station I., in one in June and in one in March; at Station IV., in two in April; at Station V., in two in June; at Station VI., in one in May and in one in June; at Station VIII., in one in August; and at Station IX., in two in April and in one in August.

Arthropods were found in 82 stomachs (45 %). They consisted of (1) *Portunus*, at Station IV., in four in August; at Station VI., in one in August; and at Station IX., in one in July: (2) *Crangon*, at Stations VI. and VII., in one in May: (3) *Hyas*, at Station II., in one in July: (4) hermit-crabs (chiefly *Eupagurus bernhardus* and *lævis*) in 73 stomachs. The proportion of the stomachs containing hermit-crabs to those containing distinguishable matter at the various Stations is as follows:—Station I., 15 of 25; II., 8 of 16; III., 8 of 13; IV., 6 of 26; V., 11 of 20; VI., 6 of 21; VII., 4 of 26; VIII., 6 of 8; IX., 8 of 18. The proportion during the various months was—April, 6 of 16; May, 4 of 17; June, 11 of 31; July, 16 of 42; August, 10 of 25; November, 13 of 16; February, 1 of 3; March, 11 of 23.

Molluscs were found in 44 stomachs (24 %). They consisted of (1) *Solen*, at Station II., in two in July, in one in August and in one in March; at Station III., in one in July; at Stations IV., VI., and VII., in two in April; and at Station IX., in one in June: (2) *Pecten*, at Station I., in one in March; at Station III., in one in August and in one in March; at Station IV., in three in November and in four in March; at Station VI., in two in August and in two in March; and at Station VII., in two in May: (3) *Scrobicularia*, at Station I., in one in May and in one in June; at Station II., in two in June; at Station V., in two in June and in one in August; and at Station IX., in one in July: (4) *Philine* (sp. *scabra*), at Station VII., in one in June: (5) *Venus*, at Station VII., in one in June: (6) *Montacuta* (sp. *bidentata*), at Station VII., in one in August: (6) unidentified gastropods, at Station IV., in one in June and in three in March: (7) unidentified lamellibranchs, at Station I., in one in May; at Station IV., in one in March; and at Station VII., in one in June.

Fish were found in 9 stomachs (4 %). They consisted of (1) sand-eels, at Station V., in one in June (this Dab, a mature male, 7½ inches long, contained nine small sand-eels); and at Station IX. in one in February: (2) herrings, at Station IV., in two in March: (3) unidentified fish remains, at Station I., in one in July and in one in August; at Station II., in one in June; at Station III., in one in July; and at Station VI., in one in August. *Ova* (probably of herring) were found at Station VI., in one in August.

Sea-anemones were found at Station VI., in one in June; and at Station VII., in one in August; and unidentified zoophytes at Station III., in two in July.

Long Rough Dabs.

(*Hippoglossoides limandoides.*)

Of 376 stomachs examined 204 were empty, and the contents of 6 were indistinguishable: 166 contained matter that could be identified.

Echinoderms were found in 45 stomachs (27 %). They consisted of (1) *Ophiura*, at Station II., in one in June and in two in November; at Station IV., in two in June; at Station V., in four in August; at Station VI., in two in June and in two in November; at Station VII., in two in June; and at Station VIII., in three in August: (2) *Ophioglypha* (sp. *albida*), at Station II., in one in July and in two in August; at Station III., in one in August; at Station VI., in four in August; and at Station IX., in one in July: (3) *Amphiura* (sp. *filiformis*), at Station VII., in one in June and in two in August; and at Station VIII., in one in May: (4) *Ophiopholis*, at Station III., in two in July and in one in August: (5) *Ophiothrix*, at Station II., in one in August; and at Station VII., in one in March: (6) unidentified sand-stars, at Station II., in one in April and in one in May; at Station V., in one in April; at Station VI., in one in February and in two in March; at Station VII., in one in April, in two in May and in two in March.

Annelids were found in 21 stomachs (12 %). They consisted of (1) *Sabella*, at Station VIII., in one in August; and at Station IX., in one in July: (2) *Sipunculus*, at Station VII., in one in August; and at Station IX., in one in July: (3) *Pectenaria*, at Station IX., in one in July: (4) *Echiurus*, at Station VIII., in one in June: (5) unidentified annelids, at Station I., in one in May and in two in June; at Station II., in two in May; at Station V., in one in August; at Station VII., in one in May; at Station VIII., in two in June; and at Station IX., in one in April, in four in May, in one in June and in one in March.

Arthropods were found in 62 stomachs (37 %). They consisted of (1) *Crangon*, at Station I., in two in April, in one in May, in three in November and in one in March; at Station II., in one in April; at Station III., in one in April, in one in May and in one in March; at Station IV., in one in November; at Station V., in two in May, in one in June, in three in August and in one in November; at Station VI. in three in November; at Station VII., in one in May; at Station VIII., in one in April and in one in November; and at Station IX., in one in April, in one in May, in two in June and in one in November: (2) *Pandalus*, at Station I., in two in June and in one in March; at Station II., in one in July; at Station IV., in one in August; at Station V., in one in November; at Station VI., in one in February; and at Station IX., in one in June: (3) *Portunus*, at Station I., in one in July; at Station V., in two in November; at Station VII., in one in June and in one in August; at Station VII., in one in November; and at Station IX., in one in June: (4) *Eupagurus*, at Station V., in three in August; at Station VII., in one in March; at Station VIII., in one in November; and at Station IX., in one in August and in one in February: (5) *Ampelisca*, at Station V., in one in June and in one in August; and at Station VIII., in one in May: (6) *Mysis*, at Station VIII., in two in June: (7) *Cuma*, at Station IX., in one in May: (8) unidentified hermit-crabs, at Station V., in three in April and in one in May: (9) unidentified schizopods, at Station VII., in one in June; at Station VIII., in one in May and in one in Jue; and at Station IX., in one in May: (10) unidentified crabs, at Station I., in one in April and in one in May: (11) unidentified amphipods, at Station VIII., in one in May.

Molluscs were found in 24 stomachs (14 %). They consisted of (1) *Scrobicularia*, at Station II., in one in June; at Station V., in five in June and in one in March; at Station VIII., in one in June; at Station IX., in one in May and in four in July: (2) *Solen*, at Stations I. and II., in one in August; at Station V., in two in August; and at Stations VIII. and IX., in one in June: (3) *Turritella*, at Station V., in one in August: (4) *Pleurotoma*, at Station V., in one in August: (5) *Natica* (sp. *alderi*), at Station IX., in one in July: (6) unidentified lamellibranchs, at Station V., in two in June.

Fish were found in 23 stomachs (13 %). They consisted of (1) whitings, at Station I., in one in July; at Stations IV., V., and VIII., in one in August: (2) lemon-dabs, at Station IX., in two in July: (3) gobies, at Station II., in one in March; and at Station IX., in one in November: (4) sand-eels, at Station II., in one in June: (5) pogge, at Station VII., in one in June: rockling (*Motella*), at Station V., in one in August: (6) gurnard, at Station II., in one in November: (7) dragonet, at Station II., in one in November: (8) unidentified fish remains, at Station I., in two in July and in two in August; at Station III., in one in July; at Station V., in two in June and in one in August; and at Stations VI. and VII., in one in June.

Witch Soles.

(*Pleuronectes cynoglossus.*)

Of 84 stomachs examined 24 were empty, and the contents of 9 were indistinguishable: 51 contained matter that could be identified.

Echinoderms (sand-stars) were found at Station VIII, in one in April and in one in May.

Annelids were found in 41 stomachs (80 %). They consisted of (1) *Sabella*, at Station V., in three in June, in one in August and in three in November; at Station VII., in one in June; and at Station VIII., in two in June: (2) *Priapulus*, at Station VII., in one in March: (3) unidentified annelids, at Station I., in one in March; at Station IV., in one in April; at Station V., in one in May, in one in August, in one in November and in six in March; at Station VII., in two in March; at Station VIII., in three in April, in three in May, in one in July and in one in March; at Station IX., in five in May and in one in June. A planarian worm (*Amphiphorus lactiflorus*) was found at Station IV., in one in June.

Arthropods were found in 9 stomachs (17 %). They consisted of (1) *Ampelisca*, at Station VIII., in two in July; and at Station IX., in one in May and in three in June: (2) *Eupagarus*, at Station IX., in one in July: (3) unidentified schizopods, at Station VIII., in one in April; and at Station IX., in one in May.

Molluscs were found in 7 stomachs (13 %). They consisted of (1) *Scrobicularia*, at Station I., in one in March; at Station IV., in one in April; and at Station V., in two in August and in two in November: (2) *Philine*, at Station IX., in one in May.

Unidentified *Fish remains* were found at Station V., in one in May.

Flounders.

(*Pleuronectes flesus.*)

Of 37 stomachs examined from April to March, 36 were empty. The remaining one contained only a little mucus.

Gurnards.

(*Trigla gurnardus.*)

Of 235 stomachs examined 93 were empty, and the contents of 3 were indistinguishable: 139 contained matter that could be identified.

No *Echinoderms* were found in any of the stomachs.

Unidentified *Annelids* were found at Station VII., in one in May.

Arthropods were found in 133 stomachs (95 %). They consisted of (1) *Crangon*, found in 60 stomachs. The proportion of the stomachs containing *Crangon* to the total number of stomachs containing distinguishable matter at the various Stations is as follows:—Station I., 5 of 17; II., 3 of 13; III., 6 of 15; IV., 2 of 9; V., 7 of 11; VI., 4 of 14; VII., 5 of 17; VIII., 10 of 20; IX., 18 of 23. Similarly the proportion during the various months at all the Stations is—April, 2 of 2; May, 16 of 22; June, 17 of 38; July, 13 of 34; August, 12 of 39; November, 0 of 3; March, 0 of 1: (2) *Pandalus*, at Station I., in two in May and in five in June; at Station II., in two in June, in one in July and in two in August; at Station III., in one in June and in four in July; at Station IV., in one in August; at Station V., in three in June; at Station VI., in one in August and in one in March; at Station VII., in two in August; at Station VIII., in one in June and in one in July; and at Station IX., in one in November: (3) *Portunus*, at Station I., in one in August; at Station II., in two in August; at Station III., in one in June and in two in August; at Station IV., in five in August; at Station V., in one in August; at Station VI., in three in August; at Station VII., in two in June and in four in August: and at Station VIII., in one in July: (4) *Eupagurus*, at Station III., in two in August; at Station IV., in two in June; at Station V., in one in August; at Station VI., in one in August; and at Station VIII., in one in June: (5) *Ampelisca*, at Station VII., in one in June: (6) *Diastylis*, at Station IX., in one in June: (7) *Erythrops*, at Station VIII., in one in July: (8) *Nephrops*, at Station IX., in one in August: (9) unidentified schizopods, at Station VII., in six in June; at Station VIII., in two in June; and at Station IX., in one in June and in one in July: (10) unidentified amphipods, at Station II., in one in July: (11) unidentified crustacea, at Station III., in one in August.

Molluscs were found in 5 stomachs (3 %). They consisted of (1) *Rossia*, at Stations V. and VIII., in one in June: (2) *Loligo*, at Station IX., in one in May: (3) *Dentalium*, at Station V., in one in August: (4) unidentified cephalopods; at Station VI., in one in August.

Fish were found in 34 stomachs (24 %). They consisted of (1) herrings or sprats, at Station II., in one in May and in one in July; at Station VI., in one in May; and at Station VIII., in two in August: (2) sand-eels, at Station VI., in three in August: (3) whitings, at Station VIII., in two in August: (4) unidentified fish remains, at Station I., in three in July and in two in August; at Station II., in one in August and in one in November; at Station III., in two in July; at Station IV., in one in August; at Station V., in one in June and in two in August; at Station VI., in one in August; at Station VII., in two in August; at Station VIII., in one in June, in two in August and in one in November; and at Station IX., in three in July and in one in August.

Cod.

(*Gadus morrhua.*)

Of 206 stomachs examined 13 were empty, and the contents of 1 were indistinguishable: 192 contained matter that could be identified.

Echinoderms were found in 4 stomachs (2 %). They consisted of (1) *Ophioglypha*, at Station VI., in one in August: (2) sand-stars, at Station I., in one in April; at Station II., in one in February; and at station V., in one in March.

Annelids were found in 12 stomachs (6 %). They consisted of (1) *Aphrodite*, at Station I., in two in May and in one in August; at Station V., in one in May, in one in November, and in one in February; at Station VI., in one in April; at Station VIII., in one in February; and at Station IX., in one in April: (2) unidentified annelids, at Station III., in one in April; at Station V., in one in May; and at Station IX., in one in August.

Arthropods were found in 165 stomachs (85 %). They consisted of (1) *Crangon*, at Station I., in two in April; at Station II., in two in April, in two in May and in two in November; at Station III., in four in April; at Station V., in one in April, in three in May, in one in June, in one in August, in five in November and in five in February; at Station VI., in two in April and in three in November; at Station VII., in one in April and in one in March; and at Station IX., in two in April and in two in November: (2) *Pandalus*, at Station I., in six in June; at Station II., in one in August, in two in November and in one in February; at Station III., in one in July and in two in March; at Station IV., in one in June, in two in August, and in two in November; at Station V., in one in June, in one in August, in one in November, and in two in February; at Station VI., in three in February and in one in March; at Station VIII., in one in February; and at Station IX., in one in July, in two in August and in five in November: (3) *Portunus*, at Station I., in one in June, in two in July and in four in August; at Station II., in one in July, in two in August and in two in November; at Station III., in three in June, in two in July and in two in August; at Station IV., in two in August; at Station V., in three in August, in four in November and in one in February; at Station VI., in two in August and in two in November; at Station VIII., in one in August and in one in February; and at Station

IX., in one in July: (4) *Nephrops,* at Station I., in one in April, in three in May, in one in June, in one in July and in two in August; at Station II., in three in May, in one in November and in two in February; at Station III., in one in June; at Station V., in one in April, in four in May, in one in August and in one in February; at Station VIII., in one in June, in two in November and in five in February; and at Station IX., in one in August: (5) *Eupagurus,* at Station I., in five in July and in three in August; at Station II., in one in June and in three in August; at Station III., in two in June, in two in July and in one in August; at Station IV., in one in November; at Station V., in one in August, in two in November, in one in February and in two in March; at Station VI., in one in August and in one in February; at Station VII., in one in March; and at Station IX., in two in July: (6) *Hyas,* at Station I., in one in July; at Station II., in one in June; at Station III., in one in June; at Station V., in one in November and in one in February; at Station VI., in one in February; at Station VIII., in one in August; and at Station IX., in one in July and in two in November: (7) *Galathea,* at Station II., in one in August; at Station III., in one in July; at Station V., in one in August; and at Station VI., in one in February: (8) *Porcellana,* at Station III., in two in July and in one in August: (9) *Munida,* at Station V., in one in November: (10) unidentified hermit-crabs, at Station I., in one in April, in two in May and in one in June; at Station II., in two in April and in two in May; at Station III., in two in April; at Station IV., in one in May; at Station V., in one in April and in two in May; at Station VI., in four in April; and at Station IX., in one in April: (11) unidentified crabs, at Station I., in two in April and in two in May; at Station II., in one in April and in two in May; at Station III., in one in April and in two in May; at Station V., in two in April and in one in May; at Station VII., in one in April; and at Station IX., in one in April: (12) unidentified crustacea, at Station III., in one in August; and at Station V., in one in August.

Molluscs were found in 22 stomachs (11 %). They consisted of (1) *Buccinum,* at Station I., in one in May, in one in July and in one in August; at Station II., in one in June; at Station III., in two in April and in one in May; at Station IV., in one in June; at Station V., in one in March; and at Station VII., in one in April: (2) *Solen,* at Station VII., in five in April: (3) *Pecten,* at Station I., in one in April; at Station III., in one in July and in one in March; and at Station VI., in one in February: (4) *Scrobicularia,* at Station V., in one in August: (5) *Turritella,* at Station III., in one in June: (6) *Rossia,* at Station VI., in one in February.

Fish were found in 110 stomachs (57 %). They consist of (1) whitings, at Station I., in two in March; at Station II., in one in April, in one in November, in one in February and in one in March; at Station III., in two in June; at Station V., in two in August, in one in November, in one in February and in two in March; at Station VI., in one in November and in three in February; at Station VII., in two in November and in three in March; at Station VIII., in two in November, in four in February and in one in March; and at Station IX., in one in November and in one in February: (2) herrings, at Station I., in two in March; at Station II., in one in April, in three in February and in one in March; and at Station VI., in one in April and in two in February: (3) sand-eels, at Station II., in one in May and in one in November; at Station VI., in one in April, in one in August and in five in February; and at Station VIII., in one in February: (4) sprats, at Station III., in four in May and in one in June; and at Station V., in one in June: (5)

codlings, at Station II., in two in April; at Station VI., in two in February; and at Station VII., in one in November: (6) long rough dabs, at Station II., in one in April; at Station V., in three in August; and at Station VII., in one in November: (7) haddocks, at Station V., in one in August; at Station VIII., in one in August; and at Station IX., in one in February: (8) lump-suckers, at Station II., in one in March; and at Station IX., in one in February: (9) pogge, at Station V., in one in February: (10) rockling, at Station V., in one in February: (11) unidentified fish remains, at Station I., in one in April, in one in May and in two in March; at Station II., in three in May, in one November, in two in February and in two in March; at Station III., in two in April, in one in August and in two in March; at Station V., in one in May, in two in June, in one in August, in two in November and in one in February; at Station VI., in one in February and in one in March; at Station VII., in one in April and in one in May; at Station VIII., in one in November, in one in February and in one in March; and at Station IX., in two in April, in one in June and in one in November.

Medusidæ were found at Station V., in one in March, and at Station VI., in one in February.

Haddocks.

(*Gadus æglefinus.*)

Of 240 stomachs examined 29 were empty, and the contents of 19 were indistinguishable: 192 contained matter that could be identified.

Echinoderms were found in 48 stomachs (25 %). They consisted of (1) *Amphiura* (sp. *filiformis*), at Station I., in one in July; at Station II., in three in June; at Station VI., in two in August; at Station VII., in two in May and in one in November; at Station VIII., in two in August; and at Station IX., in one in June, in one in July and in two in August: (2) *Ophiura* (sp. *albida*), at Station II., in three in November; at Station III., in two in June; and at Station VI., in one in November and in one in February: (3) *Ophioglypha*, at Station VI., in five in August: (4) *Ophiothrix*, at Station II., in two in August; at Station V., in one in November; and at Station VI., in two in February: (5) *Echinocyamus*, at Station VI., in two in August and in one in February; and at Station IX., in one in June: (6) *Asterias* (sp. *rubens*), at Station II., in one in February: (7) unidentified sand-stars, at Station I., in one in May; at Station III., in one in May; at Station V., in one in May; and at Station VII., in two in April, in three in May and in three in June.

Annelids were found in 40 stomachs (20 %). They consisted of (1) *Aphrodite*, at Station II., in one in February; at Station III., in one in May; and at Station VIII., in one in April, in two in May and in one in February: (2) *Priapulus*, at Station II., in two in June: (3) *Sabella*, at Station VIII., in one in August; and at Station IX., in one in June: (4) *Pectenaria*, at Station V., in one in November; and at Station VI., in one in August: (5) *Arenicola*, at Station IX., in one in June: (6) *Sipunculus*, at Station VII., in one in August: (7) *Polynöe*, at Station IX., in one in November: (8) unidentified annelids, at Station I., in one in May; at Station II., in one in April and in one in November; at Station III., in one in April; at Station V., in one in April and in two in August; at Station VI., in three in July; at Station VII., in two in May; at Station VIII., in three in April, in one in May, in two in July and in one in November; and at Station IX., in three in April and in two in May.

Arthropods were found in 114 stomachs (59 %). They consisted of (1)

Crangon, at Station I., in one in May, in one in June and in one in August; at Station II., in one in May; at Station V., in three in April, in one in May and in three in August; at Station VI., in two in November; at Station VII., in two in April and in two in November; and at Station IX., in one in April, in one in May, in two in August and in one in November: (2) *Eupagurus*, at Station I., in one in July; at Station II., in two in June, in two in July, in two in November and in one in February; at Station V., in three in August; at Station VI., in three in August; at Station VIII., in two in June and in one in November; and at Station IX., in three in June and in one in November: (3) *Ampelisca*, at Station I., in two in June; at Station V., in five in August and in two in November; at Station VI., in one in February and in one in August; at Station VIII., in three in June, in five in July, in two in August and in one in November; and at Station IX., in seven in June: (4) *Portunus*, at Station II., in one in June and in three in November; and at Station V., in one, at Station VII., in three, at Station VIII., in two, and at Station IX., in one—all in November: (5) *Diastylis*, at Station VII., in one in November; at Station VIII., in two in June and in three in July; and at Station IX., in three in June: (6) *Pandalus*, at Station I., in one in June; and at Station IX., in one in July and in one in November: (7) *Leucon*, at Station VIII., in two, and at Station IX., in one, in June: (8) *Nephrops*, at Station VI., in one in August; and at Station IX., in one in November: (9) *Galathea*, at Station I., in one in June; (10) *Corystes*, at Station VI., in one in August: (11) unidentified hermit-crabs, at Station I., in two in June; at Station III., in one in May; at Station V., in one in May; at Station VII., in one in April; and at Station VIII., in one in May; (12) unidentified amphipods, at Station V., in two in March; at Station VI., in one in March; and at Station IX., in one in April and in two in May: (13) unidentified *Cumaceæ*, at Station VII., in one in May; and at Station IX., in two in July and in one in August: (14) unidentified crabs, at Station III., in one in May; and at Station IX., in one in May and in one in August: (15) unidentified schizopods, at Station VII., in one in April; at Station VIII., in one in May; and at Station IX., in one in May and in one in July.

Molluscs were found in 102 stomachs (53 %). They consisted of (1) *Scrobicularia*, at Station I., in four in June; at Station II., in one in May, in three in June, in four in July, and in one in November; at Station V., in three in April, in three in May, in three in June, in twelve in August, in six in November, in two in February and in four in March; at Station VI., in one in March; at Station VII., in one in May; at Station VIII., in seven in May, in two in June, in two in July and in one in November; and at Station IX., in five in May, in four in July, in three in August, in one in November and in one in February: (2) *Philine*, at Station VII., in one in May, in two in June and in one in November; at Station VIII., in two in May; and at Station IX., in one in June and in one in August: (3) *Solen*, at Station II., in three in July; at Station V., in one in August; and at Stations VII., VIII., and IX., in one—all in November: (4) *Pecten*, at Stations I., in one in April and in one in May; and at Station VI., in one in August: (5) *Cylichna*, at Station VI., in one in August and in one in November; and at Station IX., in one in November: (6) *Buccinum*, at Station II., in one in February; and at Station III., in one in June: (7) *Mactra*, at Station IX., in one in August: (8) *Nucula*, at Station IX., in one in August: (9) *Actæon*, at Station VIII., in one in June: (10) *Leda*, at Station IX., in one in June.

Fish were found in 7 stomachs (3 %). They consisted of (1) long rough dabs, at Station II., in one in February; and at Station IX., in one in August: (2) goby, at Station VIII., in one in November: (3) rockling, at Station IX., in one in February; (4) unidentified fish remains, at Station VI., in one in August; and at Station VIII., in one in April and in one in August.

Cœlenterates were found in 3 stomachs in February :—*Pleurobrachia*, at Station II., in one; and medusidæ, at Station VI., in two, and at Station IX., in one.

Whitings.

(*Gadus merlangus.*)

Of 286 stomachs examined 121 were empty, and the contents of 8 were indistinguishable: 157 contained matter that could be identified.

No *Echinoderms* were found in any of the stomachs examined.

Annelids were found in 4 stomachs (2 %). They consisted of (1) *Nereis*, at Station IV., in one in November: (2) unidentified annelids, at Station VII., in one in August; and at Station VIII., in one in April and in one in May.

Arthropods were found in 37 stomachs (37 %). They consisted of (1) *Crangon*, at Station II., in one in May and in one in July; at Station III., in one in April, in one in May, in one in July and in two in August; at Station V., in one in May, in four in August and in one in March; at Station VII., in one in November; at Station VIII., in one in April, in two in May and in two in June; and at Station IX., in one in June: (2) *Pandalus*, at Station I., in one in June and in one in August; at Station III., in one in August and in two in November; at Station V., in three in August; at Station VI., in one in February; at Station VII., in two in March; and at Station IX., in one in August: (3) *Nephrops*, at Station V., in one in August; (4) *Porcellana* (sp. *longicornis*), at Station VIII., in one in August: (5) unidentified crabs, at Stations II. and V., in one in March: (6) unidentified amphipods, at Station IX., in one in May.

Molluscs were found in 7 stomachs (4 %). They consisted of (1) *Philine* (sp. *scabra*), at Station IX., in two in May; (2) *Octopus*, at Station VIII., in two in May: (3) *Scrobicularia*, at Station IX., in one in May: (4) *Rossia*, at Station VIII., in one in March: (5) unidentified lamellibranchs, at Station VII., in one in May.

Fish were found in 119 stomachs (75 %). They consisted of (1) whitings, at Station I., in one in August and in one in March; at Station III., in one in November; at Station V., in two in August, in one in November and in one in March; at Station VI., in one in November; at Station VIII., in one in July, in one in August and in one in November and at Station IX., in one in July, in one in August, and in two in February: (2) herrings or sprats, at Station III., in two in March and in one in November; at Station V., in one in August and in one in November; at Station VI., in one in August and in one in February; at Station VII., in one in June, in one in August and in five in November; and at Station VIII., in two in March: (3) gobies, at Station III., in one in November; at Station VII., in one in May; and at Station VIII., in one in June: (4) sand-eels, at Station V., in one in February; and at Station VI., in one in June: (5) unidentified fish remains, at Station I., in two in April, in four in August and in one in March; at Station II., in one in April, in three in July and in two in

November; at Station III., in three in April, in three in May, in four in June, in one in July, in four in August, in one in November and in one in March; at Station IV., in one in August; at Station V., in three in April, in two in May, in one in June, in three in August, in three in November, in three in February and in three in March; at Station VI., in one in August and in one in March; at Station VII., in one in April, in two in August and in two in November; at Station VIII., in one in April, in two in May, in four in June, in one in July, in two in August, in two in November, in two in February and in two in March; and at Station IX. in four in April, in three in June, in two in July, in three in August and in two in February. The stomach of one found at Station VI. in August was full of herring *ova*.

Skate.

(*Raia batis*, *R. clavata*, and *R. radiata.*)

Of 46 stomachs examined 24 were empty.

Arthropods were found in 20 stomachs (90 %). They consisted of (1) *Portunus*, at Station I., in two in August; at Station II., in one in November; at Station III., in three in August; at Station V., in one in August; and at Station VIII., in one in August: (2) *Pandalus*, at Station I., in one in August; at Station II., in three in November and in one in February; at Station V., in one in August; and at Station VIII., in one in November: (3) *Crangon*, at Station I., in one in April and in one in August; at Station II., in two in November; at Station V., in one in August and in one in March; and at Station VIII., in one in November: (4) *Nephrops*, at Station III., in one in August; and at Station VIII., in one in November: (5) *Eupagurus*, at Station III., in one in August: (6) spider-crabs, at Station I., in one in April.

Molluscs (*Pecten opercularis*) were found in at Station III., in one in August.

Fish were found in 7 stomachs (31 %). They consisted of (1) herrings, at Station II., in two in February: (2) whitings, at Station II., in one in February: (3) unidentified fish remains, at Station II., in two in November; at Station V., in one in August; and at Station VIII., in one in August.

Cat-Fish

(*Anarrhichas lupus.*)

Of 18 stomachs examined 6 were empty.

Echinoderms were found in 4 stomachs (33%) They consisted of (1) *Ophiura*, at Station IX., in one in April and in one in November: (2) *Ophioglypha*, at Station VIII., in one in August: (3) *Ophiothrix*, at Station V., in one in March.

Annelids (*Aphrodite*) were found at Station I., in one in March.

Arthropods were found in 6 stomachs (50 %). They consisted of (1) *Eupagurus*, at Station I., in three, and at Station VI., in one, in March; and at Station VIII., in one in August: (2) *Hyas*, at Station I., in two in March; at Station V., in one in March; and at Station VIII., in one in August: (3) *Portunus*, at Station V., in one in March; and at Station VIII., in one in August: (4) *Cancer*, at Station VI., in one in March; (5) *Nephrops* at Station IX., in one in June.

Molluscs were found in 7 stomachs (31%). They consisted of (1) *Pecten* (sp. *opercularis* and *tigrinus*), at Station I., in one in June and in three in March; at Station VIII., in one in November; and at Station IX., in one in February: (2) *Buccinum*, at Station I., in two in March, and at Station IX., in one in November: (3) *Cardium*, at Stations I. and VI., in one in March.

Fish remains, unidentified, were found at Station V., in one in June.

Angler Fish.

(*Lophius piscatorius.*)

Of 27 stomachs examined 13 were empty.

Arthropods (*Eupagurus*) were found at Station V., in one in March.

Fish were found in all the others. They consisted of whitings in three, herrings or sprats in two, skate in one, haddocks in one, sand-eels in one, rockling in one, long rough dabs in one, and unidentified fish in four.

II. ST ANDREWS BAY.

Plaice.

(*Pleuronectes platessa.*)

Of 258 stomachs examined 69 were empty, and the contents of 7 were indistinguishable: 182 contained matter that could be identified.

Echinoderms were found in 14 stomachs (7 %). They consisted of (1) *Ophiura albida*, at Station I., in one in November; at Station II., in one in October and in one in November; and at Station V., in one in October and in one in November: (2) holothurians, at Station IV., in one in October: (3) *Amphiura*, at Station V., in one in November: (4) unidentified sand-stars, at Station I., in one in October; at Station II., in two in April; at Station III., in one in April; and at Station IV., in two in April and in one in June.

Annelids were found in 98 stomachs (53 %). They consisted of (1) *Terebella*, at Station I., in three in August and in two in October; at Station II., in three in June and in one in November; at Station III., in five in June, in six in August and in one in November; at Station IV., in one in June and in one in August; at Station V., in one in October: (2) *Phyllodoce*, at Station I., in one in October, in one in November and in three in March; at Station II., in one in October and in four in March; at Station III., in one in June and in three in October; and at Station IV., in one in June and in three in October: (3) *Arenicola*, at Station I., in two in June and in five in March; at Station II., in three in March; and at Station IV., in three in June: (4) *Sabella*, at Station I., in two in October; at Station II., in one in June and in two in March; at Station IV., in one in October, in one in November and in one in March; and at Station V., in two in June and in one in October: (5) *Nereis*, at Station II., in one in November and in one in March; at Station III., in one in October; and at Station IV., in one in November: (6) *Priapulus*, at Station V., in one in June: (7) *Aphrodite*, at Station V., in one in November: (8) *Pectenaria*, at Station II., in one in October: (9) unidentified annelids, at Station I., in two in April and in three in March; at Station II., in two in April, in one in August, in three in November and in two in March; at Station III., in one in

April, in one in November and in one in March; at Station IV., in five in April and in one in October; and at Station V., in one in April and in two in October. A planarian worm (sp. ?) was found at Station V., in one in March.

Arthropods were found in 51 stomachs (28 %). They consisted of (1) *Ampelisca*, at Station I., in one in October, in two in November and in one in March; at Station II., in three in June, in one in October, in two in November and in three in March; at Station III., in one in August, in four in October, in one in November and in one in March; at Station IV., in one in August, in one in October and in one in November; and at Station V., in one in June, in one in October and in one in March: (2) *Portunus*, at Station I., in four in October and in one in November; at Station II., in three in October and in three in November; at Station III., in one in October; at Station IV., in three in June; and at Station V., in one in October and in one in November: (3) unidentified amphipods, at Stations II. and IV., in two in April: (4) *Diastylis*, at Station V., in two in October: (5) *Phoxus*, at Station V., in one in October: (6) unidentified crabs, at Station I., in one in April.

Molluscs were found in 57 stomachs (31 %). They consisted of (1) *Solen* (sp. generally *ensis*), at Station I., in three in April, in three in June, in five in August, in three in October and in one in November; at Station II., in four in June, in four in August, in three in October, in three in November and in three in March; at Station III., in three in April, in four in June, in one in August and in one in October; at Station IV., in one in April, in one in August and in two in November; and at Station V., in four in April, in one in June, in five in August, in one in November and in one in March: (2) *Nucula*, at Station I., in two in October; at Station II., in one in August and in one in October; at Station III., in five in August and in three in October; at Station IV., in one in November; and at Station V., in five in June, in three in August, in seven in October and in two in November: (3) *Scrobicularia*, at Station I., in two in October; at Station III., in one in April and in one in August; at Station IV., in one in April, in one in June, in one in August and in two in October; and at Station V., in one in April: (4) *Mactra*, at Station I., in one in June; at Station III., in one in August; and at Station V., in one in June and in one in August: (5) *Cardium*, at Station V., in one in June: (6) *Montacuta*, at Station IV., in one in October: (7) unidentified lamellibranchs, at Station I., in one in June.

Fish remains, unidentified, were found at Station IV., in one in June.

Common Dabs.

(*Pleuronectes limanda.*)

Of 189 stomachs examined 52 were empty, and the contents of 13 were indistinguishable: 124 contained matter that could be identified.

Echinoderms were found in 38 stomachs (30 %). They consisted of (1) *Ophiura* (sp. *texturata* and *albida*), at Station I., in two in June, in one in October and in four in November; at Station II., in three in October; at Station III., in three in June and in four in October; at Station IV., in one in October; and at Station V., in four in October, in five in November and in two in March: (2) *Ophioglypha*, at Station I., in two; at Station II., in two; and at Stations IV. and V., in one—all in August: (3) *Amphiura*, at Stations IV. and V., in one in August: (4) unidentified sand-stars, at Station II., in one in April.

Annelids were found in 62 stomachs (50 %). They consisted of (1) *Terebella*, at Station I., in five in June, in one in August in two in October and in one in November; at Station II., in ten in June and in seven in August; at Station III., in one in August; at Station IV., in one in August; and at Station V., in three in August, in one in October, and in two in November: (2) *Arenicola*, at Station III., in one in October; and at Station IV., in three in June: (3) *Phyllodoce*, at Station I., in two in October: (4) *Aphrodite*, at Station V., in two in November: (5) *Sabella*, at Station V., in one in October: (6) *Micrura* (sp. *purpurata*), at Station V., in one in June: (7) unidentified annelids, at Station I., in three, at Station II., in five, and at Station IV., in one —all in April; and at Station V., in one in April and in eight in October. *Echiurus* (sp. *oxyurus*) was found at Station III., in two in June; and at Station V., in one in June and in one in October.

Arthropods were found in 39 stomachs (31 %). They consisted of (1) *Portunus*, at Station I., in one in August and in ten in October; at Station II., in three in October; at Station III., in five in October; at Station IV., in three in August and in two in November; and at Station V., in one in October and in one in November: (2) *Ampelisca*, at Station I., in one in October; at Station II., in two in August and in one in November; at Station III., in one in October; at Station IV., in two in October; and at Station V., in one in August and in one in October: (3) *Crangon*, at Station III., in one in April: (4) hermit-crabs, at Station III., in one in April and in one in June: (5) unidentified amphipods, at Station I., in one in October.

Molluscs were found in 19 stomachs (15 %). They consisted of (1) *Solen*, at Station I., in one in October; at Station II., in three in August; at Station III., in three in April; at Station IV., in one in November; and at Station V., in one in April and in one in November: (2) *Scrobicularia*, at Station I., in one in October; and at Station II., in one in August and in one in October: (3) *Pecten* (sp. *opercularis*), at Station II., in one in October; (4) *Mactra*, at Station II., in one in August: (5) unidentified lamellibranchs, at Stations I. and III., in one in August; (6) unidentified gastropods, at Station III., in one in October.

Fish remains, unidentified, were found in 5 stomachs (4 %)—at Station III., in one in April; at Station IV., in one in August and in one in October; and at Station V., in two in October.

Long Rough Dabs.

(*Hippoglossoides limandoides.*)

Of 26 stomachs examined 10 were empty. Of the 16 with food 13 (81 %) contained *Echinoderms*, consisting of (1) *Ophioglypha*, at Station V., in seven in August: (2) *Ophiura*, at Station III., in one in April, and at Station V., in three in June, in one in October, and in one in March. *Annelids* (*Ampelisca*) were found at Station I., in one stomach in June. Arthropods (*Crangon*) were found at Station III., in one in April. *Fish remains* were found at Station V., in two stomachs in October.

Gurnards.

(*Trigla gurnardus.*)

Of 141 stomachs examined 23 were empty, and the contents of 2 were indistinguishable: 116 contained matter that could be identified.

Echinoderms (*Ophiura albida*) were found at Station V., in one in October.

Annelids were found in 5 stomachs (4 %). They consisted of (1) *Sabella*, at Station III., in one in June: (2) *Arenicola*, at Station IV., in one in June: (3) unidentified annelids, at Station III., in two, and at Station V., in one, in April.

Arthropods were found in 110 stomachs (95 %). They consisted of (1) *Crangon*, at Station I., in five in April, in one in October and in seven in November; at Station II., in four in April, in two in June, in one in August, in six in October, in one in November and in one in March; at Station III., in four in April, in five in October and in seven in November; at Station IV., in three in April and in three in November; and at Station V., in two in April and in seven in October: (2) *Portunus*, at Station I., in two in June, in three in August and in three in November; at Station II., in three in June, in one in August, in five in October and in one in November; at Station III., in seven in October; at Station IV., in three in June, in one in August and in one in November; and at Station V., in two in June, in three in August and in six in October: (3) *Ampelisca*, at Station I., in one in June; and at Station II., in six in June, in three in August and in one in October: (4) unidentified schizopods, at Station II., in two in June: (5) *Corystis*, at Station V., in one in October: (6) *Pandalus* (sp. *annulicornis*), at Station I., in one in March: (7) hermit-crabs, at Station IV., in one in April.

Molluscs were found in 5 stomachs (4 %). They consisted of (1) *Rossia*, at Station III., in two, and at Station V., in one, in June: (2) *Scrobicularia*, at Station V., in one in June: (3) *Loligo*, at Station V., in one in April.

Fish were found in 42 stomachs (36 %). They consisted of (1) herrings, at Station I., in one in November; and at Station III., in two in June: (2) gobies, at Station II., in two in October; and at Station III., in one in June: (3) whitings, at Station I., in one in October and in one in November; and at Station IV., in one in June: (4) dabs, at Station I., in one in June; at Station IV., in one in November; and at Station V., in one in June: (5) sand-eels, at Station IV., in one in August: (6) plaice, at Station IV., in one in November: (7) pipe-fish, at Station IV., in one in November: (8) unidentified fish remains, at Station I., in four in June, in three in August, in one in October and in two in November; at Station II., in one in April, in one in June, in one in August, in two in October and in one in November; at Station III., in one in April, in one in June, in two in August, in one in October and in two in November; at Station IV., in two in June; and at Station V., in two in August.

HADDOCKS.

(*Gadus æglefinus.*)

Of 17 stomachs examined 2 were empty, and the contents of 5 were indistinguishable. 10 contained matter that could be identified.

No *Echinoderms* were found in any of the stomachs.

Annelids, unidentified, were found at Station V., in one in April. *Echiurus* was found at Station V., in two in June.

Arthropods were found in 9 stomachs (90%). They consisted of (1) *Crangon*, at Station V., in three in April: (2) *Ampelisca*, at Station V., in one in June and in one in October: (3) *Portunus*, at Station IV., in one in October: (4) hermit-crabs, at Station V., in one in April: (5) unidentified amphipods, at Station V., in two in April.

Whitings.

(*Gadus merlangus.*)

Of 12 stomachs examined 6 were empty, and the contents of 1 were indistinguishable.

Arthropods (*Ampelisca*) were found at Station II., in three in June.

Fish remains were found at Station V., in one in October and in one in March.

Less Abundant Fish of St Andrews Bay.

Lemon Soles (*Pleuronectes microcephalus*).—Of 8 stomachs examined 1 was empty, and the contents of 3 were indistinguishable. Of the remaining 4, two at Station V., in March, contained *Sabella*, and one at Station II., in April, and one at Station I., in August, contained unidentified annelids.

Flounders (*Pleuronectes flesus*).—Of 46 stomachs examined 33 were empty, and the contents of 2 were indistinguishable: 11 contained matter that could be identified. *Annelids* were found in 9, and consisted of (1) *Terebella* at Station II., in one in June; and at Station IV., in one in August: (2) *Arenicola*, at Station III., in one in March; and at Station IV., in one in June: (3) unidentified annelids, at Stations I. and II., in one in April; at Station IV., in one in November; and at Station V., in one in April. *Arthropods* (*Eupagurus*) were found at Station IV., in one in August. *Fish remains* were found at Station IV., in one in June and in one in March.

Turbot (*Rhombus maximus*).—Four specimens were examined: whitings were found in one, herrings in one, *Ophiura* in one. One was full of tape-worm.

Skate.—Of the thornback skate (*Raia clavata*), 19 specimens were examined, 6 were empty; eleven contained *Portunus holsatus*, and one contained a swimming-crab and unidentified annelids. Of the starry ray (*Raia radiata*) 4 specimens were examined; one was empty; two contained *Eupagurus*, and one contained sand-eels.

Angler Fish (*Lophius piscatorius*).—Only one was examined; it was empty.

Cod (*Gadus morrhua*).—Of 10 stomachs examined 2 were empty. *Annelids*, found in 3, consisted of *Aphrodite* in two, and *Arenicola* in one. *Arthropods*, found in 8, consisted of *Eupagurus* in four, *Corystes* in three, *Portunus* in three, and *Crangon* in one. *Fish*, found in 7, consisted of whitings in four, herrings in one and unidentified fish remains in two.

III. FIRTH OF FORTH.

Special Trawling in May.

In the month of May four hauls were made off the southern shore of the Firth, two being in South Bay, one in Aberlady Bay, and one from Gullane Point to Ibris. The following are the results:—

Plaice (*Pleuronectes platessa*).—Of 30 stomachs examined 4 were empty, and the contents of 1 were indistinguishable. *Echinoderms* (sand-stars) were found in one. *Annelids*, unidentified, were found in seventeen. *Molluscs* consisted of *Scrobicularia*, found in six; and *Solen*, found in five.

Lemon Soles (*Pleuronectes microcephalus*).—5 were examined and of these, 2 were empty. Unidentified *Annelids* were found in two, and *Nemertes* was found in one.

Common Dabs (*Pleuronectes limanda*).—Of 13 examined 5 were empty. *Echinoderms* (sand-stars) were found in two. *Nemertes* was found in one. *Arthropods* consisted of hermit-crabs in two and *Hyas* in one. *Molluscs* (unidentified gastropods) were found in one. Unidentified *fish remains* were found in one.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 2 examined 1 was empty. The remaining one contained *Arthropods* (*Crangon*).

Flounders (*Pleuronectes flesus*).—Of 5 examined 3 were empty. One contained *Echinoderms* (sand-stars), and one *fish remains* (herring).

Turbot (*Rhombus maximus*).—Of four examined 3 were empty: one contained *Annelids*.

Thornback Skate (*Raia clavata*).—Three were examined; all were empty.

Gurnards (*Trigla gurnardus*).—Of 12 examined 2 were empty. A planarian worm (sp. ?) was found in one. *Arthropods* consisted of *Crangon* in three, *Portunus* in three, unidentified hermit-crabs in one and *Pandalus* in one. *Fish* consisted of goby found in three, and unidentified fish remains in two.

Cod (*Gadus morrhua*) 5 were examined. *Annelids*, unidentified, were found in one. *Arthropods* consisted of *Portunus* (sp. *holsatus* and *corrugatus*) in four, hermit-crabs in two, *Hyas* in one and *Crangon* in one. *Molluscs* (*Buccinum*) were found in one. *Fish* (*Agonus cataphractus*) were found in one.

IV. FIRTH OF FORTH.

Experimental Trawling in October.

Two hauls were made between Listons Bank and May Island, and three between Inchkeith and May Island. The following are the results :—

Plaice (*Pleuronectes platessa*).—Of 28 stomachs examined 4 were empty, and the contents of 3 were indistinguishable. *Echinoderms* (*Ophiura*) were found in one. *Annelids* consisted of *Sabella*, found in eight, *Phyllodoce* in one and unidentified annelids in seven. *Arthropods* (*Eupagurus*) were found in one. *Molluscs* consisted of *Scrobicularia* found in seven, *Solen* in three, *Psammobia* (sp. *ferroensis*) in two, *Mactra* in one and *Nucula* in one.

Lemon Soles (*Pleuronectes microcephalus*).—Of 26 stomachs examined 6 were empty, and the contents of 3 were indistinguishable. *Echinoderms* (*Ophiothrix*) were found in one. *Annelids* consisted of *Sabella* in thirteen, and unidentified annelids in three. *Arthropods* (*Eupagurus*) were found in three. *Molluscs* (*Solen*) were found in two.

Common Dabs (*Pleuronectes limanda*).—Of 25 stomachs examined 11 were empty. *Echinoderms* consisted of *Ophiura* in two, and *Ophiothrix* in two. *Annelids* consisted of *Sabella*, found in seven and unidentified annelids in one. Arthropods (*Eupagurus*) were found in four.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 41 stomachs examined 28 were empty. *Echinoderms* (*Ophiura*) were found in one. *Arthropods* consisted of *Portunus* found in five, *Crangon* in five, *Pagurus* in one and *Pandalus* in one. *Fish* consisted of whitings in one and common dabs in one.

Witch Soles (*Pleuronectes cynoglossus*).—One examined contained unidentified annelids, unidentified amphipods and *Molluscs* (*Solen*).

Gurnards (*Trigla gurnardus*).—Of 12 stomachs examined 1 was empty, and the contents of 1 were indistinguishable. *Arthropods* consisted of *Crangon* found in six, *Portunus* in two, *Pandalus* in one, *Ampelisca* in one and unidentified schizopods in one. Unidentified *fish remains* were found in one.

Cod (*Gadus morrhua*).—Of 22 stomachs examined 1 was empty. Annelids (*Aphrodite*) were found in two. *Arthropods* consisted of *Crangon*, found in nine, *Pandalus* in eight, *Eupagurus* in four, *Portunus* in three, *Nephrops* in two and *Hyas* in one. *Molluscs* (*Pecten*) were found in one. *Fish* consisted of whitings found in two, long rough dabs in one and unidentified fish remains in three.

Haddocks (*Gadus æglefinus*).—Of 25 stomachs examined 5 were empty. *Echinoderms* consisted of *Ophiothrix* found in eight and *Amphiura* is one. *Annelids* consisted of *Sabella*, found in two, *Priapulus* in one and unidentified annelids in one. *Arthropods* consisted of *Crangon*, found in seven, *Ampelisca* in six, *Portunus* in three, *Eupagurus* in one, *Cuma* in one and unidentified amphipods in two. *Molluscs* consisted of *Scrobicularia*, found in eight, *Solen* in three, *Psammobia* in one, *Cardium* in one and unidentified gastropods in one.

Whitings (*Gadus merlangus*).—Of 27 stomachs examined 19 were empty, and the contents of 1 were indistinguishable. *Arthropods* (*Pandalus*) were found in one. *Fish*, consisting of herrings, sprats, and whitings, were found in fifteen.

Skate.—Of 4 starry rays (*R. radiata*) examined, 3 were empty and one contained *Arthropods* (*Hyas*). Two thornbacks (*R. clavata*) examined contained *Arthropods*: one contained *Pandalus*, *Crangon*, and *Nephrops*, the other, *Portunus* and *Crangon.*

Brassie (*Gadus luscus*).—14 were examined: all contained *Arthropods*. *Pandalus* was found in seven, *Crangon* in four, *Eupagurus* in two, *Portunus* in two and unidentified crustacea in two.

Ling (*Molva vulgaris*).—Of 3 stomachs examined 2 were empty. One contained *Arthropods* (*Pandalus*).

Lythe (*Gadus pollachius*).—The 2 examined contained unidentified *fish remains.*

Cat-fish (*Anarrhichas lupus*).—One was examined; it was empty.

Angler (*Lophius piscatorius*).—Of 3 examined 2 were empty. One contained *Arthropods* (*Eupagurus*).

V. ST ANDREWS BAY.

Special Trawling in May.

The following are the results of two hauls, one on the north side of the Bay, the other a little to the north of Station I.:—

Plaice (*Pleuronectes platessa*).—Of 15 stomachs examined 3 were empty. *Echinoderms* (sand-stars) were found in two. *Annelids* consisted of *Arenicola*, found in four, *Nereis* in one and unidentified annelids in four: an unidentified planarian worm was found in one. *Molluscs* consisted of *Solen*, found in six, *Venus* in one, and *Scrobicularia* in one.

Common Dabs (*Pleuronectes limanda*).—14 stomachs were examined, and all contained annelids, *Arenicola* being found in five, and unidentified annelids in nine. *Arthropods* (*Crangon*) were found in one and *Fish* (goby) also in one.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 4 stomachs examined 1 was empty. *Echinoderms* (sand-stars) were found in three and *Fish* (goby) in two.

Haddocks (*Gadus æglefinus*).—Six were examined. *Arthropods* (unidentified amphipods) were found in one and *Molluscs* (*Venus*) were found in all the six.

Whitings (*Gadus merlangus*).—Two were examined; one was empty; one contained unidentified *fish remains*.

Gurnards (*Trigla gurnardus*).—Of 7 stomachs examined 2 were empty, and the contents of 1 were indistinguishable. *Arthropods* consisted of *Portunus*, found in one, crabs in one and unidentified amphipods in one. *Fish* (whitings) were found in one.

VI. MONTROSE—*June.*

Two hauls were made here in June, one at Station I. (Lunan Bay), the at other Station II. (Montrose Bay).

Plaice (*Pleuronectes platessa*).—Of 14 stomachs examined 1 was empty. *Annelids* consisted of *Sabella*, found in five, *Nereis* in one and unidentified annelids in two. *Molluscs* consisted of *Nucula*, found in ten, and *Venus* in one.

Common Dabs (*Pleuronectes limanda*).—Of 9 stomachs examined 5 were empty. *Echinoderms* (*Ophiura albida*) were found in two. *Molluscs* were found in three—*Solen* in two and *Tellina* in one.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 9 stomachs examined 3 were empty. *Echinoderms* (*Ophiura*) were found in four, and unidentified *fish remains* in five.

Turbot (*Rhombus maximus*).—Five were examined; 4 were empty. One contained *fish remains*.

Gurnard (*Trigla gurnardus*).—Of 12 stomachs examined 3 were empty. *Arthropods* consisted of *Crangon*, found in two, *Portunus* in one, *Ampelisca* in one, and *Diastylis* in one. *Molluscs* (*Rossia*) were found in one. *Fish* consisted of whitings in one and unidedtified fish remains in five.

Haddock (*Gadus æglefinus*).—8 stomachs were examined. *Echinoderms* (*Ophiura*) were found in one. Annelids consisted of *Sabella*, found in four, *Nereis* in one, and *Arenicola* in one. *Arthropods* consisted of *Ampelisca*, found in one, and unidentified crustacea in one. Unidentified lamellibranchs were found in one.

Whitings (*Gadus merlangus*).—Three were examined; all were empty.

VII. ABERDEEN STATIONS—*June.*

Plaice (*Pleuronectes platessa*).—Of 44 stomachs examined 10 were empty, and the contents of 1 were indistinguishable. *Echinoderms* consisted of *Ophiura* in four and *Amphidotus* in one. *Annelids* consisted of *Nereis*, found in seven, *Arenicola* in one, *Terebella* in one, *Sabella* in one, *Phyllodoce* in one and unidentified annelids in two: *Lineus bilineatus* was found in one. *Molluscs* consisted of *Nucula* (sp. *nitida*), found in four, *Natica* (sp. *alderi*) in one, *Donax* (sp. *vittatus*) in one and *Mactra* in one. Anemones were found in two.

Lemon Soles (*Pleuronectes microcephalus*).—One was examined: it was empty.

Common Dabs (*Pleuronectes limanda*).—Of 25 stomachs examined 9 were empty, and the contents of 3 were indistinguishable. *Echinoderms*

(*Ophiura*) were found in three. *Annelids* consisted of *Terebella*, found in two, *Phyllodoce* in one, *Nereis* in one, and unidentified annelids in three. *Arthropods* consisted of *Portunus*, found in two, *Mysis* in one, *Idotea* (sp. *emarginata*) in one, larval decapods in two and unidentified amphipods in two. *Molluscs* consisted of *Montacuta*, found in one, unidentified gastropods in two and unidentified lamellibranchs in one.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 6 stomachs examined 4 were empty. The two others contained *Echinoderms* (*Ophiura*), *Arthropods* (*Mysis*) and unidentified *fish remains.*

Turbot (*Rhombus maximus*).—Of 4 stomachs examined 2 were empty. The other two contained *Fish* (sand-eels and common dabs).

Thornback Skate (R. *clavata*).—One was examined; it was empty.

Gurnard (*Trigla gurnardus*).—Of 34 stomachs examined 5 were empty *Arthropods* consisted of *Mysis*, found in twelve, *Portunus* in nine, *Pandalus* in two, *Crangon* in two and unidentified schizopods in five. *Molluscs* (cephalopods) were found in two. *Fish* consisted of plaice, found in one, goby in one and unidentified fish remains in one.

Cod (*Gadus morrhua*).—One was examined: it contained *Arthropods* (*Eupagurus*) and *Fish* (dabs).

Haddock (*Gadus æglefinus*).—Of 20 stomachs examined 1 was empty and the contents of 5 were indistinguishable. *Echinoderms* (*Ophiura*) were found in six. Annelids consisted of *Sabella*, found in one, *Arenicola* in one and unidentified annelids in two: *Nemertes* was found in one. *Arthropods* consisted of *Ampelisca*, found in three, *Diastylis* in two *Portunus* in one and unidentified decapods in one. *Molluscs* (unidentified lamellibranchs) were found in one.

Whiting (*Gadus merlangus*).—Of 15 stomachs examined 8 were empty. *Arthropods* consisted of *Mysis*, found in one, *Crangon* in one, *Portunus* in one and unidentified schizopods in three. *Molluscs* (*Rossia*) were found in one. *Fish* (sand-eels) were found in one.

VIII. MORAY FIRTH STATIONS—*June and July.*

Plaice (*Pleuronectes platessa*).—Of 67 stomachs examined 22 were empty, and the contents of 1 were indistinguishable. *Echinoderms* consisted of *Amphiura*, found in four, *Amphidotus* (sp. *cordatus*) in two, and *Ophiura* in two. *Annelids* consisted of *Sabella*, found in eight, *Flemingia* in four, *Priapulus* in two, *Sipunculus* in one, *Nereis* in one, *Polynöe* in one and unidentified annelids in two. *Arthropods* consisted of *Eupagurus*, found in two and *Hyas* in one. *Molluscs* consisted of *Solen*, found in eleven, *Venus* (sp. *galina*) in three, *Mactra* in two, *Natica* (sp. *catena*) in two, *Leda* in two, *Tapes* in two and *Chiton* in one.

Lemon Soles (*Pleuronectes microcephalus*).—Of 17 stomachs examined 4 were empty, and the contents of 1 were indistinguishable. Annelids consisted of *Sabella*, found in seven, *Flemingia* in six and *Oethone* in one. *Molluscs* (*Chiton*) were found in one.

Common Dabs (*Pleuronectes limanda*).—Of 61 stomachs examined 41 were empty, and the contents of 4 were indistinguishable. *Echinoderms* consisted of *Amphiura*, found in fourteen, *Ophiura* in one and unidentified star-fish in one. Annelids consisted of *Sipunculus*, found in two and *Sabella* in one. *Arthropods* (*Eupagurus*) were found in one. *Molluscs* consisted of *Solen*, found in two, *Mytilus* in one, unidentified lamellibranchs in three and unidentified gastropods in one. *Zoophytes* were found in one.

Gurnards (*Trigla gurnardus*).—Of 40 stomachs examined 19 were empty, and the contents of 1 were indistinguishable. *Arthropods* consisted of *Portunus*, found in eight, *Ampelisca* in three and *Crangon* (sp. *vulgaris*) in two. Unidentified *Molluscs* were found in one. *Fish* consisted of dabs, found in two and unidentified fish remains in eight.

Cod (*Gadus morrhua*).—Of 6 stomachs examined 2 were empty. *Arthoprods* consisted of *Eupagurus*, found in three, *Ampelisca* in one, *Crangon* in one, *Portunus* in one and *Pandalus* in one.

Young Cod.—The stomachs of 33 young cod, ranging from 2 to 3 inches in length, were examined: only one was empty. Unidentified copepods were found in thirteen, unidentified amphipods in ten: *Caprella* in eight, *Pseudocalanus* in eight, *Atylus* in six, *Thalestris* in six, *Westwoodia nobilis* in five, *Evadne* in three, *Balanus* (ostracod stage) in two, *Dias* in two, *Amphilochus* in two, *Eupagurus* in one, *Portunus* in one, *Calanus* in one, *Longipedia* in one, *Centropages* in one, *Monoculoides* in one, *Gammaropsis* in one, *Idya* in one and *Paradoxostoma* in one. Embryo *Gastropods* were found in one. Larval *Ascidians* were found in three. *Fish remains* were found in two.

Haddocks (*Gadus æglefinus*).—Of 33 stomachs examined 7 were empty. *Echinoderms* consisted of *Amphiura*, found in twelve, *Ophiura* (sp. *texturata*) in three, *Amphidotus* in one and *Echinocyamus* in one. *Annelids* consisted of *Sabella*, found in two, *Sipunculus* in one, *Terebella* in one and unidentified annelids in one. *Arthropods* consisted of *Portunus*, found in there, *Eupagurus* in two and unidentified amphipods in one. *Molluscs* consisted of *Montacuta*, found in three, *Scrobicularia* in three, *Solen* in two and unidentified lamellibranchs in eight. *Ascidians* were found in one.

Coal-fish (*Gadus virens*).—Five young coal-fish, ranging in length from $1\frac{3}{4}$ to $4\frac{1}{2}$ inches, were examined. None of the stomachs were empty. *Atylus* was found in one, *Westwoodia* in one, *Pseudocalanus* in one, *Balanus* (ostracod stage) in one, unidentified copepods in one, unidentified amphipods in one and unidentified crustacean remains in one. Larval *Ascidians* were found in one. In the stomach of one specimen $2\frac{5}{8}$ inches in length nine small *round fish* were found.

IX. MORAY FIRTH—*July*.

The fish examined were caught in deep water off Cullen, and from 14 to 15 miles off Lossiemouth.

Common Dabs (*Pleuronectes limanda*).—Four were examined: they were all empty.

Long Rough Dabs (*Hippoglossoides limandoides*).—Of 67 stomachs examined 28 were empty. *Echinoderms*, all *Amphiura filiformis*, were found in twenty-eight. *Annelids* consisted of *Polynöe*, found in one, *Sipunculus* in one and unidentified annelids in three. *Arthropods* consisted of *Boreophausia*, found in three, *Crangon* in one, *Portunus* in one and *Mysis* in one. *Molluscs* consisted of *Scrobicularia*, found in one, and *Nucula* (sp. *tenuis*) in one. *Fish* (*Lumpenus*) were found in one.

Witch Soles (*Pleuronectes cynoglossus*).—Two were examined; one was empty. The other contained unidentified annelids and *Arthropods* (*Cuma*).

Sail-fluke (*Arnoglossus megastoma*).—One was examined: it contained unidentified *fish remains*.

Gurnards (*Trigla gurnardus*).—One was examined: it contained *Arthropods* (*Portunus*).

Haddocks (*Gadus æglefinus*).—Of 18 stomachs examined 2 contained indistinguishable matter. *Echinoderms* (*Amphiura*) were found in five.

Annelids consisted of *Polynöe*, found in two and unidentified annelids in three. *Arthropods* consisted of *Ampelisca*, found in three and *Portunus* in one. *Molluscs* consisted of *Scrobicularia*, found in seven, *Montacuta* in two and *Natica* (sp. *alderi*) in one. *Ova* were found in one.

Whitings (*Gadus merlangus*).—Of 62 stomachs examined 19 were empty, and the contents of 6 were indistinguishable. *Echinoderms* (*Echinocardium*) were found in one. *Annelids* consisted of *Sabella*, found in two and unidentified annelids in one. *Arthropods* consisted of *Boreophausia*, found in fifteen, *Crangon* in one, unidentified schizopods in fourteen and unidentified amphipods in one. *Fish* consisted of *Lumpenus*, found in one and unidentified fish remains in five. *Ova* were found in one. *Hydrozoa* (*Tubularia*) were found in one.

Hag-fish (*Myxine glutinosa*).—15 were examined : they were all empty.

Lumpenus lampetriformis.—2 were examined : one was empty. The other contained unidentified annelids.

Three-bearded Rockling (*Motella tricirrata*).—2 were examined : they contained *Arthropods* (*Ampelisca*, and unidentified amphipods and schizopods).

X. SMITH BANK—*July*.

Plaice (*Pleuronectes platessa*).—Of 8 stomachs examined 3 were empty. *Echinoderms* (*Amphiura filiformis*) were found in two. *Annelids* consisted of *Nereis*, found in one and unidentified annelids in one. *Molluscs* consisted of *Solen*, found in one, *Mactra* in one, *Thracia* in one and unidentified lamellibranchs in one.

Lemon Soles (*Pleuronectes microcephalus*).—Of 10 stomachs examined 3 were empty, and the contents of 2 were indistinguishable. *Annelids* consisted of *Sabella*, found in four and unidentified annelids in one : *Lineus* (sp. *bilineatus*) was found in one.

Common Dabs (*Pleuronectes limanda*.—Of 44 stomachs examined 33 were empty, and the contents of 2 were indistinguishable. *Echinoderms* (*Echinocyamus*) were found in found one. *Annelids* consisted of *Sabella*, found in one and *Sipunculus* in one. *Arthropods* consisted of *Eupagurus*, found in four, unidentified schizopods in one and larval crustacea in one. *Molluscs* (*Mactra*) were found in one and *Solen* in one.

Long Rough Dabs (*Hippoglossoides limandoides*).—One was examined : it was empty.

Turbot (*Rhombus maximus*).—One was examined ; it was empty.

Thornback Skate (*R. clavata*). — Of 4 stomachs examined 3 were empty. The remaining one contained *Molluscs* (unidentified gastropods).

Little Soles (*Solea lutea*).—All the stomachs examined, 35 in number, were either empty or contained only a little mucus.

Gurnards (*Trigla gurnardus*).—Of 35 stomachs examined 5 were empty. *Arthropods* consisted of *Crangon*, found in seven, *Portunus* in six, *Mysis* (sp. *ornatus*) in three, *Ampelisca* in one, *Pandalus* (sp. *annulicornis*) in one, unidentified schizopods in four and amphipods in one. *Fish* consisted of dabs, found in one, gobies in one, sand-eels in one and unidentified fish remains in eight.

Cod (*Gadus morrhua*).—2 examined contained *Arthropods* (*Eupagurus bernhardus*).

Haddocks (*Gadus æglefinus*).—Of 25 stomachs examined 2 were empty, and the contents of 7 were indistinguishable. *Echinoderms* consisted of *Amphiura*, found in nine, *Echinocyamus* in one and *Ophioglypha* (sp. *albida*) in one. Unidentified *Annelids* were found in one. *Arthropods* consisted of *Portunus*, found in one and *Eupagurus* in one. *Molluscs* (*Mactra subtruncata*) were found in five.

Whitings (*Gadus merlangus*). — Of 10 stomachs examined, 8 were empty. *Arthropods* (fragments of amphipods) were found in one and *Molluscs* (unidentified cephalopods) in one.

Angler (*Lophius piscatorius*).—Of 4 stomachs examined 2 were empty. The other two contained unidentified *fish remains.*

Dragonet (*Callionymus lyra*).—One was examined; it was empty.

XI. THE ORKNEYS—*July.*

Plaice (*Pleuronectes platessa*).—Of 24 stomachs examined 4 were empty, and the contents of 1 were indistinguishable. *Annelids* consisted of *Sabella*, found in three, and *Nereis* in three. *Arthropods* (*Eupagurus*) were found in two. *Molluscs* consisted of *Mactra* (sp. *subtruncata* and *solida*), found in five, *Solen* (sp. *pellucida*) in three, *Venus* (sp. *galina, ovata* and *exoleta*) in three, *Tellina* (sp. *pusilla*) in two, *Cyprina* in one and unidentified lamellibranchs in one. *Fish* (sand-eels) were found in five.

Lemon Soles (*Pleuronectes microcephalus.*—Of 26 stomachs examined 9 were empty, and the contents of 4 were indistinguishable. *Echinoderms* consisted of *Ophiura*, found in one and a holothurian in one. Unidentified *Annelids* were found in six and *Sipunculus* was found in one. *Arthropods* consisted of *Hyas* (sp. *coarctus*), found in one and *Eupagurus* in one. *Molluscs* consisted of *Eolis*, found in two, *Montacuta* (sp. *ferruginosa*) in one, unidentified gastropods in three and unidentified lamellibranchs in two.

Common Dabs (*Pleuronectes limanda*).—Of 45 stomachs examined 24 were empty, and the contents of 4 were indistinguishable. *Echinoderms* (*Ophiuroids*), were found in one. Unidentified *Annelids* were found in two. *Arthropods* (*Eupagurus*) were found in two. *Molluscs* consisted of *Scrobicularia* (sp. *prismatica*), found in one and unidentified lamellibranchs in four. *Fish remains* (a piece of liver) were found in one, and a piece of *dulce* was found in another.

Long Rough Dabs (*Hippoglossoides limandoides*).—One was examined; it was empty.

Thornback Skate (*R. clavata*).—One was examined; it contained *Fish* (sand-eels).

Sail-fluke (*Arnoglossus megastoma*).—Two were examined; one was empty. The other contained unidentified *fish remains.*

Gurnards (*Trigla gurnardus*).—Of 19 stomachs examined 2 were empty, and the contents of 1 were indistinguishable. *Arthropods* consisted of *Crangon*, found in seven, *Portunus* in four and unidentified amphipods in one, schizopods in one and crustacea in one. *Fish* consisted of cod, found in one, butter-fish in one and unidentified remains in five. A piece of seaweed was found in one.

Cod (*Gadus morrhua*).—6 were examined. *Arthropods* consisted of *Portunus*, found in two, *Eupagurus* in two, *Hyas* in one and *Crangon* in one. *Molluscs* (*Fusus*) were found in one. *Ascidians* were found in one. *Fish* consisted of sand-eels, found in one herrings in one and unidentified fish remains in one.

Haddocks (*Gadus æglefinus*).—Of 13 stomachs examined 1 was empty, and the contents of 3 were indistinguishable. *Echinoderms* consisted of *Amphiura*, found in three and *Ophiura* in two. *Annelids* (*Sipunculus*) were found in one. *Arthropods* consisted of *Ampelisca*, found in one and *Kröyeria* in one. *Molluscs* consisted of *Scrobicularia*, found in three, *Tellina* (sp. *pusilla*) in one, *Psammobia* (sp. *ferroensis*) in one and unidentified lamellibranchs in one. *Ascidians* were found in one.

II.—THE SPAWNING AND SPAWNING PLACES OF MARINE FOOD-FISHES. By Dr T. Wemyss Fulton, Secretary for Scientific Investigations.

I. INTRODUCTORY.

One of the main objects of scientific fishery research is to determine with accuracy the phenonema connected with the reproduction of the marine food-fishes, and the location of their spawning grounds. Erroneous views have been widely held as to the periods when and places where they spawn. For the past two years I have endeavoured to obtain all possible data referring to the spawning of sea-fishes. Since June 1888, the condition of the reproductive organs of many thousands of food-fishes has been ascertained at various parts of the coast during every month of the year, and the localities where ripe specimens were caught determined.*

1. The Time and Duration of Spawning.

The spawning time of most sea-fishes is in spring and early summer; from February to June. Both the time of its occurrence and its relative duration vary in different species, and to some extent with the same species from year to year. The duration in any given species is caused partly by the spawning process in individual fishes being prolonged; but chiefly by the successive maturation of groups or shoals of fish. A very common characteristic is the presence of ripe males both before and after the appearance of ripe females. Among flat-fishes, one of the earliest to spawn is the plaice. Plaice begin to spawn usually about the end of January, and continue spawning throughout February and a part of March. The long rough dab spawns from the end of January to April, but chiefly in March. The flounder begins to spawn in February and continues spawning till June. The common dab may spawn for a considerable period—from the end of February to July, but mainly in April, May, and June. The spawning of the lemon sole occurs in May, June and July, but ripe individuals may occasionally be obtained in other months. The witch sole spawns in May, June, July, and August; turbot in May, June, and July; and brill apparently earlier, in April and May. The black or English sole spawns in the neighbourhood of St Andrews Bay in April, May, and June. Among round-fishes, the cod spawns from the end of February to the end of May; but chiefly in March and April. The spawning of the haddock begins about the end of January and continues till the end of April or beginning of May. The great spawning period of this fish may be said to extend from the middle of March to the middle of April. The whiting spawns somewhat later than the haddock—from March to June, but chiefly in April. The spawning period of the gurnard is prolonged; it extends from March to July, but ripe individuals have

* The examination of the fish, in accordance with the scheme devised, has been almost entirely made by Mr Thomas Scott, F.L.S., on board the 'Garland'; partly also on board the steam trawler 'Southesk,' which, on several occasions, through the courtesy of the owners Messrs Johnston & Sons, Montrose, Mr Scott has been allowed to accompany. Mr Peter Jamieson also examined a number of fish landed by fishermen. My thanks are also due to many of the fishery officers along the East Coast, especially, perhaps, to Mr Murray, Newhaven, Mr Miller, Montrose, Mr Mair, Anstruther, and Mr Bain, Stonehaven, for keeping the records.

been got as early as January and as late as August. It spawns chiefly in June.

2. Spawning Places.

It is well known that many sea-fish resort year after year to the same grounds for spawning purposes. In the case of the herring, which deposits its eggs on the bottom, the spawning grounds are generally within or close to the territorial waters. The spawning places of nearly all sea-fishes whose eggs are pelagic, lie, however, at distances more or less remote from shore, and beyond the territorial waters. In the case of some small flat-fish, such as the common dab, the flounder, and to a less extent, the long rough dab, spawning goes on as well within as without the territorial waters; these fish appear to spawn almost wherever they happen to be, and the adults are present in relatively large numbers near the shore. Among round-fishes, the gurnard also spawns to some extent within the territorial limit, but to a greater extent beyond it. None of these fishes appear to congregate in well-defined shoals. The gurnard is rare near the shores in winter. They begin to approach the coast, apparently to spawn, in March and April, and leave in October and November. With the above exceptions, all the food-fishes spawn offshore; notably those which congregate in great shoals at the spawning time, such as cod, haddock, whiting, plaice, mackerel, &c. Why should great shoals of cod, haddock, whiting and plaice, congregate at distances of from about eight or ten to twenty miles from shore, on the East Coast, for the purpose of propagation? There is evidence that shortly before the spawning period, large, fully adult and nearly ripe individuals are found within two or three miles from shore; that no fully ripe specimens are got near shore during the time of spawning; and that after the spawning is over large spent fish are caught in the territorial waters. The nature of the bottom does not seem to have much influence; as a rule it is sandy or hard, but such bottoms are as common inshore as offshore. I think the selection of offshore sites for spawning may be explained by the following considerations:—(1) The conditions which regulate the choice of the spawning place have reference specially to the welfare of the progeny; (2) the grounds close inshore afford the maximum of food, shelter and warmth for the rearing of the newly hatched young; and in these areas very young fishes abound; (3) the eggs are pelagic and are hatched at or near the surface, generally within a week or two after fertilisation, during which time the great majority are carried by the prevailing surface currents towards the shore, so that the larval fishes find themselves in the best conditions for their security and growth. The pelagic ova of cod, haddock, whiting, plaice, &c. have been obtained in large numbers close inshore, where no spawning fish occur, and many of these have hatched out within a day or two after they were taken. If these fish whose ova float were to spawn, like the herring, close to the shore, a large proportion of the eggs would be stranded on the beach, or carried into turbid or brackish water, and destroyed. I believe it will be found that the selection of spawning grounds is determined chiefly by the physical conditions, in relation to the transport of the developing ova to the places where the young are reared. A considerable proportion of the pelagic ova spawned at the offshore grounds are no doubt carried seawards by the surface currents produced by winds blowing offshore, and the larval fishes in many cases find themselves in conditions less suitable for their growth and safety. This is probably one of the main reasons for the much greater fertility of the fish which produce pelagic eggs than those whose eggs are demersal. In the latter case the eggs are fixed and the young are hatched in the most suitable conditions. There is reason to believe that in some cases (*e.g.* plaice), the spawning process may be delayed until the set of the currents is suitable for the transport of the fertilised ova shorewards. We know most perhaps about the spawning and spawning grounds of the plaice. In January and February great shoals of very large ripe fish, the males averaging about sixteen or seventeen inches in length and the females about twenty-four inches, congregate on grounds at distances from about eight or ten to twenty miles from the East Coast. In the neighbourhood of the Forth and St Andrews Bay these shoals are mainly found above eight or ten miles off; off Montrose they may occur up to twenty-five miles. A great spawning ground is Smith Bank in the Moray Firth. This bank lies in from 18 to 20 fathoms of water, sixteen miles from the west side of the Moray Firth, and about thirty miles from the south shore. The bottom is hard, and the invertebrate fauna not abundant. Comparatively few fishes are obtained on this ground except at spawning time; and very few young fishes. It is therefore a typical spawning ground, to only a slight extent a feeding ground, and in no sense a nursery. Successive shoals of plaice, cod, and haddock frequent it for spawning purposes. Ripe plaice congregate on Smith Bank in large numbers in January or the beginning of February. They come to some extent from the inshore waters; but mainly from offshore. It is not possible to state from what distance offshore they may come, but some of them probably travel considerable distances, for large spent fish were obtained at the end of May at the 'Garland' Stations at the mouth of the Dornoch Firth, nearly thirty miles from Smith Bank, which had probably come from that ground or its vicinity. The plaice continue spawning during February and part of March, and then disperse. The fertilised ova are obtained in great numbers over the spawning shoals and in the waters between Smith Bank and the shore, towards which they are gradually drifted. Scarcely a single immature plaice, and none of small size, was obtained by the 'Garland' in its many trawlings over this bank and its neighbourhood; while abundance of immature individuals are obtained inshore, and the smaller the nearer to the beach. As they increase in size they gradually migrate to deeper water. During the time when plaice are spawning at Smith Bank the general direction of the wind and therefore of the surface currents is north and east and will tend to carry the floating and developing ova shorewards. Similarly, in spring the winds on the East Coast of Scotland are generally easterly; and hence the ova thrown from spawning shoals ten or fifteen miles off are gradually carried during their development towards the shore. There is little evidence as to the phenomena of the spawning of fish on the West Coast; but many of them spawn much nearer shore than on the East Coast.

Among most or all fishes which frequent the territorial zone, but go offshore to spawn, many fully adult, but not ripe individuals remain in the territorial waters throughout the spawning time. This is the case with haddock, cod, whiting, plaice, &c. Some of those in this condition, at the beginning of the spawning season, no doubt ripen and spawn before the season closes; but large numbers certainly do not. Another point of interest is the mixture of mature and ill-developed adults, which sometimes occurs on the same ground. For instance, among long rough dabs, in one haul of the net individuals of all sizes from six to twelve inches may be found with the reproductive organs fully developed and ripe, or scarcely developed at all. It is possible that in such cases the adults do not spawn every year.

A summary of the chief results obtained is given below.

II. FLAT FISH.

Plaice (*Pleuronectes platessa*).—The number of plaice examined, from May 1889 to May 1890, was 1613. Close upon 500 were from the Firth of Forth; about 370 from St Andrews Bay, and the remainder from the Stations at Montrose, Aberdeen, and the Moray Firth, and from Smith Bank and other offshore grounds. Fishery officers examined 145.

Territorial Waters.—In the Firth of Forth none were found ripe. In October and November, 1889, two males and four females were found nearly ripe at the stations at the mouth of the Firth of Forth. They were all large fish, 18 to 24 inches long. At St Andrews Bay in August a large female 26 inches long was spent. The observations made from February to May are of interest. In February, males and females up to $17\frac{1}{2}$ inches long were quite immature at the inner stations in the Forth. On 21st February a female 27 inches long was taken at Station VI. in a spent condition; some, 16 and 17 inches long, were nearly mature. In March, at all the stations in the Forth and St Andrews Bay, all the fish examined were immature. At the inner stations in the Forth some of these were 16 and 17 inches long. In St Andrews Bay, a female was caught at Station I., 24 inches long and immature. In the end of April, all were immature up to $17\frac{1}{2}$ inches at the Forth Stations; two spent females, 20 inches and 23 inches long, were taken on the 25th at Station VI. In May (12th to 16th), all were immature; but at Station VI. some very large females were found to be spent, their lengths being from 19 to 23 inches. In St Andrews Bay, on May 1st and 2nd, all were immature; at Station I., a female, 25 inches long, was spent. The same conditions were found at the Moray Firth Stations, and at Montrose and Aberdeen in May. At Montrose all were immature (up to 16 inches), except one male on May 19th, 21 inches long, which was nearly mature. At Aberdeen all were immature, up to 18 inches in length, except one male at 16 inches, which was nearly mature. At the stations in the territorial waters in the Moray Firth, all were immature at the end of May (26th to 29th); but there were considerable numbers of large spent fish. Of 51 females, of all sizes examined, 15 were spent. All those above 20 inches were spent; none below 20 inches were spent. These fish had no doubt spawned offshore, probably at Smith Bank in March, and had then retreated to the territorial waters.

Offshore Grounds.—The fishery officers examined above 200 plaice, landed along the East Coast from July to the end of December; but none were ripe. In January, 55, examined at Aberdeen, had the 'roe 'forming.'

At Smith Bank, on February 5th, 1890, a considerable number were examined by Mr Scott, but only a few were nearly mature; one male was mature. In February, of six plaice from Smith Bank, examined at Montrose, three females and two males were mature: of 70 caught in the Moray Firth, and examined at Aberdeen, ten females were spawning, and others were spent: of 15 from Smith Bank, examined at Burghead, three males and five females were mature. On February 23rd large numbers of full-sized plaice were caught at Smith Bank; none appeared to be actually spawning, but they were just about fully ripe. On May 24th, Mr Scott found males up to 15 inches and females up to 19 inches immature; one female, 21 inches long was spent. On February 6th, a large number of full-sized plaice were taken from 22–25 miles S.E. of Montrose; they were all nearly ripe but none fully mature. In March, of 30 from the Moray Firth, examined at Aberdeen, five males and fourteen females were ripe. In March, of 14 caught '60 miles off Fraserburgh (? Smith Bank) four females were mature. In April, of 30 caught from 10 to 20 miles east of May Island, two females and five males were ripe. In May 40 were immature.

Thus it appears :—(1) That plaice do not spawn in territorial waters on the East Coast of Scotland, but at grounds lying offshore as far as 20 or 25 miles; they probably also spawn at greater distances and somewhat nearer the shore,—especially off the mouth of the Firth of Forth. The floating ova of plaice were found by the 'Garland,' at Smith Bank on February 4th and 5th; 22–25 miles S.E. of Montrose on February 6th and 7th; at the outer stations of St Andrews Bay on March 26th; at the mouth of the Firth of Forth on February 22nd and March 18th, and East of Inchkeith on March 21st; larval forms, which Professor M'Intosh considers may be those of plaice, were found at Station III. (near shore) St Andrews Bay, on May 2nd, and East of Inchkeith, in the Firth of Forth, on March 21st, (2) That they spawn chiefly during January, February, and March; but that the time may vary in different years. At Smith Bank, the congregation of spawning plaice was much later in 1890 than in 1889, (3) That the larger adult plaice in the territorial waters migrate at the approach of the spawning time to offshore grounds, and return to the territorial waters on the completion of spawning.

Lemon Sole (*Pleuronectes microcephalus.*—The number of lemon soles examined was 722. The majority were obtained from the Firth of Forth; but a large number were from the Moray Forth, and other parts of the East Coast.

Territorial Waters.—Of 50 examined in the Firth of Forth in June, one female was ripe at Station V., and two females and one male nearly ripe. Of 41 in July 1889, 8 were nearly ripe. In August, of 49 specimens examined, one was nearly ripe. In October of 25 specimens, one was nearly ripe. None were found nearly ripe until March 14th, when two males were in that condition. In April, of 32 examined, one male was ripe; 7 were nearly ripe; and 5 females were also nearly ripe. In May, of 39, one male was ripe near May Island, and one male and three females were nearly ripe. In St Andrews Bay lemon soles are rare. All those examined in June, August, October, March, and May were immature. In the Moray Firth, at the end of May, one male was nearly mature and another ripe. No ripe females were obtained, but several were nearly mature. Of sixteen examined at the end of June, two females were mature, and one nearly ripe. On July 9th, another ripe female was obtained. At Aberdeen, on May 20th, a ripe male was got; two females were nearly mature.

Offshore Grounds.—In July—when there were no mature specimens among the 41 from the Firth proper—ripe specimens were obtained offshore. At Station VIII. the only specimen caught, a female 14 inches long, was fully ripe; at Station IX., which lies from 5 to 10 miles east of May Island, of four specimens examined in July all were ripe. The largest mature female was $16\frac{1}{2}$ inches long, and the smallest 14 inches; the largest ripe male was $10\frac{1}{6}$ inches and the smallest $8\frac{1}{2}$ inches. Of 30 caught from July 1st to 31st, 20 to 30 miles S.E. of Montrose, eleven were ripe. In August, most, and in September all were spent; on August 23rd, one male, caught 25 miles off, was ripe. At the end of August one female was found to be nearly mature at Station VIII. and one at Station IX. in November. At Station VIII. one male was ripe in April; and a female and a male nearly ripe in May. At Liston Bank, 22 miles from

May Island, three females out of 16 fish examined, were ripe on October 15th. At Smith Bank, on May 24th, of four males from 15 to 16 inches, three were ripe, the fourth, 7½ inches long, was nearly half ripe; of four females examined, one, eighteen inches long, was ripe; and three from 15½ to 17 inches were nearly ripe.

The 'Garland' obtained pelagic ova apparently belonging to this fish, at Station II. (in Largo Bay), Firth of Forth, on May 7th in the surface-net; and what Professor M'Intosh believes to be the larval stage of the lemon sole was obtained on the same day just beyond the mouth of the Firth of Forth.

It appears therefore that while the lemon sole may spawn to a slight extent on the margin of the territorial waters, it spawns mainly offshore, as at Smith Bank, during May, June, and July, but mainly in June.

Common Dabs (*Pleuronectes limanda*).—The number of specimens examined was 1124; about a third from the Firth of Forth.

Territorial Waters.—In May, of 16 specimens examined, five females and one male were ripe, and two males nearly ripe at the mouth of the Firth of Forth; in June, of 35 specimens examined, two males (the largest 9 inches and the smallest 7½ inches) and one female, 7½ inches, were ripe, and ten males nearly ripe. In July, of 46 specimens, one male was ripe and six nearly ripe. In August, of 32 specimens, four males were nearly ripe. In October, two males, out of 37 specimens, were nearly mature. In November, of 34 specimens, five males and one female were nearly ripe. In February, of eight specimens, one male was nearly ripe. In March, of 40 specimens, two males and two females were mature, and six males and eight females were nearly ripe. In April, of 27 specimens, three females and six males were ripe, and one female and two males nearly ripe. In May 1890, of 35 specimens examined, six females (8½–11 inches) and one male were fully ripe, and seven females and five males nearly mature. In St Andrews Bay, in June, of 40 specimens, one male and one female were ripe, and three males and four females nearly ripe. There were none ripe in August (42 specimens), October (46 specimens), or November (38 specimens). In March, of 30 specimens, five females and one male were ripe. In May, of 36 specimens, two females and five males were fully mature, and three females nearly mature. At the Aberdeen stations, one female, out of 28 specimens, was ripe in May 1889; none were ripe in May 1890. Thirty-nine specimens in September were all more or less immature. At the stations in the Moray Firth, of 49 specimens examined in May, 1890, nine females and five males were mature. In June 1889, of 37 specimens, six females and five males were ripe. In July, of 38 specimens, three males, but no females, were mature.

Offshore Grounds.—At Stations VIII. and IX., at the mouth of the Firth of Forth, of nine specimens, two females and one male were ripe in May 1889. In June 1889, of thirteen specimens, nine males and four females were nearly ripe. In May 1890, of 43, none were ripe, and only one male nearly ripe. In July 1889, four males, of 8 examined, were mature. In August, one female, out of eleven, was ripe. In October and November none were mature. In February, of 8 specimens, one male was ripe, and one male and two females nearly ripe. In March one male was mature and three females nearly mature, of the specimens examined. In October at Liston Bank, of twenty-three specimens, none were mature, but several females seemed to be spent. At Smith Bank, in June and July, 1889, of 44 specimens, thirteen females were found mature; and thirteen females and two males nearly ripe. On February 5th, none of thirteen specimens were mature or nearly mature. At the end of May 1890, of 17 females, six were ripe ($5\frac{1}{2}$ to 8 inches) and a number nearly ripe. On February 7th, none of twelve, obtained from 20 to 25 miles S. E. of Montrose, were mature; but seven were nearly ripe. Ripe males and females were therefore obtained in the territorial waters in March, April, May, and June; and ripe males in July; and ripe individuals of both sexes in the offshore waters in May and August; ripe males alone in February and March; and ripe females alone in June and July.

The common dab, therefore, spawns both offshore and in territorial waters, but chiefly in the latter. It seems to spawn almost anywhere; and the spawning time extends from March to June or July; probably chiefly in May.

The pelagic ova of the common dab were obtained by the 'Garland' at the following places:—St Andrews Bay; at Stations IV. and V. on March 26th; at Station I. on 28th March. In the Firth of Forth, near May Island, on February 22nd; Station VIII., 18th March; and East of Inchkeith, 21st March (abundant).

Witch Sole (*Pleuronectes cynoglossus*).—I have collected and compared all the data relating to the specimens of this species since June, 1888 In all, 223 specimens were examined, 69 males and 154 females. The ripe specimens were eleven in number; one male and ten females; there were also eleven females spent. Those nearly mature numbered 43; 18 males and 25 females. Ten of the fully ripe specimens were obtained offshore; the nine females at the Forth Stations VIII. & IX., three in May and six towards the end of July. The single ripe male was got near Liston Bank, about 15 miles off, in October. Of the eleven spent females, two were got at Station VIII., in August, two at the same station in November; and the rest near this station, also in August and November. The nearly ripe specimens were also mostly caught at Stations VIII. or IX; two were obtained in July in the Moray Firth, in 53 fathoms, about twelve miles off; others were got near the mouth of the Firth of Forth. The nearly mature individuals were obtained in March, April, May, and especially in June. The witch sole is uncommon in the territorial waters. It spawns offshore, and not in the territorial waters. The spawning time appears to be May, June, July, and perhaps August. The ova do not yet seem to have been obtained in the 'Garland's' tow-nets.

Flounder (*Pleuronectes flesus*).—I have also studied the data as to the spawning of the flounder which have been collected since June 1888. It is one of the very few sea-fishes in which the males are more numerous than the females. The number of specimens examined was 217; 122 males and 95 females. They were obtained chiefly in the Firth of Forth and St Andrews Bay. A very large proportion were ripe; viz., 76—41 males and 35 females, and nine were spent. Mature individuals were got at all the stations in St Andrews Bay. They were 57 in number, 25 males and 32 females; and were obtained from March 19th to May 2nd. In March and April, fifteen ripe females and thirteen ripe males were caught, in May nineteen ripe males and ten ripe females. In the Firth of Forth ripe males and females were obtained in February, two on 13th March, April and May, and one ripe female was got in June. In the Forth ripe individuals were obtained at stations I., II., III., IV., VII., and VIII.; most of them at the stations pretty well up the estuary.

The spawning of the flounder is of interest from the proportionally large number of ripe specimens caught, and some details may be given. In St Andrews Bay, for instance, on the 26th and 27th of March, 1890, males of from 8 to $10\frac{1}{2}$ inches were ripe, and there were twelve ripe males to two ripe females; the females were $10\frac{1}{2}$ and 14 inches long. In May there were nineteen ripe males and ten ripe females. The males ranged from 7 to 10 inches, and the females from $8\frac{1}{2}$ to 16 inches. As is usual, a number of individuals of much larger size than the smaller ripe specimens were quite immature, *e.g.*, males $8\frac{1}{2}$, 9 and 12 inches. Four females, from 9 to 14 inches, were spent. The 'Garland's' tow-nets obtained ova which Professor M'Intosh thinks belong to the flounder, on 21st March, east of Inchkeith; and larval or post-larval flounders were obtained in St Andrews Bay on 1st and 2nd May at all the stations.

It appears, therefore, that the flounder spawns to a considerable extent, like the dabs, in territorial waters, from February to the beginning of June.

Long Rough Dabs (*Hippoglossoides limandoides*).—The number examined was 774, the majority of which were from the Firth of Forth.

Territorial Waters.—Of 144 examined in the Forth in May, June and July, 1889, none were ripe or nearly ripe. Of 50 examined in August, a female was nearly ripe and one was spent. In October 42 were examined, and all were immature. In November, of 43, none were ripe, but, 20 females and 6 males were nearly ripe, both at the inner and outer stations. In February 1890, of 26 specimens, one male ($6\frac{1}{4}$ inches) was ripe and one male and sixteen females nearly mature. In March, of 41 specimens, six females were mature, and fourteen females and one male nearly mature. In April, out of 40 specimens, only one female was mature. In May 42 specimens were examined. None were ripe, but twelve females (8 to 14 inches) were spent. This species is rare in St Andrews Bay. Of 30 specimens examined, none were ripe. Two females were spent on May 1st at Station V., and two were nearly ripe. This flat-fish does not appear to spawn in the Bay.

Offshore Grounds.—The long rough dabs is very abundant offshore. In the Firth of Forth area no ripe or nearly ripe specimens were got at Stations VIII., IX., in 1889, from May till August, inclusive (72 specimens examined). In October, of ten specimens, four females were nearly mature. In November, of 21 specimens, one male was ripe, and eleven females and one male nearly. In February 1890, of 13 specimens, ten females and one male were mature. In March ten specimens were examined, four females were mature, and two nearly mature, at Station IX., and two nearly mature at Station VIII. In April, of 21 specimens, all were immature; as were also twelve in May. Twenty-one were examined at Liston Bank in October; two females were nearly mature—none were ripe. In May 20 were examined; all were unripe.

At Smith Bank, on February 5th, four were examined; they were females and were almost mature (8 to 9 inches). Two females obtained, 22–25 miles south east of Montrose, on February 7th, were almost mature; ripe specimens were therefore obtained in territorial waters in February, March, April, May, and August; but ripe individuals of both sexes only in March. At offshore grounds mature specimens were caught in November and March; in the latter month alone were both sexes obtained. The process of spawning in the long rough dab is probably accomplished very rapidly. It spawns both in territorial waters and far from shore, apparently chiefly in March.

Turbot (*Rhombus maximus*).—Nothing very definite is known as to the spawning places of the turbot. The number of specimens examined by Mr Scott was 42; fishery officers examined 225. Of nine obtained in the Firth of Forth (almost all at the outer stations) none were ripe or nearly ripe. Four were spent; two, 23 and 28 inches, in

August, one in May (27 inches) and one in November (23 inches), six were caught in St Andrews Bay; one female, 27 inches long, was nearly mature in May. Others caught in the territorial waters off Aberdeen and Montrose, and in the Moray Firth, in June and September, were unripe. On February 7th, four, obtained from 22–25 miles S.E. of Montrose, were nearly half mature; they ranged in size from 23 to 28½ inches. On May 22, 1890, two caught at Station VII., Aberdeen, were about half ripe; one was male, 18 inches long, and the other female, 23 inches long. On February 12th, three females were caught about two miles from Dunbar; one, 28 inches long, was about half mature, and the other two, each 31 inches long, 'rather mature.' Of 173 examined by fishery officers along the East Coast from October to the end of April none were mature. In May, of 50 caught 10 to 30 miles East of May Island, five males and four females were ripe. At Stonehaven, two, examined in May, were spent. Professor M'Intosh obtained the ova of turbot 47 miles East by South of May Island on 9th July 1884, and ripe females were at the same time observed.*

Brill (*Rhombus lævis*).—Only 13 specimens were examined on board the 'Garland.' Of two males and three females obtained at the mouth of the Forth (Station VI.) in April, May and August, only one was ripe, a female 23 inches long, caught on May 3rd. In August a female 24 inches long was immature. On the 7th February, 7 caught from 22–25 miles S.E. of Montrose were examined, none were ripe. Three of the five were about half mature; their lengths were 20, 22, and 23 inches. Two males, at 18 inches and 8 inches, were immature. Each of the two females was 25 inches long; one was immature, and the other nearly half ripe.

Black Sole (*Solea vulgaris*).—Only three females were examined, all from Station IV., St Andrews Bay. On October 10th, one, 17½ inches long, was about half mature; on March 27th, one, 19 inches long, was nearly ripe; and on May 1st, the third, 17 inches long, was spent.

Halibut (*Hippoglossus vulgaris*).—A female, 23½ inches long, caught about 5 miles from Dunbar, on February 15th, was about half ripe, of 94 examined by fishery officers 3 were ripe; one on March 21st, 30 to 50 miles off Fraserburgh; two on May 22nd, 40 miles off Macduff.

II. ROUND FISH.

Haddock (*Gadus æglefinus*).—10,132 were examined; 737 were mature, and practically all in extra-territorial waters.

Territorial Waters.—In the Firth of Forth all were immature in May, June, July, August, October, and November (202 examined). At the middle of February, of 14 specimens, two males and three females were nearly mature. The males were 15 and 16 inches long, and the females from 18 to 20 inches. In March, all those examined in the territorial area were immature (spawning was going on offshore). All were immature in April and May. At Dunbar, in December, males and females (14½ to 18½ inches) caught by line fishermen within or about three miles from shore were about three parts mature; on 22nd January a female, 27 inches long, was very nearly mature. On February 4th, many males and females up to 15 inches in length were quite immature; some, 14½ inches long,

* *Seventh Annual Report Fishery Board*, Part III. p. 304.

were three parts mature. On February 7th and 10th, females, from 16 to 17½ inches, were three parts mature; others up to 14 inches were quite immature. On February 25th, one female, 16½ inches, was found spent two miles off; and several others from 17–23 inches were very nearly ripe. On March 7th a female, 26 inches long, was found newly spent. On March 27th, nearly all the large fish were newly spent. In a boxful of large fish examined on 29th March, and caught about three miles off, one female was nearly ripe, and all the others spent. On April 1st and 4th, some males, up to 14 inches long, caught 3 miles off and some females up to 15½ inches, were quite immature; a female of 21 inches was nearly mature. In a boxful examined on April 1st, caught 3 miles off, about half a dozen females were nearly ripe; the others and the males were spent. All those obtained at the stations at Aberdeen, Montrose, the Moray Firth, and the Orkneys in June, July, and December, were immature. In May 1890, a number of half mature males, from 12 to 17 inches long, were obtained at Aberdeen, Montrose, and the Moray Firth; all females were immature. As in other cases on the West Coast, some haddocks were found ripe near shore. At Ullapool, within half a mile, in January; off Cantyre, within one mile, in February and April.

Offshore Grounds.—In the Firth of Forth area one nearly mature male (10 inches long) was got at Station VIII. on May 16th, 1889. Of 96 specimens examined from June to November, all were immature. On February 14th, of eight, at Station IX., five females (16–18 inches) were nearly ripe; two (13½ and 14 inches) were immature. Of two males, one, 14 inches long, was nearly mature. On March 18th, of five examined at Station IX., two males (15 and 16 inches) and one female (15 inches) were fully ripe, and two females nearly so. On April 23d, of nine examined, one male was ripe. In May each of the twelve specimens was immature. Fifteen miles off Dunbar, a ripe female with the ova running, 24 inches long, was caught on January 21st, 1890; but hundreds of others smaller in size were from half to three parts mature. On February 6th and 10th, from ten to twelve miles off, thirteen of the largest females were ripe; the others and the males about three parts mature. On March 7th, females, from 17 to 23 inches long, were ripe; some 18 inches long, only half ripe. On 11th March a large number of spent fish were got; on 18th March, females and males were fully ripe, spawning or spent. In another 'shot on March 19th, twelve miles off, none of the fish, which were large, were either ripe or spent; they were mostly about three parts mature. In the offshore grounds in the Moray Firth, at the beginning of February, thirty haddocks were examined. Of the thirty females, 13 to 20 inches, and six males, from 12 to 19 inches, none were ripe or nearly ripe.

Haddocks begin spawning to a slight extent at the end of January; they spawn chiefly in February, March, and April. Their floating ova have been got by the 'Garland' at the beginning of February, 25 miles from shore; also in the Firth of Forth and St Andrews Bay in February and March.

Cod (*Gadus morrhua*).—6272 specimens were examined—5864 by fishery officers and 408 by Messrs Scott and Jamieson,—the majority of these being caught in the Firth of Forth.

Territorial Waters.—Of 186 caught in the Forth, between May and November, none were ripe or nearly ripe. On February 15th none were mature, but a few were nearly or three parts mature. For instance, at the inner stations, females 38 and 39 inches long, and males at 34 inches, were fully three parts ripe. On March 14th–17th, all the specimens were immature, females up to 26 inches and males up to 27 inches. On April

19th–25th, all were immature; males from 14 to 23 inches long and females from 13½ to 25 inches. In May all were immature; males up to 20 inches and females up to 23 inches. At Dunbar, in the end of January, males and females where half or three parts mature—males 26 to 34 inches and females up to 42 inches. On February 5th, females 35 inches and males 34 inches were fully three parts ripe. On April 1st, a male, 36 inches long, was got perfectly ripe three miles off. All the cod caught in St Andrews Bay were immature; on March 3d, one male and one female, each 28 inches in length, were nearly mature. All those obtained at the Aberdeen, Montrose, and Moray Firth Stations were immature. Cod appear sometimes to spawn on the West Coast much nearer shore than on the East Coast. In March, of 31 caught about a mile east of Lismore Lighthouse, Loch Linnhe, nine were ripe. In April, of thirty caught about half a mile from Lismore Lighthouse, fourteen were mature and nine were spent. In March, three were mature among five caught under three miles from shore at Cantyre.

Offshore Grounds.—Of several thousands examined by fishery officers along the East Coast from June till the end of January, none were ripe. The first ripe fish is recorded on February 8th, caught 35 to 45 miles off Aberdeen. All were immature at the offshore Firth stations from May till November. On February 14th, one male, 33 inches long, was fully ripe, and two females, 39 and 44 inches, nearly mature; a female 40 inches long was only half ripe. On March 17th, only two females, 18 inches long, were examined; they were immature. In April, of three examined, one male, 27 inches long, was ripe, and a female of 40 inches nearly ripe. On May 13th, a male, 26 inches long, was mature. On January 24th, eight miles from Dunbar, males, 32 and 33 inches long, and females, 25 to 30 inches, were half ripe. On February 10th, 12 miles off, males and females, 40 inches long, were three parts mature. On February 4th and 5th, none of 31 cod caught in the offshore waters of the Moray Firth were mature; four males, from 27 to 34 inches long, and two females, 34 to 36 inches, were nearly ripe. One male of 18 inches was 'scarcely mature.'

The cod begins spawning at the beginning of February, but the great period is March; large numbers spawn in April; in May nearly all are spent, but ripe males and females have been caught as late as 9th May. The pelagic ova of the cod were obtained by the 'Garland' in February and March in the Forth and St Andrews Bay.

WHITING (*Gadus merlangus*).—The number examined was 716.

Territorial Waters.—In the Forth a ripe male was got on May 17th, and a ripe female on May 2d. On June 6th, of 14 specimens, one female was ripe and one nearly ripe. All were immature from July to October. On February 13th and 14th, of twelve examined none were ripe, but six females, of 12 to 21 inches, were nearly mature. On March 13th–17th, of 27 specimens, two females were mature, one 12½ inches, at the mouth of the Firth, and the other, 9 inches long, at Station III. Eleven females and five males were nearly mature, some of them being at the inner stations. On April 19th–25th, of 34 examined, four females (9½ to 15 inches) and one male (12 inches) were fully ripe; two of the females being at an inner station (II.). In May none were ripe, but two females and three males were nearly ripe; the females were 14 inches and the males from 10 to 13. In St Andrews Bay a male was nearly ripe on May 2d. At Dunbar, at the end of December, females from 11½ to 23 inches, and males from 11½ to 13 inches, were half mature. In January they were half mature; on February 7th and 14th, females from 12 to 22 inches long, and males from 13½ to 14 inches, were three parts mature. On April 15th, of six females examined, four from 11 to 13 inches were spawning. No ripe fish were obtained at Aberdeen, Montrose, or Moray Firth in June, July, or September. In May 1890, no males were ripe, one, 11½ inches long, at Montrose, was nearly ripe; most are described as immature. Two females of 12½ and 13 inches were ripe, one at Aberdeen and one in the Moray Firth; one 12½ inches long was spent.

Offshore Grounds.—At Stations VIII. and IX., in the Forth area, in May, four females were ripe and two males nearly ripe; on June 6th, one female was mature; all were immature thereafter till February. On February 14th, of thirteen specimens, six males and four females were nearly ripe; on March 18th, of 19 specimens, three males and two females were ripe, and two males and nine females nearly mature; on April 24th, of 20 specimens, six females from 11 to 14½ inches, and three males, 10½ to 14 inches, were ripe; on May 13th, of 19 specimens, none were mature; two males and four females were nearly mature. Ten miles off Dunbar, on March 7th, none were ripe, but individuals from 11½ to 15 inches were nearly ripe.

Lythe (*Gadus pollachius*).—Of nine specimens examined, none were found ripe or nearly ripe in June, July, August, or October.

Saithe (*Gadus virens*).—Of six examined, on February 4th, in the Moray Firth, females from 14 to 15½ inches were immature; two males, 37 to 38 inches were fully half mature. Of 494 examined by fishery officers, 14 were ripe, one on July 5th, 100 miles east of May Island; 6 on February 22nd, 10 miles off May Island; 4 on February 22nd, twelve miles off; one on March 4th, ten miles from May Island; one on April 15th, 15 miles off Eyemouth. Most obtained in March, all but one in April, and all in May were spent.

Brassie (*Gadus luscus*).—Twenty-three specimens were examined. From July to February none were found ripe in the Firth of Forth. In February, a female and a male were fully half mature. On March 14th, at Station IV., a female, 9 inches long, was fully ripe. On May 13th, a fully ripe female, also 9 inches in length, was caught at Station VIII. Pelagic ova, which Professor M'Intosh thinks may belong to the brassie, were got in the surface tow-net at Station I., on 28th March.

Ling (*Molva vulgaris*).—Of ten specimens examined by the 'Garland' in April, August, October, and November, all were immature. A female taken on February 4th, offshore, in the Moray Firth, was about half ripe; a female, 26 inches long, captured off Dunbar at the end of December, was about half mature. Fishery officers examined 775 specimens, of which 127 were ripe. The earliest ripe specimens were got on March 5th, 10 to 45 miles off Fraserburgh. The greater number of ripe fish were got in April and May. They were caught from 10 to 160 miles off the East Coast. The pelagic egg of the ling was obtained 25 miles off Montrose, on February 6th.

Gurnard (*Trigla gurnardus*).—The number examined was 703.

Territorial Waters.—In the Firth of Forth, of 50 specimens in May 1889, four females were ripe and 19 nearly ripe; one male was nearly ripe. In June, of 39 specimens, twelve females were ripe, seven nearly ripe, and ten three parts mature; two males were three parts ripe. In July, of 39, two females were ripe and two spent; five females and six males were nearly ripe. In August, October and November none were ripe or nearly ripe. In March one female was ripe. In April 18th to 25th, of 39 specimens, ten females (12–14 inches) and one male (12 inches) were ripe; five males and eight females were nearly mature. In

May, of 34, one female was mature, and thirteen nearly mature. Ripe specimens were got at all stations in the Forth. In St Andrews Bay, in June, sixteen females, out of 33 fish examined, were mature and ten nearly mature; two males were examined, but were not ripe. In August, of 27, five females and one male were spent. In October and November all were immature. In March, of 13, ten females were nearly mature. In May, of 46, fifteen females were mature; and twelve nearly mature; eleven males were nearly ripe. In June and July a large proportion in the Moray Firth and at Montrose were ripe.

Offshore Grounds.—In June, of 17 specimens at Stations VIII. and IX., off the Firth of Forth, two females were ripe, and 5 nearly ripe. On July 26th, of 9, six females were mature, and two females and a male nearly mature. In August a female was spent. All were immature in October and November. In April, of ten specimens, five females and two males were nearly ripe. In May, of 24, eight females were ripe, and nine females and one male nearly ripe. At Smith Bank, in June and July, of 34, four females were mature, and five nearly mature; six males were nearly ripe. In May most were nearing maturity.

Catfish (*Anarrhichas lupus*).—Of 46 examined, nearly all in the Firth of Forth, in nearly every month in the year, a female was found partly spent at Station I., in St Andrews Bay, on March 5th. It was 33 inches long. At Smith Bank, on May 24th, a female, 36 inches long, was spent, a male, 40 inches long, rather immature, and a female 42 inches long, about half ripe. On May 29th, at Station I., Moray Firth, a female, 39 inches long, was fully half ripe. On April 19th, a female, 36 inches long, was spent at Station I., Firth of Forth; on May 12th, at the same station, a male 42 inches long and a female, 34 inches, were spent. Fishery officers examined twelve specimens; three females were ripe, one on July 5th and the other two on September 12th and 27th, the others being spent. They were caught from 25 to 45 miles off the East Coast. The 'Garland' obtained young specimens, $\frac{7}{8}$ of an inch long, in the surface tow-net at the mouth of the Forth on 21st February, and also near the Bass Rock on May 7th.

Angler (*Lophius piscatorius*).—Of 46 specimens, chiefly from the Forth, in the months from June to May, none were quite ripe, except a male, 36 inches long, at Smith Bank, on May 24th. On October 3rd, at Station III., St Andrews Bay, a male, 45 inches long, was spent. On August 3rd, at Station V., Firth of Forth, a male, 49 inches long, was spent. On February 14th, a male, 31 inches long, was half ripe. In March the reproductive organs of some specimens up to 30 inches were so undeveloped that the sex could not be distinguished.

Dragonet (*Callionymus lyra*).—Eleven were examined. One female, $6\frac{1}{2}$ inches long, was quite mature on May 29th, at Station II., Moray Firth; and one female, 8 inches long, on June 13th, at Station V., St Andrews Bay. One female was spent in June at Station VII., Firth of Forth; on May 17th, two females were nearly ripe at this station. The pelagic ova were obtained in the surface tow-net on 7th May at Station II., in the Forth; and young forms at Station I., on 3d July.

Lumpsucker (*Cyclopterus lumpus*).—A spawning female, 17 inches long, was caught at Station II., Firth of Firth, on March 17th; and two mature females, 14 and 15 inches long, at Stations IV. and V., at the end of April.

Hagfish (*Myxine glutinosa*).—Twelve from 53 fathoms in the Moray Firth were examined in July. Females, 10 and 11 inches, and males, 12 inches, were about half mature; the sex of some specimens, 10 inches long, could not be determined.

III.—ON THE PELAGIC FAUNA OF THE BAY OF ST ANDREWS DURING THE MONTHS OF 1888. By W. C. M'Intosh, M.D., LL.D., F.R.S., Professor in the University of St Andrews.

Part II.

REMARKS ON THE MORE INTERESTING MEMBERS OF THE INVERTEBRATE PELAGIC FAUNA.*

Appendicularia.

Mid-Water-Net.

First appearance.—One on 19th January, and a few, 9 mm., on 29th March 1889.

Last appearance.—18th September, very few, small.

Most frequent.—In May, when they occurred in swarms at almost every haul of the net. Few in June and very few small examples thrice in July, some in August. Numerous, small, thrice in September.

Bottom-Tow-Net.

First appearance.—28th June, a few young.

Last appearance.—28th September, small.

Most frequent.—In August, when many or a few got almost daily, these being all very small. In July a few eight or nine times, young forms. In September a few, small, eight times.

Surface-Tow-Net.

First appearance.—9th May, a few.

Last appearance.—26th September.

Most frequent.—In August and September, when a few occurred almost daily. These were all small. None in June, and very few, small, twice in July.

Membranipora.

Cyphonautes compressus.

Bottom-Tow-Net.

First appearance.—28th June, many.

Last appearance.—10th December, many.

Most plentiful.—In July, when they occurred almost daily, very few at beginning, many towards end of month. In August very few procured six times. In September few, twice, in October, many, once in December, many on 10th.

Surface-Tow-Net.

First appearance.—2nd August, a few.

Last appearance.—10th December, numerous.

Most plentiful.—In August, a few, seven times. In September, very few, nine times; more in October and November. On December 10th, numerous.

* As stated in connection with Part I., I am much indebted to Mr J. Pentland Smith, M.A., B.Sc., for aid in preparing this report, which was forwarded with Part I. last year.

Actinotrocha.

Mid-Water-Net.

First and last appearance.—5th September.

Surface-Tow-Net.

First appearance.—A few on 6th September.
Last appearance.—12th September.

Bottom-Tow-Net.

First appearance.—5th July.
Last appearance.—22nd September, 1.
Most frequent.—In August, four times, a few each time, and in September, six or seven times; very few as a rule. Only occurred once in July.

Phoronis.

Bottom-Tow-Net.

First appearance.—18th July.
Last appearance.—One on 22nd September.

Sagittæ.

Mid-Water-Net.

First appearance.—16th January, a few good.
Last appearance.—18th December, in swarms, 1 inch and less. Some showed sperm-cells (clear and translucent) and a large ovary.
Most plentiful.—In December, in swarms as a rule. In May, June, and September, a very few got not unfrequently. None obtained in July, and only twice procured in August. On June 26th, sizes from 6 mm.–14 mm. On January 24th, forms, with reproductive organs small, but ova visible.

Bottom-Tow-Net.

First appearance.—21st January, very few, about 1 inch.
Last appearance.—18th December.
Most plentiful.—From beginning of December to end of March. A few, generally, each time in December, but many at beginning of year. year.

Surface-Tow-Net.

First appearance.—21st January, one or two about $\frac{1}{2}$ inch.
Last appearance.—18th December, a few various sizes.
Most plentiful.—In December, many as a rule each time. None got in June, July, and October.

COPEPODA.

As has often been pointed out no group is more important than the Copepoda in connection with the nourishment of fishes, especially in their post-larval stages, and they are ubiquitous in distribution. Their varying sizes—from the minute larval nauplii to the larger adults, such as *Calanus*,—as well as their highly nutritious nature, render them perhaps the most valuable fish-food in the ocean.

Off Kiel Giesbrecht and Möbius procured some that have not yet been recognized at St Andrews, viz., *Oithona spinirostris*, *Eurytemora hirundo*, *Lucullus acuspes*, *Paracalanus parvus*, *Euchæta norvegica*, *Clausia elongata*, *Rhinocalanus gigas*, *Heterochæta spinifrons*, *Metridia armata*, *Candace pectinata*, *Acartia discaudatus*, *Ectinosoma atlantica*, *Idia furcata*, and *Monstrilla danae*. It has to be remembered, however, that they have only been glanced at for a comparatively short time. The somewhat monotonous continuance of the same species throughout the year is a marked feature in the inquiry, and this was likewise brought out during the trawling expeditions. Though Copepods are sometimes very abundant in the Bay, they are, so far as I could judge from the spirit-preparations made under Dr John Murray, apparently in greater profusion in the area of the estuary of the Clyde. Moreover, they appear in large numbers earlier in the year.

It must not be considered that the following remarks on the periods of appearance and disappearance of the species have greater importance than belongs to the simple record of a year.

Calanus finmarchicus, Gunner.

Mid-Water-Net

First appearance.—24th January, many.
Last appearance.—18th December.
Most plentiful.—Found not unfrequently in January, February, and March, but at other times of rare occurrence.

Bottom-Tow-Net.

First appearance.—24th January.
Last appearance.—18th December.
Most plentiful.—In December, many, as a rule, each time. In January, February, and March got almost every time the nets put down, otherwise not very common.

Surface-Tow-Net.

First appearance.—21st February, very few.
Last appearance.—18th October, very few.
Most plentiful.—A few times at beginning of year. During rest of year very scarce.

This is one of the most abundant species, not only in the waters of the Bay proper, but far beyond it, and at a considerable depth as well as in the upper regions of the water. It is cosmopolitan in its range so far as the northern waters are concerned, apparently being as abundant in the Arctic Seas, where it is said to constitute in part the food of the whale, as off our own shores, where it enters largely into the food of the post-larval fishes. It is chiefly this species which tints, of a delicate pinkish hue, the translucent abdomen of the little fishes. *Calanus finmarchicus* is less abundant in the Baltic than in the North Sea.

Pseudocalanus elongatus, Boeck.

Bottom-Tow-Net.

First appearance.—13th February.
Last appearance.—10th December, numerous.
Most plentiful.—In September and December, especially in latter month. Not unfrequently procured, January, February, and March. By no means so common as *Halitemora longicornis*.

Surface-Tow-Net.

First appearance.—13th February.
Last appearance.—30th October.
This form occurred very seldom in the net.

Mid-Water-Net.

First appearance.—13th February.

Last appearance.—5th September.

Most plentiful.—These were almost the only times in which this form appeared.

Another abundant species both in the open sea and inshore. It is interesting to note that in the majority of instances it occurred chiefly in the bottom-net, thus apparently showing a certain sensitiveness to atmospheric conditions or temperature.

Acartia longiremis, Lilljeborg.

Mid-Water-Net.

Found in the net on 8th March and 5th September.

Bottom-Tow-Net.

First appearance.—23rd June, numerous.

Last appearance.—24th November, myriads.

Most plentiful.—From 24th June to 24th November, numerous or in myriads, as a rule, each time. During this period it occurred very frequently.

Surface-Tow-Net.

First appearance.—21st January (?) certainly on 21st February.

Last appearance.—10th December.

Most plentiful.—In August, September, and October, many or numerous, each time, as a rule. Very few of this species were procured in May and June, but on the whole it occurred very frequently.

A most abundant species in St Andrews Bay, where it affects in a marked manner the upper and lower regions of the water respectively, only once occurring in the mid-water-net—though in large numbers. The maximum period both at the surface and bottom seems to be in autumn.

Acartia bifilosus, Giesbrecht.

First and last appearance in the surface-net on 5th September.

Halitemora longicornis, O. F. Müller.

Mid-Water-Net.

This form was procured only three or four times.

Bottom-Tow-Net.

First appearance.—8th March.

Last appearance.—5th December, in swarms.

Most plentiful.—From 23rd June to 5th December, numerous (or myriads of) specimens procured, as a rule, each time. The occurrence of this species was extremely frequent.

Surface-Tow-Net.

First appearance.—8th March.

Last appearance.—30th October, many.

Most plentiful.—In August and September, many, generally, each time. Very few in June and July. Not so common in the mid-water-net as in the bottom-tow-net.

This ubiquitous species occurs in profusion throughout the greater part of the year, and covers the entire area examined both within and without the Bay. Like some of the previous forms it is most abundant in the surface- and in the bottom-nets, rarely being captured in mid-water. This feature in the habit of the Copepods may be associated with the presence of other forms of pelagic life, in the midst of which *Halitemora* finds suitable nourishment. It is very plentiful in autumn, and somewhat later.

Centropages hamatus, Lilljeborg.

Bottom-Tow-Net.

First Appearance.—28th June, numerous.

Last appearance.—30th October. This form is not so common as *Acartia longiremis* or *Halitemora longicoris*, but still occurred frequently in this net.

Surface-Tow-Net.

First appearance.—26th April, numerous.

Last appearance.—26th September. Between the two dates above mentioned this species was often procured—more frequently indeed than in the bottom-tow-net.

Centropages hamatus is found in the Bay throughout the greater part of the year, especially from April to August, and like others is more frequently met with in the surface and bottom-nets than in the mid-water. It ranges, according to Prof. Brady, from the tidal rocks to the open ocean.

Centropages typicus, Kröyer.

Bottom-Tow-Net.

This form appeared first on the 14th of August, in St Andrews Bay, but on the 10th of that month it was found 15 miles S.E. of the Isle of May. During the remainder of the month it occurred once or twice.

Surface-Tow-Net.

Only on the 30th of August and 8th September was *C. typicus* found in this net.

It is noteworthy that this species occurred less frequently than the foregoing (*C. hamatus*), and was later in its appearance this season. According to Prof. Brady it is one of the most abundant Copepods in the British Seas, and ranges to the North Sea and the Atlantic.

Longipedia coronata, Claus.

Bottom-Tow-Net.

First appearance.—14th July.

Last appearance.—18th October.

Most plentiful.—In the latter half of July, in September, and during the first half of October, many, as a rule, each time. It occurred frequently during the period mentioned above.

Surface-Net.

First appeared on 23rd July, then on 26th and 31st, three times at end of August, on 5th and 26th September many, and on 17th October.

Anomalocera patersonii, Templeton.

Found in the bottom-net on the 9th August, 15 miles E.S.E. of Bell Rock.

The species is easily recognized by its fine bluish coloration and other features. It appears to keep to the open water, but it may yet be found within the Bay. It is stated by Brady to be generally distributed over the North Sea, and extends to the Mediterranean.

Oithona spinifrons, Boeck.

Bottom-Tow-Net.

First appearance.—18th July, a few.
Last appearance.—11th October.
Most plentiful.—From 18th July to 11th October, many specimens, as a rule, each time. This form was not very common.

Surface-Tow-Net.

Only found in this net on the following dates:—31st July, 31st August, 26th September, and 15th October, a very few each time.

Oithona spinifrons was procured most abundantly in the bottom-tow-net, and while it extended from July to September yet attained its maximum in the former month. Its frequency in the bottom-net is interesting, for Prof. Brady observes 'so far as I know it haunts exclusively the surface of the sea, being taken only in the towing-net.' * The species has a wide distribution round the British shores and the North Sea generally.

Thalestris rufocincta, Norman.

A single example occurred in the bottom tow-net on 15th September.

Cyclopina littoralis, Brady.

First appearance.—19th July.
Last appearance.—22nd August.
It was captured only thrice, and always in the bottom-net.

Dactylopus tisboides, Claus.

In the bottom-tow-net, E.S.E. of Bell Rock, 9th August. It has not yet been observed within the limits of the Bay.

Cladocera.

Pleopis polyphemoides, Leuckart.

First appearance.—14th July.
Last appearance.—31st July.
It was captured thrice, and only in the bottom-net.

Evadne nordmanni, Lovén.

This form only occasionally appeared in the bottom-tow-nets in March April, and May, but it was otherwise in June and July, since it then became much more abundant, though less so in the surface-nets than in former years in the latter month (July). It occurred in August and September in both bottom- and surface-nets, more frequently in the latter than the former. The brood-pouches of the females were still in full activity. During October it was present only once or twice respectively in the bottom- and surface-nets. None were observed in the surface-nets in November and December, and none in the bottom-net in the former month. A single example, however, was captured in the bottom-net on the 5th December.

The abundance of this species considerably augments the food of the post-larval fishes.

Parasita.

Caligus rapax, M. Edw.

Mid-Water-Net.

First appearance.—11th March.

* *Op. cit.* p. 91.

Last appearance.—16th October, very few.

Most plentiful.—In June, a few generally each time—mature forms, ♂ and ♀. Parasitic *Udonella caligorum* once or twice seen.

This form was not very frequently procured this year. It is sometimes abundant in the free condition in November and December.

Only once in *Bottom-Tow-Net* on 5th July,—1 specimen.

Surface-Tow-Net.

On July 18th, very few.

These move on the surface of the living cod with great activity.

In their stationary larval form (*Chalimi*) they are very frequent on the young food-fishes, such as cod, whiting, green cod, and Pleuronectids.

LARVAL ANNELIDS.

Nerine—group.

Bottom-Tow-Net.

The larval forms of *Nerine* and *Polydora* made their appearance in this net about the 4th July, though some years they are found much earlier, and they continued in considerable though diminishing numbers till the end of October. A few occurred subsequently till December. They were most frequent in September, though also in large numbers in July and August.

Surface-Net.

The *Nerine group* were first observed on the 30th July, and they continued till the 8th October. They were most frequent in September, when some occurred daily. In July a few were captured two or three times; while in August similar numbers appeared about six times.

The most common larval form was *Polydora*, so abundant along the rocky border and in dead and living shells everywhere in and near the Bay. The adult bores into various rocks and shells and is thus stationary, but the swarms of larvæ spread the species throughout the ocean.

Polynoë—group.

Bottom-Net.

These were first noticed on the 18th July, and they continued till the 17th October or a little later. They were most frequent in July, when they were sometimes (*e.g.*, 25th) in swarms. They were captured often in September and occasionally in August.

Surface-Net.

They were only procured once or twice in September.

Many of the Polynoidæ are ripe in January, and their larvæ abound in rock-pools and tow-nets a little later.

Terebella—group.

Bottom-Net.

The tubes containing the larval Terebellæ appeared at the beginning of July, and a few continued till September, though they were most frequent in July.

Surface-Net.

A few occurred only on the 26th July, so that they are comparatively rare in this region of the water.

Many of the larval annelids, *e.g.*, *Aphrodita, Pholoë, Nephthys, Phyllodoce, Nereis, Arenicola, Aricia, Cirratulus, Magelona, Capitella,* Sabellids and Serpulids were also occasionally noticed, chiefly in July, August, and September. No group is more striking in the pelagic fauna, and none more valuable as fish-food.

LARVAL ECHINODERMS.

Plutei

Bottom-Tow-Net.

First appearance.—23rd June.

Last appearance.—26th September, very few.

Most plentiful.—26th June to 17th August. They were of frequent occurrence in this net, and many or numerous specimens were obtained each time.

Young star-fishes and Echinoids seen occasionally in bottom-tow-net from 26th July to 14th August.

Surface-Tow-Net.

First appearance.—8th March, 1.

Last appearance.—10th December, one; arms short and apparently atrophied, skeleton still visible, no star-fish.

Most plentiful.—7th July to 26th September, generally a few each time. None from 26th September to 17th October, when a few procured, and none from latter date till 10th December. They occurred almost as frequently in this net as in the bottom-tow-net.

The pelagic ova of *Cucumaria* were abundant in the tanks of the laboratory on April 15th, first in long strings and afterwards as separate reddish ova.

CRASPEDOTÆ.

Order I.—Anthomedusæ.

Sarsia tubulosa, Lesson.

Mid-Water-Net.

First appearance.—4th May.

Last appearance.—24th July.

Most plentiful.—In May and June of very frequent occurrence, in the former month appearing oftener than in June, but in the latter month more specimens obtained each time.

Bottom and Surface-Tow-Nets.

This species was obtained not unfrequently in the latter net, but very seldom in the former.

The earliest appearance noted is that of Thompson, who found it in April (1840), in Belfast Bay. As a rule it occurs in May, June, and July, though young forms appear in March.

A minute Medusa about $\frac{1}{16}$ inch in vertical diameter, procured in the bottom-net in April and May, presented certain features of interest. The umbrella was bluntly rounded, and had four bright carmine specks in a somewhat triangular area above the margin. One of these nearly corresponded with the origin of a long granulated tentacle with a greatly enlarged base, the centre of which was also coloured pinkish. Moreover, from the same region sprouted an elongated bud of considerable size—

almost equalling the diameter of the adult umbrella. From the free extremity of the bud a pair of similar tentacles with enlarged bases sprang. Grape-like masses occurred at the same part, and apparently the enlarged bases of two shorter tentacles. The other three carmine points were devoid of tentacles in the specimens, so that at first sight they had some resemblance to *Steenstrupia*, though they probably approach *Hybocodon* of Agassiz, the "hunchback" Medusa of North America, and perhaps the *Diplonema* of Green. The manubrium of the parent is large, and with a trumpet-shaped tip. In one it contained the remains of a copepod. A. Agassiz figures a Tubularian as the hydroid stock of his *Hybocodon*. The relationships of the Medusoid from St Andrews are at present unknown.

Tiara octona (*Oceania octona*, Fleming).

Mid-Water-Net.

First appearance.—30th March, young.
Last appearance.—28th September, 1, unripe.
Most plentiful.—From 22nd August to 28th September of very frequent occurrence; ripe forms procured on 27th August and 10th September.

This form was first found by Dr Fleming, near the Bell Rock; again by Forbes and H. Goodsir in the Firth of Forth, and by the former off the Coast of Shetland. It is also not uncommon in the Outer Hebrides, such as near Lochmaddy, in August.

Oceania globulosa, Forbes.

Mid-Water-Net.

A very few specimens were procured on 22nd, 29th, and 30th of August, and on 3rd September.

Forbes found it in the Sound of Bressay, and says it somewhat approaches *Turris* in external appearance.

Oceania turrita, Forbes.

First appearance.—7th August (bottom-tow-net), off Boarhills.
Last appearance.—8th August (mid-water-net), off Fife Ness.

Margelis ramosa, Agassiz (*Bougainvillia britannica*, Forbes).

Mid-Water-Net.

First appearance.—8th March, very small.
Last appearance.—26th September, small, unripe.
Most plentiful.—In June and September, when a few, as a rule, were procured each time. Not quite mature during the latter half of May, but ripe in September (although small and unripe were found on 26th of the same month). This species did not occur very frequently. *

Bottom and Surface-Tow-Nets.

On 8th August, at Fife Ness, this form was procured in the bottom tow-net, and in St Andrews Bay on 12th September, in the surface-tow-net.

Thamnitis nigritella (*Bougainvillia nigritella*, Forbes).

Mid-Water-Net.

First appearance.—29th August young in St Andrews Bay, 11th August, E.S.E. of Isle of May.
Last appearance.—18th September.
On the above dates only did this form occur.

* Though it is not uncommon.

Order II.—Leptomedusæ.

Thaumantias hemisphœrica (*Gronovius*), O. F. Müller.

Mid-Water-Net.

First appearance.—12th June 1888, numerous.
Last appearance.—5th December.
Most plentiful.—In June, July, August, and September found very frequently in large numbers, often in swarms. From 17th October to 5th December none occurred; only 2 or 3 procured on latter date. Mature forms very frequent from 23rd June to 28th September, and at that time very large, *e.g.*, $\frac{3}{4}$ inch.

Bottom-and Surface-Tow-Nets.

This species of *Thaumantias* also occurred frequently in these nets, especially in the latter.

Thaumantias melanops, Forbes.

Mid-Water-Net.

First appearance.—11th May.
Last appearance.—8th August, off Fife Ness, and 4th August, in St Andrews Bay.
Most plentiful.—In June and July. Appeared in myriads on 20th and 25th July. Procured frequently during the period mentioned.

Bottom and Surface-Tow-Nets.

This species was found two or three times in these nets.

Thaumantias inconspicua, Forbes.

Mid-Water-Net.

A few times in June and August. Many in former month, mature and immature.

Laodice cruciata (*Thaumantias pilosella*, Forbes).

Mid-Water-Net.

First appearance.—11th May.
Last appearance.—17th October.
Most plentiful.—In May and June. On 25th June specimens procured were not quite ripe, on 18th July, mature, and on 26th September, immature. Met with occasionally almost 1 inch in diameter.

Bottom-and Surface-Tow-Nets.

This species was found occasionally in these nets.

Obelia dichotoma L. (Gonozoids).

Bottom-Tow-Net.

First appearance.—18th July.
Last appearance.—17th August.
Most plentiful.—In July, found a few times, and once or twice obtained in August.

Surface-Tow-Net.

First appearance.—18th July.
Last appearance.—30th August, only on these two occasions.

Phialidium variabile, Hæckel.

Var. *globosa* and var. *sarnica*, Forbes, found frequently in great numbers in the mid-water-net, from 26th May to 26th June. Var. *convexa* was found only a very few times in August.

Thaumantias lucifera, Forbes, *T. octona* and *T. maculata* also occurred in great numbers from 26th May to the 25th June. *T. lucifera* was also obtained at the end of March.

Thaumantias quadrata was captured a very few times in August.

Tima bairdii, Johnston.

Mid-Water-Net.

First appearance.—20th January, $1\frac{1}{2}$ inch; reproductive organs almost fully developed.

Last appearance.—12th December, some nearly 3 inches in diameter, and almost ripe.

Most plentiful.—In September and October, some $1\frac{1}{2}$ inch in diameter in September, but no ripe, or nearly ripe forms until December. None from 9th February to 9th August (Garland), 30th August (in Bay). None in November; occurred almost as frequently as *Margelis ramosa.*

One example, procured at the end of September, was devoid of mouth and peduncle, as in the case of certain other forms previously described.*

Stomobrachium octocostatum, M. Sars.

First appearance.—26th January.

Last appearance.—12th December, nearly ripe.

Most plentiful.—In October, when large but unripe specimens procured. In December some about $\frac{1}{2}$ inch in diameter, nearly ripe, occurred; a few times in September, several each time.

Bottom and Surface-Tow-Nets.

A very few specimens have occasionally been procured in these nets. Forbes found it on the West Coast in July.

Circe rosea, Forbes.

Mid-Water-Net.

First appearance.—24th January.

Last appearance.—18th December, $\frac{1}{2}$ inch to less than $\frac{1}{2}$ inch; reproductive organs developing.

Most plentiful.—In December and March, when many or myriads obtained each time. From end of March until beginning of November none procured, but from latter to former date of common occurrence.

Bottom-Tow-Net.

First appearance.—21st January.

Last appearance.—18th December.

Most plentiful.—In December and March; but not so frequently found in this net as in mid-water-net.

Surface-Tow-Net.

First appearance.—22nd January.

Last appearance.—18th December.

Most plentiful.—In December and February.

Forbes found it in the Zetlandic Seas in August—whereas in our neighbourhood it is a winter species, and, therefore, in keeping with the habit of the original form (*Circe camtschatica*) discovered by Mertens on the coast of Kamtschatka.

* *Vide* Ann. Nat. Hist., January 1890.

Acraspeda (Discophora).

Cyanea capillata, Esch.

First appearance.—8th March, ephyræ.
Last appearance.—11th June.
Most plentiful.—4th May to 11th June, of very infrequent occurrence, on 16th May a pinkish hue seen, while on 11th June the specimen examined was larger than the former one and exhibited a yellowish coloration.

The scarcity of *Cyanea* this year is remarkable. In 1884 they occurred in enormous numbers, so that even the trawls were impeded in their operations in June and July.

Aurelia aurita, L.

Mid-Water-Net.

First appearance.—7th March, ephyræ.
Last appearance.—3rd August, 3 specimens, 8 inches in diameter.
Most plentiful.—7th July to 3rd August. This form occurred very seldom.

The scarcity of this species in the Bay during this year (1888) is also peculiar. They are occasionally so numerous that the surface of the sea for nearly a square mile is mostly covered with them.

Ctenophora.

Pleurobrachia pileus, Flem.

Mid-Water-Net.

First appearance.—14th January, numerous, both large and small.
Last appearance.—18th December, in swarms, $\frac{1}{6}$ to $\frac{3}{4}$ inch.
Most plentiful.—Numerous all throughout the year, except in January, February, and March. Especially numerous from beginning of July to end of October, when they appeared almost daily in myriads. During August and September small forms the rule, and in September only specimens from $\frac{1}{8}$ to $\frac{1}{2}$ inch procured. Almost the only form obtained every month of the year.

Surface-Tow-Net.

First appearance.—18th July, very few, large.
Last appearance.—14th December, a few $\frac{5}{8}$ inch and downwards.
Most plentiful.—18th July to end of September (many ova found from beginning of September to middle of October). On 15th October embryos well developed. Only small forms as a rule procured. Generally a few each time; much less frequent than in mid-water net.

Bottom-Tow-Net.

First appearance.—14th July, very few, along with some larval forms.
Last appearance.—14th December, $\frac{1}{5}$ inch and under.
Most plentiful.—In July and August. (Ova got frequently in September, and larval forms from 14th July to end of October.) A few generally obtained each time, and these as a rule small, $\frac{1}{8}$ to $\frac{9}{16}$ inch. Occurred oftener in this net than in surface-tow-net.

BEROË.

Mid-Water-Net.

First appearance.—22nd January, $3\frac{1}{2}$ inches, and smaller.
Last appearance.—12th December, a few.
Most plentiful.—From 20th to 26th July (inclusive), when they occurred in swarms. In September, generally small.

Six specimens, large and small, got in surface-tow-net of 18th July, and 1, minute, in surface-tow-net of 22nd March.

Lesueuria vitrea, M. Edwards.

Mid-Water-Net.

First appearance.—2nd March, fragment. Young forms with large mouth on 30th March.
Last appearance.—14th December, 1, $\frac{2}{3}$ inch, on 13th, 3, $\frac{5}{8}$ inch to 1 inch.
Most plentiful.—In June, when they occurred in swarms, young and adult. In May and July also numerous. On 7th July forms bearing ova which measured ·016 inch. From 3rd August (when a few were got 2 to $3\frac{1}{2}$ inches) till 6th December (when procured), none appeared. Occurred frequently.

A few were found in *Bottom-Tow-Net* on 2nd July, and perhaps also at other times during that month.

Larval Peachia.

Mid-Water-Net.

First appearance.—14th July, many, and in bottom-tow-net.
Last appearance.—25th July.
Most plentiful.—14th to 25th July, when found five or six times, clinging as a rule to *Thaumantias melanops*, *T. hemisphærica*, and *Phialidium variabile*, var. *globosa*.

Bottom-Tow-Net.

This form occurred twice in this net.

The *Arachnactis*-stage of Edwardsia was also procured in the Bay in July.

A few other species were also found, viz. :—*Lizzia octopunctata*, *Lizzia blondina*, *Stauridium productum*, *Oceania episcopalis*, *Podocoryne carnea* (?); and some minute forms. Small specimens of *Lizzia octopunctata* were found as early as the 30th of March, in the bottom-tow-net. During January, February, and March, *Tima bairdii*, *Margelis ramosa* (Bougainvillia britannica), and *Circe rosea* were the only forms procured, the latter being common in all the nets. In June, July, August,—especially in the two former months, myriads of specimens, comprising many species, were obtained. *Lizzia octopunctata* presented numerous buds in March.

IV.—REPORT ON THE PELAGIC OVA, LARVAL, AND YOUNG FOOD-FISHES PROCURED BY THE 'GARLAND.' By Professor M'Intosh,* LL.D., F.R.S., &c.

THE PELAGIC OVA.

With the exception of the ova of the rockling and dab comparatively few specimens occurred at the several stations, showing how widely diffused the eggs become throughout the water, except on certain grounds where the fishes congregate at the spawning season, as off the Island of May and on the banks at Lofoten in Norway. It occasionally has happened, indeed, that the masses of ova—chiefly of the cod—have been beached as a low rampart by the retiring tide at Lofoten. Nothing like this, however, has been seen in British waters.

The collections made on board the 'Garland' are of interest as showing the general condition of our waters during the main spawning period, and are also of value for comparison with more local observations. Thus, at the commencement of the year the eggs of the earlier fishes such as the plaice, together with young fishes of the previous season, alone appear, followed by the eggs of the haddock, dab, rockling and bib. Soon after these early eggs come the minute larval fishes, and these gradually increase in size as the season advances, though in most cases the ranks are very irregular in any given species from the irregularity of the spawning time, as well as the more or less lengthened period during which the issue of the eggs take place in a given example. The variable rate of growth is also another factor which soon comes in.

So far as these collections go they tend to corroborate the view elsewhere mentioned that the post-larval cod and haddock probably resemble each other very closely, so closely indeed that it has not yet been possible to separate them until the characteristic features of the cod appear—as shown in the 'Researches.' † The youngest stages of the haddock after the early post-larval condition are unknown (as such), being either at present indistinguishable from the same stages of the cod, or what is less probable, since no trace of them has appeared during recent investigations, they form separate schools. The cod and the whiting have been traced with considerable completeness from the egg onward in British waters, but at what period the young haddock puts on its special characteristics after consorting with the post-larval cod we are unable to say. The smallest specimens hitherto procured, and which have all the features of the adult, measure about 2½ inches. The close resemblance of the forms just mentioned as well as of many of the common pleuronectids (flounders), raises some interesting questions in regard to their phylogeny, which, however, cannot be touched on here.

Some of the forms, *e.g.*, the gadoids, pleuronectids, herrings, and sand-eels, procured in the 'Garland' have a very wide distribution round our shores, while others, such as the wolf-fish have an area more or less restricted, a feature perhaps due to the demersal ova, and the comparatively large size and vigorous condition of the larval fishes. It is remarkable that no trace of the pelagic eggs of the frog-fish (easily recognised as a long gelatinous riband, especially after the blackish embryos are formed)

* I have to acknowledge the kind assistance of Mr Ernest W. L. Holt in looking over part of the collection, which was made by Mr Thomas Scott, F.L.S., on board the 'Garland.'

† *Trans. Roy. Soc. Edin.*, vol. xxxv. part iii.

has been found by scientific observers on the east coast. It should be carefully looked for in May, June and July—especially the two latter months.

The present series gives interesting phases in the life-history of the rocklings (*Motellæ*). These fishes live on the bottom in their adult state, and are widely distributed in British waters. The eggs and larval fishes are typically pelagic, while the early post-larval stages are often procured in the bottom-net. In the latter (earliest post-larval) stages neither Mr Prince nor the writer could see ventral fins, though Mr Brook has been more fortunate,* for he describes and figures them at very early stages. At any rate, these fins soon attain considerable size, as in the ling, and are remarkable for their conspicuous black pigment. The stages (5 to 8 mm.) furnished with long ventrals frequently seek the surface, as they also do at a much later stage when they are known as 'mackerel 'midges'. They afterwards go downwards, and remain on the bottom.

In the following notes on the preserved eggs the diagnosis cannot be upheld as absolutely certain in all cases, since many of the characteristic features disappear with vitality. It only carries us as far as our present knowledge goes, and since in some widely divergent forms, as for instance, the bib and the lemon-dab and the dab and the turbot, the eggs are nearly equal in size, there is occasionally room for doubt—especially as the eggs vary a little in each case.

Haddock.—The ova of the haddock appeared on the 4th and 5th February on Smith Bank, and shortly afterwards (6th and 7th) on well known grounds 22 to 25 miles south-east of Montrose. These pelagic ova abound all along the east coast till the end of April and perhaps even later. In the present collection they occurred in various parts of the Forth and St Andrews Bay—chiefly at the surface, though occasionally at the bottom, and the use of the trawl-like tow-net of the Laboratory shows that they are often abundant near the bottom.

Cod.—The eggs of the cod were captured both at the surface and the bottom—the first appearing on the 22d February in the Forth. This is one of the most common eggs, both at the surface and the bottom. The spawning period thus at least extends from February to May, though it is noteworthy that in 1884 ripe cod were first met with only in April. It is unsafe, however, to rely on the observations of a single year.

Bib.—Certain ova from St Andrews Bay in February and March correspond in size and appearance with those of the bib, which are a little less than those of the haddock.

Whiting.—Few ova of the whiting appear in the collection—though there is no reason why they should have been so scarce. They abound in April and May.

Ling.—A single egg, apparently of the ling, appears in the collection made on the fishing ground 22 to 25 miles south-east of Montrose. If the diagnosis be correct, this is considerably earlier than those procured from deep water and hatched at St Andrews, viz., in the end of April.

Rockling.—No egg is more generally distributed than those of the rockling, but it is possible that more than one species is included in the series: the size certainly varies considerably. Though these eggs are small, they are easily recognised by the bright oil-globule. They are very abundant in March and also in April and May.

Plaice.—The earliest pelagic ova in the collection are those of the plaice, which were procured in the Moray Firth on the 4th and 5th February. Ripe males were procured by the trawl on Smith Bank (where the pelagic ova occurred), but no ripe females. This may, however, have been accidental. In former years (*e.g.*, 1884) many fine

* *Proc. Lin. Soc.*, vol. xviii., p. 298, pl. x., fig. 11.

examples were trawled on the same ground at the end of the first week in April, but though nearly ripe, none were quite ripe. The pelagic ova are abundant towards the end of April. The spawning period of the plaice, therefore, would seem to extend from January to May, and it probably varies according to the nature of the season. As shown elsewhere, spawning plaice are extremely rare in such bays as St Andrews—the inshore waters being tenanted by the younger forms.

Long Rough Dab.—The ova of the long rough dab are not at present very clearly differentiated, though a partially ripe example procured during the trawling expeditions shows that the eggs are somewhat larger than those of the whiting.

Lemon Dab.—The eggs of the lemon dab, which in spirit have the size of those of the bib, appear in the collection from the Forth.

Common Dab.—The ova of the dab were captured in considerable abundance especially in March, but they are also common in April and May. In this collection they were chiefly from the surface both in St Andrews Bay and the Forth. In size they are only a little larger than those of the rockling.

Flounder.—Ova apparently agreeing with those of the common flounder came from St Andrews Bay and the Forth towards the end of March; they are plentiful in March and April in St Andrews Bay.

Unknown.—A considerable number of the large (Pleuronectid?) ovum B* (with large perivitelline space) occurred both in St Andrews Bay and the Forth, chiefly at the surface, but also at the bottom in St Andrews Bay. It is difficult to say with what species this egg is connected, yet it must be a common one, for it has been found regularly every season in March and April since 1884—both in St Andrews Bay and the open sea beyond. The brill is one of the pleuronectids—the eggs of which require investigation, for though Raffaele states that it probably has an oil-globule, still there is no certainty.

Gurnard.—It is remarkable that the ova of the gurnard are absent from the collection. The spawning period in the neighbourhood of St Andrews Bay is, however, later than that of most forms.

Dragonet.—A single egg of *Callionymus lyra*, the Skulpin, comes from the surface of the Forth, where I think Mr Cunningham formerly procured it. He also met with it off Millport. From its small size (resembling that of the rockling) it is apt to be overlooked, but the remarkable reticulation of its thin zona radiata is diagnostic. Dr F. Raffaele, in his valuable paper on the pelagic eggs and larval fishes of the Bay of Naples, describes the egg of *Callionymus festivus* as perfectly smooth and translucent, and suggests that perhaps I had examined an ovarian egg of *C. lyra* at St Andrews with the follicular layer still present. The description given in 1885, however, was correct, and the figures † of the ripe egg by Mr Prince make identification easy.

Sprat.—The eggs of the sprat appear from St Andrews Bay and the Forth in March and May. They are very frequently met with in April and May, and often in the bottom-net in profusion.

Turbot.—The eggs of turbot, again, appear somewhat later, for those removed from the ripe fish from 44 fathoms were procured in July, and at the same time many eggs agreeing in size were found at the surface. Like some other adults this species seems to spawn chiefly in deep water.

* "Development of Food Fishes," M'Intosh and Prince, *Trans. Roy. Soc. Edin.*, 1890, p. 853.

† *Ann. Nat. Hist.* (5), vol. xvi., pl. xiii. figs. 1–4.

LARVAL, POST-LARVAL, AND YOUNG FISHES.

St Andrews Bay.—In the beginning of March the bottom-net gave larval and early post-larval herrings, with post-larval examples of *Cottus.* A larval form apparently prematurely hatched from Pleuronectid ovum B. was also present. Minute sand-eels of several stages, post-larval armed bullheads, Montagu's suckers, a larval rockling and larval cod were added before the end of the month. Considerable obscurity still exists with regard to the development and earliest stages of certain of these common forms, such as *Agonus*, *Liparis montagui*, and even the cottoids, for there seems to be great variety in regard to size and coloration of the ova of the latter group. Post-larval flounders usually appear about the middle of April in the mid-water-net, and about the same time the older, though still very translucent, forms are found in the rock-pools. In the 'Garland' the first young flounders (pelagic) were captured in the bottom-net at the beginning of May, the eye being still on the ridge. On the same date the sand-eels and herrings have increased in size, and a larval lump-sucker was added to the list. The earlier post-larval cod are now increasing in length (6·5 mm.), the pigment along the sides is changing, and they generally occur in the bottom-net. On the 5th May some post-larval herrings had reached 16 mm., and the larval stage of *Cottus quadricornis*, the unknown post-larval E.,* and other forms previously noted occurred

The Frith of Forth.—One of the most interesting features in this region is the presence of the young of the wolf-fish (*Anarrhichas*), about $\frac{3}{4}$ in. long, at the surface, in February—showing that the escape of this species from the egg must take place at the commencement of the year. As usual in such cases a margin on either side of this date is necessary in defining the hatching period—some being earlier and others later. The coloration in this example differed from that of those reared in the Laboratory, the black pigment being characteristically grouped on the sides, anteriorly forming conical processes with their bases at the dorsum, but blending posteriorly into the ventral series below the lateral line. The pigment has not yet invaded the fins. This form apparently represented a very large example, since it could scarcely be relegated to the previous season. Others, from 19 to 20 mm. in length, were captured the first week in May, likewise at the surface, and in these the characteristic grouping of the pigment-bars was also evident. The more direct exposure to light in the glass vessels of the Laboratory, as in the case of the pleuronectids and others, rapidly increases the pigment in these young fishes.

Amongst other forms young clupeoids $1\frac{1}{4}$ in. long occurred in the bottom-net off Bo'ness in February. In March larval cod, *Cotti* and post-larval D.† about 11 mm. In April post-larval plaice, herring, *Cotti* and *Agoni.* In May larval haddock, rockling, post-larval cod 6 mm., young sand-eels 12·5 mm., *Cottus* 12 mm. long, pleuronectid, and Montagu's sucker (?) were procured. In June a young turbot of 9 mm., and a grey gurnard of 13 mm. appeared at the surface. The occurrence of young dragonets at the end of July, in the bottom-net, and of herrings (18 mm. long) in October (autumnal brood) completed the series.

* "Development of Food Fishes," M'Intosh and Prince, p. 861.
† *Op. cit.*, p. 860.

LIST OF SOME OF THE PELAGIC OVA, LARVAL, AND YOUNG FISHES, OBTAINED BY THE 'GARLAND' IN 1890.

I. Moray Frith.

February 4 and 5. Numerous ova of plaice. One egg of haddock.

Smith Bank.—Surface-net (1st trawl), 24th May. Numerous young rocklings, 5 to 8 mm., young gadoids, 10·5 mm.

Smith Bank.—Surface-net, 5th June. Young grey gurnard, 13 mm., young turbot, 9·5 mm.—right eye appearing on ridge.

Station V.—Moray Frith.—Surface and bottom-nets, 27th May. Post-larval pleuronectids, 5·5 to 10 mm., young gadoid, 15 mm., *Cottus*, 6 mm., young flounders (dabs?), 12–13 mm.—eye on ridge or over.

Station VI.—Moray Frith.—Surface-net, 27th May. Young green cod, 22 mm., young flounders, 13 to 13·5 mm., young *Motellæ*, 9 mm., young *Cottus*, 11 mm.

Station VI.—Bottom-net, 27th May. Numerous gadoids from 7 to 17 mm., with the abdomen pinkish from crustacean food, pleuronectids (plaice?), 7 to 11·5 mm. Eyes lateral.

Stations I. and II.—Bottom-net, 29th May. Post-larval gadoid, 6 mm., flounders, 3·5 to 8 mm. (eyes lateral), *Motella* and Montagu's sucker.

Off Lossiemouth.—Deep-water (bottom?), 28th May. Post-larval gadoids, 5 to 8 mm., young flounders, 12 mm.—eye on ridge or approaching. Post-larval *Motellæ*, 5·2 to 7·5 mm.—long ventral fins.

Cromarty Frith.—Bottom-net, 26th May. Gadoids, 7 and 17 mm., flounders, 9·5 and 11 mm. Eyes on ridge. Numerous gobies (*G. minutus*?), 3 to 8 mm.

II. Off Montrose.

February 6 and 7. 22–25 miles off Montrose. Eggs of plaice and haddock. Egg of ling.

Station I.—Montrose.—Bottom-net, 19th May. Post-larval flounders, 5·5 to 12·3 mm., post-larval gurnard, 16 mm., young *Cottus scorpius*, 17 mm.

Station II.—Montrose.—Bottom-net, 19th May. Post-larval flounders, 5·5 to 12·5 mm., post-larval sand-eels, 15 to 20 mm., young Montagu's sucker, 12·5 mm.

III. St Andrews Bay.

Station V.—3d March. Bottom-net. Post-larval *Cottus*. Two larval herrings.

Stations I. to V.—March 3 to 5. Young sand-eel. Post-larval *Cottus*. Early post-larval herrings 8 mm. long. Unknown post-larval D.* Pleuronectid larva B.† apparently prematurely removed.

Station I.—5th March. Bottom-net. Ova of cod (?) and sprat. Post-larval herrings, and sand-eels of 2 stages.

Station V.—Bottom-net, 26th March. Young sand-eels 17 mm. Post-larval *Agonus* (armed bull-head). Post-larval herrings and *Cottus* (with large pigment spots on head).

Station IV. and Station V.—Surface-net, 26th March. Eggs of plaice, haddock, and dab. Larval cod and *Motella* (rockling). Post-larval sand-eels, *Cottus* and *Agonus*.

* *Op. cit.*, p. 853. † *Op. cit.*, p. 853.

Station I.—Surface-net, 28th March. Eggs of haddock, bib (?) cod, whiting, rockling, pleuronectid B.* and dab.

Station III.—Bottom-net, 28th March. Egg of pleuronectid B. and of rockling. Larval herrings—some with yolk-sac, others 11 mm. long, post-larval sand-eels—2 stages, Montagu's sucker, and *Agonus.*

Station IV.—Bottom-net, 1st May. Larval rockling. Young flounders (still pelagic). Post-larval herrings, sand-eels, Montagu's sucker and *Cyclopterus* (lump-sucker).

Station V.—Bottom-net, 1st May. Eggs *Motella*-like though larger (about 800 mm.†). Post-larval cod, 6·5 mm. Young flounders (eye appearing on ridge).

Station II.—Bottom-net, 2d May. Young flounders as before. Post-larval H.* Post-larval *Motellæ*, 3·5 mm., no ventral fin.

Station I.—Bottom-net, 2d May. Post-larval cod, herring (16 mm.), flounder (2 stages), post-larval *Motella* 3·5 mm. and *Agonus.* Larval Montagu's sucker. Young Montagu's sucker.

Station III.—Bottom-net, 2d May. Young flounders, as before. Post-larval plaice (?). Young sand-eels, herrings, and Montagu's sucker.

No label.—Probably from St Andrews Bay, in March or April. Eggs of flounder (?), post-larval flounders, sand-eel, cod, *Cottus,* young Montagu's sucker (one very pale).

IV. The Frith of Forth.

Station VI.—Surface-net, 21st February. Young wolf-fishes, $\frac{7}{8}$ inch.

Cross-Section I.†—Surface-net, 22d February. Eggs of plaice, haddock, cod, whiting (?), dab.

Off Bo'ness.—Bottom-net, 28th February. Young clupeoids (probably herrings), $1\frac{1}{4}$ inches.

Station VII.—Bottom-net, 14th March. Larval cod, post-larval *Cottus*, post-larval D.

Station VIII.—Surface-net, 18th March. Eggs of haddock, pleuronectid B., plaice and dab.

Station VIII.—Bottom-net, 18th March. Post-larval D. about 11 mm.

Cross-Section III.†—North-half, surface-net. 21st March. Eggs of haddock, rockling (many), pleuronectid B., plaice, dab (many), flounder (?).

Station I.—Bottom-net, 19th April. Post-larval plaice (?), herrings, *Cottus*, and *Agonus.*

East of Inchkeith.—Mid-water net, 3d May. Post-larval cod, post-larval sand-eels, *Cottus*, 12 mm. long.

Station I.—Surface-net, 7th May. Post-larval cod, 6 mm., young flounders (dabs ?), 15 mm. (eye on edge), young sand-eels, 12·5 mm., *Cottus*, and *Motella*, 4·5 mm. with long ventrals.

Station II.—Surface-net, 7th May. Egg of lemon-dab (?), eggs of sprat, skulpin (*Callionymus lyra*). Larval cod, haddock, and rockling.

Bass Rock, West by North.—Surface-net, 7th May. Young lemon-dab (?) 25 mm., wolf-fish, 19–20 mm.

Station IV.—Net (bottom ?), 13th May. Post-larval herring, sand-eel, D., Montagu's sucker.

Station III.—Forth—Bottom (?), 16th May. Post-larval pleuronectids, 7·2 mm., young pleuronectids, 14 mm.—eye near ridge, young *Motellæ*, 4 mm.

Station VII.—Forth—Bottom (?), 15th May. Post-larval cod, 7 mm.,

* Pelagic Fauna, Seventh Annual Report Fishery Board, 1889, p. 308, Pl. iv. fig. 1.

† Cross-Section I. is at the mouth of the Frith, between Fife-Ness and the Bass; Cross-Section III. is east of Inchkeith, between Buckhaven and Prestonpans.

sand-eel, 13 mm., post-larval pleuronectids, 6·5 to 13 mm., post-larval *Cottus*, post-larval Montagu's sucker, young *Agonus*.

Station I.—Bottom-net, 30th July 1889. Young skulpins (*Callionymus lyra*)—2 stages.

Forth.—17th October 1889. Young herrings, 18 mm.

V. Aberdeen Bay.

Station I.—Aberdeen.—Surface-net, 20th May. Egg of lemon-dab (?), two kinds of flounder—one of which is probably plaice and another probably dab, both dextral; young gadoids, as before, only none so small and none so large, the largest being about 14 mm.; the flounders were about 10·5 mm. in length, and none so small as before.

Station I.—Aberdeen.—Bottom-net, 20th May. Sand-eel, 22 mm. in length, small cod, 7·5 mm., the longest being about 12 mm., flounders (dextral) from 6·5 mm. to 12 mm. in length.

Station III.—Aberdeen.—Bottom-net, 20th May, 11 a.m. to noon. Many young gadoids, varying from 7 to 20 mm., young flounders (post-larval plaice &c.), from 6 to 14 mm., young sand-eels, from 16 to 23 mm., post-larval *Motella*.

Station V.—Aberdeen.—Bottom-net, 22nd May. Young gadoids as before, flounders, as before, young *Cottus*; smallest gadoid, 8 mm., largest, 20·5 mm., smallest flounder, 6·5 mm., largest, 15·5 mm.

Station VI.—Aberdeen.—Bottom-net, 22nd May. Same as before (V.).

Station VII.—Aberdeen.—Bottom-net, 22nd May. Young gadoids, 7 to 25 mm., young flounders, 7 to 12 mm. (eye on ridge), young sand-eel, 27 mm., young gurnard, 34 mm., young *Cottus*, 5 mm., young *Agonus*, 8 mm. (*vide Trans. R.S.E.*, vol. xxxv. p. 864, pl. xviii., fig. 10.

V.—ON THE DEVELOPMENT OF THE COMMON SCALLOP (*Pecten opercularis*, L.) BY J. H. FULLARTON, M.A., D.Sc.

(Plates V.–VIII.)

The Common Scallop—*Pecten opercularis*, L., exists in great abundance in the Firth of Forth. The beds there, supplying annually to the fishermen of the neighbouring shores above 1000 tons, which are entirely used for bait, have already been described by the writer.*

During the summer of 1889 the Fishery Board for Scotland instructed me to proceed to Cockenzie, a fishing village on the shores of the Forth, to study the development and life-history of the Scallop or Clam as it is known locally, and that was undertaken so far as the appliances at my command permitted.

Nothing, so far as I am aware, has been done in the investigation of the life-history of the developing embryos of the Common Scallop, though Lacaze-Duthiers has figured the ova and spematozoa of *Pecten glaber* and *P. varius*. Before, however, dealing with embryological details, there are certain points connected with the sexual organs which should be mentioned. Like the Monomyarian oyster the genus *Pecten* is hermaphrodite. The sexual organs of *P. opercularis* (pl. viii. fig. 34, *ov.* and *t.*), chiefly lie posterior to the rudimentary foot. They form a prominent abdominal mass stretching to the middle of the under surface of the single large adductor muscle. Relatively to the adductor they are situated anteriorly and inferiorly; the anterior end lies on the under surface of the liver, close behind the mouth. Slightly constricted behind the foot they gradually increase in size posteriorly till they attain their greatest breadth nearly opposite the posterior end of the organ of Bojanus (*k.*). From this they taper quickly, and end in a blunted point. Their ventral outline is markedly convex, while the dorsal boundary, where this is separable from the subjacent tissues, is concave. The hinder pointed end of the organ is free, but half the distance from the posterior end of the organ of Bojanus it is connected to the tissue that covers the undersurface of the adductor and the large parieto-splanchnic ganglion. From its posterior point of connection forwards, it is in a more or less close union with the subjacent organs and tissues. Where it lies on the adductor muscle, it is easily separated from the muscle, but anterior to this it is in close union with the adjoining tissues. It is interrupted by the foot, and, internally, by the coils of the intestine. The greater portion of the organ posterior to the foot consists of generative tissue, but anterior to the foot it simply forms a thin covering of tissue on other organs.

The ovigerous area (*ov.*) of the hermaphrodite organ is at the hinder blunted end, and its colour marks its anterior boundary from the male portion (*t.*) The bounding surface line between the two kinds of tissue is very irregular in different individuals. In some examples the ovarian tissue comes further forward, and overspreads the spermatic tissue, while in others, as we cut into the organ, it is seen that the ovarian tissue is as far forward in the deeper layers as it is on the surface. Generally the ovary occupies about one-third of the mass, and the lobes of the ovarian tissue dove-tail into the lobes of the testes, so that the surfaces of contact are very uneven, forming in fact, a series of pits and prominences. The intestine sometimes winds into the ovarian mass, but it is for the most part confined to that part of the organ which functions as testes. The latter is interrupted by the foot, but otherwise it covers the whole of the remaining surface from ovary forwards to near the mouth.

* *Seventh Annual Report of the Fishery Board for Scotland*, Part III. p. 341.

After the discharge of the generative products, the organ is in a collapsed condition, and exhibits a light brown or cream colour. When, however, the reproductive tissues become active, the flabbiness disappears, and the organ increases in size, the colour changing with the increase in size. The testes become white and opalescent, while the ovary assumes a reddish tinge. The colour of the latter becomes more pronounced, passing from a pale red to a bright scarlet, and often a rich vermilion. Sometimes the opalescence of the testes persists, but generally these become cream coloured on the ripening of their products. During this alteration in colour of the sexual organs they gradually pass in shape from the collapsed rounded form to a knee-shaped form, flattened laterally; this form, flattened laterally, fills up so that in transverse vertical section its ellipsoid shape becomes at some parts nearly circular.

The products of the generative organs in the same individual do not ripen at quite the same time. When the ova are ready to be shed, the spermatozoa have either been shed, or they are not quite ripe. Some have been found with ova quite ripe and spermatozoa not ripe, while the converse has also been the case. The interval, however, that separates the ripening of both is not many days at most; in some scarcely has the one organ collapsed when the other immediately succeeds.

As Lacaze-Duthiers* has noticed, the generative products do not pass directly to the external medium, but into the organ of Bojanus. He figures the generative duct in *P. varius* and *P. glaber*, as opening into the anterior end of the cavity of the organ of Bojanus, but in *P. opercularis* (*g.d.*), so far as made out by the injection of coloured fluids, the openings are not always quite so far forward, nor are they so distinctly seen as in *P. varius*. The hermaphrodite duct runs for a short distance alongside of the organ of Bojanus, and in some cases at least opens into the organ of Bojanus between the anterior extremity and the middle of that organ. The external and common opening (*k.o.*) for the discharge of the renal and generative products is at the posterior apex of the organ of Bojanus, and can easily be found either by puncturing the walls of the organ of Bojanus, and inflating it, or by using the blowpipe close to the posterior apex, when the rush of air into the organ reveals the presence of the external opening.

From the organ of Bojanus of either side (the organs are quite separate) the common generative duct runs backwards for a short distance close to the surface of the testes, and then divides into two branches, one of which ramifies chiefly in the testis, while the other branches for the most part in the ovary. The canals repeatedly divide and redivide, and the course of these, on the surface especially, is easily traceable by employing coloured injections. While one of the two main canals functions principally as an oviduct, and the other as a vas deferens, yet small branches of each convey also products of the other sexual organ to the cavity of the organ of Bojanus. The postero-dorsal branches of the hinder of the two main canals are exclusively oviducal, while the anterior or sub-hepatic branch of the main testis-canal is entirely spermatic, but many of the smaller canals between these act as both oviduct and vas deferens.

The reproductive products are apparently discharged at once to the exterior, for after often repeated examinations of sexually mature forms I was unable to find in the organ of Bojanus, or even within the valves of the shell, either ova or spermatozoa. Fertilisation therefore must take place in the surrounding water, and the dispersion of the generative products is well provided for by the continual flapping motion of the valves even in gravid specimens.

* "Organes Genitaux des Acephales Lamellibranches," *Ann. de. Sc. Nat.*, Ser. iv, tom. i.

In the waters of the Firth of Forth, the reproductive activity of the Scallops extends over a lengthened period of the year. At the end of February and beginning of March specimens were obtained with reproductive organs having the characteristic colour which the sexually mature forms exhibit. The number, however, in this condition in the early spring was not numerous; but as the season advanced the proportion with ripe reproductive organs increased, till in July and August a maximum was reached. In those months almost all of the forms dredged from a particular area were ripe, but as September was approached the specimens taken from the same area showed by the colour of their reproductive organs, and by the diminished size of these, that the period of spatting was drawing to a close. In this same area towards the middle of September hundreds might be examined without a single ripe specimen being found. During September, when ripe forms were desired, these were obtained from ground about a mile eastwards from the dredging ground of the previous months. This is interesting, as showing how, in the same species on neighbouring bottom, the spatting period may differ to the extent of a month or even two. As the season progressed, and in October, the condition of the generative organs showed that the sexual products had been shed. In the beginning of October it was still possible to obtain a few ripe forms, but not without examining large quantities taken by the dredge.

On the whole, while reproductive activity was most marked in the summer months, the spatting period of *P. opercularis* on the Forth clam beds has a much wider range. In the summer of 1889 it reached its maximum in the beginning of August, and in September immense numbers of free swimming larval Lamellibranchs, which I took to be *P. opercularis*, were obtained by the tow-net worked at various heights above the beds.

The method adopted in fertilising was to cut out the ovarial and seminal parts of the 'tongues' from a dozen ripe animals into two glass vessels. The ovarial portions were separated roughly from the testicular, and minced fine, and then strained through very fine muslin into the vessel partially filled with clear sea-water. The spermatic portions were similarly dealt with, and the filtered contents of this vessel were added to the vessel containing the ova. The whole was stirred and allowed for some time to settle, when the supernatant water was decanted off, and a fresh supply of sea water introduced. The changes of this water were frequent at first, but, notwithstanding, the death-rate was occasionally very large. More than once the brood was entirely destroyed; especially if the fluid was allowed to stand for a few hours too long before being changed the death-rate was increased, and the decaying dead forms brought about the death of the remainder. One or two difficulties were experienced which militated against successful hatching. One was the getting of sufficiently clean water for the small glass aquaria. Time after time the whole of the embryos were lost from the continuing accumulation of fine sediment that settled on the bottom of the aquaria in spite of the precautions taken to obtain clear water, by filtering, a necessity in the absence of settling ponds. A substitute for these last was found in carrying the water from the hollows in the rocks situated between tide marks. These hollows acted as miniature settling ponds, and the water was carried about three hundred yards to the wooden sail-shed (part of which was placed at the writer's disposal), where the glass aquaria were. The dust at all times so abounded in the atmosphere of this temporary structure that it was extremely difficult to keep it from entering the aquaria, although these were covered to prevent the entrance of dust.

When liberated artificially from the ovum the ovarian cells are more or less irregular in shape, being generally polyhedral and drawn out into a short stalk-like portion. If the unfertilised eggs so liberated are ripe, or nearly ripe, they quickly separate from each other, but if a mollusc is selected where the eggs are not mature, they remain adherent to each other for some time. In these irregular ovarian cells there is a large quantity of nutritive matter of a brown or brownish green, but not so much as always to obscure the clearer nucleus. The peripheral portions of these cells are somewhat clearer than the central parts.

When, however, the ovary is of the characteristic brilliant reddish-brown colour already noticed, the artificially liberated eggs soon assume a regular spherical form (Pl. V. fig. 1). The ovum having assumed this symmetrical shape, the distribution of the deutoplasmic granules in the vitellus is more uniform. From the time of liberation of the ova till the redistribution of the deutoplasmic granules and the assumption of the spherical form, it takes, in the case of very mature cells, only a few minutes, but in other cases half an hour elapses between the polyhedral and perfectly spherical stages, the rate of alteration being perhaps also dependent on the temperature.

In the ripe unfertilised and spherical ovum the nucleus (Pl. V. fig. 1) is not so apparent as in the irregular polyhedral cell. This is due to the difference in distribution of the deutoplasmic granules, whose brownish-green colour completely obscures the nucleus. Notwithstanding, in some of those of a perfectly spherical shape, both a nucleus and nucleolus is distinctly seen. These, however, are the exception and not the rule. The vitelline membrane is clearly visible in both forms of ova. As in other Lamellibranch ova such as the common mussel,* *Mytilus edulis*, and *Cardium pygmaeum*,† at times outside of the bounding wall of the ovum, and enveloping it, one can see a hyaline investment, which, however, is so perfectly transparent that it is not easily made out. When the granules of deutoplasm do not obscure the nucleus, this is seen to have a diameter rather greater than one-third of the diameter of the ovum. The nucleolus when seen is not sufficiently clear to reveal a regular chromatin structure, though there is an indication of differentation by the manifestation of a difference in the contents. The size of the ovum is ·068 mm. When the testes are mature, the spermatozoa (Pl. V. fig. 2) exude as a milky white fluid on the organs being punctured. When minced, and when some of the particles are transferred to a slide, along with the motile spermatozoa are found numerous spermatoblasts. The spermatoblasts (Pl. V. fig. 3) are ovoid bodies, and when ready to liberate the spermatozoa the tails of the contained spermatozoa project from the surface and perform vibratile movements. The spermatoblasts exhibit certain clear vesicles—the mother sperm cells —and are found in abundance. Though the spermatozoa may, when liberated articially from the testes, be united in bundles, yet the heads quickly separate, and the individual spermatozoa move away from each other by the action of their tails and by any currents set up in the fluid under the cover glass. Amongst the specimens examined, it was now and again difficult to obtain individuals with ripe spermatozoa, the proportion of animals with ripe ovaries in some hauls of the dredge being greatly in excess.

The spermatozoon differs slightly in shape from those of *P. varius* and *P. glaber*, as figured by Lacaze Duthiers.‡ The head is ovate, but somewhat drawn out at the apex, presenting in fact an intermediate shape between the very pointed spermatozoon of the mussel as drawn by Wilson,§ and the blunted apices of *P. varius* and *P. glaber*. The spermatozoon figured is magnified 1300 times.

* Wilson, "On the Development of the Common Mussel," *Fifth Annual Report of the Fishery Board for Scotland*, p. 247, 1887.

† Loven, "Bidrag til Känned. om Utweckl. af Moll. Acephala Lamellibr.," *Vetensk. Akad. Handl.*, 1848 (Translation, *Archiv. f. Naturg.*, 1849).

‡ *Loc. cit.* § *Loc. cit.*, plate xii. fig. 33.

Many spermatozoa are seen endeavouring to bore their way into the ovum at different points of its surface, and the heads of some at least have succeeded, as is shown by their disappearance into the vitelline membrane, while the vibratile tails project from the surface of the bounding membrane. The changes resulting inside the ovum are cloaked by the abundant deutoplasmic granules. Most of my observations were made on living ova, in which it is impossible to see the phenomena connected with fertilisation and the expulsion of the polar globule (Pl. V. fig. 4, *p.g.*). Moreover, in those ova which I fixed, stained, and mounted, the alterations were not visible. Whatever the changes may be that supervene on the union formed, the result is apparent in the subsequent activities of the coalesced products.

The polar globule extruded by the ovum, so far as seen, is not stalked but sessile, and in many cases it persists till the oosphere has undergone repeated segmentation. When seen in the segmenting oosphere, though not distinctly stalked, it is generally ellipsoidal in shape.

While these changes are in progress, the ova, which on liberation have descended to the bottom of the glass aquaria, remain there unless stirred up, as it is advisable to do when the contents of the spermatic vessel are mixed with the water containing the ova. They rapidly settle again upon the bottom till they develop to a stage when they are clothed with cilia, and freely move about.

A very marked feature in the active cell, in several fertilisations which were effected, was the great number of irregular changes simulating segmentation that took place. The protoplasmic contents were continually undergoing change, and the number of vesicles which were budded off and reabsorbed into the cell from which they arose was so varied, that within four hours upwards of 80 distinct shapes were assumed by the cell or by the mass. Sometimes the periods of activity were intermittent, and resting stages occurred during which no change in shape took place. During these resting stages, although the shape of the mass remained the same, there might be exhibited a regrouping of the contents of the cell and vesicles, but the regrouping was not so manifest as in the formation of the vesicles, when the protoplasmic flow into the vesicles was very apparent. The vesicles at first were colourless, but the deutoplasmic granules carried in the stream soon coloured them. A characteristic of such a cell was the smaller quantity of deutoplasmic granules present in it as compared with a normally segmenting cell. After a period of rest a fresh spurt of activity ensued, the coming changes being presaged by the clearing up of the cell contents at the point where the alteration was to take place. Though I watched a single changing cell of this character for a whole day, I never was able to ascertain whether any progressive development took place, or whether the alterations were a sign of pathogenetic forces at work. The result of several hours of change, with intervening resting stages, was that the object generally assumed the form of a single cell, indistinguishable from the cell from which the serial changes started. Undoubtedly some of the changes that took place are comparable with what Brooks * observed in the American oyster, *Ostrea virginica*, but as I never found that the cell, which had exhibited this false segmentation, after it had returned to its original shape, underwent further development, I prefer to regard it as simulating segmentation, and not merely a departure from the normal type of segmentation which was now and again the case. The last exhibited progressive development and the segments differed only in their arrange-

* "The Development of the Oyster," *Studies from Biological Laboratory of Johns Hopkins's University*, 1880.

ment from the normal, while the vesicles in the first, both in their mode of origin, shape and grouping, diverged widely from the regular and irregular types of segmentation.

In order to arrive at the order of development, it is impossible always to have the oosphere under observation, so the following account of the segmentation of *Pecten opercularis*, L., while in some instances recording the successive stages of development in one oosphere, is built up from examination of many specimens, confirmed by parallel phenomena repeatedly exhibited by other oospheres.

After fertilisation and the expulsion of the polar globule, there is no visible alteration in the oosphere for a few hours. When this period of rest has lapsed, the protoplasmic contents become much clearer at one place. This affords an index of the formative or animal pole. The oosphere ceases to be spherical, and becomes pear-shaped by the prolongation of the clear end into a blunted or lobate process (Pl. V. fig. 5). This lobate process is gradually drawn out (Pl. V. fig. 6), and its transparent point becomes darker, while a constriction appears at the base, and the oosphere is segmented into one macromere and one micromere, the micromere occupying the formative or animal pole (Pl. V. fig. 7). The polar globule (*p.g.*) is usually found in the furrow between both cells (Pl. V. fig. 8), but sometimes it is situated at the distal pole of the micromere (Pl. V. fig. 7), as Moebius * has observed in the oyster. Neither at this nor at any subsequent stage has anything been seen corresponding to the lenticular bodies, which Bobretzky † describes and figures for *Nassa mutabilis*, and Wilson ‡ for *Mytilus edulis*.

The micromere is at first sharply marked off from the macromere, but in a few minutes the surface of contact between the two is increased, and they are flattened against each other. The macromere becomes clearer near the furrow between it and the micromere, and a second micromere is budded off from it (Pl. V. fig. 9). The contact surfaces of the micromeral cells are flattened, and the appearance of the oosphere is as in fig. 9. Although at this point the micromeres generally subdivide, yet the macromere may again become active, when a third micromere is formed at its expense (Pl. V. figs. 10 and 11). Whether, however, this last micromere is adjacent to that first formed or to the second one, was not observed. The micromeres are rounded on the peripheral part of the oosphere, but became flattened against the micromere.

While these changes were going on, after the extrusion of the polar globule, no nucleus was plainly visible either in the ovum or in the macromere or two micromeres, but when the oosphere had reached the four-celled stage the segmentation nuclei were manifest. In fig. 10 the micromeres are flattened against the macromere, but in fig. 11 they are more rounded, and the polar globule is seen projecting beyond the middle micromere. The micromeres are now active, and each subdivides into two. The subdivisions arising from the oosphere with two micromeres, and that with three micromeres give rise to oospheres of one macromere and four micromeres (Pl. V. fig. 12), and of one macromere and six micromeres respectively (Pl. V. figs. 13 and 14). In some cases the area of attachment of the micromeres and macromere is greater than in others. This corresponds with the differences exhibited in figs. 13, 14, 15, 16, and 17. Where the area of attachment is greatest, the oosphere shows polar flattening; where the micromeres are more crowded round at the formative pole the oosphere is elongated in the direction of the polar

* *Die Auster und die Austernwirthschaft*, 1877.

† *Vide* Balfour, *Comparative Embryology*, vol. i. p. 292.

‡ *Loc. cit.*, p. 251.

diameter. A similar change is manifest in the direction of the junction lines running between the macromere and micromeres. In figs. 15, 16, and 17 segmentation has proceeded at the expense of the micromeres previously formed; in fig. 17 the macromere appears more or less helmet-shaped, in fig. 15 it is nearly circular, while in fig. 16 the macromere is flattened at the side next to the micromeral segments, while it is rounded at the nutritive pole. Fig. 15, therefore, shows that the micromeres have spread over a greater proportion of the surface of the macromere than in either fig. 16 or fig. 17. The tendency of the micromeres at each new subdivision is to extend themselves along the surface of the macromere, and envelope it. In fig. 17 (Pl. VI.) the clear hyaline membrane which is also seen to envelope some of the ripe unfertilised ova is shown.

As segmentation proceeds the spherical shape is lost, and just before the subdivision of the macromere, which is almost invested by the numerous micromeres, the oosphere is hat-shaped, with the macromeres projecting from the under surface (Pl. VI. fig. 18).

The oosphere is now composed of one macromere and numerous micromeres. The macromere begins to segment, the first division resulting in the formation of two equal cells (Pl. VI. fig. 19). These two cells are seen through the micromeral segments in fig. 19, and the appearance of the oosphere in side view is as represented at fig. 20. The micromeres which form the ectoderm have in great measure enveloped the two macromeres, which are the first two cells of the entoderm. If fig. 19 be compared with the same stage as is represented by Horst * (fig. 6), the likeness between the European oyster at this stage and fig. 19 will be manifest. The two macromeres become subdivided, and the oosphere is as drawn in Pl. VI. fig. 21, where the four macromeres are visible through the enveloping ectoderm. In figs. 19 and 21 the margin of the oosphere, or periphery, exhibits a somewhat crenate outline, which is also seen in the two succeeding stages. While the cells of entoderm continue to divide (Pl. VI. figs. 22 and 23), they become completely closed in by the ectodermic layer. The oosphere has now a covering of cilia as represented in fig. 22, and the embryo performs a rotary motion, circling on its own axis, sometimes without moving away from the field of vision of the microscope, at other times making excursions out of the field. Fig. 22 was drawn during a period of rest, which, however, is always of short duration. Fig. 23 shows at least eight cells of entoderm encircled by the ectoderm with two cells at the blastopore, and is the first stage at which the gastrula with macromeral cells as guard cells was seen. A gastrula fixed and stained showing the segmentation nuclei, is represented at fig. 24. Here also the surface continuity is interrupted at one point, *bp*, the blastopore. The embryo (Pl. VII. fig. 25) is now composed of a series of clearer peripheral cells clothed with cilia and darker central cells. By leaving the ciliated embryo in a small quantity of sea water in a watch glass till the water was reduced by evaporation, I found that the embryo became cleared up (Pl. VII. fig. 26). Numerous small clear vesicles as well as granular particles could be seen all over the surface of the embryo, and in fig. 26 two cells projecting beyond the periphery were seen. Whether these projecting cells have any significance, further observations on other specimens did not throw any light on the subject.

The next significant advance in the development of the embryo is the appearance of a recurved-like furrow (Pl. VII. fig. 27) proceeding from a smaller depression, *sp*, on the rounded surface of the embryo. This is indicated in fig. 27 in a living and actively moving embryo, and in fig. 28, which was fixed and stained. In the latter it is seen to occupy a position

* De ontwikkelingsgeschiedenis van de Oester (*Ostrea edulis*), 1884.

some distance along the surface from the blastopore, and as Horst * has pointed out in the case of the European oyster, as development advances, it is seen at the dorsal pole of the animal (Pl. VII. fig. 30). This figure shows that the primitive shell of the embryo is in the same position as that occupied by the depression in figs. 27 and 28, and I believe that this depression in *Pecten opercularis*, as figured in 27, corresponds to the depression noticed by Lacaze-Duthiers † and by Davaine ‡ in the oyster, and so fully described by Horst in the same species. On comparing this figure with that of the same stage (fig. 32) of *Ostrea virginiana*, observed by Brooks,§ it appears to me likely that the dorsal depression which he regards as the blastopore, or opening of the primitive intestinal canal, is, as Horst rightly suggests, the depression of the preconchylian gland. Lankester § was the first to discover the organ in *Pisidium*, and in some gasteropods, and subsequently Hatschek || described the same organ in *Teredo.*

The relative position of the blastopore and the preconchylian gland is shown in figs. 28, 29, and 30. In fig. 29, which is a drawing of this stage, the embryo exhibits the velum, *v*, as foot-like structure projecting between the blastopore and preconchylian gland. Here it is seen to occupy only a very small portion of the oosphere, but in fig. 30 the velum is of much greater size, and the blastopore is further apart from the developing shell. In one specimen a distinct area, covered by the growing and extending valves of the shell, was manifest on one side, and a few clear vesicles were seen within the body of the embryo. The form is very irregular, and differs from the spherical form by a lobate process which projects (figured at the bottom of the drawing), and may possibly be the representative of the velum, though the cilia with which it is beset do not differ in length from the cilia covering other parts of the body. It is a highly irregular form, and but for the indication of the shell valve its right to be regarded as a stage at this point of development might be denied.

In my observations a hiatus occurred here, and the next stage seen had a pair of very well developed shell valves. Fig. 32 is a view of the dorsal surface of the embryo, which shows the slightly divaricated valves of the shell above the large velum, which is extended beyond the margins of the valves. An indication of the liver is apparent through the valves by the dark patches shown on either side of the middle or hinge line. Fig. 33 gives a lateral view of the embryo, with the velum partially extended. At the middle of the crown of the velum is a darkened patch, *c.d.*, indicating the cephalic disk present also in other Lamellibranchs, but there is no flagellum present on the velum. The long row of cilia are seen on the velum, and posterior to it is the opening of the mouth, *m*. This leads by a ciliated canal or œsophagus, *œ*, the cilia being in constant motion upwards till it is hidden by the dark lobe of the liver, *lv*, which is also seen to obscure the ventral half of the stomach, *st*. The intestine, *in*, is visible at one or two points, a loop being covered by the stomach and liver; the rectum, *r*, is seen to run downwards and backwards till it opens (near the mouth) at the anus, *a*. Two velar muscles for retraction are seen, one being posterior, *pr*, and the other anterior, *ar*, both indicating a bifurcation at

* *Loc. cit.*, pp. 287, *et seq.*

† "Memoire sur le développement des Acephales lamellibranches," *Comp. Rend. de l'Ac. de Sc. de Paris*, vol. xxxix. p. 103; and "Nouvelles observations sur le dévelopement des huîtres," *Idem.*, p. 1197.

‡ "Recherches sur le génération des huîtres," *Comp. Rend. de la Soc. de Biol.*, vol. iv., p. 297.

§ "Contributions to the Developmental History of the Mollusca," *Phil. Trans.*, vol. 165.

|| "Ueber die Entwicklungsgeschichte van *Teredo*," *Arb. Zool. Inst. Vienna*, vol. iii.

their velar ends. The anterior adductor, *ad*, is well developed in front of the velum, and at the upper angles of the valves near the hinge line are a number of small oval cells. The indications of the mantle are shown both posteriorly and anteriorly.

Although this was the most advanced larva which I succeeded in rearing in the glass aquaria, I obtained by the tow-net free swimming veliger larvæ, with distinct heart, gill papillæ, and other organs.

EXPLANATION OF THE PLATES.

Fig. 1. Egg of the Scallop (*Pecten opercularis*, L.), showing the nucleus and nucleolus within the vitellus. Zeiss Oc. 3, lens D.

Fig. 2. Spermatozoon. Zeiss Oct. 4, Seibert $\frac{1}{16}$ im. lens.

Fig. 3. Spermatoblasts showing spermatozoa with heads imbedded and free tails.

Fig. 4. Ovum showing polar globule on circumference; the nucleus has become invisible. Zeiss Oc. 3, lens D.

Fig. 5. Oosphere, with animal pole drawn out.

Fig. 6. Oosphere, with animal pole more drawn out.

Fig. 7. First stage of segmentation; the oosphere has become divided into a macromere and micromere, the polar globule being visible near distal pole of the micromere. Zeiss Oc. 4, lens A, doubled.

Fig. 8. First stage of segmentation, the macromere and micromere are flattened against each, and the polar globule is seen in the furrow to the right. Zeiss Oc. 4, lens D—one-third less.

Fig. 9. Second stage of segmentation; oosphere of one macromere and two micromeres. Zeiss Oc. 4, lens A, doubled.

Fig. 10. Oosphere of one macromere and two micromeres; the nuclei of the segments are visible.

Fig. 11. Oosphere of same stage as preceding, with micromeres more rounded and polar globule seen opposite middle micromere.

Fig. 12. Oosphere of one macromere and four micromeres, with polar globule between macromere and micromere.

Fig. 13. Oosphere of one macromere and six micromeres. Figs. 9–13. Zeiss Oc. 4, lens A, doubled.

Fig. 14. Oosphere of same stage as preceding, but not so flattened. Zeiss Oc. 4, lens D, one-half.

Fig. 15. Oosphere of one macromere and numerous micromeres, the latter extending half-way round the former.

Fig. 16. Oosphere of one macromere and numerous micromeres, the micromeres occupying about one-half the mass.

Fig. 17. Oosphere of one macromere and numerous micromeres, the micromeres occupying less of the mass than in 15 or 16; a clear hyaline investment is seen surrounding the oosphere. Figs. 15–17. Zeiss Oc. 4, lens A, doubled.

Fig. 18. Oosphere with the numerous micromeres enveloping the macromere.

Fig. 19. Oosphere with the macromere segmented into two seen through the micromeres.

Fig. 20. Oosphere of the same stage as preceding seen in profile.

Fig. 21. Oosphere still more advanced where thefi rst macromeres are subdivided.

Fig. 22. Gastrula (ciliated), with the ectoderm and entoderm visible.

Fig. 23. Gastrula with macromeres forming the entoderm, and showing two macromeral guard cells at side of blastopore, *bp*. Figs. 18–23. Zeiss Oc. 4, lens D.

Fig. 24. Gastrula fixed and stained showing blastopore *bp*, and segments with nuclei. Zeiss Oc. 4, lens D.

Fig. 25. Ciliated gastrula showing clearer peripheral edge and darker cells towards middle.

Fig. 26. Ciliated gastrula showing clear vesicles; cleared up by evaporation of the sea-water in the sun. Zeiss Oc. 4, lens D.

Fig. 27. Embryo showing the depression, *sh*, of the preconchylian gland.

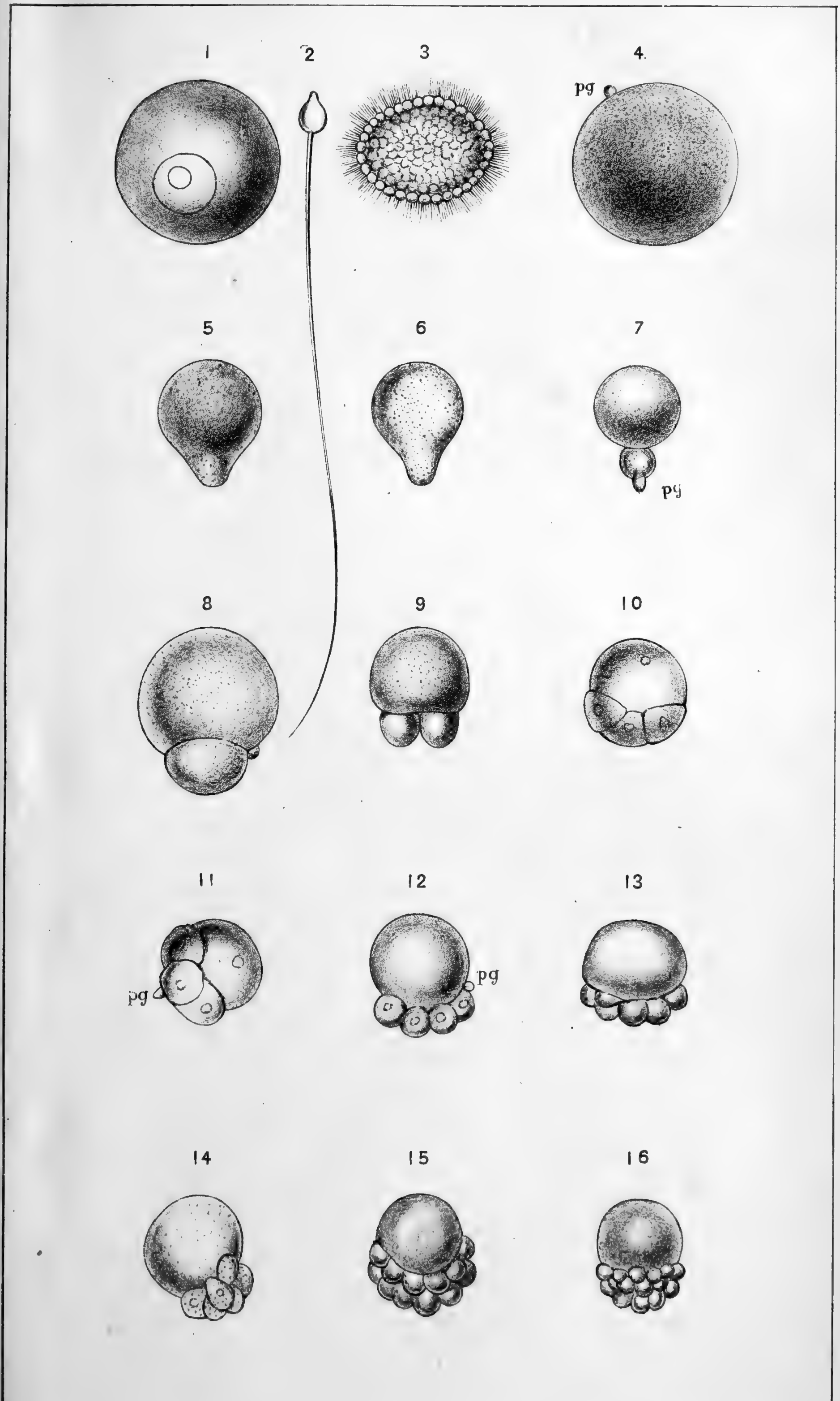
Fig. 28. Embryo fixed and stained, showing blastopore, *bp*, and depression for preconchylian gland, *sh*.

Fig. 29. Embryo showing position of blastopore, *bp*; depression of preconchylian gland, *gl*, and velum, *v*.

Fig. 30. Embryo showing position of blastopore, *bp*; velum, *v*; and incipient shell, *sh*.

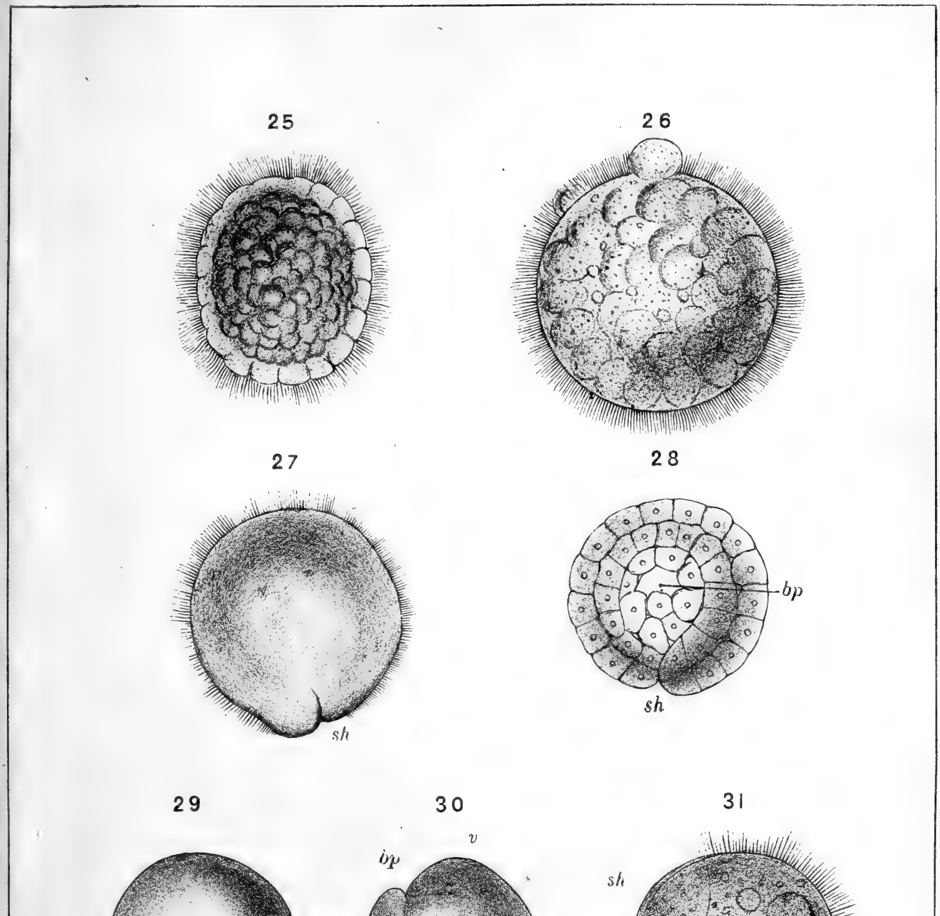
Fig. 31. Irregular ciliated embryo, showing developing shell, *sh*, clear vesicles, and lobate process.

PLATE V,



J. H. F. del ad nat.

J. T. M. Imp



J. H. F. del ad nat.

J. T. M. Imp.

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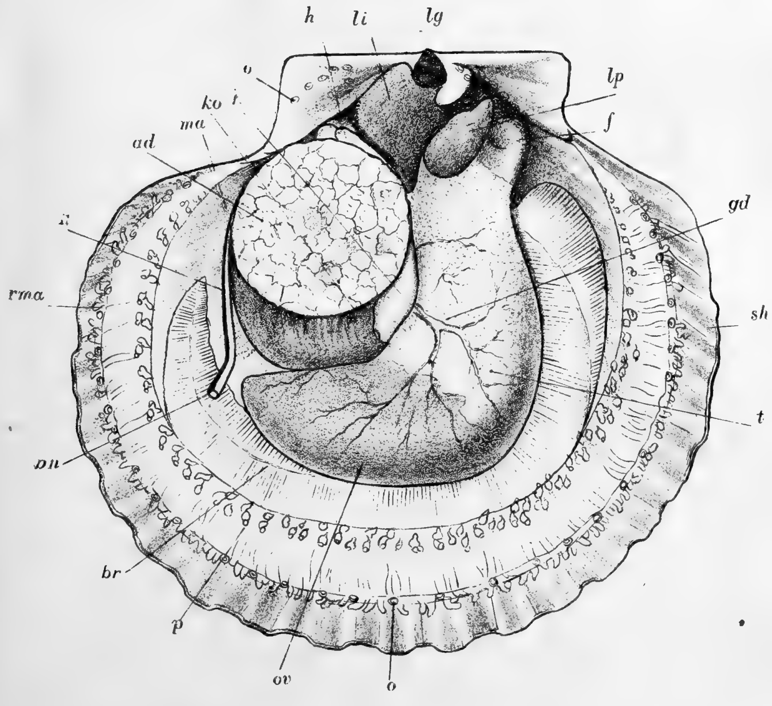


J. H. F. et J. T. M. del ad nat.

J. T. M. Imp.

Fig. 32. Veliger embryo—dorsal view,—showing extended velum, *v*; two valves of shell, *sh*; and liver through the shell, *lv*.

Fig. 33. Embryo with shell well developed, showing velum, *v*, with cephalic disk, *c.d.*; retracter muscles of velum,—anterior retractor, *ar*, posterior retractor, *pr*; mouth, *m*; œsophagus, *œ*; stomach, *st*; intestine, *in*; anus, *a*; liver, *lv*. adductor, *ad*; mantle *ma*.

Fig. 34. Adult *Pecten opercularis*—natural size—with reproductive organs mature. The left valve, left lobe of the mantle, the outer of the left pair of labial palps and the left pair of gills have been removed. Ovary, *ov*; testes, *t*; generative duct, *g.d*; organ of Bojanus, *k*; opening of organ of Bojanus, *ko*; foot, *f*; liver, *lv*; labial palp, *l.p*; rectum, *r*; heart, *h*; adductor, *ad*; mantle, *ma*; reflected part of mantle, *r.ma*; eyes, *o*; sensory papillæ, *p*; ligament, *lg*; gill, *br*.

VI.—ON THE DEVELOPMENT OF THE COMMON SKATE (*Raja batis*). By Dr J. Beard.

(Plates IX.–XI.)

Although the skate is one of the commonest elasmobranch fishes of our seas, very little has been written of its life-history and development. The sharks and torpedoes have mainly yielded material for embryological work on elasmobranch fishes. Indeed, to such an extent have these latter forms been studied, that it would be easy to make a list of some hundred or more memoirs dealing with the development of the various organs of *Scyllium*, *Acanthias* or *Torpedo*.

Our knowledge of their embryology practically dates from 1874–75, which saw the first fruits of the memorable researches of Balfour and Semper. Since then, almost every embryologist who has paid attention to fish-development has contributed something to our knowledge of elasmobranch fishes.

Of recent years the rays find little mention in embryological works, and beyond a few papers and some observations on particular organs by Van Bemmelen, Dohrn, Ewart, Van Wyhe and others, our knowledge of their actual development has advanced no further than the point at which it stood in 1864, after the appearance of Professor Wyman's memoir.*

As the volume containing this work is rarely † met with in libraries, it may be well to give some account of Wyman's results.

Our author commences with a fairly accurate description of the egg-case or 'purse.' One or two small points in his account may be corrected later on, when I describe those 'purses' of rays which have come under my own observations. It may, however, be remarked that Wyman's description does not apply to the purse of the British *Raja batis*, and from several circumstances, to be afterwards detailed, I conclude that Wyman was in error in supposing that the purses he examined were those of *R. batis*, and that the form he really investigated was *R. oculata* (Mitchell). The memoir is illustrated by one plate, containing eleven figures. These figures relate to but five embryos, and the text also bears evidence of the paucity of the material at the author's disposal. The earliest embryo depicted showed four well-marked gill-slits. The drawing is not very accurate, and from various circumstances (viz., the size of the embryo, the great development of the unpaired fins, and the extensive yolk-sac circulation) it may safely be concluded that the whole number of gill-slits was really present, and, indeed, that the external gill-filaments were in course of development. Probably with reference to its great length and tenuity Wyman describes this embryo as 'eel-shaped.'

In the second stage figured the embryo was much further advanced. Its most characteristic features were the fairly developed gill-filaments, the well-marked anterior and posterior paired fins, and an anal-fin. The next embryo was well described as 'shark-like;' it showed a second anal fin behind the first, and Wyman found that these two fins are temporary structures, which disappear in later stages.

The following embryo had taken on many of the skate characters. It was

* Wyman Jeffries, 'Observations on the Development of *Raja batis*,' in *Memoirs of the American Academy of Arts and Sciences*, vol ix., 1877, p. 31–44. (The volume is dated 1867, but contains memoirs extending from 1864 to 1873.

† My thanks are due to H. Webster, Esq., University Librarian, Edinburgh, and to the Royal Society of Edinburgh for opportunities of consulting this work.

somewhat younger than the one figured by me in figs. 16 and 17. The last figure was that of a newly hatched skate.

In dealing with such an extensive subject as the development of the skate, it was necessary that some plan of treatment should be adopted, all the more as the amount of space and the number of plates of figures at my disposal were strictly limited. Seeing that almost no figures of skate embryos, especially early stages, have been published till now, it was natural that this branch of the subject should receive attention. A detailed account of the development of the internal organs would have occupied very much space, and have required an extensive series of figures. In the end this would have had little practical value.

Other points to be noticed more especially were the breeding and spawning seasons, the characters of the egg-cases or purses of different species of skate, the duration of development, and such points in the physiology of the embryo as could be determined.

Unfortunately I am at present unable to give much account of the actual time the development occupies. Many embryos, which would ere this have hatched out, were lost in a storm during the winter. This much can be said, viz., that the development occupies a longer period than is usually supposed, and for the blue skate (*R. batis*) I should incline to the belief that development requires nine or ten months. The oldest embryo I have yet obtained is figured life-size in figs. 16 and 17; the yolk-sac attached to the embryo weighed (in spirit) 22 grams. or about $\frac{3}{4}$ of an ounce. The rate of development is very different in summer and in winter. In winter the temperature of the water varied between $4\frac{1}{2}$ and 6° C., while it rose to 11° and 12° C. in the early summer months. Under the latter conditions development proceeds as rapidly again as in winter, and a stage reached in three months in winter is attained in less than two in the summer. The material * at my disposal was all that could be wished, and thus the dimensions of this paper are only limited by considerations of space and time.

The Breeding and Spawning Periods of the Skate.

To these points but little attention has hitherto been paid, and in the literature one finds very little information. In volume ii. of his *British Fishes* Dr Day has recorded all that he could learn about the breeding and spawning of the skate.

It must be mentioned that the period of 'ripening' and fertilisation of the egg much precedes that of its oviposition. For some weeks at least the egg undergoes development without the maternal oviduct, and there it normally lies until the first traces of the embryo appear. It is then laid by the mother-skate, and undergoes its subsequent long development at the bottom of the sea. Eggs taken from the parent skate, as soon as or after their complete enclosure in the purse, will develop in a perfectly normal fashion in sea-water. The plan adopted by me was to place the purses taken from the parent-skate in perforated fish-boxes in the harbour, and if the purses were good at the start, there was, except in the case of those of *R. circularis,* very little mortality subsequently.

The purses of *R. circularis* are very tender, and most probably they are only deposited by the parent skate in perfectly sheltered bays, and where

* To Mr George Sim, A.L.S., Aberdeen, and to Messrs J. Murray and W. Mair, Fishery Officers of the Fishery Board for Scotland, I am chiefly indebted for the material used in these investigations. My thanks are also due to Mr P. Jamieson, of the Scientific Staff of the Scottish Fishery Board, for all the trouble and care he has bestowed on the rearing, &c., of the embryos.

there is little or no current. It is not necessary in this paper to describe the structure of the male and female reproductive organs of the skate, for such descriptions can be found in any of the common text-books of practical zoology. It may, however, be well to recall the fact that the purse is formed by a special glandular portion of the oviduct, but whether the process of its formation begins before or after the arrival of the egg in the oviduct is not easily decided.*

Wyman (p. 32) has already expressed the opinion that the purse is partly formed before the egg leaves the ovary.

From many circumstances I have also long inclined to this view. One often finds part of a purse in the oviduct and no yolk or egg within it. It appears very likely, nay, almost certain, that the lower half of the purse is formed before the egg arrives at the oviducal gland, and that after the arrival of the egg the closure of the purse is at once effected. My conclusions on this matter were confirmed by a circumstance noted, regarding some shark purses which came into my hands. These were all perfectly formed, and had been laid; that is, they had not been taken from the present shark. Fully ten per cent. of those purses, though quite intact and closed up, contained no egg. White was present, but no trace of a yolk. The only explanation I can give of this circumstance is that no egg arrived from the ovary in time for reception in the partly formed purse, and that the purse was completed without ever having contained a yolk. These abnormal purses were laid in the confinement of an aquarium, and I cannot say that anything of the sort has come under my notice among the ray-purses in my possession.†

Fertilisation must be effected in the upper limit of the oviduct.

Of the blue skate (*R. batis*), Day (vol. ii. p. 336) says that they are stated to generate in March and April, and that the purses are cast from May to September. According to Parnell, the young appear in the following spring.

I can confirm and extend these statements. On referring to my lists I find that the greatest number of purses was received in March and April, and that many of them were only just formed. Purses naturally deposited have never come into my possession.

For this species of skate I can, however, much extend the period of reproduction, for I have received purses of *R. batis* in all months of the year; certainly but few in winter and most in the spring.

Hence we must say of the blue skate that the chief time of reproduction is in the spring months, March and April, but that some eggs are developed and fertilised in all the other months of the year.

Of the thornyback skate (*R. clavata*), Day says that it is found in shallower water than the blue skate. This I also found to be the case. In the fishing villages on the Firth of Forth it is the form which is caught nearest inshore. 'It begins to germinate in June, and brings forth its young (? eggs) in July and August' (Tennant). Much more correct is the statement of Couch, that the eggs are deposited in May and June.

I can say little of the existence of winter breeding in this form, for until January I received no thornyback purses; from this month they were obtained in increasing numbers until June. In Holland this skate is caught in abundance in June, and during that month great numbers of thornyback purses may be found in the fishing boats. After being caught the fish have deposited their purses in the boat.

* Never more than two eggs, one in each oviduct, are found in a single skate.

† Since this was written I have met with one completely formed and closed purse of *R. radiata*, which contained no yolk, and another of *R. batis* also destitute of a true egg.

The Homelyn—or sandy ray (*R. maculata*), is said by Couch to lay its purses in very shallow water. The purses are stated to be smaller than those of the preceding species; a fact I cannot confirm, for they appear to differ in no respect from those of the thornyback. The only lot of purses I have received came to me on April 11.

As Day states, the starry ray (*R. radiata*) is essentially northern. I have never seen a purse of this species from a fish caught in the Forth, but it is quite possible that some are obtained there, for the starry ray, though not abundant, is often caught in the Firth of Forth.* All the purses of the starry ray which I obtained I owe to Mr G. Sim, A.L.S., of Aberdeen.

Day says nothing of its breeding season. The purses are plentiful at Aberdeen in February and March, and continue to be got until June at least.

The cuckoo or sandy ray (*R. circularis*) is said by Day (vol. ii. p. 349) to prefer sheltered bays.

In such places I should presume that it deposits its eggs, for they are extremely sensitive and difficult to bring to development. Couch makes some erroneous statements regarding the breeding period. According to him, it deposits its eggs in December, but yet in July he saw one with eggs, some of which appeared almost ready to be shed. In my lists I find records of purses of this species received from February to June, and I cannot determine that they were more plentiful in any one of the five months than in the others.

This species is common at Aberdeen, but the largest purse of *R. circularis* I have as yet seen was taken from a fish caught off Dunbar.

The Egg-Cases or 'Purses' of Skates.

There is no description extant of the 'purses' of the skate common to our seas. As the egg of each species has, as a rule, a form of purse which is characteristic of the species, it may be of use to give a description of the purses of the five species of skate which I have had opportunities of investigating. There are many points in the structure of the purses which, apart from other facts of anatomy and development, point to a shark-like ancestry of modern skates. The purse of *R. circularis* (the cuckoo or sandy ray) is the most shark-like of any of those I have examined. This remark applies to its form, size, and transparency. Least shark-like are the purses of the blue skate (*R. batis*) which are by far the largest purses of the lot. The smallest purses I have seen are those of the starry ray (*R. radiata*), while those of the thornyback and spotted skate occupy an intermediate position between the extremes of the series. The description given of the purse of the thornyback ray (*R. clavata*) appears to apply completely to that of the spotted ray (*R. maculata*). Of the latter form only one small lot of purses † came into my hands. The best proof of their practical identity with those of *R. clavata* is furnished by the following statement. When received by me they were placed with three purses of *R. clavata* in one of the hatching boxes, and, on receiving information in a later letter from Mr Sim, of their true nature, an attempt to distinguish them from the purses of the thornyback was made, but without success. Until some of those purses are near the time of hatching, it will be impossible to distinguish between those of the two species contained in the one box.

* On June 26th two purses of the starry ray were obtained from a skate caught off Dunbar.

† I have to thank Mr G. Sim, A.L.S., for these. As he is perhaps the best living authority on the fishes of the Scottish coast, his statement that the purses were taken from *R. maculata* is absolutely trustworthy.

The Sandy Ray (*R. circularis*). As previously stated, the purses of this species are very like those of Selachians. When fresh, they are of an amber-brown colour, and translucent, or almost transparent. When they have lain in sea-water, the colour deepens, but the translucency remains.

A flattened side of the purse, so characteristic of those of the other four species, is not obvious. The purse is curved somewhat in a S-shaped fashion, and its walls are composed of finer horny fibres than those of the other species.

The purse of the skate may be described as composed of a body, which at each end is prolonged into a pair of hollow horns. The purse of the sandy ray does not possess strings for its attachment, nor are the horns drawn out into long filaments for this purpose, as those of the Selachian purse. The body of the purse is about $2\frac{1}{2}$ inches long and $1\frac{3}{8}$ inches broad.

The horns are a pair of short ones ($1\frac{1}{4}$ inches long) at the lower or first formed end of the purses, and a pair of much longer ones (4 inches in length) at the upper end.

The usual small apertures leading into the cavity of the horn are found on the inner side of the tips of the horns. Unlike those of sharks, the filamentous ends of the horns are not coiled in the form of a spiral thread, nor do they approach anything like the length of the spiral thread of the shark purse, where they exceed several feet.

The Starry Ray (*R. radiata*). The purse of this form is the smallest of the five. It is always quite flat on one side, and strongly convex on the other. The embryo is usually found under the flattened side of the purse.* Unlike the egg-case of the preceding form, the purse of the starry ray is quite opaque. It is composed of coarsely beaded fibres of a deep olive green colour, inclining to black. The whole purse, including horns, measures some $4\frac{1}{2}$ inches. Of this length about 2 inches goes to the body of the purse, *i.e.*, to the part containing the egg. This part of the egg-case is slightly over $1\frac{5}{8}$ inches broad at its widest portion, and about half an inch thick at the centre or point of greatest convexity. The lower horns are rather more than 1 inch long and the upper ones exceed $1\frac{1}{2}$ inches.

The lateral margins of the purse are somewhat flattened at the seam, as in that of *R. clavata*, and a few fixing filaments are usually present near the lower end. They are, however, very rudimentary in this and the other forms, except *R. batis*. The yolk of the egg is very small, and not more than $\frac{3}{4}$ of an inch in diameter; it is usually of a beautiful rosy colour.

The Blue Skate (*R. batis*). The egg-case of this species exceeds that of any of the others very much in size and weight. When freshly taken from the oviduct of the mother-skate, the purse is of a greenish yellow colour, which after exposure to sea-water for some time darkens to a dull olive-green, and finally becomes almost black. Its extreme length is fully 9 inches, with a breadth of $3\frac{1}{4}$ to $3\frac{1}{2}$ inches, and at the point of greatest convexity the purse is about an inch thick. The egg-case is built up of less coarsely beaded fibres than that of the starry ray. As in the other forms, the lower end of the purse is closed in a crescent-shaped fashion, the upper and last-closed end being more squarely rounded off. The horns of the two ends project inwardly. They are shorter in proportion than those of the starry ray, projecting beyond the body of the purse at the lower end for about $1\frac{1}{2}$ inches. The upper horns are rather shorter, about an inch in length, and somewhat twisted or curled. On

* Because the yolk sac turns more easily to the position of stable equilibrium, *i.e.*, with the embryo uppermost, when the curved surface of the purse is on the under side.

each side of the body of the purse, close to the origin of the lower horns, a large number of long silky fibres or strings are attached to the margin of the purse. These fibres are silky, soft, and sticky when fresh, but they become more consistent on exposure to sea-water. Their purpose is obviously to anchor the purse to a rock, weed, or other suitable object. Fishermen state that sometimes in summer, when the skate may deposit its purses after being hooked, the purses stick to the lines by these threads and are drawn up to the surface. At the extremities of the horns on the inner side the usual slit-like apertures are found. From these in old purses a little of the white of the egg may project. In the purse of the blue skate it is somewhat difficult to distinguish which is the flatter side, under which, as a rule, the embryo lies. The yolk measures some $2\frac{1}{2}$ inches in diameter, and is of a pale yellow or greenish colour—rarely rosy.

The Thornyback Skate (*R. clavata*). The purses of this form occupy a position intermediate between those of the other species. They are of a deep-green colour, and become almost black in the sea-water. Including the horns, the purse measures rather over 6 inches in length, with a breadth of from $2\frac{1}{2}$ to $2\frac{3}{4}$ inches. The thickness varies from $\frac{1}{2}$ an inch to $\frac{3}{4}$ of an inch. The contrast of a flattened and a convex side is always as well marked as in the starry ray. The egg-case is opaque. The lower horns are short, usually $\frac{3}{4}$ of an inch in length, the upper ones long, like those of *R. circularis*, and rather over 2 inches long. The margins of the purse are broad and much flattened. The purse is built up of fine beaded threads. Filaments of attachment, if present, are very rudimentary. The yolk is often rosy in colour, but sometimes pale yellow, and has a diameter in the young egg of $1\frac{1}{2}$ inches. The white, as in the other cases, is clear, transparent, and jelly-like, in later development it becomes very watery. As previously stated the egg-cases of the spotted skate (*R. maculata*) appear to differ in no respect from those of the thornyback.*

The Development of the Blue Skate (*R. batis*).

In fig. 1 a figure of one of the early stages of the segmentation is given. The germinal disc of the egg was prepared from a specimen freshly taken from the oviduct of a skate. The section figured reveals the presence of a limited number of rather large segmentation cells, which form a layer of about three cells deep on the surface of the yolk. From the upper surface of the latter new cells are being added to those already formed. The outermost layer of the cells is somewhat more regular than the inner layers, and forms an epithelium,—it may already be spoken of as the epiblastic layer. Each cell is but roughly spherical, perhaps better wedge-shaped; it contains a nucleus, and is filled with yolk particles.

In the yolk are seen a few of the wandering cells or 'merocytes' (me) of Rückert.

At this stage the germinal area has a diameter of about 3 mm.

The following stage is rather more advanced (fig. 2). The section is from a germinal disc of a period in which the segmentation, in a strict sense, is almost completed. The figure is from a specimen slightly younger than the one depicted in fig. 9, pl. 2, of Balfour's monograph.

The figure was drawn under the same magnification as the preceding one, and the much smaller size of the segmentation cells is obvious.

In size the germinal area has not grown appreciably larger than it was in the stage of fig. 1.

* From the size (which is far too small to apply to the purses of *R. batis*), structure, form of horns, colour and filaments, the purses described by Wyman appear to resemble very closely those of *R. maculata*. This species is perhaps identical with, or closely allied to, the *R. oculata* of the American seas.

The outermost cells form a well-marked layer, the epiblast, though whether this designation of the layer as alone forming the epiblast is perfectly justifiable, is open to question. It appears certain that many of the lower cells have arisen from the outer layer. Below the outer layer lies a mass of cells which shows no order; the cells resting on a concave depression of the yolk. In the yolk itself (*y.c.*) many cells formed in it, and in process of wandering into the blastoderm are seen. Besides these elements lying in the yolk, a number of 'merocytes'—many more than in the preceding stage, are also met with. These cells to which Rückert assigns a rôle in the formation of blood-corpuscles, have been more fully investigated by Ziegler, who has pointed out that they never show the phenomenon of 'indirect' or karyokinetic cell division, but that they undergo 'fragmentation.' He holds that they are, in fact, degenerating cells or nuclei, and that they are concerned in causing or producing some changes in the yolk itself. Ziegler has shown that the blood is formed from quite another source.

It is interesting to recall in this connection the 'fibrine ferment' of the blood, which, according to A. Schmidt and Gamgee, is produced from the nuclei of the white corpuscles, and which induces the coagulation of the blood. In a similar fashion the 'merocytes' may be supposed to produce some 'ferment' by their degeneration, which initiates such changes in the yolk as render it fit for absorption, and of use to the embryo in building up its tissues.

The succeeding stage (stage iv. of Kastschenko's nomenclature) is figured in surface view of the entire germinal disc in fig. 4.

It is more particularly described as the stage of a visible segmentation cavity (*s.c.*, figs. 3 and 4). In this figure (in section in fig. 3 along the line marked in fig. 4) a great aggregation of the lower cells has taken place towards one end of the germinal disc. This is the preliminary to the formation of the embryo, and in the following stage we shall see the first traces of the future embryo formed at this thickened end.

The segmentation cavity (*s.c.*) is bounded on the outside partially by 'epiblast,' and partially by segmentation cells, inside and laterally by segmentation cells (*f.c.*) and the yolk (*y*).

In fig. 5 we have a surface view of the first rudiments of the embryo, in the form of a semi-lunar thickening of the rim of the germinal disc (*e.t.*). This embryo, which may reach this stage in two or three weeks during the summer months, requires five or six weeks for its development to the same point in the cold winter months.

Development now goes on somewhat more rapidly, and we soon see an outgrowth or knob from the central portion of the semilunar embryonic thickening towards the centre of the germinal area (fig. 6). The axis of this is the long axis of the future skate, and its pointed end is the anterior or head end.

In fig. 7,* which shows only the embryonic portion of the blastodermic area, the process has grown apace, and now forms a lancet-shaped curved plate. The embryo, for so it may be called, grows forwards at the expense of the lateral thickenings of the embryonic rim (*l.r.*). The groove (*b*) at the hinder end of the disc is part of the blastopore, still open over the yolk.

The next figure (fig. 8) is characterised by the commencing formation of the medullary groove (*m.g.*) along the axis of the embryo. It forms a spoon-shaped depression, which does not yet reach to the anterior end of the embryo. The figure corresponds to Balfour's stage C.

In fig. 9 (D. of Balfour) the anterior end of the embryo has broadened

* Figs. 5 and 7 correspond to stages A and B of Balfour's nomenclature.

out. This widened portion (h) is the rudiment of foundation of the future brain-region of the skate. The embryo has grown somewhat in length. The medullary groove is deeper, and in the following phase (fig. 10) the medullary folds (*m.f.*) are commencing to grow upwards and inwards as a preliminary to the closing in of the central nervous system. This upgrowth reaches its maximum in fig. 11, where towards the middle region of the embryo the folds meet. The steps of the closure would require several figures for their illustration. The first fusions of the folds are usually at two points; the one lying about the middle of the embryo, the other a little further back.

The stage of almost complete closure of the folds is depicted in fig. 12; the only points still left open lie at the extreme anterior and posterior ends of the neural axis. The anterior opening also soon closes. A fictitious importance, both physiological and morphological, has been attached to it by Van Wyhe and one or two others; but it is beyond the limits of my subject to enter into any discussion of that matter in this paper.

In figures of the embryo, as an opaque object, nothing of the internal structure is revealed, but it may be stated that at this period considerable differentiation has taken place within the embryo, especially in the mesoblast. In the stage figured in fig. 11, some 25 or 26 mesoblastic somites had been formed. In fig. 12 a few more were present. In fig. 11 there was hardly any trace of a tail swelling, but this structure, which forms the future tail of the skate, is well marked in fig. 12 (*t.s.*).

It becomes raised above the level of the blastoderm, and begins to grow backwards, and soon forms a long process. In the stage of fig. 12 the first gill cleft is also in course of formation.

Some of the following stages are best studied in preparations of embryos stained and mounted whole as transparent objects. Figs 13, 14, and 15 are from such preparations. In these figures much of the internal structure of the embryo is represented.

The embryo of fig. 13 measured about 5·8 mm. It was well raised and folded off from the gigantic yolk-sac, from which it draws the supplies of nutrition for its subsequent growth through the medium of its blood, which has already commenced to be formed. In that yolk-sac lies its nourishment for the next six months at least (*Raja batis*).

By the rapid growth of the brain (b) the cranial flexure, so characteristic of elasmobranch and some other vertebrate embryos, has commenced. The mouth has not yet broken through, but the point at which it will be formed can be seen as a depression at m. At this point also the hypophysis cerebri, or rather its oral portion, will also arise. Whatever the meaning of this structure may be, its close connection with the formation of the mouth is a point which should not be lost sight of. The anus is also not yet developed—it arises late in all elasmobranch fishes.

The neural canal (*n.c.*) is wide, and communicates posteriorly with the cavity of the alimentary canal (*a.c.*) by means of the 'neurenteric canal' (*n.c.*). The notochord (*n.o.*) is now entirely split off from the endoderm or hypoblast along nearly its entire length, posteriorly and in front of the neurenteric canal it is fused with or passes into the floor of the medullary tube above, and the endoderm or hypoblast below.

In the anterior end of the embryo, the nose (not seen in the figure) is represented by a pair of epiblastic thickenings. The primary optic vesicles (*o.*) which will form the sensory portion of the future eye, are present as a pair of outgrowths from the anterior cerebral vesicle. The pineal body (*p.b.*) can be seen as a minute structure lying on the roof of the hinder portion of the anterior cerebral vesicle. The auditory organ (*au.*) is represented by a vesicle.

The foundations of two of the gill-clifts (*g.c.*), and traces of a third are also seen. Some 46 mesoblastic somites (structures which give rise subsequently to most of the muscles and also to much of the deeper portion of the skin) can be made out. In front of these somites 2 others subsequently appear, and behind them the formation of new ones goes on until upwards of 130 are present. In this stage the pronephros and some portion of the segmental dust are already present. In the next stage represented (fig. 14) the embryo had grown considerably in length. It measured 7·5 mm.

Four gill-clifts (*g.c.*) were present, and a fifth was in course of formation. While the preceding embryo corresponds to stage H of Balfour, this one is from the latter half of the stage J, as defined by Van Wyhe. Some 68 somites could be counted. The figure shows how these decrease in size from before backwards. The neurenteric canal is still present. It apparently persists as long as mesoblastic somites are being formed.

In the brain no great changes can be noted as regards external appearance. In the eye the formation of the lens has commenced. The ear shows no appreciable difference from the preceding stage.

The mouth opening is not yet formed, but the oral part of the hypophysis cerebri (*hy.*) is seen as an involution of epiblast towards the floor of the brain. Five well-marked gill-slits are characteristic of the following stage; the need of a limitation of the number of figures has prevented its representation, and, as it is not shown, I shall not describe it in this paper.

The embryo of the following figure (fig. 15) had the full complement of 6 gill-clifts, and more than 100 somites were present. Their exact number could not be determined, owing to a slight malformation and curling-up of the tail of the embryo. In other respects the embryo was perfectly normal.

Only the anterior end of the embryo is depicted. It measured fully double the length of the part shown in fig. 14.

The mouth is formed, and all the gill-clifts are freely open towards the exterior. The most anterior (the future spiracular clift) is already undergoing constriction in its ventral portion. On the posterior margins of the hyoid, first, second, and third branchial arches, the first rudiments of the external gill-filaments (*e.g.*) (about which more is written in another section of this paper), are seen as small processes. These grow larger and larger, blood-vessels are also developed with them and within them (in the form of a looped tube in each filament), the number of these filaments increases, and shortly there projects a bunch of these filaments from each of the five posterior clifts. The spiracular cleft never possesses them. The heart (*ht.*) is now very obvious, and at this stage, and earlier, actively performs its functions. Along the umbilical cord (*u.c.*), the vessel which brings blood back from the yolk-sac is seen passing to the heart, and from the anterior end of the latter organ the branchial aorta (*b.a.*) is shown lying below the gill-clifts.

The lens (*l*) of the eye has separated from the ectoderm, the true retina (*r*) is in course of development, and the outer layer (*pr.*) of what was the secondary optic vesicle, is already pigmented in some places; it is the future 'pigment layer of the choroid.' The ear (*a.u.*), though larger, has undergone but little differentiation; the auditory nerve (VIII.) is seen applied to it. In front of this nerve, and fused with it, is seen the large facial nerve (VII.) passing to the spiracular cleft, with the upper wall of which it is fused. At the point of this fusion (a fusion with a patch of sensory epithelium over each of the gill-clefts) the foundation of the future organs of the lateral line or lateral sense organs takes place in the case of each gill-cleft, as I showed some years ago. It would extend this paper too much to say more about this question now. In front of the facial nerve lies the fifth nerve (V.) and behind the auditory organ the glossopharyngeal nerve (IX.) and vagus nerve (X.) are seen. I now pass over many stages, and proceed to describe the oldest embryo I have till now obtained.

The embryo is shown life-size in figs. 16 and 17.

It is fully 9 centimetres in length. The purse from which the embryo was taken had lain in sea-water for at least six winter months, and none the less the embryo still had a large yolk-sac attached to it, and must have been some two or three months distant from the time at which, in the natural course of events, it would have 'hatched out.' The yolk-sac weighed (in spirit preparation) 22 grms., so that a good supply of food material was still present in it.

The undescribed stages between this embryo and the preceding one would have shown us, among other things, the development and degeneration of the anal fins originally described by Wyman. In this embryo there is no trace of them.

The younger embryos described and figured were shark-like in appearance. Any zoologist would recognise the present one as that of a skate. The broadened anterior paired fins and the long, striking tail are very characteristic. At this stage the proportionate size of tail to body is much greater than in the young skate.

Fig. 16 is a dorsal view. Attention may be drawn more particularly to the greatly developed eyes (*o.*) the spiracular cleft (*s.p.*) just behind the eyes, some greatly developed canals of the future mucous or sensory tubes, (*s.t.*) and the unpaired fins (*u.f.*). In the figure of the ventral aspect, the mouth (*m.*) and nostrils (*m.o.l.o.*), the numerous and long external gill-filaments, the stump of the cut umbilical cord, the anus, and the posterior paired fins must be noted. What appear to be the rudiments of the claspers show that the embryo would probably have been a male skate. When the purse containing the living embryo was opened, the beautiful bright red appearance of the gill-filaments, and of the numerous blood-vessels in the anterior fins, attracted the eye at once. A considerable amount of what appeared to be sea-water was also contained in the purse, and in this fluid the gill-filaments floated loosely.

The External Gill-Filaments of the Skate-Embryo.

The bright red external gills which are such striking objects in advanced stages of development, are structures over whose meaning many zoologists have puzzled themselves. Home, Cuvier, Davy and Johannes Müller were perhaps the first to pay much attention to them. Davy assumed that one of their purposes was to absorb the yolk from the yolk-sac, an explanation Müller was inclined to accept.

Others (Home and Wyman) have seen in these structures respiratory organs, and in order to support their views have assumed that sea-water finds its way through the slits, previously described in the horns of the purse, into the body of the egg-case. Wyman (p. 32) even speaks of 'an inward and outward flow of water which passes through the egg during incubation.' It is needless to say that such an inward and outward current is non-existent, indeed, there is no mechanism present in the egg which would cause such a current to flow.

As Hartog has recently pointed out (with reference to another animal in which sea-water is present within the animal), it is unnecessary to assume an outward and inward flow in the case of an animal living in sea-water. What holds for an animal in sea-water applies also to the skate-purse.

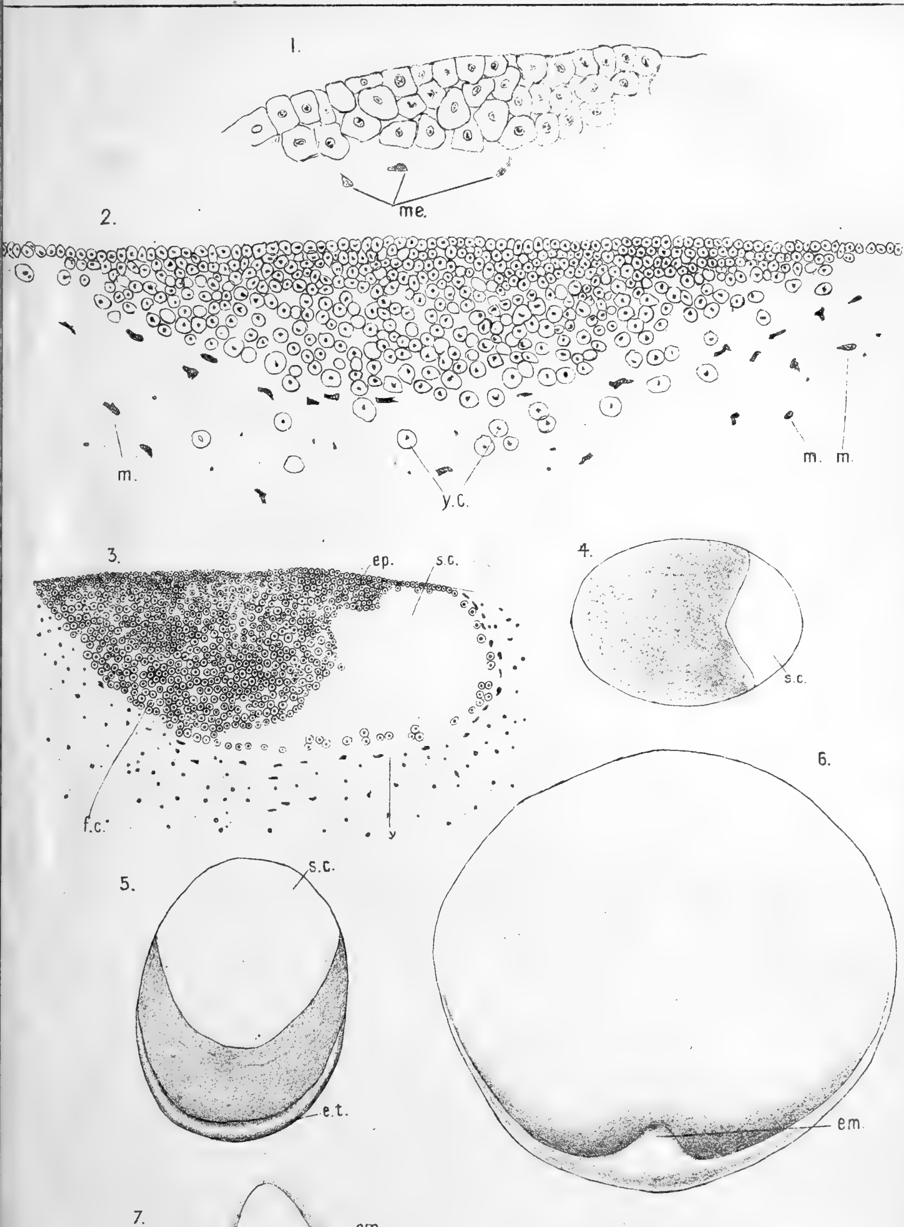
The ordinary laws of endosmosis and exosmosis are quite sufficient to account for the presence of sea-water in the egg capsule, and to provide for its aëration. That the slits have some other function I feel quite certain, and possibly this has something to do with the preservation of the vital contents of the egg under different pressures (either natural or accidental).

The yolk-absorbing function of these filaments has been maintained by Dohrn, who believed that he had detected a yolk-emulsion in the blood contained in the vessels of the filaments. At first, Dohrn says, he attached no importance to the appearance, but when he afterwards found the same yolk-emulsion in the roots and main trunks of the branchial arteries, he began to make further investigations. These taught him that not only were the gill-filaments full of this emulsion, but also the blood-corpuscles themselves of the filaments were filled with it.

As Dohrn never investigated this matter on living embryos, his researches remain incomplete. I have studied the gill-filaments of skate embryos in both live and preserved specimens. In none of those specimens and in none of my numerous preparations of other elasmobranch embryos of all ages have I been able to detect any trace of a yolk-emulsion. Dohrn also referred, in support of his argument, to the bladder-like widening of the end of the gill-filament of *Raja* and some other forms. I have figured a specimen showing this widening in fig. 18, which is taken from a filament of an embryo blue skate aged 23 weeks. One does not meet with this appearance in every gill-filament, and, for my part, I explain the widening as due to a simple hypertrophy of the capillary vessel, which results in a slower flow of the blood, and gives opportunities for its increased aëration.

There are many interesting morphological questions which arise in connection with the gill-filaments, but this is not the place for their discussion. The filaments arise very early as buds or processes on the hinder border of all the true branchial arches. Their development has been described by Dohrn, and it is figured by me in surface view in fig. 15 (*b.f.*). A much later stage, in which the filaments are functionally active, is shown in fig. 17 (*b.f.*). An embryo enclosed in a strong shell like that of the skate-purse cannot breathe after the manner usual to fishes, even when its muscles, etc. are well developed. It must either breathe by its yolk-sac circulation or by some other special apparatus. The yolk-sac circulation is increased in such forms as *Mustelus*, in which a sort of placenta is formed, but here the gill-filaments also help. Above the fishes, *i.e.*, beginning with the reptiles, the allantois takes the place of external gills, and initiates the formation of the placenta. In the bony-fishes in which external gill-filaments, like those of elasmobranchs, are never formed, a very different sort of respiration may be established, if needed. I am now referring to the young of the viviparous Blenny (*Zoarces viviparus*), which grows for some eight or nine months within the mother. My friend, Mr J. C. Mitchell, drew my attention to numerous large intestinal villi in the intra-uterine young of this species. These are very vascular, and from the curious muscular and barrel-shaped structure of the intestine, I do not doubt, though as yet I cannot prove it, that the intestine in the intra-uterine life of this form functions as a respiratory organ.

In the skate-embryo the filaments are said to disappear shortly before hatching. It may be expected that their atrophy commences when the purse ruptures sufficiently to allow of the passage of sea-water directly to the embryo. Then the ordinary piscine mode of respiration would be initiated, and the external gills would disappear.



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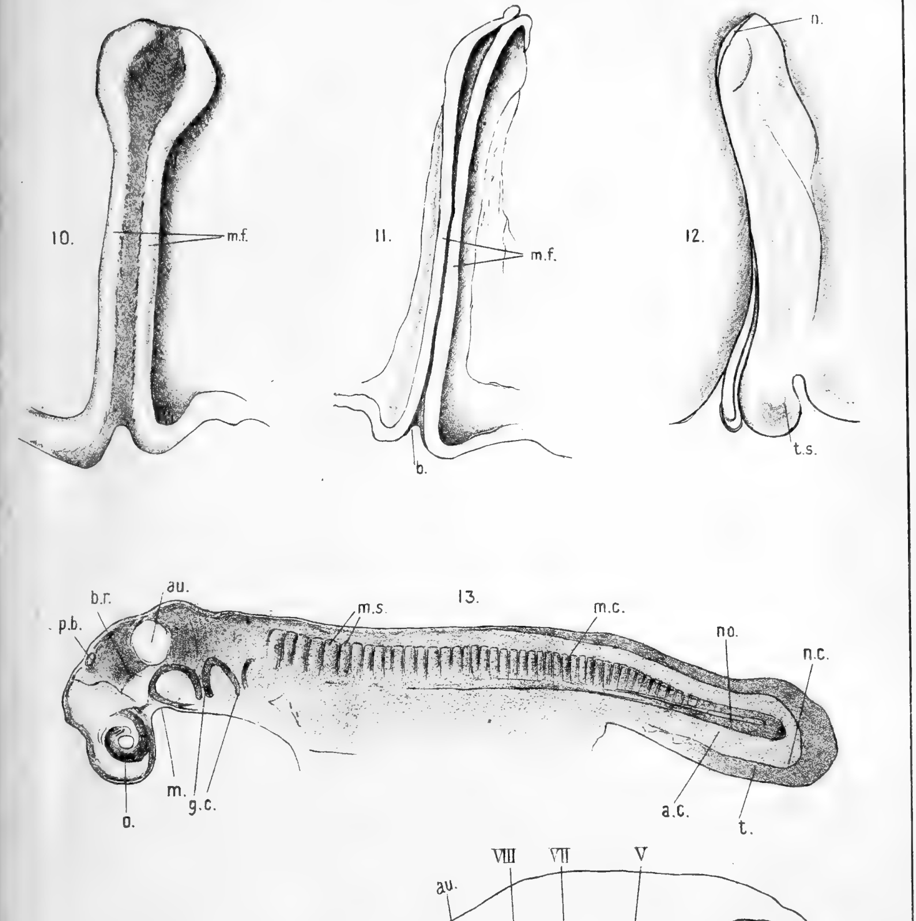
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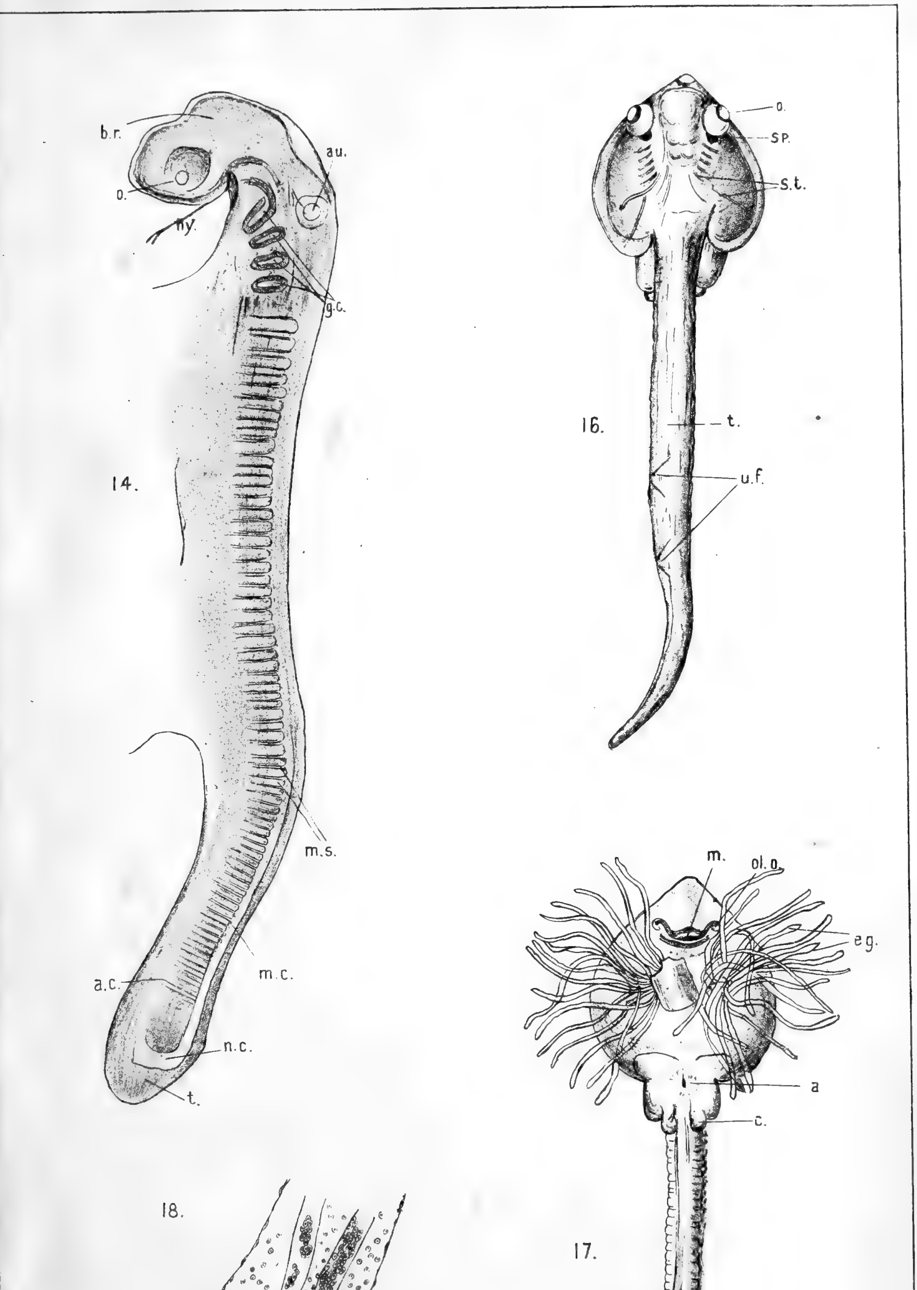

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DESCRIPTION OF PLATES.

The figures, except figs. 16 and 17, were drawn by means of the camera lucida.

Reference Letters.

a.c.	alimentary canal.	*ms.*	somites.
a.	anus.	*n.c.*	neurenteric canal.
au.	ear.	*no.*	notochord.
b.	blood.	*o.*	eye.
br.	brain.	*ol.o.*	olfactory organ.
b.o.	branchial aorta.	*p.b.*	pineal body.
b.v.	blood-vessel.	*p.r.*	pigment layer of retina.
c.	claspers.	*r.*	retina.
e.	epiblast.	*s.t.*	sensory tubes.
epi.	epithelium.	*sp.*	spiracle.
e.g.	external gill.	*t.*	tail.
g.c.	gill clefts.	*u.c.*	umbilical cord.
ht.	heart.	*u.f.*	unpaired fins.
hy.	hypophysis.	*v.*	trigeminus nerve.
l.	lens.	*vii.*	facial nerve.
m.	site of mouth.	*viii.*	auditory nerve.
m.c.	medullary canal.	*ix.*	glossopharyngeal nerve.
me.c.	mesoblast cells.	*x.*	vagus nerve.
me.	merocytes.		

Fig. 1. Superficial segmentation.
Fig. 2. Deep segmentation.
Fig. 3. Shows segmentation cavity in section.
Fig. 4. Entire blastoderm of preceding stage, aged thirty-one days.
Fig. 5. First embryonic thickening, forty days.
Fig. 6. Embryo of fifty-four days (winter).
Fig. 7. Embryo of ten weeks (winter).
Fig. 8. Embryo of eleven and a half weeks (winter).
Fig. 9. Embryo of twelve weeks (winter).
Fig. 10. Embryo of about twelve weeks (winter).
Fig. 11. Embryo of nearly fourteen weeks (winter).
Fig. 12. Embryo of fourteen weeks (winter).
Fig. 13. Embryo of thirteen and a half weeks (spring), length 5·8 mm.
Fig. 14. Embryo of eleven weeks (early summer), length 7·5 mm.
Fig. 15. Head end of embryo of *R. clavata.*
Fig. 16. Dorsal view of embryo of six months, life size.
Fig. 17. The same as seen from the ventral aspect.
Fig. 18. End of an external gill-filament of an embryo twenty-three weeks old. × 60 diameters.

All the figures, except fig. 15, refer to *R. batis.*

VII.—ADDITIONS TO THE FAUNA OF THE FIRTH OF FORTH.

By Thomas Scott, F.L.S. (Plates XII., XIII.)

In the present paper there are recorded over 90 species not previously recognised as belonging to the fauna of the Firth of Forth. A few of these are now recorded for the first time for the east of Scotland, one or two are additions to the British fauna, and one or two new to science.

Most of them were obtained last year, during the investigations carried on on board the 'Garland,' since the publication of the Seventh Annual Report, only a few having been obtained earlier, but not determined in time to be included in either of the two previous papers on the Forth fauna.*

The forms here recorded belong exclusively to the Invertebrata, and comprise 23 species of Foraminifera, 61 species of Crustacea, and 7 species of Mollusca. Other invertebrate groups are being studied, and information as to their distribution, &c., collected with a view to publication later on.

As was pointed out in a previous paper, the study of the marine Invertebrata, from a fishery point of view, is of considerable interest and importance. As regards the Crustacea, the Rev. A. M. Norman says (*Museum Normaniarum*, part 3):—'I venture to prophecy that when the 'Crustacean Fauna of the Arctic and Temperate regions shall have been 'thoroughly investigated, it will hereafter be found to embrace not less 'than 5000 species. It was little suspected a generation ago that the 'Crustacea is the class which undoubtedly embraces more forms than any 'other outside the Insecta.' The scientific investigations carried out under the directions of the Fishery Board have helped very much to prove that the Crustacea is also one of the most important groups—if not the most important of the Invertebrata—that constitute the food supply of fishes. The movements of fishes are also undoubtedly partly influenced by the prevalence in particular localities of invertebrate forms which they, for the time being, may be partial to as a source of food. The study therefore of the distribution, habits, and life-histories of the Invertebrata should hold a place next in importance to the study of the food, distribution, habits, spawning, and development of the fishes themselves. This study has been and is being carried on from year to year on board the 'Garland,' along with the other and more important fishery investigations, as opportunity offers, and the present and previous similar papers are the results of an attempt to collect all the information within reach bearing on the distribution and habits of these lower forms of life, especially within the area of the Firth of Forth.

The information contained in these papers, especially in the present one and in the one published last year, is mainly the outcome of a personal examination of the various organisms referred to in them; and though the restricted area to which the information principally applies imparts to it a value which is perhaps chiefly of local importance, yet the more thorough and accurate the information relating to the fauna of separate areas becomes, its value will increase tenfold, because reliable comparisons of various kinds will become possible, and from these comparisons theories and principles of great importance may be worked out. There has also resulted a wider acquaintance with, and greater certainty

* *Sixth Ann. Report*, Part iii. p. 235, 1888; *Seventh Ann. Report*, Part iii. p. 311, 1889.

in identifying, the different objects observed in the stomachs of fishes; and therefore more satisfactory and reliable information respecting the food of fishes is now being collected.

In preparing this paper the following among other works have been consulted:—

1850. Baird, *British Entomostraca.*
1868. Williamson, *Recent Foraminifera of Great Britain.*
1870. H. B. Brady, "The Foraminifera of Tidal Rivers, *Annals and Magazine of Natural History.*
1884. " *Foraminifera of the Challenger Expedition.*
" G. S. Brady, *Monograph of the British Copepoda.*
1868. " *Monograph of Recent British Ostracoda.*
1870. " and David Robertson, *The Ostracoda of Tidal Rivers.*
1889. " and A. M. Norman, *Monograph of the Marine and Fresh Water Ostracoda of the North Atlantic and North-Western Europe.*
1863. Bate and Westwood, *British Sessile-eyed Crustacea.*
1872. G. O. Sars, *Monograph of the Norwegian Mysidæ.*
1876–79. " *Monograph of the Mediterranean Mysidæ and Cumacea.*
1862–69. J. G. Jeffreys, *British Conchology.*

I have also to acknowledge the kindness of Professor G. S. Brady, F.R.S., Dr H. B. Brady, F.R.S., the Rev. A. M. Norman, D.C.L., F.L.S., Rev. T. R. R. Stebbing, F.L.S., and Mr David Robertson, F.L.S., F.G.S., in naming obscure and difficult species. Indeed, but for the help of these gentlemen, this paper could not possibly have been so full or so valuable.

FORAMINIFERA.

I am indebted to Mr Robertson for indentifying a few of the species in this group mentioned below; and also for notes of the occurrence of others which have not as yet come under my own observation.

MILIOLIDÆ.

Miliolina tricarinata (d'Orbigny).

Triloculina tricarinata, d'Orb., Ann. Sci. Nat., tome vii. p. 277, No. 7 *a*; Modelé, No. 94 (1826).

Miliolina tricarinata, H. B. Brady, Foram. Chall. Exped., p. 165, pl. iii. fig. 17, *a–b* (1884).

Habitat.—Vicinity of Bass Rock. This species is easily distinguished from *M. trigonula* by the three sharp keel-like ridges extending from end to end and about equidistant from each other. It is much rarer in the Forth then *M. trigonula.*

Miliolina fusca, Brady.

Miliolina fusca, Brady, Ann. and Mag. Nat. Hist., ser. iv., vol. vi. p. 286, pl. xi. fig. 2, *a–c* (1870).

Miliolina fusca, Robertson, Fauna and Flora of the W. of Scotland, p. 51 (1876).

Habitat.—Brackish water pools by the shore near Aberlady, common. This is an arenaceous species. It is much smaller than *M. agglutinans*, and frequently dark brownish in colour. It is considered to be a somewhat rare species, and seems confined to water more or less brackish.

ASTRORHIZEDÆ.

Psammosphæra fusca, F. E. Schulze.

Psammosphæra fusca, F. E. Schulze, II. Jahresberichte d. Komm. Untersucht d. deutsch. Meere., p. 113, pl. ii. fig. 8, *a–f* (1874).

Psammosphæra fusca, H. B. Brady, Foram. of the Chall. Exp., p. 249, pl. xviii. figs. 1–8 (1884).

Habitat.—East of Inchkeith, not common. This species has been obtained off Loch Scavaig, Skye, in 45 to 60 fathoms. It has also been found in seven of the Challenger stations in the South Atlantic in depths of from 150 to 2800 fathoms, and in the North Atlantic from 440 to 2750 fathoms.

LITUOLIDÆ.

Reophax fusiformis (Williamson).

Proteonino fusiformis, Williamson, Rec. Foram. Gt. Brit., p. 1, pl. i. fig. 1 (1858).

Reophax fusiformis, H. B. Brady, *op. cit.*, p. 290, pl. xxx. figs. 7–11 (1884).

Habitat.—Largo Bay, off St Monance, and other parts of the Forth, but nowhere very common—a much more robust species than *R. scorpiurus*.

Reophax nodulosa (?) H. B. Brady.

Reophax nodulosa, Brady,* Quart. Jour. Micr. Sci., vol. xix. N. S., p. 52, pl. iv., figs. 7, 8 (1879); Brady, Foram. Chall. Exped., p. 394, pl. xxii. figs. 1–9 (1884).

Habitat.—Off St Monance, Largo Bay, and other parts of the Forth, frequent. This is a very variable species as regards size. The Forth specimens are very small, but H. B. Brady says (*op. cit.*) that there are specimens of this species which are amongst the very largest of recent arenaceous Foraminifera.

Reophax findens (Parker).

Lituola findens, Parker (in Dawson's paper) Canad. Nat. vol. v. N.S., p. 177, pl. 180 fig. 1 (1870).

Reophax findens, H. B. Brady, Foram. of the Chall. Exp., p. 299, pl. xxxi. figs, 10–11 (1884).

Habitat.—East of Inchkeith, not very common. The only other British examples are from the estuary of the Dee, N. Wales (J. D. Siddal). There appears to be no other authenticated British locality for this species.

Ammodiscus gordialis (Jones and Parker).

Trochamina squamata gordialis, Jones and Parker, Quart. Jour. Geol. Soc., vol. xvi. p. 304 (1860).

Ammodiscus gordialis, H. B. Brady, *op. cit.*, p. 333, pl. xxxviii. figs. 7–9.

Habitat.—Aberlady Bay, rather rare, structure arenaceous, colour brownish; the test consists of a tube coiled upon itself in an irregular manner, inclining to complanate.

* There is some diversity of opinion as to whether the organisms here referred to *R. nodulosa* are foraminiferal; it i therefore with some hesitation that they are included in the present list.

Trochamina inflata (Montagu).

Nautilis inflata, Montagu, Test. Brit., Suppl., p. 81, pl. xviii. fig. 3 (1808).

Rotalina inflata, Williamson, Rec. Foram. Gt. Brit., p. 50, pl. iv. figs. 93, 94 (1858).

Trochamina inflata, H. B. Brady, *op. cit.*, p. 338, pl. xli. fig. 4, *a–c*.

Habitat.—Brackish water pools by the shore near Aberlady; vicinity of Inchkeith, and others parts of the Forth; rare, except at Aberlady, where it is comparatively common. This seems to be an inshore, rather than a deep water species. Colour brownish.

Trochamina macrescens (?) Brady.

Trochamina inflata, var. *macrescens*, Brady, Ann. and Mag. Nat. Hist., ser. iv. vol. vi. p. 290, pl. xi. fig. 5, *a–c*. (1870).

Trochamina macrescens, Robertson, Fauna and Flora of the W. of Scotland, p. 51 (1876).

Habitat.—With the last, but not so common; the cells of this species are concave above and below, and look as if the sides had been partially crushed in. The cells are not all equally concave, those in the centre being frequently only flattened—probably a form of *H. canariense*.

Trochamina ochracea (Williamson).

Rotalina ochracea, Williamson, Rec. For. Gt. Brit., p. 55, pl. iv. fig. 112; pl. v. fig. 113 (1858).

Trochamina ochracea, H. B. Brady, Foram. of the Chall. Exp., p. 338 (1884).

Habitat.—Off St Monance, common; other parts of the Forth rather rare. This is a very small species, 'and,' as Brady remarks, 'composed of a large number of segments.' 'On the inferior side the septal lines are arcuate, 'flexuose, and very prominent.' It is not uncommon in the British seas, though not previously recorded for the Forth.

TEXTULARIDÆ.

Textularia gramen, d'Orbigny.

Textularia gramen, d'Orbigny, For. Foss. Vien., p. 248, pl. xv., figs. 4–6 (1846).

Textularia gramen, H. B. Brady, *op. cit.*, p. 365, pl. xliii. figs. 9–10.

Habitat.—Off St Monance, and from other parts of the Forth. This seems to be a generally distributed species. The test is of an elongated tapering form, is not so compressed as *T. sagittula*, and the lateral edges are rounded instead of being sharply keeled.

Textularia variabilis, Williamson.

Textularia variabilis, Williamson, Rec. Foram. Gt. Brit., p. pl. figs.

Habitat.—Granton Harbour (David Robertson).

Gaudryina filiformis, Berthelin.

Gaudryina filiformis, Berthelin, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 25, pl. i., fig. 8 (1880).

Gaudryina filiformis, H. B. Brady, Foram. of the Chall. Exp. p. 380, pl. xlvi. fig. 12, *a b c* (1884).

Habitat.—East of Inchkeith, not very common.

Bulimina elegans, d'Orbigny.

Bulimina elegans, d'Orbigny, Ann. Sci. Nat., vol. vii. p. 270, No. 10; Modelé, No. 9 (1826).

Bulimina elegans, Brady, *op. cit.*, p. 398, pl. l. figs. 1–4.

Habitat.—Bo'ness (David Robertson). East of Inchkeith, not uncommon. In this species the cells are arranged in a triserial manner, and the shell tapers gradually towards the apex, it is thus distinctly different from *B. elegantissima*, d'Orb.

Bulimina fusiformis, Williamson.

Bulimina pupoides, var. *fusiformis*, Williamson, Rec. Foram. Gt. Brit., p. 63, pl. v. figs. 129–130 (1868).

Habitat.—East of Inchkeith, not common.

LAGENIDÆ.

Lagena pulchella, Brady.

Lagena pulchella, H. B. Brady, Ann. and Mag. Nat. Hist., ser. iv., vol. vi. p. 294; pl. xii. fig. 1, *a. b.* (1870).

Habitat.—Granton Harbour (David Robertson). This species has a tricarinate form, and the "convex" faces are ornamented with irregular longitudinal, branching costæ.

Lagena melo (d'Orbigny).

Oolina melo, d'Orbigny, Form. Amer. Merid., p. 20, pl. v. fig. 9 (1839).

Habitat.—Granton Harbour (David Robertson).

Polymorphina compressa, d'Orbigny (fistulose variety).

Polymorphina compressa, d'Orbigny, Foram. Foss. Vien., p. 233, pl. xii. figs. 32–34 (1846).

Polymorphina compressa, var. *fistulosa*, Williamson, Rec. Foram. Gt. Brit., p. 72, pl. vi. fig. 150 (1858).

Polymorphina compressa (fistulose form), H. B. Brady, *op. cit.*, p. 566, pl. lxxiii. fig. 17.

Habitat.—Near Phidra, rather rare.

Uvigerina angulosa, Williamson.

Uvigerina angulosa, Williamson, Rec. Foram. Gt. Brit., p. 67, pl. v. fig. 140 (1868).

Uvigerina angulosa, H. B. Brady, Foram. of the Chall. Exp., p. 576, pl. lxxiv. figs. 15–18 (1884).

Habitat.—East of Inchkeith, not very common.

ROTALIDÆ.

Rotalia nitida (Williamson).

Rotalia nitida, Will., Rec. Foram. Gt. Brit., p. 54, pl. iv. figs. 106–108 (1858).

Rotalia nitida, Robertson, Fauna and Flora of the West of Scotland, p. 52 (1876).

Habitat.—Various parts of the estuary of the Forth, frequent; a much smaller and more delicate species than *R. beccarii.*

Spirillina vivipara, Ehrenberg.

Spirillina vivipara, Ehrenberg, Abhandl. k. Akad. Wiss. Berlin, p. 442, pl. iii. fig. 41 (1841).

Spirillina vivipara perforata, Williamson, Rec. Foram. Gt. Brit., p. 92, pl. vii. fig. 202 (1858).

Spirillina vivipara, H. B. Brady, *op. cit.*, p. 630, pl. lxxxv. figs. 1–5.

Habitat.—Aberlady Bay, rare. This is a widely distributed species, but does not seem to be very common; I have found it also in the Clyde.

Patellina corrugata, Williamson.

Patellina corrugata, Williamson, Rec. Foram. Gt. Brit., p. 46, pl. iii. figs. 86–89 (1858).

Patellina corrugata, H. B. Brady, *op. cit.*, p. 634, pl. lxxxvi. figs. 1–7.

Habitat.—Largo Bay, rare; a small but pretty species. It has been found at a depth of 620 fathoms in the South Pacific.

NUMMULINIDÆ.

Operculina ammonoides (Gronovius).

Nautilus ammonoides, Gronovius, Zooph. Gron., p. 282, No. 1220, and pl. v. (1781).

Nonionina elegans, Williamson, Rec. Foram. Gt. Brit., p. 35, pl iii. figs. 74, 75 (1858).

Operculina ammonoides, H. B. Brady, *op. cit.*, p. 745, pl. cxii. figs. 1–2.

Habitat.—Largo Bay, not very common.

Note.—The curious Rhizopods *Dendrophrya erecta*, Str. Wright, and *Dendrophrya radiata*, Str. Wright, discovered by Dr Wright in low-water pools in the Old Quarry at Granton, and described by him in the Annals and Magazine of Natural History in 1861, seem to have been overlooked by the authors of the "Invertebrate Fauna of the Firth of Forth." I am indebted to my friend Mr David Robertson for drawing my attention to these species; he informs me that he also has found *D. erecta* in Granton Old Quarry; he has found both forms in low-tide pools at Cumbrae. So far as I can learn, there does not seem to be any known British habitat for these curious organisms other than the localities here referred to.

CRUSTACEA.

COPEPODA.

CALANIDÆ.

Candace pectinata, Brady.

Candace pectinata, Brady, Mon. Brit. Copep., vol. i. p. 49, pl. viii. figs. 14, 15; pl. x. figs. 1–12 (1878).

Habitat.—In surface and bottom tow-net gatherings from various parts of the Forth between Inchkeith and May Island, moderately frequent, and easily distinguished from the other and commoner Copepoda by the dark-coloured plumes and terminal spines of the swimming feet. The only place where this species was obtained by Dr Brady and Mr Robertson, as stated in the monograph referred to above, was 'on very hard ground, and in a 'depth of about 40 fathoms south-west of the Island of St Agnes, Scilly,' where a very few specimens were dredged. The dark-coloured strongly-toothed crest on the joint next to and above the hinge of the right antennæ of the male is a peculiar and striking object. I have also obtained this species in St Andrews Bay, and off Montrose, 20 to 30 miles S.E.

MISOPHRIIDÆ.

Pseudocyclops obtusatus, Brady and Robertson.

Pseudocyclops obtusatus, Brady and Robertson, Ann. and Mag. Nat. Hist., ser. iv., vol. xii. p. 12; pl. viii. figs. 4–7 (1873).

Pseudocyclops obtusatus, Brady, *op. cit.*, vol. i. p. 84; pl. xii. figs. 1–13 (1878).

Habitat.—Off St Monance, where it was taken with the dredge, but somewhat sparingly. The body is robust, and the dorsal aspect is boldly arched, the abdomen is slender, the antennæ moderately short and stout.

CYCLOPIDÆ.

Thorellia brunnea, Boeck.

Thorellia brunnea, Boeck, Oversigt over de ved Norges Kyster iagt. Copep., p. 26 (1864).

Thorellia brunnea, Brady, *op. cit.*, vol. i. p. 95, pl. xvi. figs. 1–10.

Habitat.—Near Oxcar, 30 to 40 fathoms, and Largo Bay, rather rare. I have found this species frequently at Tarbert, Loch Fyne, and at Rothesay amongst weeds in shallow water.

HARPACTICIDÆ.

Ectinosoma melaniceps, Boeck.

Ectinosoma melaniceps, Boeck, Oversigt Norges Copepoder, p. 30 (1864).

Ectinosoma melaniceps, Brady, *op. cit.*, vol. ii. p. 11, pl. xi. figs. 17–20.

Habitat.—Largo Bay and other parts of the Forth, moderately frequent. This is a smaller species than *E. spinipes*, which it somewhat resembles, but from which it may be distinguished by a small, more or less distinct, black patch near the base of the rostrum.

Ectinosoma erythrops, Brady.

Ectinosoma erythrops, Brady, *op. cit.*, vol. ii. p. 12, pl. xxxvi. figs. 11–17.

Habitat.—Off St Monance, 10 to 15 fathoms, bottom clean sand or gravel; and Largo Bay, rather rare. This species is readily distinguished by its having two brilliant red eye-spots, one on each side close to the anterior margin of the cephalic segment. The eye-spots appear to lose their colour when the specimens are kept a while in spirit.

Ameira longipes, Boeck.

Ameira longipes, Boeck, Oversigt Norges Copepoder, p. 49 (1864).

Ameira longipes, Brady. *op. cit.*, vol. ii. p. 37, pl. liii. figs. 1–10.

Habitat.—Largo Bay and off St Monance, as well as other parts of the Forth. This is not a very satisfactory species, and great care is required in discriminating between it and *Stenhelia ima*.

Laophonte serrata (Claus).

Cleta serrata, Claus, Die frei-lebenden Copepoden, p. 123, t. xv. figs. 13–20 (1863).

Laophonte serrata, Brady, *op. cit.*, vol. ii. p. 71, pl. xxxiii. figs. 1–14.

Habitat.—Off St Monance, rare.

Laophonte longicaudata, Boeck.

Laophonte longicaudata, Boeck, Oversigt Norges Copepoder, p. 55 (1864).

Laophonte longicaudata, Brady, *op. cit.*, vol. ii. p. 82, pl. lxxiv., figs. 12–15; pl. lxxvi. figs. 10–15.

Habitat.—Off St Monance, rather scarce.

Laophonte hispida (Brady and Robertson).

Asellopsis hispida, B. and R., Ann. and Mag. Nat. Hist., vol. xii. p. 137, pl. ix. figs. 6–10 (1873).

Laophonte hispida, Brady, *op. cit.*, vol. ii. p. 85, pl. lxxxi. figs. 1–11.

Habitat.—Largo Bay, frequent. This species is rather robust, with short caudal segments; these and one or two of the last abdominal segments are more or less covered with close-set short hairs.

Cletodes limicola, var. *gracilis*, Brady.

Cletodes limicola, var. *gracilis*, Brady, *op. cit.*, vol. ii. p. 96.

Habitat.—Largo Bay, off St Monance, and other parts of the Forth in company with the type. The caudal segments in this form are long and slender, and have a prominent jointed (?) spine arising nearly at right angles from the upper surface and near the middle of each segment. I have observed both male and female, the latter with ova, in material dredged off St Monance in from 12 to 14 fathoms. With the exception of the long caudal segments (which are fully two-thirds the length of those of *C. longicaudata*), very little difference can be observed between this variety and the typical *C. limicola*.

Cletodes longicaudata, Brady and Robertson.

Cletodes longicaudata, B. & R., Brit. Assoc. Report, p. 196 (1875).

Cletodes longicaudata, Brady, *op. cit.*, vol. ii. p. 92, pl. lxxix. figs. 13–19.

Habitat.—Off St Monance, rare. This species has long, slender, caudal segments, and differs from the *C. limicola*, var. *gracilis*, by the form of the fifth feet and anterior antennæ; the caudal segments are also longer.

Enhydrosoma curvatum (Brady and Robertson).

Rhizothrix curvata, B. & R., Brit. Assoc. Report, p. 197 (1875).

Enhydrosoma curvatum, Brady, *op. cit.*, vol. ii. p. 98, pl. lxxxi. figs. 12–15; pl. lxxxii. figs. 11–19.

Habitat.—Largo Bay, not uncommon; the extremities of both branches of the first feet are furnished with two long slender setæ, at the ends of which are a few fine flagellum-like hairs.

Thalestris serrulata, Brady.

Thalestris serrulata, Brady, Mon. Brit. Cop., vol. ii., p. 133, pl. lix., figs. 2–11 (1880).

Habitat.—East of Inchkeith, several specimens taken with surface net. This species was described by Dr Brady from a single specimen—a male—dredged on a bottom of muddy sand in New Grimsbay Harbour, Scilly. Last year (1889) another specimen—a female—was observed by I. C. Thompson in a tow net gathering from Puffin Island.* The Forth specimens comprised both male and female, and were of a dark brick-red colour, which made them very conspicuous in the tow-netting. Some of the coloured copepoda, as *Alteutha*, retain their colour for a considerable time after being in spirit; but in the case of this *Thalestris* not a trace of colour remained after a few hours immersion. I have obtained this species also in Dornoch Firth. This seems to be the first record of it for Scotland.

Harpacticus flexus, Brady and Robertson.

Harpacticus flexus, B. & R., Ann. and Mag. Nat. Hist., ser. iv., vol. xii. p. 134, pl. ix. figs. 17–21 (1873).

Harpacticus flexus, Brady, *op. cit.*, vol. ii. p. 152, pl. lxiv. figs. 12–18.

Habitat.—Off St Monance, scarce.

Zaus goodsiri, Brady.

Zaus ovalis, Claus, Die frei-lebenden Copepoden, p. 146, tab. xxii. fig. 18; tab. xxiii. figs. 11–18 (1863).

Zaus goodsiri, Brady, *op. cit.*, vol. ii. p. 156, pl. lxvi. figs. 10–13.

* *Proc. Biol. Soc., Liverpool*, iii., p. 188 (1889).

Habitat.—Off St Monance, frequent. Dr Brady says that this species 'must be looked upon as one of the rarest, as it is certainly one of the 'finest of the British Harpacticidæ.' It has, somewhat like *Alteutha depressa*, a broad reddish purple band across the thorax.

(Family uncertain.)

Cylindropsyllus lævis, Brady.
Cylindropsyllus lævis, Brady, *op. cit.*, vol. iii. p. 30, pl. lxxxiv. figs. 1–8.

Habitat.—Off St Monance, frequent. This species, which does not seem to have been previously recorded for Scotland, might be easily passed over as belonging to some other group than the *Copepoda*. Its comparatively long and cylindrical form and short swimming feet impart to it a somewhat close resemblance to a young *Pseudatanais*—a kind of Isopod. Both the genus and species were described from a single specimen dredged off Hartlepool, and from the structure of the mouth it was conjectured to be of parasitic or semiparasitic habits. All the specimens found by me have, however, been unattached to any other organism. I also found this species in East Loch Tarbert (Loch Fyne) in 1885, but it was not recorded. It has been observed by the Rev. A. M. Norman at Plymouth.

Fifteen species of Copepoda are recorded above, which brings up the number observed within the area of the Firth of Forth to sixty. I expect that this number will be yet further increased. There are several forms that are doubtful, or that have not yet been identified with described species, which will be recorded later on. I am greatly indebted to Dr G. S. Brady for the trouble he has taken in examining and identifying doubtful species, not only belonging to this, but also to the following group, the Ostracoda.

OSTRACODA.

Thirty-two species of Ostracoda are here added to those recorded in my two previous papers. Four of these have not as yet been identified with known species, and are for the present provisionally named and described. I am also indebted to Mr David Robertson for notes of a few species not as yet observed by me in the Firth of Forth.

PODOCOPA.

Cyprididæ.

Aglaia complanata, Brady and Robertson.
Aglaia complanata, Brady and Robertson, Ann. and Mag. Nat. Hist., ser. iv., vol. iii. p. 66, pl. xx. figs. 4, 5 (1869).
Aglaia complanata, Brady and Norman, Mon. of the M. and Fw. Ostrac. of the N. Atlantic and N.-W. Europe, p. 94 (1889).

Habitat.—Bo'ness (David Robertson). A note of the occurrence of this rare and interesting species was communicated to me by Mr Robertson, who observed it among some material he had collected at Bo'ness some years ago. The only localities where it had previously been recorded from are Westport Bay, Roundstone Bay, and Birterbuy Bay, Ireland.

Pontocypris acupunctata, Brady.
Pontocypris acupunctata, Brady, Mon. Rec. Brit. Ostrac., p. 386, pl. xxiv. figs. 53–56 (1868).
Pontocypris acupunctata, Brady and Norman, *op. cit.*, p. 109.

Habitat.—Off St Monance, several specimens, and one or two from other parts of the Forth. This species seems to have been previously recorded from only two places in Scotland—St Magnus Bay, Shetland, and the Minch (see Monograph by Brady and Norman). I have, however, also observed it among some material dredged last year (1889) among the Orkney Islands.

Pontocypris trigonella, G. O. Sars.

Pontocypris trigonella, Brady, *op. cit.*, p. 387, pl. xxv. figs. 31–34; pl. xxxviii. fig. 3.

Pontocypris trigonella, Brady and Norman, *op. cit.*, p. 109 pl xxii. figs. 18–25; pl. xxiii. fig. 6.

Habitat.—Largo Bay and other parts of the Estuary, but not very common.

BAIRDIIDÆ.

Bairdia inflata, Norman.

Bairdia inflata, Brady, *op. cit.*, p. 388, pl. xxvii. figs. 9–17; pl xxxviii., fig. 5.

Bairdia inflata, Brady and Norman, *op. cit.*, p. 112.

Habitat.—Off St Monance, rare.

CYTHERIDÆ.

Loxoconcha viridis (Müller).

Cythere viridis, Müller, Entom., p. 64, pl. vii. figs. 1, 2 (1785), non Brady.

Loxoconcha elliptica, Brady, *op. cit.*, p. 435, pl. xxvii. figs. 38, 39; 45–48; pl. xl. fig. 3.

Loxoconcha viridis, Brady and Norman, *op. cit.*, p. 185.

Habitat.—Granton Harbour (David Robertson). This is a brackish-water species, and may have accidentally got into the harbour.

Loxoconcha multifora (Norman).

Cytheropteron multiforum, Brady, *op. cit.*, p. 449, pl. xxix. figs. 38–42.

Loxoconcha multifora, Brady and Norman, *op. cit.*, p. 185.

Habitat.—Granton Harbour (David Robertson). These two species of *Loxoconcha* were observed by Mr Robertson in material collected by him in Granton Harbour twenty years ago.

Cythere finmarchica (G. O. Sars), ♂ ♀.

Cythere finmarchica, Brady, *op. cit.*, p. 410, pl. xxxi. figs. 9–13.

Cythere finmarchica, Brady and Norman, *op. cit.*, p. 163.

Habitat.—Off St Monance, frequent.

Cythere whitei (Baird).

Cythereis whitei, Baird, Brit. Entom., p. 175, t. xx. figs. 3, 3*a* (1850).

Cythere whitei, Brady, *op. cit.*, p. 416, pl. xxx. figs. 21–24.

Cythere whitei, Brady and Norman, *op. cit.*, p. 169.

Habitat.—Largo Bay, rather rare.

Cythere (?) *semiovata,* n. s. (Pl. XII. figs. 1–2).

Shell seen from the side semiovate, dorsal and ventral margins nearly parallel; dorsal margin a flattened curve sloping downwards posteriorly, and forming with the nearly straight ventral margin a somewhat bluntly angular extremity; anterior end sharply rounded below, then curving obliquely upwards and backwards till it merges in the dorsal margin.

Seen from above, the width is greatest near the anterior end, but varies little for about three quarters of the length, when the sides converge and form posteriorly a somewhat wedge-shaped extremity. The anterior end is broadly rounded, inclining to angular in the middle, where the valves meet; greatest breadth equal to height; height about $\frac{1}{3}$ the length. Surface of the valves smooth, but having a slightly resinous appearance. Length, ·35 mm.

Habitat.—Off St Monance, not very rare. Specimens of this form have been dredged on several occasions at this place, depth 12 to 14 fathoms, bottom clean gravel and sand. The animal has not yet been made out, the species is therefore for the present doubtfully referred to *Cythere.*

Cytheridea torosa (Jones).

Cytheridea torosa, Brady, *op. cit.*, p. 425, pl. xxviii. figs. 7–12; pl. xxxix. fig. 5.

Cytheridea torosa, Brady and Norman, *op. cit.*, p. 175.

Habitat.—Brackish water pools by the shore at Aberlady Bay, common. Associated with *Cytherura gibba* (Müller), *Candona candida* (Müller), *Trochamina inflata* (Mont.), *Haplophragmium canariense*, &c., Granton Harbour (Robertson). I have this species also from Montrose Basin and from Orkney; it is a brakish-water species. The above are the only records of its occurrence on the east of Scotland.

Krithe bartonensis (Jones).

Krithe bartonensis, Brady, *op. cit.*, p. 432, pl. xxxiv. figs. 11–14; pl. xl. fig. 5.

Krithe bartonensis, Brady and Norman, *op. cit.*, p. 179.

Habitat.—Near the mouth of the Estuary, moderately common. This species is new to the east of Scotland.

Cytherura gibba (Müller).

Cythere gibba, Müller, Entomostraca, p. 66, pl. vii. figs. 7–9, ♀ (1785).

Cytherura robertsoni, Brady, *op. cit.*, p. 444, pl. xxxii. figs. 16–18, ♀.

Cytherura gibba, Brady and Norman, *op. cit.*, p. 190 (non *Cytherura gibba*, Brady, Mon. Rec. Brit. Ostrac.)

Habitat.—Largo Bay, rare (dead), frequent in brackish-water pools at Aberlady Bay (living); Granton Harbour (Robertson); it occurs also in Montrose Basin. This is a brackish-water species, and is sometimes observed in moderate abundance where the water is only slightly saline. Its occurrence in Largo Bay and in Granton Harbour is probably accidental.

Cytherura cornuta, Brady.

Cytherura cornuta, Brady, *op. cit.*, p. 445, pl. xxxii. figs. 12–15.

Cytherura gibba, idem ibidem, p. 444, pl. xxxii. figs. 68–70, ♀ (non *Cytherura gibba*, Müller).

Cytherura affinis, idem ibidem, p. 443, pl. xxxii. figs. 17–21, ♀ var. (non *Cytherus affinis*, G. O. Sars).

Cytherura lineata, idem ibidem, p. 443, pl. xxxii. figs. 30–34 (jun.).

Cytherura cornuta, Brady and Norman, *op. cit.*, p. 192, pl. xviii. figs. 21, 22.

Habitat.—Vicinity of Phidra, off Musselburgh, and Burntisland, but not common. Though of frequent occurrence on the west coast, I do not find any previous record of it from the east coast of Scotland.

Cytherura bodotria,* n. s. (Pl. XII. figs. 6, 7).

Shell seen from the side of nearly equal height throughout; dorsal and

* Bodotria, the ancient name of the Forth.

ventral margins nearly straight, the former is slightly convex towards the anterior extremity; anterior margin evenly rounded, posterior extremity with a short beak situated about the middle, its termination narrow, truncate. Seen from above, ovate, slightly constricted in front, where the valves meet. At the posterior end, the middle is bluntly mucronate, and the sides are produced to an acute angle, so as to impart to it a somewhat tridentate appearance; dorsal ridge prominent, where it bends downwards in front. Surface sculptured with flexuous longitudinal riblets, crossed by a few indistinct ones arranged irregularly. Length, ·5 mm.; breadth, $\frac{3}{5}$ length; height, fully $\frac{1}{3}$ the length.

Habitat.—Off St Monance, in 12 to 14 fathoms, bottom sand and gravel, rare.

This species somewhat resembles *Cytherura acuticostata*, but differs in being not so stout, and in having the valves produced backwards, so that the posterior extremity of the shell has a tridentate form.

Cytherura mucronata, n. s. (Pl. XII. figs. 3, 5).

Shell seen from the side, elongate, narrow; height about equal at both ends, length two and a half times the height; dorsal margin nearly straight, ventral margin slightly and evenly concave, posterior end much produced and wedge-shaped, forming a 'beak,' which is situated below the middle; anterior margin broadly rounded, somewhat produced in the middle. Seen from above, oval, with the ends acuminate; the margin at each end, especially the anterior margin, is produced, so as to form a distinct 'mucro.' The surface is marked with indistinct raised lines, which are somewhat irregularly distributed; the breadth is equal to the height; length, ·33 mm.

Habitat.—Off St Monance, not very rare.

Cytherura simplex, Brady and Norman.

Cytherura simpex (name only), Brady and Robertson, Ann. and Mag. Nat. Hist., ser. iv., vol. xi. p. 66 (1872).

Cytherura sarsii ("local variety"), idem ibidem, vol. xiii. p. 117, pl. iv. figs. 6, 7 (1874).

Cytherura simplex, Brady and Norman, *op. cit.*, p. 200, pl. xviii. figs. 1, 2.

Habitat.—Off St Monance, frequent, depth 12 to 15 fathoms; bottom clean sand, part gravel. Viewed laterally, the shell of this species differs somewhat from the usual form of *Cytherura*, which has a more or less distinct 'beak' at the posterior end, whereas this has no posterior beak. New to the east of Scotland.

Cytherura fulva, Brady and Robertson.

Cytherura fulva, Brady and Robertson, Ann. and Mag. Nat. Hist., ser. iv., vol. xiii. p. 116, pl. iv. figs. 1–5 (1874).

Cytherura fulva, Brady and Norman, *op. cit.*, p, 205, pl. xix. figs. 9–11.

Habitat.—Largo Bay and other parts of the Estuary, but not common. New to the east of Scotland.

Cytheropteron punctatum, Brady.

Cytheropteron punctatum, Brady, *op. cit.*, p. 449, pl. xxxiv. figs. 45–48.

Cytheropteron punctatum, Brady and Norman, *op. cit.*, p. 211.

Habitat.—Off St Monance, rather rare. I do not find any previous record of this species for the east of Scotland.

Bythocythere turgida, G. O. Sars.

Bythocythere turgida, Brady, *op. cit.*, p. 452, pl. xxxiv. figs. 35–38.

Bythocythere turgida, Brady and Norman, *op. cit.*, p. 221.

Habitat.—Off Musselburgh and other parts of the Estuary, but not common. The only other Scotch localities where this species has been observed are the Clyde, Orkney, and Shetland.

Bythocythere recta (Brady).

Cytheropteron rectum, Brady, *op. cit.*, p. 476.

Bythocythere recta, Brady and Norman, *op. cit.*, p. 222, pl. xix. figs. 13–14.

Habitat.—Largo Bay, rare. This species has also been recorded from Lerwick and St Magnus Bays, Shetland, which appear to be the only records of it for Scotland.

Cytherois fischeri (G. O. Sars).

Paradoxostoma fischeri, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iii. p. 362, pl. xii. figs. 1–3 (1870).

Cytherois fischeri, Brady and Norman, *op. cit.*, p. 228, pl. xxi. figs. 20–22.

Habitat.—Generally distributed throughout the Estuary; common in brackish pools by the shore at Aberlady, where it is more or less of a dark bluish colour: those dredged off St Monance are nearly white.

PARADOXOSTOMATIDÆ.

Paradoxostoma variabile (Baird).

Paradoxostoma variabile, Brady, *op. cit.*, p. 459, pl. xxxv. figs. 1–7, 12–17; pl. xli. fig. 8.

Paradoxostoma variabile, Brady and Norman, *op. cit.*, p. 229, pl. xxiii. fig. 10.

Habitat —Largo Bay and other places, frequent

Paradoxostoma obliquum, G. O. Sars.

Paradoxostoma obliquum, Brady, *op. cit.*, p. 459, pl. xxxv. figs. 18–21.

Paradoxostoma obliquum, Brady and Norman, *op. cit.*, p. 230.

Habitat.—Off Phidra, Musselburgh, and Burntisland, rare.

Paradoxostoma hibernicum, Brady.

Paradoxostoma hibernicum, Brady, *op. cit.*, p. 460, pl. xxxv. figs. 35, 36; pl. xl. fig. 7.

Paradoxostoma sarniense, idem ibidem, p. 460, pl. xxxv. figs. 26–29; pl. xl. fig. 9.

Paradoxostoma hibernicum, Brady and Normau, *op. cit.*, p. 232, pl. xxi. figs. 15–17.

Habitat.—Largo Bay, rare. Neither this nor the previous species appear to have been recorded before for the east of Scotland.

Paradoxostoma arcuatum, Brady.

Paradoxostoma (?) *arcuatum*, Brady, *op. cit.*, p. 461, pl. xxv. figs 37–38.

Paradoxostoma arcuatum, Brady and Norman, *op. cit.*, p. 234, pl. xxi. figs. 5, 6.

Habitat.—Off St Monance, Largo Bay, and near Inchkeith; several specimens Granton Harbour (Robertson).

Paradoxostoma hodgei, Brady

Paradoxostoma hodgei, Brady, Nat. Hist. Trans. Northumberland and Durham, vol. iii. p. 371, pl. xii. figs. 12, 13 (1870).

Paradoxostoma hodgei, Brady and Norman, *op. cit.*, p. 235, pl. xxi. figs. 7, 8.

Habitat.—Off St Monance and Phidra, frequent. New to the east of Scotland.

Paradoxostoma (?) *affine*, provisional name. (Pl. XII. figs. 8–9).

Shell seen from the side elongate, subovate, highest a little behind the middle; dorsal margin evenly but not boldly arched, inferior nearly straight, slightly sinuate towards the anterior extremity; anterior extremity rather higher than the posterior, and the margins of both evenly rounded; surface smooth, with a few irregular scratched lines. Outline seen from above compressed, ovate, the posterior half of nearly equal breadth, with the extremity obtusely pointed; anteriorly the shell is more compressed, the extremity being somewhat acuminate; breadth about equal to height and a third of the length; length, ·42 mm.

This form resembles a small *P. arcuatum*, but is not so narrow posteriorly, and the greatest breadth is nearer the posterior extremity.

Habitat.—Off St Monance, not common.

MYODOCOPA.

Cypridinidæ.

Asterope mariæ (Baird).

Cypridina mariæ, Baird, Proc. Zool. Soc. Lond., part xviii. (1850), p. 257, pl. xvii. figs. 5–7.

Cylindroleberis mariæ, Brady, Mon. Rec. Brit. Ostrac., p. 465, pl. xxxiii. figs. 18–22; pl. xli. fig. 1 (1868).

Asterope mariæ, Robertson, Fauna and Flora of the West of Scotland, p. 39 (1876).

Habitat.—Bass Rock, but not common. This is a generally distributed, though not an abundant species. I have specimens from the Moray Firth and from Orkney: it is not uncommon in the Clyde.

CLADOCOPA.

Polycopidæ.

Polycope orbicularis, G. O. Sars.

Polycope orbicularis, G. O. Sars, Oversigt af Norges Marine Ostracoder, p. 122.

Polycope orbicularis, Brady, *op. cit.*, p. 471, pl. xxxv. figs. 53–57.

Habitat.—Off Phidra, rare. There is no previous record of this species for the east of Scotland.

Note.—In the Monograph by Brady and Norman, recently published by the Royal Dublin Society, the following species are recorded from the Firth of Forth:—*Loxoconcha fragilis*, G. O. Sars; *Loxoconcha pusilla*, Brady and Robertson; and *Cythere pulchella*, Brady, which, with the exception of the first, I also have observed in different parts of the Estuary.

AMPHIPODA.

Gammaridæ.

Gitana sarsi, Boeck.

Gitana sarsi, Boeck, De Skand. Arkt. Amphip., p. 439, pl. xi. fig. 2 (1876).

Amphilochus sabrinæ, Stebbing, Ann. and Mag. Nat. Hist., p. 364, pl. xv. (1878).

Habitat.—Off Inchkeith (Nov. 1889) rare. This is a small species, and easily missed when mixed up among a lot of other things.

Guernia coalita (Norman).

Helleria coalita, Norman, Ann. and Mag. Nat. Hist., p. 418, pl. xxii. fig. 8; pl. xxiii. figs. 1–6 (1868).

Guernia coalita, Chevreux, Cat. Amphip. du Sud-ouest de la Bretagne (1889).

Habitat.—Off St Monance. A few specimens only of this curious little species were observed in material dredged off St Monance, depth from 12 to 14 fathoms, bottom sand and gravel.

Hippomedon holbölli (Kröyer).

Anonyx holbölli, Kröyer, Natur. Hist. Tidsskr., 2 R, 2 B, p. 8 (1846).

Anonyx denticulatus, Sp. Bate, Cat. Amphip. Crust. Brit. Mus., p. 75 (1862).

Hippomedon holbölli, A. Boeck, De Skand. Arkt. Amphip., p. 136, pl. v. fig. 6; pl. vi. fig. 7 (1876).

Habitat.—A little north-west of May Island (1888), rare.

Megaluropus agilis, Norman.

Megaluropus agilis, Norman, Ann. and Mag. Nat. Hist. (1889), p. 446, pl. xviii. figs. 1–10.

Habitat.—Largo Bay, frequent. 'The most remarkable characters in the genus,' to which this species belongs, 'are the eye, which is situated on a greatly projected lobe, and the expanded foliaceous branches of the last uropods.'* The peculiar form of these uropods is even more striking than the prominent eye on its curious stalk-like lobe, which projects forward between the peduncles of the antennules and antennæ. In Scotland this species has been observed at Cumbrae, Firth of Clyde (D. Robertson), and 25 miles off May Island, Firth of Forth (John Murray). This last station is considerably beyond the limits of the Forth, and the present is therefore the first record of the occurrence within the Estuary.

Monoculodes carinatus, Bate.

Westwoodia carinata, Bate, Brit. Assoc. Rep. (1855), p. 58.

Monoculodes carinata, Bate and Westw., Brit. Sess.-eyed Crust., vol. i. p. 165.

Monoculodes stimpsoni, ibid ibidem, p. 160, ♂ (jun.)

Monoculodes affinis, Boeck, Crust. Amphip., bor. et arct., p. 84 (1870).

Monoculodes carinatus, Norman, Ann. and Mag. Nat. Hist. (1889), p. 447, pl. xix. figs. 1–5.

Habitat.—Off St Monance, near Phidra, and in Largo Bay, but not common. In Largo Bay, *M. longimanus*, Bate (a species I have already recorded for the Forth), is of frequent occurrence; females with ova are occasionally observed. This species is not so large nor so robust as the other, being scarcely half the size. *M. carinatus* has been taken '25 miles 'off May Island,' which is considerably beyond the limits of the Firth of Forth. This is the first record of its occurrence within the Estuary. Mr Robertson records it from several places in the Firth of Clyde, and T. Edward at Banff.

* Norman, *Ann. and Mag. Nat. Hist.* (1889), p. 446.

Urothoe elegans, Spence Bate.

Gammarus elegans, Spence Bate, Brit. Assoc. Rep. (1855).

Urothoe elegans, Spence Bate, Sess.-eyed Crust., vol. i. p. 200 (1863).

Habitat.—Largo Bay, not uncommon. A small but robust species, which does not appear to have been previously recorded for the Forth.

Leucothoe spinicarpa (Abildgaard).

Gammarus spinicarpus, Abildgaard, Zool. Dan., vol. iii. p. 66, pl. cxxix. figs. 1–4.

Leucothoe spinicarpa, A. Boeck, Crust. Amph., bor. et arct., p. 78 (1870).

Leucothoa spinicarpa, Bate and Westwood, Brit. Sess.-eyed Crust., vol. i. p. (1863).

Habitat.—Largo Bay, rare. *Leucothoe* is readily distinguished by the peculiar form of the hands of the first pair of gnathopods, which somewhat resemble the blades of a pair of scissors with curved points. I have frequently taken this species, but usually in the branchial cavities of large Ascidians, and very seldom otherwise. I have observed it in such situations at East Loch Tarbert (Loch Fyne), at Scapa Flow, Orkney, and in the Moray Firth. It is of a delicate reddish or pink colour, and moderately active. It is curious that this somewhat semiparasitic habit of *L. spinicarpa* has been so seldom referred to by authors.

Phoxocephalus fultoni,* n. s. (Pl. XII. figs. 10–12), and Pl. XIII. figs. 13–19.

Rostrum (fig. 12) extending to about the end of the second joint of the peduncle of the antennules. Antennules short, not longer than the peduncle of the antennæ; joints of peduncle stout, sparsely furnished with hairs, the last rather more than half the length of the penultimate joint; flagellum shorter than the peduncle, 4-jointed joints sub-equal; secondary appendage 3-jointed, extending to the end of the second joint of the flagellum. Antennæ short, stout, furnished with a few hairs, especially on the upper distal margin of the joints. There is no very marked difference between the peduncle and flagellum; second and third joints of peduncle about equal in length; flagellum 3-jointed, rather longer than the last joint of the peduncle. The thigh of the first gnathopods is long, the anterior distal angle of the short stout meros is produced into a small rounded process; the adjacent parts of meros and wrist are correspondingly hollowed out, and thus a kind of ball and socket joint is formed (fig. 15, *a*); hand (fig. 15) subquadrate, the length about twice the breadth; sides nearly straight and parallel; palm slightly convex, and produced forward at an obtuse angle from the joint of the finger; finger slightly curved, the point reaching nearly to the extremity of the palm, and fitting into a small notch. Second gnathopods very like the first, but the hand is to some extent proportionally broader; the hands of both first and second gnathopods have a fringe of short hairs along each side of the palm. The first, second, and third perieopods are short and stout; the fourth are longer, the fifth are also short and stout. The outer branch of posterior pleiopods is 2-jointed, the terminal joint being very much shorter than the other; the inner branch is 1-jointed, and small, being scarcely more than half the length of the first joint of the outer branch (fig. 19).

I obtained two forms of this species; they resemble each other closely.

* It gives me much pleasure to have the opportunity to name this species after my friend, Dr T. Wemyss Fulton, Secretary to the Scientific Department of the Fishery Board.

The one that seems to be the female differs from that now described chiefly in the following points :—The flagellum of the antennules is 5-jointed, the first and second joints rather shorter than the others (figs. 10–11). The flagellum of the antennæ is 10-jointed; the first joint is moderately long—longer than the next two together, which are short, and about equal in length, fourth joint rather longer than the preceding; the remaining joints gradually increase in length, and become more slender (fig. 11). The inner joint of the posterior pleiopods, which is also 1-jointed, is rather longer than, and as stout as the first joint of the outer branch; the two forms are very much alike otherwise.

Habitat.—Off St Monance, in 12 to 15 fathoms, not very common.

Amphithopsis latipes (M. Sars).

Calliope ossiani, Bate and Westwood, Brit. Sess.-eyed Crust., vol. i. p. 261 (1868).
Calliope fingalli, idem ibidem, vol. i. p. 263.
Amphithopsis latipes, Norman, Mus. Norm., part iii. p. 15 (1868).

Habitat.—Several specimens attached to a Zoophyte (*Antennularia*) brought up in the trawl-net a few miles east of Inchkeith; they were, with one or two exceptions, all prettily marked by brown bands extending from the side along the posterior edge of each segment of the posterior pleon; the coxæ were also of the same colour. In the form of the antennules and antennæ, and of the gnathopods and in the coloration, they agreed with the form described by Spence Bate as *Calliope ossiani.* The Rev. T. R. R. Stebbing, to whom I submitted specimens, and who corrobated my diagnosis, informs me that Boeck and Norman identify *Calliope ossiani* and *C. fingalli*, Bate and Westwood with *Amphithopsis latipes* (M. Sars). I have therefore followed them in ascribing my specimens to Sars's species.

Epimeria cornigera (Fabricius).

Gammarus cornigera, Fab., Reisenach Norwegen (1779), p. 383.
Acanthonotus testudo, White, Cat. Crust. Brit. Mus. (1847), p. 57.
Acanthonotus owenii, Bate and Westwood, Brit. Sess.-eyed Crust., vol. i. p. (1863).
Epimeria cornigera, A. Boeck, Crust. Amphip., bor. et arct. (1870), p. 105.

Habitat.—East of Inchkeith, about 3 miles. The colour of this pretty species is white, somewhat pellucid, beautifully variegated with bright red; the postero-lateral margins of each segment is of this colour, which is also more or less diffused over the dorsal surface. I have also got this species in the Moray Firth; and Mr Robertson records it from various places in the Clyde district.

COROPHIIDÆ.

Siphonœcetus colletti (?), Boeck.

Siphonœcetus colletti, Boeck, Crust. Amphip., bor. et arct. (1870), p. 178.
Siphonœcetus colletti, idem, De Skand. og Arkt. Amph. (1876), p. 633, pl. xxviii. fig. 9.

Habitat.—Largo Bay, frequent. New to Britain. It is quite possible that this may have been passed over as a *Corophium*, otherwise it is difficult to account for its not being previously recorded. The specimen comes very near to *S. typicus*, and it may ultimately be found to belong to that species. I prefer therefore to consider it for the present as doubtful.

ISOPODA.

SPHÆROMIDÆ.

Sphæroma rugicauda, Leach.

Sphæroma rugicauda, Leach, Edin. Enc., vol. vii. pp. 405, 408.
Sphæroma rugicauda, Bate & Westwood, Brit. Sess.-eyed Crust., vol ii. p. 408 (1863).

Habitat.—In brackish-water pools on the shore at Aberlady Bay, Common. They appeared mostly to creep upon or through the surface layer of the soft oozy mud forming the bottom of the pools; and only when the mud was stirred would they rise and swim very rapidly through the water for a short distance, then drop down again and burrow among the mud. When prevented from swimming, or when taken out of the water, they rolled themselves into a ball. Though observed at Berwick-on-Tweed by Dr Johnston, they do not appear to have been previously recorded for the east of Scotland. Mr Robertson found them plentiful in a weedy brackish pool with a soft muddy bottom at Hunterston, Ayrshire.

CUMACEA.

Only four species are added to the Forth Cumacea in this Report, viz.:—

CUMIDÆ.

Cuma pulchella, G. O. Sars, ♂ ♀.

Cuma pulchella, G. O. Sars, Nye Bidrag til Kundakaben om Middelhavets Invert-fauna, part ii., Cumacear, p. 24, tab. vi. and tab. lx. (1879).

Habitat.—Off St Monance, and in the vicinity of Phidra; Largo Bay, common. This is a small species, and easily overlooked. Dr Norman says that 'a good point for distinguishing the species is the first joint of 'the second foot, which is furnished with a series of backward directed 'tooth-like processes,' which is well shown in tab. lx. fig. 7, of Sars' Monograph referred to above. This seems to be the first time that *C. pulchella* has been observed in Britain; previously it has been noticed at Naples by G. O. Sars, and Bayonne by Marquis de Folin. The integument is ornamented with numerous microscopic circular depressions arranged in irregular oblique rows; the anterior part of the cephalon is dorsally of a dusky colour, and is darkest in the vicinity of the rostrum.

Eudorellopsis deformis (Kröyer).

Leucon deformis, Kröyer, Voyage en Skand., pl. vi. fig. 3.
Eudorella? deformis, G. O. Sars, Beskrivelse af de paa Fregatten Josephines Exped., fundne Cumaceer, p. 50, figs. 118–121 (1871).

Habitat.—Off St Monance and Aberlady Bay, not common. Dr Norman states in reference to this species, 'not yet recorded as British, but I have 'had specimens in my collection, determined, since 1866, when I found 'them in a gathering from Bridlington, sent me by G. S. Brady.' It does not seem to have been observed anywhere else in Britain, and thus forms an interesting addition to the Forth Fauna. In 1882 G. O. Sars described this under the generic name *Eudorellopsis.*

Diastylus rugosa, G. O. Sars.

Diastylus rugosa, G. O. Sars, Om den aberrante Krebsdyrgruppe Cumacea og dens nordiske Arter, p. 41.
Diastylus strigata, Norman, Ann. Nat. Hist., ser. 5, vol. iii. p. 62 (male).

Diastylus rugosa, G. O. Sars, Middelhavets Cumaceer, p. 98, Tab. 34–38 (1879).

Habitat.—Largo Bay and other parts of the Forth. This seems to be a well-marked species, though it has not previously been recorded for the Estuary.

Campylaspis affinis, G. O. Sars, ♂ ♀.

Campylaspis affinis, G. O. Sars, Nye Dybrands Crustaceer fra Lofoten, p. 160 (1870); Extract, p. 16.

Habitat.—Vicinity of the Bass Rock, rare. The cephalic shield is thickly sprinkled with purple spots, which impart to it a somewhat uniform purplish colour. The Rev. T. R. R. Stebbing, to whom I submitted the specimen, points out that it comes very close to *C. rubricunda* (Liljeborg) in the form of the tail appendages; it differs in the coloration.

SCHIZOPODA.

Mysidæ.

Erythrops serrata, G. O. Sars.

Nematopus serratus, G. O. Sars, Beretning om en Sommeren (1862), foretagen Zoologisk Reise i Christianias og Trondhjems Stifter, p. 43.

Nematopus serratus, Norman, Last Report on Dredging among the Shetland Isles: Report Brit. Assoc. (1868), p. 270.

Erythrops serrata, G. O. Sars, Mon. over de ved Norges Kyster Forkommende Mysider., Frste Hefte, p. 27, tab. ii. figs. 1–2 (1870).

Habitat.—South-east of the Bass Rock 4 or 5 miles, rather rare. In this species the outside edges of the antennal scales are deeply toothed, with the teeth pointing forwards, and thus differs from the other two species of *Erythrops* recorded for Britain. There appears to have been some confusion in previous records of the distribution of *Nyctiphanes norvegica* and *Boreophausia raschii*, the first being understood to be a more common species. I find, on the contrary, that the latter is comparatively abundant, especially in the outward part of the Estuary, while the other is rather rare.

MOLLUSCA.

Miss J. E. Carphin kindly placed her extensive collections of Forth Mollusca at my service, which has enabled me to include a few interesting additions to the local list of species belonging to this group.

LAMELLIBRANCHIATA.

Lucinidæ.

Diplodonta rotundata (Montagu).

Telene rotundata, Mont., Test. Brit., p. 74, t. ii. fig. 3.

Diplodonta rotundata, Jeffreys, Brit. Conch., vol. ii. p. 254; vol. v. pl. xxxiii. fig. 4.

One living specimen of this pretty bivalve was found at Newhaven Pier by Miss J. E. Carphin. It had been brought in from the outer part of the Estuary on the fishermen's lines.

Cardiidæ.

Cardium nodosum, Turton.

Cardium nodosum, Turt., Conch. Dith., p. 186, t. xiii. fig. 8.

Cardium nodosum, Jeffreys, Brit. Conch., vol. ii. p. 283; vol. v. pl. xxxv. fig. 4.

Habitat.—Between Inchkeith and May Island, several specimens of this species were dredged, a few being alive. Though widely distributed, it does not appear to be a common species. My friend Mr J. T. Marshall, M.C.S., Torquay, kindly examined one of the specimens for me, and confirmed my identification. He says 'it is a rare species in Scotland, 'and I have it thence from only two localties.' It may be remarked that some experience is necessary to enable one to discriminate the smaller species of Cardium.

CYPRINIDÆ.

Circe minima (Montagu).

Venus minima, Mont., Test. Brit., p. 121, t. iii. fig. 3.

Circe minima, Jeff., Brit. Conch., vol. ii. p. 322, pl. vi. fig. 4; vol. v. pl. xxxvii. fig. 6.

Procured from the fishermen's lines at Newhaven Pier by Miss J. E. Carphin.

GASTEROPODA.

TROCHIDÆ.

Trochus montacuti, W. Wood.

Trochus montagui, Wood, Ind. Test., Suppl., pl. vi. fig. 43.

Trochus montacuti, Jeff., Brit. Conch., vol. iii. p. 320; vol. lxiii. fig. 1.

This species was found at Newhaven Pier by Miss J. E. Carphin, having been brought in from the outward part of the Estuary on the fishermen's lines.

Trochus zizyphinus, L., var. *lyonsii* (Leach).

Trochus lyonsii, Flem., Brit. Anim., p. 323.

Trochus zizyphinus, var. *lyonsii*, Jeff., Brit. Conch., vol. iii. p. 331.

Two fine and living specimens of this pretty variety of *Trochus zizyphinus* were found by Miss J. E. Carphin at Newhaven Pier; they had been brought in attached to the fisherman's lines from the outer part of the Estuary. I have also obtained two living specimens of this variety and one typical specimen among trawl refuse a few miles west of May Island, while trawling the Forth stations.

EULIMIDÆ.

Eulima polita (Linné).

Turbo politus, Linn, S. N. p. 1241.

Eulima polita, Jeff., Brit. Conch., vol. iv. p. 201; vol. v. pl. lxxvii. fig, 3.

Habitat.—Off St Monance, rare. Two adult living specimens and one or two young ones were dredged at this locality.

NUDIBRANCHIATA.

HERMÆIDÆ, A. & H.

Alderia modesta (Loven).

Stiliger modestus, Loven, Trans. Royal Swedish Academy.

Alderia modesta, idem, Index Molluscorum Scandinaviæ.

Alderia modesta, A. & H., Brit. Nud. Moll., fam. 3, pl. xli. figs. 1–5.

Alderia modesta, J. G. Jeffreys, Brit. Conch., vol. v. p. 33 (1869).

Habitat.—Brackish-water pools between tide marks, Aberlady Bay, frequent, but easily overlooked. Not before recorded for the Forth. Jeffreys says*—'This curious animal is almost amphibious, being only

* *Brit. Conch.*, vol. v. p. 33.

'found in very shallow brachish-water barely within the reach of the 'tide, and occasionally crawlimg on the moist weed beyond. It is a rare '[or local] species, but generally plentiful where it does occur.' I obtained one specimen of this species in the vicinity of Skeirvuie—a small island near the head of East Loch Tarbert (Loch Fyne)—where *Zostera marina* grows in considerable abundance; the specimen was kept alive for some time, and carefully examined by myself and others, so that though the conditions of the locality mentioned are different from those of the *habitat* which this species is said to be restricted to as stated above, there was no doubt as to the correct identification of the specimen.

Note.—In the course of our examination of the stomachs of fishes, taken in the Firth of Forth by the 'Garland's' trawl-net, the Annelids *Priapulus caudatus* and *Echiurus oxyurus*, and the Tunicate *Pelonaia corrugata* have been occasionally observed, and in some instances so little injured as to indicate that they had been quite recently captured by the fish. It is in the stomach of the haddock and cod that these organisms are usually observed. *Priapulus* and *Pelonaia* have been recorded from the Forth; but so far as I know, *Echiurus* has not been hitherto observed in the Estuary. In St Andrews Bay, however, it is occasionally met with. *Macropsis slabberi*, which, as a British species, was considered to be confined to the upper part of the Firth of Forth, has been taken by me during the last year in the vicinity of the Bass, in St Andrews Bay, and and in the Estuary of the Tay opposite Tayport; this would indicate that its distribution is not so restricted as was supposed, or that it is spreading gradually to other parts of our coast. I have also obtained the somewhat rare *Isocardia cor* and *Palmipes membranacea* (*placenta*) in the Moray Firth. Of the first, two large specimens—one living and one dead—were brought up by the trawl of the 'Southesk' last year during the time I was on board; a specimen of the other was brought up by the 'Southesk's' trawl on one or two occasions while I was on board in the early part of this year (1890).

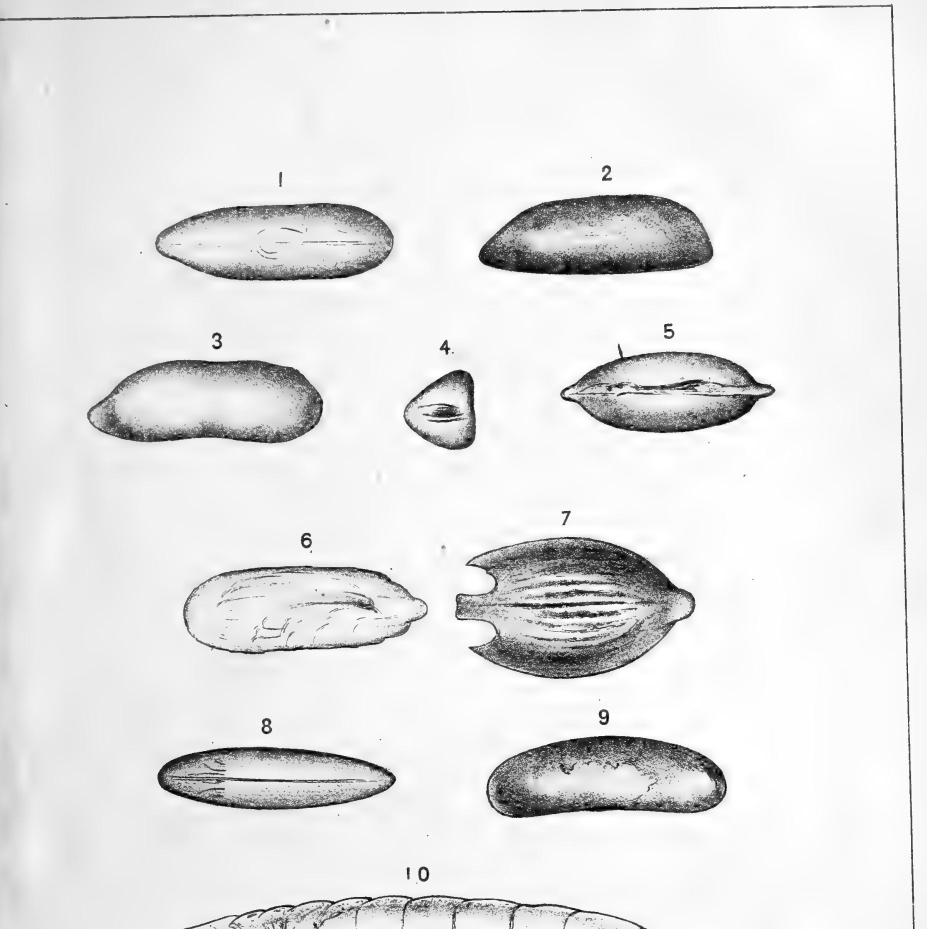
CORRIGENDA.

In my paper 'Some Additions to the Fauna of the Firth of Forth,' in last year's Report, the Amphipods referred by me to *Gammarus edwardsi*, Spence Bate (p. 321), I am now satisfied do not belong to that species, but are a form of *G. locusta*, L.

Note on *Cymbasoma rigidum* (Thompson), Scott, 'Some Additions to the 'Fauna of the Firth of Forth,' *Seventh Annual Report*, pt. iii. p. 316 (1889).

In a paper by G. C. Bourne, M.A., F.L.S., Director of the Plymouth Laboratory of the Marine Biological Association, on the genus *Monstrilla*, Dana, in the *Quarterly Journal of Microscopical Science*,† this genus is fully and carefully described; short descriptions are also added of various species belonging to it which have been more or less satisfactorily determined. In this paper Mr Bourne identifies *Cymbasoma*, Thompson, with *Monstrilla*, Dana, and refers the form recorded by me for the Firth of Forth in the *Seventh Annual Report* as *Cymbasoma rigidum* to *Monstrilla helgolandica*, Claus (of which there is no previous record for

† Vol. xxx. pt. iv. pp. 565–578, pl. xxxvii. (February 1890).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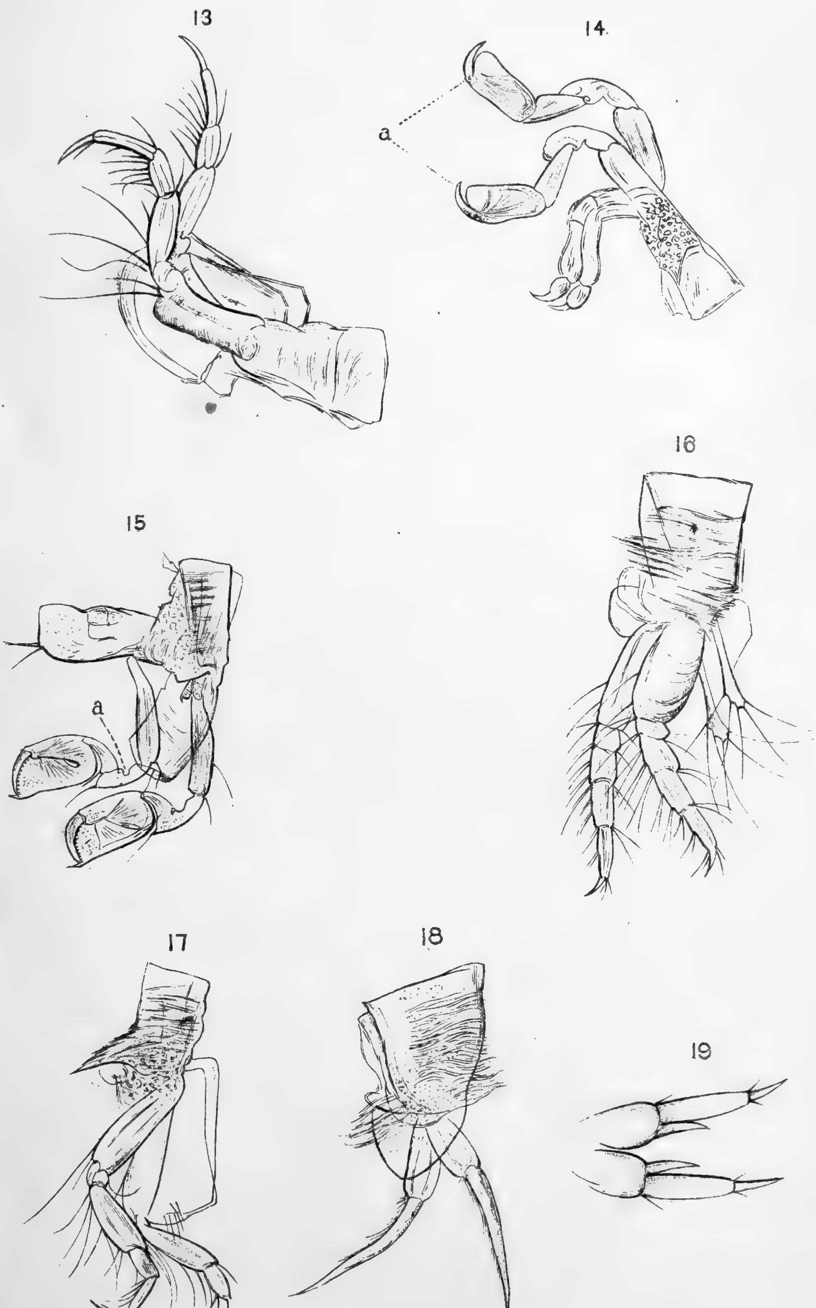
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Britain). Its distinctive characters, as described by Bourne—who examined the dissections of my specimens—are 'six setæ on each furcal 'member, four abdominal segments, antennæ four-jointed, the two last 'joints elongate, subequal. The protopodite of the swimming feet bears 'a spine on its interior lower angle.'

Habitat.—Heligoland and Firth of Forth.

EXPLANATION OF PLATES XII., XIII.

Plate XII.

Fig. 1. *Cythere* (?) *semiorata*, seen from above.
Fig. 2. „ „ seen from right side.
Fig. 3. *Cytherura mucronata*, seen from right side.
Fig. 4. „ „ end view.
Fig. 5. „ „ seen from above.
Fig. 6. *Cytherura bodotria*, seen from left side.
Fig. 7. „ „ seen from above.
Fig. 8. *Paradoxostoma* (?) *affine*, seen from above.
Fig. 9. „ „ seen from right side.
Fig. 10. *Phoxocephalus fultoni* ♀ ?
Fig. 11. „ „ ♀ ? *a* rostrum, *b* antennules, *c* antennæ.
Fig. 12. „ „ ♂ ? *a* rostrum, *b* antennules, *c* antennæ.

Plate XIII.

Fig. 13. „ „ 2nd perieopods.
Fig. 14. „ „ 1st gnathopods.
Fig. 15. „ „ 2nd „
Fig. 16. „ „ 3rd perieopods.
Fig. 17. „ „ 1st „
Fig. 18. „ „ 1st pleiopods.
Fig. 19. „ „ posterior pleiopods.

No. VIII.—THE INVERTEBRATE FAUNA OF INLAND WATERS. —I. REPORT ON LOCH COULTER AND THE COULTER BURN, STIRLINGSHIRE. By Thomas Scott, F.L.S.

The systematic investigation of the fauna of fresh water lakes, especially in those of great depths, has in recent years been largely undertaken on the Continent, by Forel, Pavesi, Fol, and a number of other investigators; but in this country comparatively little has yet been done on this subject. It is now proposed to make, from time to time as opportunity allows, a biological and physical investigation of the great Scottish lochs and inland waters, which cannot fail to be of interest in regard to the food-fishes which inhabit them, and will also incidentally throw light upon many other questions of scientific interest. The physical, and to some extent the biological, conditions of some of the West Coast lochs have been inquired into by Dr John Murray, the Director of the Challenger Commission; and Mr J. S. Grant Wilson a year or two ago made a physical examination of the lochs in Perthshire. A comparison will be made of the fauna of lochs, which have been in recent geological times cut off from the sea, with the fauna of typical inland lochs, and with that of those where there now occurs an admixture of sea water. The nature and distribution of the invertebrate organisms in the waters of very deep lochs will also be investigated. It is well known that marked differences exist between the trout and other edible fishes of many lochs. This inquiry by determining the main food of these fishes may lead to useful measures being recommended.

In compliance with instructions received, I began in June 1889 an investigation of the invertebrate fauna—especially the Crustacea and Mollusca—of Loch Coulter, and its effluent, the Coulter Burn.

Loch Coulter is situated in a natural hollow about 300 yards to the east of the Stirling and Kilsyth Road, and nearly midway between these two places. It lies almost due east and west; its greatest length is about 1100 to 1200 yards, its greatest breadth 600 to 700 yards, and it has a somewhat quadrangular outline. From the peculiar physical conditions of the district in which this loch is situated, only a few ditches drain into it, but one or more springs are reported to exist somewhere within its area. The Coulter Burn is the only outlet for the water of the loch. It takes its rise from the north-west corner, and flows east and north by a rather circuitous route, passing on its way through the well-known Howietoun Fisheries and Goldenhoof Dam, and joins the Bannock Burn a little to the south of the site of the historical battle of that name.

Sir J. Ramsay-Gibson-Maitland, Bart., kindly gave me information and advice, which were of the greatest value to me in making arrangements as to the manner in which the investigation should be made.

As I had to return to Edinburgh, in order to continue my investigations on the 'Garland,' it was decided, that as soon as arrangements could be made for proceeding with the work, my son, Mr Andrew Scott, should take my place in carrying on the proposed investigations, which he did on 12th June. In order to enable him to carry out the examination as carefully and accurately as possible, I drew up for his guidance a plan of work, dividing the district into sections, and instructing him to examine each separately and consecutively, and to take notes of the organisms observed and collect samples of material. My son completed his investigations on the 22nd of June, having examined Loch Coulter and traversed and examined the Coulter Burn from its source to its confluence with the Bannock, and thence to the Forth, a distance of between 10 and 12 miles,—and it is chiefly from his notes and the material he collected that this Report is prepared.

The scheme of work to which I have referred, and which was adhered to as closely as possible, was as follows :—

1. Loch Coulter.
2. The Coulter Burn from the Loch to Craigquarter Wood.
3. The Coulter Burn from Craigquarter Wood to the Hatching House (connected with the Howietoun Fisheries).
4. The Coulter Burn from the Hatching House to the Ponds at Howietoun, including as far as possible an examination of the Ponds.
5. The Coulter Burn from the Ponds to Goldenhoof Dam, including an examination of the Dam.
6. The Coulter Burn from Goldenhoof Dam to its confluence with the Bannock.
7. The Bannock Burn from thence to the Forth.

In stating the results of the examination of the loch and its effluent it will perhaps be better to refer to each section separately, as this will to some extent simplify and localise the information secured.

1. Loch Coulter.

In our examination of Loch Coulter, the tow-net, hand-net, and dredge were used. We first of all used the tow-net, towing it for a time just under the surface of the water, when we soon ascertained that the water all over the loch was teeming with Entomostracan organisms. The tow-net was then fixed to the dredge rope, the dredge being used as a 'sinker,' and towed close to the bottom. Various parts of the loch were examined in this way, and Entomostraca were again observed to be abundant; in fact, on looking over the side of the boat, they could easily be observed in great numbers swimming about near the surface. The bottom was next examined by means of the dredge, and the results showed that the depth of the loch did not much exceed 5 fathoms at the deepest part, which was near the east end. At this end the bottom was hard and stony, and appeared to be unsuitable for the existence of Mollusca or other non-pelagic organisms, as very few were obtained at this part. Towards the north end the bottom was found to consist, more or less, of fine vegetable mud, on which several species of Molluscs appeared to live, a few of them being common, while others were more sparingly distributed. The examination of the mud also yielded a number of species of Ostracoda; the individuals of this group were, however, not very plentiful, the macrospores of *Isoetes lacustris*—an aquatic plant allied to the Clubmosses—were very common in the mud. As Entomostraca were observed to be so abundant in the water of Loch Coulter, we endeavoured to ascertain whether the fish in the loch were feeding on them. For this purpose efforts were made, by means of hook and line, to capture some of the fish, but a few perch only were obtained; and though the stomachs of these were carefully examined, no Entomostraca were observed, a few insects being the only objects discernible. Though trout were noticed swimming about in the water, they appeared to be very shy, and none were caught; I am, therefore, unable to say whether they were feeding on the Entomostraca or not. The following is a list of the Mollusca and Crustacea observed in and round the sides of the loch :—

MOLLUSCA.

Sphærium corneum (Linné). Not common.
Pisidium amnicum. Rare.
,, *fontinale* (Draparnaud). Frequent.
,, *pusillum* (Gmelin). Frequent.
,, *nitidum* (Jenyns). Common.
Valvata piscinalis (Müller). Common.
Planorbis albus, Müller. Rare.
,, *contortus* (Linné). Common.
Limnæa peregra (Müller). Not common.
,, *truncatula* (Müller). Not Common.

CRUSTACEA.

Daphniadæ.

Daphnia pulex,	Very Common.	*Ephippia* also frequent.
,, *vetula*,	Frequent.	

Copepoda.

Diaptomus castor,	Very common.
Cyclops pulchellus,	Common.
,, *strenuus*,	Frequent.
,, *gigas*,	Very common (several stages).

Ostracoda.

Cypria ophthalmica (Jurine). Frequent.
Cypria serena (Koch). Frequent.
Cyclocypris globosa (G. O. Sars). Not very common.
Erpetocypris strigata (O. F. Müller). Not common.
,, *tumefacta*, Brady and Robertson. Not common.
Cypridopsis villosa (Jurine). Not very common.
Candona candida (O. F. Müller). Frequent.
,, *rostrata*, Brady and Norman. Scarce.
,, *kingsleii*, Brady and Robertson. Scarce.

Insect larvæ, aquatic Coleoptera, Diatoms, and Confervæ were also observed to be more or less common both in the loch and around its margins.

2. The Coulter Burn from the Loch to Craigquarter Wood.

After the loch had been carefully examined we next proceeded to examine this section of the Coulter Burn. Its course is over open moorland, and there are comparatively few places along its banks which form suitable habitats for aquatic organisms. No Mollusca* nor Crustacea were observed in this part of the burn, the only things noticed being insect larvæ—chiefly of the Phryganeidæ—but in the few marshy places and pools along its sides several species of Entomostraca and one or two of Mollusca were obtained. The water of the burn was very pure.

The following is a list of the Mollusca and Crustacea observed :—

* *Sphærium corneum* is, however, very abundant in the covered passages through which the burn runs from the sluice of Loch Coulter for several yards.

MOLLUSCA.

Pisidium pusillum (Jurine). Frequent.
Limnæa truncatula (Müller). Frequent.

CRUSTACEA.

OSTRACODA.

Cypria ophthalmica (Jurine). Frequent.
Cyclocypris globosa (G. O. Sars). Rare.
Erpetocypris tumefacta (Brady and Robertson). Frequent.
Cypridopsis villosa (Jurine). Not common.
Candona candida (O. F. Müller). Frequent.
,, *rostrata*, Brady and Norman. Not very common.
,, *kingsleii*, Brady and Robertson. Not very common.

3. THE COULTER BURN FROM CRAIGQUARTER WOOD TO THE HATCHING HOUSE.

Part of the course of the burn in this section is alongside the Kilsyth Road, so that its banks presented conditions even less favourable to the existence of aquatic organisms than in the previous section. The burn itself was also unproductive of anything noteworthy. The species observed and identified in this section were—

MOLLUSCA.

Pisidium pusillum (Gmelin). Few.
Limnæa peregra (Müller). Few.

CRUSTACEA.

OSTRACODA.

Cypria ophthalmica (Jurine). Few.
,, *serena* (Koch). Not very common.
Cyclocypris globosa (G. O. Sars). Few.
Erpetocypris strigata (O. F. Müller). Not common.
,, *tumefacta* (Brady and Robertson). Not common.
Cypridopsis villosa (Jurine). Not common.
Candona candida (Müller). Frequent.
,, *kingsleii*, Brady and Robertson. Few.

4. THE COULTER BURN FROM THE HATCHING HOUSE TO THE PONDS AT HOWIETOUN.

This section included the examination of the burn from the Hatching House to the ponds at Howietoun and a few of the ponds. In describing our examination of Loch Coulter, reference was made to the immense number of Entomostraca in the water there, and the question of what became of these organisms suggested itself as one of the first points requiring consideration. An explanation, that seemed a fairly reasonable one, was that a great many of them would be carried down the burn with the overflow water, especially when during wet weather a larger quantity of water than usual passed down the burn. At the time we visited the loch, the level of the water, we were informed, was about 4 feet higher than it usually is at that season, and consequently the overflow was greater than usual. In order, therefore, to ascertain whether Entomostraca were being carried down the stream, a tow-net was fixed in mid-channel a short distance up from where the water is led off into the rearing ponds at Howietoun; and, further, the net was so arranged that a large proportion of the water would pass through it, and thus give the experiment a fair trial. The net was fixed in position at 7.15 P.M. of the 13th, and removed about 8.15 A.M. of the 14th. Thus the water was allowed to pass through the net for fully 13 hours, but the result was not what had been expected, only a few *Cyclops*, *Gammarus*, Ostracods, and the larvæ of insects being captured. There was also a small quantity of mud in the net. The *Gammarus*, Ostracods, and insect larvæ were very likely carried into the net from some place in the vicinity of where the net was fixed, while the few *Cyclops* were probably the only organisms carried down from the loch. It was thus fairly evident that though Entomostraca were abundant in Loch Coulter, very few found their way down the stream.

On the stones in the burn a few of the common *Limnæa peregra* were observed, and a somewhat rare Ostracod—*Candona acuminata*—was obtained in a marshy place at the side, otherwise nothing requiring special notice was observed between the Hatching House and the ponds. In the ponds nothing of special interest was observed except that in one of them *Candona acuminata* was again noticed, and *Cypria exculpta* in another, in the 'Botanical pond' *Conferva* was moderately common.

The following are the species of Mollusca and Crustacea observed in this section:—

MOLLUSCA.

Sphærium lacustre (Müller). Plentiful in one of the ponds.
Pisidium fontinale (Draparnaud). Not common.
,, *pusillum* (Gmelin). Not common.
,, *nitidum* (Jenyns). Not common.
Ancylus fluviatilis (Müller). Common.
Limnæa peregra (Müller). Abundant.

CRUSTACEA.

AMPHIPODA.

Gammarus pulex (Linné). Frequent in the stream.

COPEPODA.

Cyclops pulchellus, Koch. A few in the net fixed in the stream.
,, *serrulatus*, Fischer. A few in material collected by hand-net in one of the ponds.
,, *crassicornis*, Müller. A few in the same material with the last.
Canthocamptus minutus (Müller). Frequent in one of the ponds.

OSTRACODA.

Cypria exculpta (S. Fischer). Frequent in one of the ponds.
,, *ophthalmica* (Jurine). Frequent in one of the ponds.

Erpetocypris tumefacta (Brady and Robertson). A few in the burn and in the ponds.
Cypridopsis vidua (O. F. Müller). A few in one of the ponds.
" *villosa* (Jurine). A few in the burn and in one of the ponds.
Candona candida (Müller). Frequent in the burn and ponds.
" *lactea*, Baird. In one of the ponds, rather rare.
" *acuminata* (Fischer). In the burn and one of the ponds, rather rare.
" *kingsleii*, Brady and Robertson. In marshy ground by the side of the burn, not common.

Aquatic *Acari* and *Coleoptera*, the larvæ of *Coleoptera* and Phryganeidæ, were also observed both in the burn and in the ponds.

5. The Coulter Burn from Howietoun to Goldenhoof.

This section includes the Howietoun Ponds to Goldenhoof Dam as well as the dam itself. Between the ponds and Goldenhoof the burn is locally known by the name of the Stockbridge Burn. Very few organisms were observed in this part of the burn. It flows too rapidly to permit of anything, except perhaps insect larvæ or *Ancylus*, getting a foothold. There were, however, a few marshy places by the side of the burn that yielded a number of *Ostracoda*, among which was *Cypris reticulata*—a species which, though generally distributed, is not very common.

The dam is of comparatively small area; part of its margin is densely fringed with reeds and other aquatic plants, which afford shelter to numerous organisms. Among these *Mollusca* and various groups of Entomostraca were common, as well as Diatoms, Confervæ, and the larvæ of insects. The water is not very deep, the deepest part being scarcely over 6 feet; the bottom is formed of fine mud, evidently consisting very much of vegetable débris, for when it was disturbed bubbles of marsh-gas rose to the surface of the water. Trout were moderately common in the dam, and it was ascertained, by the examination of the stomachs of some of them, that they were feeding on insects and *Entomostraca*, especially Ostracoda. The following are the species of Mollusca and Crustacea observed and identified in this section:—

MOLLUSCA.

Pisidium pusillum (Gmelin). Frequent in the dam.
Planorbis spirorbis, Müller. Frequent in the dam.
Limnæa peregra (Müller). Frequent in the dam and burn.

CRUSTACEA.

Daphniadæ.

Eurycercus lamellatus (Müller). Not common in the dam.
Chydorus sphæricus (Müller). Not common in the dam.
Acroperus harpæ, Baird. In the dam not common.

Copepoda.

Cyclops serrulatus, Fischer. Frequent in the dam.
Canthocamptus minutus (Müller). Frequent in the dam.

OSTRACODA.

Cypria exsculpta (Fischer). In the dam moderately common.
,, *ophthalmica* (Jurine). In the dam frequent.
,, *serena* (Koch). Marshy ground by the side of the burn, and in the dam frequent.
Cyclocypris globosa (G. O. Sars). In the dam not common.
Cypris reticulata, (Zaddach). Marshy ground by the side of the burn, rare.
Erpetocypris reptans (Baird). In the dam not common.
,, *strigata* (Müller). Marshy ground by the side of the burn, rare.
,, *tumefacta* (Brady and Robertson). In the dam not common.
Cypridopsis villosa (Jurine). In the dam frequent.
,, *vidua* (Miiller). In the dam frequent.
Candona candida (Miiller). By the side of the burn and in the dam frequent.
,, *lactea*, Baird. In the dam not common.
,, *rostrata*, Brady and Norman. In the dam not common.
,, *acuminata* (Fischer). In the dam not common.
,, *kingsleii*, Brady and Robertson. In the dam not common.

6 & 7. THE COULTER BURN FROM GOLDENHOOF TO THE BANNOCK AND THENCE TO THE FORTH.

The Coulter Burn after leaving Goldenhoof Dam runs eastward for 600 to 700 yards, then northward for a few hundred yards more, and joins the Bannock not very far from the site of the famous battle of Bannockburn. Along the part of its course the water flows with considerable rapidity except in a few places where quiet pools are formed. The freshwater limpet *Ancylus fluviatilis*, and the larvae of Caddis flies, were observed under or attached to the stones in the stream; while in the quiet pools, as well as in the marshy places along its banks, a number of Entomostraca and a few Mollusca were obtained. The Bannock Burn, from where it is joined by the Coulter down to the village of Bannockburn, also yielded a number of Mollusca and Entomostraca, but from that village to the Forth, very few such organisms were observed, probably owing to the water being more or less contaminated by the refuse from the public works on its banks. Between the village of Bannockburn and the Forth the Bannock flows between steep banks through a comparatively level tract of country and its course is very tortuous. The distance as the crow flies from where the Bannock is joined by the Coulter Burn to its union with the Forth is scarcely $3\frac{1}{2}$ miles, while the course of the burn measures fully 6 miles. Though the water appeared to be contaminated, both trout and sticklebacks were observed to be moderately frequent; the impurity of the water did not seem to have so much effect on these as on the Entomostraca.

The following is the list of the Mollusca and Crustacea observed and identified with Sections VI. and VII:—

MOLLUSCA.

Pisidium pusillum (Gmelin). Moderately common in Section VI. and upper part of Section VII.

Pisidium nitidum, Jenyns. Moderately common in upper part of Section VII.

,, *roseum*, Sholtz. Rare, lower part of Section VII.

Planorbis contortus (Linné). Frequent in upper part of Section VII.

Ancylus fluviatilis (Müller). Frequent in Section VI.

Limnæa peregra (Müller). Not very common in both sections.

,, *truncatula* (Müller). Not very common in both sections.

CRUSTACEA.

Daphniadæ.

Chydorus sphæricus Müller. Not very common, Section VI.

Copepoda.

Cyclops serrulatus, Fischer. Frequent in Section VI.

Canthocamptus minutus (Müller). Frequent in Section VI.

Ostracoda.

Cypria ophthalmica (Jurine). Frequent in Section VI. and upper part of Section VII.

,, *serena* (Koch). Frequent in upper part of Section VII.

Cyclocypris globosa (G. O. Sars). Not common in upper part of Section VII.

Erpetocypris reptans (Baird). Not common in upper part of Section VII.

,, *strigata* (Müller). Rare in Section VI.

Cypridopsis villosa (Jurine). Not common in Section VI.

,, *vidua* (Müller). Not common in Section VI.

Candona candida (Müller). Frequent in both sections.

,, *rostrata*, Brady and Norman. Rare in Section VI.

,, *kingsleii*, Brady and Robertson. Rare in Section VII.

,, *fabæformis* (Fischer). Rare in Section VI.

,, *acuminata* (Fischer). Rare in Section VI.

Ilyocypris gibba (Ramdohr). Not common in lower part of Section VII.

As considerable changes have recently been made in the terminology of the fresh-water Ostracoda, I propose now to give a list of the species observed throughout the district examined, adding to each a synonymy sufficiently full to allow of the older works on this group of Crustacea being referred to with greater facility, together with notes on the distribution of the rarer species.

OSTRACODA.

Cypria exsculpta (S. Fischer).

1854. *Cypris exsculpta*, Fischer, Beitrag zur Kenntniss der Ostrac., p. 18, pl. xix. figs. 36–38.

1868. *Cypris striolata*, Brady, Mon. rec. Brit. Ostrac, p. 372, pl. xxiv. figs. 6–10.

1880. *Cypris granulosa*, Robertson, Fresh and Brackish water Ostrac. of Clydesdale, p. 18, (jun.)

1889. *Cypria exsculpta*, Brady and Norman, Mon. M. and Fw. Ostrac. of the N. Atlantic and N. W. Europe, p. 68, pl. xi. figs. 1–4.

This is a widely distributed species, though not previously recorded for Stirlingshire.

Cypria ophthalmica (Jurine).

1820. *Monoculus ophthalmicus*, Jurine, Hist. des Monocles, p. 178, pl. xix. figs. 16–17.
1835. *Cypris compressa*, Baird, Trans. Berw. Nat. Club, vol. i. p. 100, pl. iii. fig. 16.
1868. *Cypris compressa*, Brady, *op. cit.*, p. 372, pl. xxiv. figs. 1–5; pl. xxxvi. fig. 6.
1889. *Cypria ophthalmica*, Brady and Norman, *op cit.*, p. 69, pl. xi. figs. 5–9.

One of the commonest of the British species.

Cypria serena (Koch).

1838. *Cypris serena*, Koch, Deutschlands Crustaceen, H. xxi., 22.
1868. *Cypris lævis*, Brady, *op. cit.*, p. 374, pl. xxiv. figs. 6–8.
1889. *Cypria serena*, Brady and Norman, *op cit.*, p. 70.

A common species in Britain.

Cyclocypris globosa (G. O. Sars).

1863. *Cypris globosa*, G. O. Sars, Om en i Sommeren 1862 foretagen Zoologisk Reise i Christianias og Trondhjems Stifter, p. 27.
1868. *Cypris cinerea*, Brady, *op. cit.*, p. 374, pl. xxiv. figs. 39–42; pl. xxxvi. fig. 7.
1889. *Cyclocypris globosa*, Brady and Norman, *op. cit.*, p. 71, pl. xiv. figs. 1–2; pl. xi. figs. 10–18.

The distribution of this species seems to be more restricted. In Scotland it has been observed in the islands of Lewis and Bute, at West Loch Tarbert (Loch Fyne); in Kirkcudbrightshire; Loch Fitty, Loch Dow, and Black Loch, in Fife. Not previously recorded for Stirlingshire.

Cypris reticulata, Zaddach.

1844. *Cypris reticulata*, Zaddach, Synops. Crust. Pruss. Prodr., p. 24 (jun.)
1868. *Cypris tessellata* (in part), Brady, *op. cit.*, p. 336, pl. xxiii. figs. 39–45.
1883. *Cypris affinis*, Lilljeborg, International Fisheries Exhib. London. Sweden Cat., p. 146.
1889. *Cypris reticulata*, Brady and Norman, *op. cit.*, p. 76, pl. viii., figs. 1–2; pl. xi. figs. 5–7.

This does not seem to be a commonly distributed species. The following are the Scotch localities where it has been observed:—Johnston Loch; Possil Marsh; Bishop Loch; side of Paisley Canal; side of Loch Ascog, Bute; Hairmyres, near East Kilbride; Mill Loch, Lochmahen; and Barron Loch, Peebles.

Erpetocypris reptans (Baird).

1850. *Candona reptans* and *similis*, Baird, Brit. Entom., pp. 162, 167.
1868. *Cypris reptans*, Brady, *op. cit.*, p. 370, pl. xxv. figs. 10–14; pl. xxxvi. fig. 4.
1889. *Erpetocypris reptans*, Brady and Norman, *op. cit.*, p. 84 pl. xiii. fig. 27.

A common British species.

Erpetocypris strigata (O. F. Müller).

1785. *Cypris strigata*, O. F. Müller, Entomostraca, p. 54, pl. iv. figs. 4–6.
1844. *Cypris jurinii*, Zaddach, Synops. Crust. Pruss. Prodr., p. 36.
1870. *Cypris ornata*, Brady (non Müller), Nat. Hist. Trans. Northumb. and Durham, vol. iii. p. 364, pl. xiv. figs. 1–3.
1889. *Erpetocypris strigata*, Brady and Norman, *op. cit.*, p. 85, pl. viii. figs. 14, 15.

This is not so commonly distributed as the last. The following are some Scotch localities:—Duddingston Loch; Ponds near Taymouth Castle; Isle of Cumbrae; Hayston Dam, Peebles. Not previously recorded for Stirlingshire.

Erpetocypris tumefacta (Brady and Robertson).

1870. *Cypris tumefacta*, Brady and Robertson, Ostracoda and Foraminifera of Tidal Rivers, Ann. Nat. Hist., ser. iv., vol. vi. p. 13, pl. iv. figs. 4–6.
1889. *Erpetocypris tumefacta*, Brady and Norman, *op. cit.*, p. 87, pl. viii. figs. 5–7; pl. xiii. fig. 18.

This seems to be one of the less common species. It has not been previously recorded for Stirlingshire.

Cypridopsis vidua (Müller).

1785. *Cypris vidua* (Müller), Entomostraca, p. 55.
1850. *Cypris sella*, Baird, British Entom., p.
1868. *Cypridopsis vidua*, Brady, *op. cit.*, p. 375, pl. xxiv. figs. 27–36, 46.
1869. *Cypridopsis obesa*, Brady and Robertson, Ann. Nat. Hist., ser. iv., vol. iii. p. 364, pl. xviii. figs. 5–7.
1889. *Cypridopsis vidua*, Brady and Norman, *op. cit.*, p. 89.

This is a widely distributed species.

Cypridopsis villosa (Jurine).

1820. *Monoculus villosa*, Jurine, Hist. des Monocles, p. 178.
1850. *Cypris westwoodii* and ?*elongata*, Baird, Brit. Entom., p. 156.
1868. *Cypridopsis villosa*, Brady, *op. cit.*, p. 377, pl. xxiv. figs. 11–15; pl. xxxvi. fig. 9.
1889. *Cypridopsis villosa*, Brady and Norman, *op. cit.*, p. 90.

This is moderately common in Scotland.

Candona candida (Müller).

1785. *Cypris candida*, Müller, Entom., p. 62, tab. vi. figs. 7–9.
1850. *Candona lucens*, Baird, Brit. Entom., p. 160, tab. xix. fig. 1.
1889. *Candona candida*, Brady and Norman, *op. cit.*, p. 98, pl. x. figs. 1, 2, 14–23.

Common everywhere—very variable.

Candona lactea, Baird.

Candona lactea, Baird, Proc. Zool. Soc. Lond., p. 255, pl. xviii. figs. 25–27.
1868. *Candona detecta*, Brady (var.), *op. cit.*, p. 384, pl. xxiv. figs. 35–38; pl. xxxvii. fig. 2.
1889. *Candona lactea*, Brady and Norman, *op. cit.*, p. 100.

Generally distributed, but not so common as the last.

Candona rostrata, Brady and Norman.

1857. *Cypris compressa*, Fischer, Ueber das genus Cypris, p. 144, pl. ii. figs. 7–12; pl. iii. figs. 1–5.
1889. *Candona rostrata*, Brady and Norman, *op. cit.*, p. 101, pl. ix. figs. 11, 12, 12 *a* and *b*; pl. xii. figs. 22–31.

This is one of the less common *Candonæ*, though it may be more widely distributed than we know of at present. It has been observed in Duddingston Loch; in Loch Fitty and Lurg Loch, in Fife; Loch Fad, in Bute, &c.; but it does not appear to have been recorded before for Stirlingshire.

Candona kingsleii, Brady and Robertson.

1870. *Candona kingsleii*, Brady and Robertson, Ann. and Mag. Nat. Hist., ser. ix., vol. vi. p. 17, pl. ix. figs. 9–12.
1889. *Candona kingsleii*, Brady and Norman, *op. cit.*, p. 102, pl. ix. figs. 19–22; pl. xiiii. fig. 19.

A widely distributed species, but not previously recorded for Stirlingshire.

Candona fabæformis (Fischer).

1851. *Cypris fabæformis*, Fischer, Ueber das Genus Cypris, p. 146, pl. iii. figs. 6–16.
1870. *Candona diaphana*, Brady and Robertson, Ann. and Mag. Nat. Hist., ser. iv., vol. vi. pl. v. figs. 1–3.
1889. *Candona fabæformis*, Brady and Norman, *op. cit.*, p. 103, pl. ix. figs. 1–4.

This species is somewhat restricted in its distribution, and does not appear to have been previously recorded for Stirlingshire. It is found at Corstorphine and Luffness Links.

Candona acuminata (Fischer).

1857. *Cypris acuminata*, Fischer, Ueber das Genus Cypris, p. 148, pl. iv. figs. 12–16.
1889. *Candona acuminata*, Brady and Norman, *op. cit.*, p. 104, pl. ix. figs. 9–10; pl. x. figs. 5, 6.

This is considered to be a rare species in Britain, though it is probable that its distribution is more extensive than is known at present. It has not been previously recorded for Stirlingshire.

Ilyocypris gibba (Ramdohr).

(?) *Cypris gibba*, Ramdohr, Mag. und Geselesch. Naturforsch. Freunde zu Berlin, ii. p. 91.
1868. *Cypris gibba*, Brady, *op. cit.*, p. 369, pl. xxiv. figs, 47–54; pl. xxxvi. fig. 2.
1889. *Ilyocypris gibba*, Brady and Norman, *op. cit.*, p. 107, pl. xxi. figs. 1–5.

A common British species.

TABLE I.—MOLLUSCA.

List of the Mollusca obtained, showing their Distribution in the District, in June 1889, as well as their Distribution in Britain.

× signifies 'rare,' × × 'frequent,' and × × × 'common.'

Name of Species.	Distribution in the District examined.							Distribution in Britain.		
	Section I. Loch Coulter.	Section II. Coulter Burn.	Section III. Coulter Burn.	Section IV. Coulter Burn and Ponds	Section V. Coulter Burn and Coltenhave Dam.	Section VI. Coulter Burn	Section VII. Bannock Burn.	England.	Scotland.	Ireland.
Sphærium corneum,	×							× × ×	× × ×	?
,, *lacustre*,				×				× ×	×	× ×
Pisidium amnicum,	×							× ×	×	?
,, *fontinale*,	× ×			×				× × ×	× ×	× ×
,, *pusillum*,	× ×	× ×	×	×	× ×	× ×	× ×	× × ×	× × ×	?
,, *nitidum*,	× × ×			×			× ×	× ×	× ×	?
,, *roseum* ?,							×	×	×	?
Valvata piscinalis,	× × ×							× × ×	× ×	?
Planorbis albus,	×							× × ×	× ×	?
,, *spirorbis*,					× ×			× ×	× ×	?
,, *contortus*,	× × ×						× ×	× × ×	× ×	?
Limnæa peregra,	×		×	×	× ×	×	×	× × ×	× × ×	× × ×
,, *truncatula*,	×	× ×				×	×	× × ×	× × ×	× × ×
Ancylus fluviatilis,						× ×		× × ×	× × ×	× × ×

TABLE II.—DAPHNIADÆ AND COPEPODA.

List of Daphniadæ and Copepoda obtained, showing their Distribution in the District, in June 1889, and also their Distribution in Britain.

× signifies 'rare,' × × 'frequent,' and × × × 'common.'

Name of Species.	Distribution in the District examined.							Distribution in Britain.		
	Section I. Loch Coulter.	Section II. Coulter Burn.	Section III. Coulter Burn.	Section IV. Coulter Burn and Ponds.	Section V. Coulter Burn and Dam.	Section VI. Coulter Burn.	Section VII. Bannock Burn.	England.	Scotland.	Ireland.
DAPHNIADÆ.										
Daphnia pulex,	× × ×							× × ×	× × ×	× × ×
" *vetula*,	× ×							× × ×	× ×	?
Acroperus harpæ,					×			× ×	×	?
Chydorus sphæricus,					×	×		× ×	× ×	?
Eurycercus lamellatus,					×			× × ×	× × ×	?
COPEPODA.										
Diaptomus castor,	× × ×							× × ×	× × ×	× × ×
Cyclops gigas,	× × ×							× × ×	× × ×	× ×
" *serrulatus*,				×	× ×	× ×		× × ×	× × ×	× × ×
" *strenuus*,	× ×							× ×	× ×	
" *pulchellus*,	× × ×			×				×	×	
" *crassicornus*,				×				× ×	× ×	
Canthocamptus minutus,				× ×	× ×	× ×		× × ×	× × ×	× × ×

TABLE III.—OSTRACODA.

List of the Ostracoda obtained, showing their Distribution in the District, in June 1889, and also their Distribution in Britain.

× signifies 'rare,' × × 'frequent,' and × × × 'common.'

Name of Species.	Distribution in the District examined.							Distribution in Britain.		
	Section I. Loch Coulter.	Section II. Coulter Burn.	Section III. Coulter Burn.	Section IV. Coulter Burn and Ponds.	Section V. Coulter Burn and Dam.	Section VI. Coulter Burn.	Section VII. Bannock Burn.	England.	Scotland.	Ireland.
Cyria exsculpta, . . .				× ×	× × ×			× ×	× ×	× ×
" *ophthalmica*, .	× ×	× ×	×	× ×	× ×	× ×	× ×	× × ×	× × ×	× × ×
" *serena*, . . .	× ×		×		× ×		× ×	× × ×	× × ×	× × ×
Cyclocypris globosa, .	×	×	×		×		×	×	×	
Cypris reticulata, . .					×			×	×	×
Erpetocypris reptans, . .					×		×	× × ×	× × ×	× × ×
" *strigata*, . .	×		×		×	×		×	×	
" *tumefacta* .	×	× ×	×	×	×			×	×	
Cypridopsis vidua, . .				×	× ×	×		× × ×	× × ×	× ×
" *villosa*, . .	×	×	×	×	× ×	×		× × ×	× × ×	×
Candona candida, . .	× ×	× ×	× ×	× ×	× ×	× ×	× ×	× × ×	× × ×	× × ×
" *lactea*, . . .				×	×			× × ×	× × ×	× × ×
" *rostrata*, . .	×	×			×	×		×	×	
" *kingsleii*, . .	×	×	×	×	×		×	× ×	× ×	×
" *fabæformis*, . .						×		×	×	×
" *acuminata*, . .				×	×	×		×	×	
Ilyocypris gibba, . . .							×	× × ×	× × ×	

IX.—THE PROPORTIONAL NUMBERS AND SIZES OF THE SEXES AMONG SEA FISHES. By Dr T. Wemyss Fulton, Secretary for Scientific Investigations.

In carrying on the inquiries as to the spawning of the food-fishes, it was necessary to measure each individual fish obtained, to determine the sex and the condition of the reproductive organ. During the past two years there has, therefore, accumulated a mass of data as to the numerical proportions and the relative sizes of the males and females of the various species. It is from these data that I have written this paper. The information obtained has a special scientific value; and it will also help us to understand many points in relation to the generation of fishes which are at present obscure.

With the exception of statistics relating to man and certain of the domestic animals, there is very little accurate information as to the proportion of the sexes among different species, especially those living in a state of nature. Our knowledge of the proportional numbers of males and females among fishes has hitherto been confined to fresh water forms, and even that is imperfect and scanty. This paper embodies the most extensive and detailed investigation which has been made on the subject; and one of the most surprising results is the differences which obtain between closely allied species.

The total number of fish of all kinds examined was 12,666. Of this number 3858 were males, and 8808 females, showing a general ratio of 228 females to 100 males. The results regarding 21 species are detailed in the accompanying table. The fish include all sizes—from the smallest sexually differentiated to large adults.

I. Proportional Numbers.

1. *Flat-fish.*

The number examined was 8209; 2075 were males, and 6134 females, or a ratio of 295 females to 100 males. In all cases but two the females exceed the males in number, but in very different proportions. One exception is the flounder (*Pleuronectes flesus*) in which the males preponderate; the ratio of females to males being 84 to 100.*

The brill (*Rhombus laevis*) is perhaps also an exception; but the small number examined makes it uncertain. The relative preponderance of females over males among the other flat-fish varies very much. There is generally one male to about two or three females. The ratio is low in plaice (*Pleuronectes platessa*), 138 females to 100 males; and remarkably high among long rough dabs (*Hippoglossoides limandoides*), 842 females to 100 males, or nearly seventeen females to every two males. The ratio is large also among lemon soles (*Pleuronectes microcephalus*), 297 females to 100 males, and common dabs (*Pleuronectes limanda*), 295 females to 100 males. Among turbot there are about two females to each male.

*The ratios which are given in the table, except when the numbers are small, may be relied upon as indicating with great accuracy the proportions, both of number and size, existing between the two sexes. The ratios were calculated on four or five occasions during two years, as the records accumulated, and now, on making the final calculations for the whole period, I have been impressed with the general equality of the averages derived from even comparatively small numbers. Where the numbers were large (plaice, haddock, &c.) the averages at the successive computations rarely required the alteration of the first decimal.

	Numbers Examined.		Ratio of Females to each 100 Males.	Average Length in Inches.		Ratio of Length of Females to Males at 1000.
	Males.	Females.		Males.	Females.	
Plaice,	930	1282	138	13·62	15·64	1165
Lemon Sole,	217	646	297	11·72	12·40	1058
Common Dab,	522	1539	295	7·87	8·17	1038
Flounder,	118	99	84	9·18	11·09	1208
Witch Sole,	69	154	223	15·02	17·07	1136
Long Rough Dab,	158	1330	842	6·35	8·43	1327
Turbot,	23	45	196	16·85	20·83	1236
Brill,	13	10	77	17·61	22·30	1266
Sail Fluke,	7	9	129	11·78	16·28	1382
Little Sole,	18	20	111	3·19	3·95	1238
Cod,	410	547	133	21·39	20·45	956
Haddock,	476	899	188	13·97	13·82	989
Whiting,	423	895	211	11·29	11·78	1043
Gurnard,	255	1044	409	10·86	11·77	1084
Ling,	3	7	233	30·00	23·50	783
Brassie,	14	26	185	8·43	8·46	1003
Cat-fish,	33	26	79	29·48	27·69	939
Dragonet,	1	10	1000	8·50	8·15	959
Lythe,	2	6	300	23·75	19·58	824
Angler,	61	16	26	27·70	24·34	879
Skates and Rays,	101	177	175	17·24	17·63	1022

2 *Round-fish, &c.*

The number examined was 5457, of which 1783 were males, and 3674 females; a ratio of 206 females to 100 males. Among the more common of the fish generally classed as round-fish, the females are in excess, but in very varying degrees. Among cod the ratio is 133 females to 100 males; among haddocks 188 females to 100 males; among whitings 211 females to 100 males; and among gurnards (*Trigla gurnardus*) 409 females to each 100 males. The number of ling and lythe (*Gadus pollachius*) examined was insufficient for accurate results, but they also show preponderance of females. The figures for the dragonet (*Callionymus lyra*) show that the females preponderate, although from the small number examined the ratio is probably too great. In the cat-fish or wolf-fish (*Anarrhichas lupus*), and especially in the angler (*Lophius piscatorius*) the males preponderate. The ratio for the cat-fish is 79 females to 100 males, and for the angler only 26 females to 100 males. These fish are especially predaceous, as is also the cod, which has the next lowest ratio of females.

Among skates and rays females are in excess; the ratio being 175 females to 100 males. The observations were mainly made on the thorn-back ray (*Raia clavata*), but also on the starry ray (*Raia radiata*) and grey skate (*Raia batis*). The females specially preponderate in the latter species. Of four pogge (*Agonus cataphractus*) three were females, of six father-lashers (*Cottus scorpius*) all were females, of three lump-suckers (*Cyclopterus lumpus*) two were males, of twelve hag-fish (*Myxine glutinosa*) eleven were females.

The numbers of the sexes in the herring are remarkably equal. Of 3457 examined by Fishery Officers at various places round the coast, the males numbered 1724 and the females 1733.

II. Proportional Size.

1. *Flat-fish.*

Among all the flat-fishes without exception the female is longer than the male. The ratio varies in the different species. In the long rough dab and sail-fluke (*Arnoglossus megastoma*) the female is about a third longer than the male. In the flounder, turbot, brill and little sole (*Solea minuta*) the female also markedly exceeds the male. The female is relatively not so long in the witch sole (*Pleuronectes cynoglossus*), and plaice, and especially in the common dab and lemon sole.

2. *Round-fish, &c.*

In the cod, haddock, cat-fish and angler, and probably also in the ling, dragonet and lythe, the male slightly exceeds the female in length. Like the greater ratio of males to females, it is most marked in the specially predaceous fish, the angler, cat-fish and cod. The males of the angler and cat-fish are more numerous and somewhat larger than the females. The male hag-fish obtained was also larger than the females. The males and females of skates and rays are pretty nearly equal in size. In the whiting, gurnard, and brassie the females are rather longer than the males.

X.—NOTES AND MEMORANDA.

1. *The Anchovy in Scottish Waters.*

Last year anchovies were captured at several places on the British coast. It appears from a recent paper by Mr J. T. Cunningham * that they were caught in considerable numbers in the English Channel in November, December, and January last. Anchovies were caught by the sprat fishers at Dover, who use drift-nets with meshes about half an inch square, about a mile from the shore. Mr Cunningham was informed that some shots had yielded 1000 anchovies to 4000 sprats. Anchovies were also caught at other places in the Channel and on the south coast. The first intimation of the appearance of the anchovy off the Scotch coast was conveyed by Professor Ewart in an article in the *Scotsman*, in which it was stated that he had received specimens caught in the Moray Firth in December. At the beginning of the year I sent a circular to all the fishery officers of the Board located around the coast of Scotland, together with a drawing and description of the anchovy, and requested them to furnish me with any account of its appearance off the coast, together with specimens, if any should come into their hands. I give here a summary of the information thus obtained.

East Coast.—None appear to have been caught off the coast of Berwickshire, where, however, the herring fishing ceased in September. A single specimen, 5 inches in length, was obtained by Mr Peter Jamieson, among herrings landed at Dunbar on 22nd January 1890. It was a female, with the roe well developed. The fishermen could not say they had ever caught any others. Some of the sprat fishers in the Tay thought they had seen anchovies among the sprats; no specimens were procurable.† One crew of Anstruther herring fishermen were certain they had caught some anchovies among herrings in the Firth of Forth (off the Fifeshire coast) at the end of December 1889. None were reported from the coast of Forfarshire. One was captured in a herring net about half a mile off Stonehaven in the early part of December. Another was taken on a haddock line (mussel bait) on 13th November, off Rattray Head, at a distance of 8 miles from land. The fishery officer saw this specimen after its capture; it was too much damaged, he thought, to forward. He says, 'the drawing and particulars in your letter place its identity beyond 'doubt.' None were reported from the Macduff district in the Moray Firth. The fishermen of Buckie stated they had caught them chiefly in the second and third weeks in January 1890, but some at the end of December (when few boats were fishing) from off Fraserburgh to Cape Wrath. One crew got them 8 miles off Fraserburgh; another, 20 miles south-east of Buckie; several crews caught them about 6 miles off Tarbet Ness; and one crew about 6 miles off Cape Wrath, at the end of December. None were seen after the middle of January. A Buckie fisherman who goes to the Yarmouth herring fishing in September and October states he has frequently caught them there.‡ A Buckie crew tried the anchovies for bait, but they were too soft to stay on the hooks.

* *Jour. Marine Biol. Assoc.*, vol. i. No. 3, p. 328 *et seq.*, April 1890.

† The drawings sent were always shown to the fishermen.

‡ Mr O. T. Olsen, of Great Grimsby, to whom I wrote, kindly investigated the catches of the sprat fishers there, but found no anchovies.

The Burghead, Cromarty, and Lybster officers reported that none had apparently been captured by the fishermen of these places. Fishermen at Helmsdale reported having caught two or three strange fish among the herring about the middle of January, 'more like a trout than a herring'; on being shown the drawing of the anchovy they said 'it was like the 'fish they got.' On cooking one of them it gave forth 'a strong peculiar 'smell, different from either trout or herring.' None appear to have been caught by Wick fishermen off that coast; but on 1st March a few were caught by a Wick boat in the Minch, between Stornoway and Cape Wrath.

West Coast.—Anchovies were caught in considerable numbers in the Minch. Mr Ingram, the Fishery Officer at Stornoway, states, on 23rd January, that the herring fishing had just begun, and that anchovies were detected among the herrings. On 29th January he reported that ten of the herring boats had each caught about half a dozen anchovies, all before 22nd January, from 3 to 8 miles from shore. The next was caught on 13th February, 5 miles off Chicken Head, in 80 fathoms. Others were caught on 27th February, one boat catching 8 about the middle of the Minch. The largest of those sent to me from Stornoway was five and three quarter inches long. At Castlebay, Barra, none were reported. None were reported to the fishery officers at Ullapool, Loch Broom, Broadford, Skye, Oban, Campbeltown, Girvan, Ardrishaig, or Rothesay; conference was held with the fishermen, and the sketch of the anchovy shown to them, but none had ever caught or seen a similar fish. A paragraph in the newspapers states they were captured in the Solway Firth in May 1890.*

Thus anchovies were captured in Scotch waters apparently from the middle of November to at least 1st March; an examination of the dates and places shows that they probably appeared almost simultaneously at various parts of the coast.

The great fisheries for anchovies are carried on off the Mediterranean coasts of France, Italy, and Spain, on the Atlantic coasts of Portugal and Spain, and in the estuary of the Schelde in the Zuider-Zee, Holland. It appears also, from Mr Cunningham's inquiries, that anchovies are taken every winter in greater or less abundance by the sprat and pilchard fishermen on the Southern coasts of England. Their appearance in the waters off the Scotch coast, however, is very rare. Day mentions † that Peach obtained a specimen caught in the herring-nets off Wick. So far as I can learn it has not previously been recorded from the west coast of Scotland, where, perhaps, it was most abundant.

It would be difficult to explain the cause of the incursion of anchovies into Scotch waters last year. Mr Cunningham thinks that they are permanent residents in the North Sea, and that those which appeared in the Moray Firth in December did not migrate very far. The results of modern research certainly tend to discredit the old theory of the migration of sea fishes for long distances. But the capture of anchovies off the Hebrides forms a possible difficulty. There are three hypotheses: (1) That the anchovies caught off the Scottish coast were derived from the shoals frequenting their normal habitat many hundreds of miles away; (2) that the anchovy is a permanent resident off the Scotch coast, but only appears in Scotch waters in years when they happen to be very abundant; (3) that they are normal inhabitants and that their presence was discovered only when special attention was drawn to the subject.

* The fishery officer at Greenock states that several fishermen in the Firth of Clyde informed him that every season they captured one or two of the fishes described.

† *British Fishes*, vol. ii. p. 207.

In order to ascertain any special circumstances connected with the regular anchovy fisheries on the Continent, I communicated with several of the fishery authorities abroad, and shall give here a summary of part of the information obtained—Professor Marion, the director of the Station Zoologique D'Endoume, Marseille, has recently made a special study of the anchovy in the Gulf of Marseilles. The anchovies approach the coast in spring, and enter bays and estuaries; sometimes the great shoals are met by the fishermen 20 miles off. The fishermen of Martigues state that the anchovy comes in sometimes in March or April and sometimes in summer, and that they pass out again in October, or November, or December, according to the degree of cold and the prevalence of rains or gales. Last year young anchovies were very abundant on the Mediterranean coast, but it does not appear whether they were specially abundant as compared with other years.

Señor Rafael Gutierren Vela, of the Spanish fisheries department, informs me that the anchovy is obtained on both the Atlantic and Mediterranean coasts; and that in the Mediterranean, especially in the waters of Malaga and Ceuta, it is obtained not only in great abundance, but frequently in the young and undeveloped stage. In this stage they are called *Voquerones*, and are highly esteemed for their delicacy and flavour; and although these young individuals are taken in great quantities, no diminution has as yet been observed in the anchovy fishery. On the Atlan.ic coast they do not often meet with the immature anchovy. Señor Vela's opinion, in regard to the appearance of anchovies in unusual localities, is that 'their deviation from the normal zone of the great 'shoals' is due to physical changes in the sea. He also states that some fishermen hold the opinion that whales are very fond of the anchovy (and the number of whales has in recent years increased on the Cantabrian coast), and it seems that when whales appear the shoals of anchovies are driven out of their usual course, or are broken up.

The important anchovy fishery in Dutch waters has been referred to. I am informed by Captain Drechsel that anchovies are seldom caught in Danish waters, and never in any quantity; but they have been caught in different places. Professor Giglioli knows of no fact relating to the Mediterranean anchovy which would explain their occurrence in exceptional abundance last winter on the coasts of Great Britain. He adds:—'But surely the existence of *Engraulis encrasicholus* in the North Sea 'is not a novelty. The unusual fact is their greater number, is it not?'

It has been suggested that there might be a chance of starting an anchovy fishery in Scotland by the use of special nets, but a little consideration will show that the presence of the anchovy in Scottish waters is probably a passing phenomenon, and likely to remain only a matter of zoological interest. Mr Cunningham made efforts to start an anchovy industry in England; but when specimens of the English anchovy were submitted to an eminent firm of anchovy-merchants, 'they reported that 'such fish would be perfectly useless to them for any of their manu- 'factures.' In Norway and Denmark sprats are prepared as anchovies, and are sold in this country as such.

2. *Experiments on the Migratory Movements of Sea Fish.*

On board the 'Garland' last year, from March to November, numbered brass labels were attached to about a thousand fishes, captured in the trawl, and the fish were then returned to the sea. The experiments were chiefly conducted in the Firth of Forth and St Andrews Bay. The numbers of the more important kinds of fish thus labelled and set free are shown in the accompanying table.

	Plaice.	Common Dab.	Lemon Sole.	Long Rough Dab.	Flounder.	Thornback Ray.	Cod.	Haddock.	Whiting.	Gurnard.
Firth of Forth, ...	48	43	29	70	11	8	15	5	1	6
St. Andrews Bay, . . .	259	60	2	6	22	4	1	1	...	10

The brass labels were tied round the tail of the fish, and aluminium wire was for several months employed to attach them; more recently black silk cord has been alone used, and it answers well. All the fish known to have been recaptured had the label attached by the silk cord. These are shown in the second table.

I think these experiments are fairly satisfactory; especially as they represent only a few months trial since the silk cord was used. It will be observed (1) that only plaice, cod and skate were recaptured; (2) that the length of the fish had, when re-measured, diminished as a rule; (3) that the fish were recaptured almost always very near to the place where they were returned to the sea, sometimes months before. The other fish labelled included witch soles, starry rays, cat-fish, lump-suckers, anglers, and grey skate.

It is probable that many of the lemon soles, dabs, and flounders perished because of their diminished vitality when returned to the sea (*vide*, p. 183); plaice are very tenacious of life. About $2\frac{1}{2}$ per cent. of the plaice and over 18 per cent. of the cod were recaptured. In devising these experiments I desired to obtain information not only as to the migrations of fishes, but also as to the rate of growth. I was therefore surprised to find on measuring the specimens sent to me that they had often diminished rather than increased in length. By keeping a fresh plaice, however, and measuring it on successive days, I found that it gradually shrank from drying, *e.g.*, a plaice 12 inches long shrunk two-fifths of an inch within 48 hours. As the fish when they came into my hands had usually been removed from the sea a day or two before, the measurements given are in all cases under what they would have been when the fish were just captured. Allowing for shrinking it would appear that their rate of growth is not rapid, but it must be stated that the ligature had caused abrasion round the tail which may have interfered with their growth. Most of the fish were, however, very plump and in good condition.

It is perhaps surprising that these fishes should not have travelled further. The two plaice described as having been caught beyond the Bell Rock, and the skate, were caught by beam-trawlers; but none of the fish caught by fishermen were obtained outside the territorial waters. Plaice, up to 13 inches seem to remain within the territorial waters during the spawning season off-shore (*vide*, p. 260). As the cost of these experiments is very small, they will be continued on a large scale.

3. *The Migrations and Reproduction of the Common Eel* (Anguilla vulgaris).

There are many points connected with the life-history, and especially with the reproduction, of the eel which are obscure. Eels, it is known,

Name of Fish.	Where Labelled.	Date.	Where Caught.	Date.	Size when Labelled.	Size when Measured.	How Caught.
		1889		1890	Inches.	Inches.	
Plaice,	Station VI., Forth,	Nov. 7	2 miles off Elie,	May 27	$13\frac{1}{8}$	$12\frac{4}{5}$	Fishermen.
,,	,, V., St Andrews Bay,	,, 13	3 ,, E. Bell Rock	,, 19	$10\frac{3}{4}$	$10\frac{3}{5}$	Trawler.
,,	,, IV., ,, ,,	,, ,,	(?)	April ?	$9\frac{1}{2}$	(?)	Fishermen.
,,	,, ,, ,, ,,	,, ,,	(?)	Feb. 8	$12\frac{1}{4}$	$12\frac{1}{2}$	,,
,,	,, III., ,, ,,	,, 14	2 miles N. St Andrews,	,, 7	$11\frac{3}{4}$	$11\frac{1}{2}$	,,
,,	,, ,, ,, ,,	,, ,,	Washed ashore on sands,	,, 17	9	(?)	Washed ashore.
,,	,, II., ,, ,,	,, ,,	Tents Moor,	April	$11\frac{1}{2}$	(?)	Fishermen.
,,	,, ,, ,, ,,	,, ,,	5 miles N.E. Bell Rock,	June 2	$12\frac{1}{2}$	$12\frac{7}{10}$	Trawler.
				1889			
Cod,	7 to 8 miles E. of Inchkeith,	Oct. 17	2 ,, N.N.W. Gullane,	Nov. 23	$19\frac{1}{2}$	18 '(estimated)'	Fishing boat.
,,	Station III., Forth,	Nov. 11	3 ,, E. Inchkeith,	Feb. 20	$14\frac{1}{4}$	$14\frac{1}{2}$ '(,,)'	,,
,,	,, VI., ,,	,, 7	1 ,, off St Monance,	Dec. 10	17	16 '(,,)'	,,
Thornback Ray,	7 to 8 miles E. of Inchkeith,	Oct. 17	7 ,, S.E. May Island,	Nov. 23	$14\frac{5}{8}$	(?)	Trawler.

only propagate in the sea, or in brackish water, where the males are only found. The females descend from inland waters to the sea in autumn, and the young (female) eels ascend from the sea in spring. With the females are sometimes found specimens having the snout broader and of great size—sometimes weighing 5 or 6 kilogrammes. The reproductive organ in these consists of modified ovaries, that have undergone fatty degeneration, the ova being completely absent; they are sterile females which do not descend to the sea, like those sexually developed which descend in autumn. Professor Vaillant states that when the eels reach the sea the reproductive organs are imperfectly developed; the ova are not mature or ready for fertilisation. They are contained within the organ, they are all of the same size, destitute of vitelline membrane, and have never been found as in other fishes when mature, lying free in the abdominal cavity. Similarly, the testes show the mother cells, but no sperms. What becomes of the eels when they reach the sea is a mystery; none large or small have been obtained, and Dr Jacoby's special researches on this subject at Commachio were fruitless. The eel fishermen in France believe they perish after reproduction; but this is very improbable.

Some interesting facts in regard to the eel have been recently obtained. At the beginning of May 1890, it was found at Howietoun that the water-supply from Loch Coulter had been interfered with on ten successive nights. On each morning a number of eels were discovered in the sluice, where the water is ten feet deep. Thirty females were obtained, and one of these, 32 inches in length, and weighing about 2 lbs. was sent in by Sir James Maitland, Bart. Each ovary was about 12 inches long *in situ*, and about 30 inches long when the frills or plications were measured. Microscopic sections were made, which showed that the ova were in various stages of development, some of them, 0·25 mm. in diameter, being nearly ripe. Mr Ramsay Smith made a calculation of the number of eggs present in the two ovaries, and found that these were approximately 10,077,000. Seeley,* gives the number as several millions; and Syrski,† who has made an elaborate study of the reproductive organs of the eel, calculated that the ovaries contained 5,000,000. The largest ova obtained by Syrski had a diameter of one-fourth to one-fifth of a millimetre. Seeley states that in August their diameter is 0·09 mm.; in September 0·10 mm.; in October, 0·16 mm.; and in November 0·23 mm. The diameter of the larger ova in the Howietoun eel was, it will be seen, greater. Eels have been found in December and January on the Prussian coast with the ova having a diameter of only 0·03 to 0·09 mm.

In the eels found at Howietoun many of the ova were very nearly mature; this was apparent not merely from their size, but from their microscopic appearance. Many were, however, much less advanced in development. The sections showed very well the formation of the ovarian leaflets, and the progressive stages of the ova.

There can be no doubt that these eels when caught were migrating to the sea, and from the condition of the ovaries it is obvious that the migration was for the purpose of reproduction. The interest relates to the period of migration. The general seaward migration of female eels approaching maturity takes place in autumn. Two explanations may be offered; (1) that these eels had by some means been prevented from migrating at the usual time—not a very satisfactory explanation; (2) that the eels from Loch Coulter begin to migrate at the beginning of summer. It is known that the commencement of the migrating movement varies

* *Fresh-water Fishes of Europe*, p. 378, 1886.
† *Boll. della Soc. Adriatica di Scienze naturali in Trieste*, No. I. *Trieste* 1875.

somewhat in different places. Loch Coulter is joined to the river Forth by a water-course about ten miles long (the Coulter Burn and Bannockburn); but the water is not brackish for several miles below the point of junction.

4. *Rare and Uncommon Fishes.*

Carelophus ascanii.—A specimen of this fish was obtained by Mr Peter Jamieson, of the Board's Marine Laboratory, Dunbar. It was $5\frac{1}{2}$ inches long, and was caught on a hook, two miles off the mouth of the Tyne, Haddingtonshire, on 13th September 1889. It has not been previously recorded as having taken a bait, but is occasionally captured in crab pots.

Caranx trachurus.—One specimen of the horse mackerel, 13 inches long, was taken in the trawl at Station I., Firth of Forth on 31st August 1889.

Motella mustella.—Two specimens, one 4 inches and the other $3\frac{1}{2}$ inches long, were taken in the trawl at Station IV., St Andrews Bay, on 19th October 1889; another specimen, $4\frac{1}{2}$ inches long, was caught in the trawl on 21st March 1890 in Largo Bay.

Motella cimbria.—A specimen of the four-bearded rockling was captured in the trawl on 16th May 1889, at Station IX., Forth. Three specimens, $6\frac{1}{2}$ and $5\frac{1}{2}$ inches long were caught in the trawl on 22nd February 1890, near the mouth of the Forth.

Motella tricirrata.—Two specimens, $5\frac{1}{2}$ inches long were captured in the trawl on 10th May, at Station V., Forth; one, 6 inches long, on 9th May at Station VIII.; three from 6 to 9 inches long, in 53 fathoms in the Moray Firth on 11th July 1889. This fish is frequently captured in crab pots. One, $15\frac{3}{4}$ inches long, was taken on 2nd June in a crab pot off Dunbar; one, 16 inches long, was caught in a crab pot on 1st May, half a mile from Berwick.

Lumpenus lampetriformis.—A large number of specimens of this fish were taken in the trawl; one, 6 inches in length, near May Island on 17th October 1889; eight, 12 and 10 inches long at Station II., Firth of Forth, on 14th May 1889; one, $10\frac{1}{2}$ inches long at Station VIII., on 16th May 1889; eight from $9\frac{1}{2}$ to $12\frac{1}{4}$ inches long at Station IX., on 16th May 1889; eight from 4 to 7 inches long at the mouth of the Forth on 22nd February 1890; 61 specimens, in two hauls, from 3 to 10 inches, in the same locality on March 19th 1890; 135 in one haul, from 4 to 14 inches, also at the mouth of the Forth, on 28th April 1890; 21 near the same locality, also on 28th April; 96 in one haul, from 6 to 11 inches long at Station V., Forth, on 10th May 1890. No doubt a migration of this fish to the mouth of the Forth has taken place.

Zeugopterus punctatus.—A specimen $2\frac{1}{2}$ inches long was captured in the trawl in Largo Bay on 21st March; Mr Peter Jamieson obtained a male specimen, 7 inches long, caught in a crab pot off Dunbar on 6th May.

Trachinus draco.—The Greater Weever was captured on 21st May 1889 by Mr Thomas Scott, F.L.S., in Largo Bay, Firth of Forth; it was 9 inches in length. Mr Scott states that it is an addition to the faunistic list of the Forth.

Myxine glutinosa.—Twenty-two specimens were captured in the trawl on 11th July in the Moray Firth, in 53 fathoms of water, 12 miles off Cullen. They were from $7\frac{1}{2}$ to 12 inches long.

Mr F. Nansen, has stated* that *Myxine* is usually a protandric hermaphrodite. Until it is about $12\frac{1}{2}$ inches long it is a male; after that it produces ova, which are deposited throughout the year.

* *Jour. Roy. Micr. Soc.*, part ii. 1889, p. 188.

Clupea alosa.—A large specimen of the Alice Shad, 24 inches long and weighing 6 lbs. was caught on 28th April 1890 in a salmon-net near Peterhead.

5. *Experiments in the Cross-fertilisation of different species of Fish.*

I instructed Mr Thomas Scott, while carrying on his work on board the 'Garland,' to take such opportunities as offered to test the effect of the influence of the milt of one species on the ova of others. These experiments are of much interest in relation to the question of hybridism.

(1) *Gurnard and Whiting.*—Mr Scott fertilised the ova of *Trigla gurnardus*, belonging to the family Cottidæ, with the milt of *Gadus merlangus*, which belongs to the Gadidæ. Development proceeded for above 36 hours; thereafter the ova died, apparently from the want of fresh sea water.

(2) *Lemon Sole and Turbot.*—Mr Scott fertilised the ova of *Pleuronectes microcephalus* with the milt of *Rhombus maximus*, which belong to different divisions of the Pleuronectidæ. Development proceeded rapidly until the middle of the third day, when the ova perished from dust getting into the water. The embryo was then well formed, and hatching would probably have occurred about the 7th or 8th day.

(3) *Lump-sucker and Flounder.*—The eggs of *Cyclopterus lumpus* belonging to the Discoboli, were treated with milt of *Pleuronectes flesus*, belonging to the Pleuronectidæ. Development proceeded for a short time, but they were dead and had lost their red colour, within 20 hours after impregnation.

T. WEMYSS FULTON.

SECTION C.—CONTEMPORARY WORK.

NOTES ON CONTEMPORARY WORK RELATING TO FISHERIES IN THIS AND OTHER COUNTRIES. By Dr T. Wemyss Fulton, Secretary for Scientific Investigations.

In the following account of the scientific fishery work being carried on in foreign states, it will be noticed that there are three prominent subjects engaging attention; (1) The establishment of hatcheries for sea fish, lobsters, &c.; (2) the investigation of the action of various modes of fishing respecting the capture of immature fish, and the institution of means to lessen such capture; (3) investigations into the reproduction, food, and habits of sea fishes.

A large part of the information has been made available by the receipt of fishery and other publications in exchange for the Board's Annual Report; and an important and highly useful fishery library is thus gradually being formed.

I have to thank many foreign fishery authorities for assistance in this department; not merely in supplying reports and publications referring to their work, but in furnishing, promptly and readily, all information in their power on points submitted to them.

Among these I may mention M. Raveret Wattel, Secretary to the Societé d' Acclimitation de France; Dr P. P. C. Hoek, Scientific Superintendent of Dutch Fisheries; Colonel Marshall McDonald, the Fishery Commissioner of the United States; Captain Drechsel, the Superintendent of Danish Fisheries, and the Naturalist Dr Petersen; Professor Pouchet, the Director of the Concarneau Laboratory; Professor Marion, the Director of the Laboratoire d' Endoume, Marseille; Captain Dannevig, the Superintendent of the well-known hatchery at Flödevig; Señor Rafael Gutierren Vela, of the Spanish Fisheries Department; Sir Charles Tupper, the High Commissioner for Canada; Mr Nielsen, the Superintendent of the Newfoundland Fisheries; Professor Giglioli, of Florence; and His Highness Prince Albert of Monaco. Among those at home who have been always willing to co-operate I must specially mention Sir Thomas F. Brady and the other Inspectors of Irish Fisheries, and Professor M'Intosh, F.R.S.; also Mr Bourne, the Director of the Marine Biological Association's Laboratory at Plymouth; Mr Olsen, the Secretary of the Grimsby Marine Fisheries Society: and Mr J. Wrench Towse, the Honorary Secretary to the National Sea Fisheries Protection Association.

To Mr W. Anderson Smith, Ledaig, I am specially indebted; both for aid in translating foreign reports, and for advice and assistance.

1. GREAT BRITAIN.

A most important contribution to fishery science during the year is the extensive and elaborate memoir by Professor M'Intosh and Mr E. E. Prince, 'On the Development and Life-Histories of the Teleostean 'Food and other Fishes.' * The observations were made at the Fishery Board' Marine Laboratory at St Andrews under the auspices of the Board. The authors give the results of their studies of the ovarian

* *Trans. Roy. Soc. Edin.*, vol. xxv. part iii. (No. 19), pls. i–xxviii.

growth, oviposition, hatching, and development of a large number of the food-fishes, the descriptions being illustrated by twenty-eight beautiful plates. The ova examined are arranged in two divisions (1) pelagic or floating eggs; (2) non-pelagic or demersal eggs. Under the former come those of the long rough dab, turbot, plaice, lemon dab, craig-fluke, common dab, common flounder, sole, Müller's topknot, ling, five-bearded rockling, cod, haddock, bib, whiting, poor cod, green cod, pollack, frog-fish, skulpin, lesser weever, sprat, and grey gurnard. Under the latter division those of the herring, smelt, salmon, trout, bimaculated sucker, wolf-fish, shanny, viviparous blenny, Montagu's sucker, lump-sucker, goby, armed bullhead, cottus, fifteen-spined and three-spined stickleback, sea-bream, gunnel, &c.

The eggs of most of these species are described in detail. When dealing with the extrusion and deposition of the eggs, the authors state that among those whose eggs are demersal, deposition may be very rapid (salmon, lump-sucker, *Cottus scorpius*); while among those with pelagic ova extrusion may be prolonged and intermittent, as is the case with the ling, flounder, cod, and especially the common gurnard.

The authors give an elaborate description of the various phenomena of development, the structure of the ova &c., which cannot be summarised here. Of more general interest are the chapters on the embryonic, larval, and post-larval conditions of the food-fishes belonging to the gadidæ, pleuronectidæ, &c. Professor M'Intosh succeeded in obtaining a complete series of the young cod. In June they were captured in the trawl tow-net and in the mid-water net sunk three or four fathoms in water six or seven fathoms deep, showing that they generally frequent the lower regions of the water. The post-larval stages of the haddock have hitherto escaped detection. Among the general remarks on the post-larval fishes is an interesting account of the habitats and migrations (so far as known) of the young of various round and flat fish; but it is evident our knowledge of this chapter of fish life is as yet very imperfect. The development and life history of the wolf-fish (*Anarrhichas lupus*) is very fully described.

There is little doubt this memoir will become classical in fishery literature.

Mr W. Anderson Smith, Ledaig, has made a study of the marine life destroyed by the trawl, and its influence on fish life,* in which he chiefly deals with the destructive action of the beam trawl on the organisms which form the food of edible fishes. He states that multitudes of crustacea, echinodermata, mollusca, &c., are taken and destroyed by the trawl-net, which also destroys the *Alyconia*, Sertularidæ, &c., upon which these invertebrates largely feed. 'We thus find that this great engine 'tears up the sea-bottom, and practically clears it of its invertebrate life, 'so that the stretches of bottom covered with zoophyte growths are 'destroyed as fish nurseries. The crustacean fauna is killed or captured, 'or its food supply removed. The molluscan or soft-bodied fauna is like-'wise destroyed, while the sea-urchins and star-fish are cleared away 'wholesale.' Mr Smith also refers to the capture and destruction of immature fish by the beam trawl and shrimp trawl, especially near shore.

The National Sea Fisheries Protection Association held a conference last year at which some subjects of general interest were discussed.† The capture and sale of immature fish was the first subject considered, and the following resolution was passed:—'That the subject be adjourned in

* *Trans. Highland and Agricult. Soc. Scot.*, Fifth Series, vol. ii. p. 44, 1890.

† *Report of Proceedings at the Conference of Representatives of the Sea Fishing Industry*, 1889. London, 1889.

'order that more time may be given to examine the grounds of alarm felt 'as to the effect upon our fisheries by the taking and sale of immature 'fish, to watch the operation of the Sea Fisheries Regulations Act, 1888, 'and the recent legislation in Denmark, and to enable the results of 'observations and experiments which are proceeding to be obtained. 'Also, that a committee be appointed to consider and report on the subject 'to the next conference, or earlier, at the discretion of the Executive 'Committee.' The association has arranged for an International Conference being held on this subject in London in July next (1890).

The inspectors of Irish Fisheries issued last year a blue book, containing a report on their inquiry as to the desirability of passing a bye-law to prohibit beam trawling in Lough Swilly, County Donegal, together with the evidence brought before them at the various places visited. The inspectors point out that there are no statistics available as to the quantity of fish captured in Lough Swilly, and report as follows:—(1) There is no evidence to show that trawling destroys the spawn or spawning beds of any fish; (2) there is evidence that immature fish are taken in the trawl-net; but the quantity is, in their opinion, almost infinitesimal, and certainly inappreciable as affecting the supply; (3) it is difficult to determine whether the action of the trawl through the water would have the effect of breaking up or scaring away the shoals or schools of herrings or mackerels coming into the bay; that such is the case was not proved in evidence; (4) that they do not possess the means for a scientific investigation of the effect of trawling in Irish waters, such as is possessed by the Scotch Fishery Board, in order to determine what might be the effect of the suspension of trawling, and that until such means are provided it would be unwise to interfere with beam trawling in the Lough. There can be little doubt that there would be much risk in applying the results or conclusions derived from experimental observations on the East Coast of Scotland to the coast of Ireland, where the fauna, physical conditions, &c. are so different.

The Marine Fisheries Society, Great Grimsby, recently issued their first Annual Report.* This society was formed at Grimsby in 1888 to inquire into various questions related to the protection and promotion of English fisheries, and especially to establish a hatchery for the artificial culture of sea fish. The hatchery is situated at Cleethorpes, and the hatching room measures thirty-seven by twenty-one feet. The aquarium tanks are seventeen in number, forming a reservoir capable of storing about 4000 gallons of water. In each hatching tank there is room for twelve wooden boxes or trays, each 16 inches by 10 inches and 9 inches deep. Unfortunately, owing to the non-completion of the hatchery and the fixing of the engine and pump for circulating the water, no actual work could be commenced until the spawning season was over.

Since our last report appeared two numbers of the Journal of the Marine Biological Association have been published. In the first of these† the papers deal generally with subjects of scientific interest, such as certain points in the anatomy of *Dinophilus*, by Mr S. F. Harmer, the cœlom and nephridia of *Palæmon serratus*, and the function of the spines of the crustacean zoœa, by Mr W. F. R. Weldon; the structure of the thallus of *Delesseria sanguinea*, by Mr M. C. Potter; and *Tealia tuberculata*, Cocks, a study in synonymy, by Mr J. T. Cunningham. There is also a report by Mr G. C. Bourne, the director, on the pelagic copepoda collected at Plymouth; and one by Mr W. Garstang, on the nudibranchiate mollusca of Plymouth Sound. Of more general interest

* *First Ann. Rep. Marine Fisheries Soc., Great Grimsby*, Grimsby, 1890.
† New Ser., vol. 1, No. 2, October 1889.

is a paper by Mr Bourne on the destruction of immature fish. It is stated that very young flat-fish are not captured in the large beam trawls working off Plymouth in depths of thirty to forty fathoms; and that while flat-fish somewhat less than six inches in length are not uncommon, they invariably belong to worthless or nearly worthless species. Mr J. T. Cunningham, the naturalist of the association, found very young flat-fishes in Mevagissey Harbour in the pools at low tide. There were a few soles, about half an inch long, but the great majority were flounders, from three-eighths to three-quarters of an inch in length. Mr Bourne states that in regard to 'round-fish it is known that when young they frequent 'rocky bottoms where the trawl cannot work, and their rarity in the trawl 'proves that they are not destroyed by it.'—This is probably true, without much qualification, in regard to very small haddock; but it is not the case with regard to cod or whiting, several thousand immature whitings having been taken in one haul of the 'Garland's' special trawl (*vide*, p. 173). In the director's report it is stated that the first practical investigation last year was a renewed study of the development of the herring, but the larvæ perished as soon as the yelk–sac was absorbed, from the common difficulty of providing them with suitable food. The experiments in the hatching and rearing of lobsters were carried on with success up to a certain stage; but the welled vessel in which they were confined unfortunately sprung a leak and sank, and the young lobsters escaped.

In the second number of the Journal * there is a valuable and suggestive paper by Mr W. Bateson, on the sense organs and perceptions of fishes; with remarks on the supply of bait. Mr Bateson after describing the sense organs of fishes, gives the results of his researches and experiments on the mode in which various fishes use them in obtaining their food. The majority of fishes seek their food chiefly if not entirely by sight, but a certain number hunt for and recognise it by the sense of smell alone, while a few species are also aided by special organs of touch. Lists of these fishes are given and the results of various experiments. This part of Mr Bateson's paper is most excellent, and throws much light upon the habits of fishes. It is however questionable if it will furnish the readiest path to the solution of the bait problem; and for this reason, that the baits found most successful by fishermen have usually little relation to the natural food of the fish. For instance, mussels form the best bait for haddocks and codlings, and many thousands of tons of these fish are caught off the Scotch coast every year with mussel bait; but a mussel is never found in their stomachs. The same observation may be made in regard to the clam (*Pecten*) and many other baits. At the same time there is no doubt Mr Bateson's experiments may be useful in suggesting a cheap substitute for natural bait. The experiments I made on a large scale in 1888, by using a great variety of substances, differently coloured, and scented with fish and other extracts, were unsuccessful.† Another paper of interest in this number of the Journal is Mr Cunningham's on anchovies in the English Channel. Mr Cunningham gives an account of all that is known about the anchovy, and describes its appearance in the English Channel. This paper is referred to elsewhere (p. 351).

An account of the work carried on at the Marine Biological Station at Puffin Island is given in the third volume of the Proceedings of the Liverpool Biological Society, by Professor Herdman, the Director. It is mentioned that myriads of young mussels are sometimes found in the neighbourhood, in such abundance that all projecting objects are almost blackened by the adhering masses; but that very few reach maturity,

* New Ser., vol. 1, No. 3, April 1890.

† *Vide Seventh Annual Report Scot. Fishery Board*, part iii. p. 352, 1889.

most of them disappearing very soon. He suggests it might be found worth while to establish artificial mussel-beds in the locality. In the same volume, Mr J. C. Thompson describes tow-net collections from the west coast of Norway. He refers to the general absence of ovisacs among marine Copepoda; and states his opinion that one of the most abundant, *Calanus finmarchicus*, so important as food for the herring, casts its ova directly into the water, just as fishes do. The general absence of ovisacs in females of marine *pelagic* copepods was much impressed upon me two or three years ago when working at the group; and as Mr Thompson, to whom I wrote on the subject, promised to pay attention to the point, and has been engaged since in their study, it may be now generally accepted that these forms cast their ova free into the water. Grobben, some years ago, proved that this was the case with *Calanus*, which he kept in a watch-glass until the eggs were deposited. The volume also contains reports on various groups of marine invertebrates found in the district.

Mr George Brook * has described the larval stages of *Motella cimbria*. A shoal of the larvæ of this species was met with at the surface, in September, in Whiting Bay, Arran. A peculiarity of *Motella* is the enormous development of the ventral fins in the larvæ; Mr Brook gives a table showing the relative development of the fins in larvæ of different sizes.

2. THE UNITED STATES.

The Fourteenth Report of the United States Fish Commission, that for 1886, was published last year; it is a bulky volume of over 1000 pages. The work of the United States Fish Commission may be divided into two branches; first, inquiries into the fishing grounds, and the life-histories, reproduction, &c., of the food-fishes frequenting them; and second, operations in the hatching of fish and shell-fish. In 1886 operations were carried on along the Eastern coast from the Straits of Florida to Newfoundland, and inquiries were made into the range and habits of the important food-fishes, such as the halibut, the mackerel, menhaden, sardine, &c. In 1886 the Commission became possessed of an additional vessel, the 'Grampus,' a sailing ship specially constructed to carry on fishery work, and provided with a well in which marine fishes can be kept alive and transported to the hatcheries where their eggs may be available. The 'Grampus' is fitted for using a beam trawl to test its commercial utility in American waters, where, however, the flat-fishes are not by any means so important as in Europe.

It is intended to utilise a welled vessel like the 'Grampus' to transport valuable food-fishes from Europe, such as the sole, turbot, plaice, and brill, which are not found in American waters. In 1886 several consignments of English soles were received alive from England; they were kept at Wood's Holl in the hope of using them for breeding purposes. Among other fishes whose artificial propagation has been undertaken are the halibut, which is getting scarce on the old fishing grounds, the cod, the mackerel, the black bass, the perch, smelt, white fish, and various species of salmonidæ. Hundreds of thousands of young cod, hatched at Wood's Holl, have been successfully transported to the Gulf of Mexico and Chesapeake Bay, with the hope of forming cod colonies at these places. By means of the 'Grampus' over 43,000,000 cod eggs were made available at Wood's Holl, and of these 20,000,000 were hatched and planted in the immediate vicinity of the station. In 1886 the Commission distributed over ninety millions of shad fry which were planted in various

* *Proc. Roy. Phys. Soc. Edin.*, vol. x. part i., 1889.

waters. At Wood's Holl the experiments on the hatching and rearing of lobsters were continued, the numbers in the hatching jars reaching sometimes nearly a million. The young were deposited in Vineyard Sound and adjacent waters. Five thousand lobsters two or three weeks old were planted in Cold Spring Harbour.

The Appendices to the Report contain thirty-two papers and reports. There is an elaborate account of the sea fisheries of Eastern North America by the late Commissioner, Professor Spencer Baird, who founded the Fish Commission, and under whose wise and broad administration it has grown to be the custodian and conservator of one of the most important food resources. In this paper the food and the reproduction of the sea fishes, their migrations and movements, numbers and abundance, &c., are discussed at length. The important fishing grounds and the methods of capture and the best methods of preserving fish and bait are described. The maintenance and improvement of the fisheries by wise legislation, artificial propagation, and the transfer of species from one region to another are recommended. Messrs Goss and Jordan give a review of the flounders and soles (Pleuronectidæ) of America and Europe, with the synonymy of all the genera and species and analytical keys, and Mr E. Linton describes the entozoa of marine fishes.

This report shows how thoroughly well equipped the United States Fish Commission is for the work in which it is engaged. It possesses three steamers and a sailing vessel entirely devoted to fishery inquiries, a large staff, a large number of hatcheries, including the extensive one at Wood's Holl, specially constructed for the culture of sea fish and lobsters; and it receives a very large annual appropriation from the Government.

The authorities of Johns Hopkins University have been good enough to send such of their publications as contain matters bearing upon fishery investigations. In the *Studies from the Biological Laboratory*,* Mr S. Watase describes the morphology of the compound eyes of several crustacea, and also discusses briefly the visual organs in star-fishes and sea-urchins. In the *University Circular* for April 1890, there is a paper by Mr H. V. Wilson on the Development of the Sea-Bass; and one by Mr F. H. Herrick on the Development of the American lobster (*Homarus americanus*). The spawning season of the American lobster does not appear to be confined to any special season of the year, although it is probable they are most prolific during the summer months. The period of hatching at Wood's Holl in the summer (July—September) is not far from 100 days.

An account is given of the process of segmentation and development of the egg.

3. CANADA.

In 1889, the Canadian Government, desirous of increasing the diminishing exports of Canadian herring (especially to the United States, and the British West Indies) by improving the selection and cure, appointed a Commission, consisting of Mr William Gunn and Mr M. G. M'Leod, to visit Great Britain and Holland and report upon the herring fisheries and mode of cure in these countries. The report of the Commissioners was recently issued as a blue book,† and contains a description of the Scotch and Dutch fisheries and mode of cure. The Commissioners 'consider

* Vol. iv. No. 6, p. 287, 1890.

† *Report of Mr William Gunn of Walkerton, Ont., and Mr M. G. M'Leod of New Haven, U. S., appointed to inquire into the Herring Fishing Industry of Great Britain and Holland*, Ottawa, 1889.

'the Scotch system of treating herring as an article of commerce, to be as 'perfect as any system can be when honestly carried out in all its in- 'tegrity'; and urge the adoption, as far as possible in Canada, of the Scotch system. Their chief recommendations are (1) that the curing of herrings should not be, as now, left in the hands of the fishermen, but should be undertaken by a special class; (2) that an inspector or superintendent should be appointed to arrange a general classification of herrings, and a graded branding standard; the object being to secure, as nearly as possible, a general Dominion standard on the same lines as the graded standard of Scotland; (3) that a thoroughly trained Scotch herring cooper should be established in each sea-board county, to act as head inspector and superintend everything relating to the selection, cure, and branding of the fish; (4) that a crew of expert herring-gutting girls should be imported from Scotland to each county.

4. NEWFOUNDLAND.

Up till a year or two ago the Newfoundland fisheries were under no special fishery department, although fishing forms by far the most important industry in the island.* Many unsuccessful efforts were made by the legislature in successive years to secure a scientific investigation of the fisheries, and to place their supervision under a special bureau or fishery department. The depressed condition of the Newfoundland fisheries during the past few years, and the frequent and alarming failures in the shore fisheries, combined to emphasise the necessity of taking prompt and energetic means for their restoration and protection. After inquiry as to the working of fisheries departments in other countries, an executive committee was formed, a superintendent (Mr Adolf Neilsen) appointed, and arrangements made for the erection of fish hatcheries for the propagation of cod and other sea fishes and lobsters. This hatchery was erected last year at Dildo Island, Trinity Bay, but too late for the hatching of cod during last season.† By means of floating hatching boxes, however, 4,039,000 lobsters were hatched, and it is recommended that lobster hatcheries should be established round the coast, especially for the utilisation of the immense quantities of lobster spawn, at present wasted at the lobster factories.

There is little doubt that this enlightened and energetic policy of the Newfoundland Government will lead to the promotion of the important fishing industries of the colony.

5. HOLLAND.

Two or three years ago the scientific investigations in connection with the Dutch fisheries were placed on a secure foundation by the appointment of Dr P. P. C. Hoek as Scientific Superintendent of Fisheries.

During the years 1888 and 1889 a systematic investigation of the fisheries in the Zuider-Zee was carried on by Dr Hoek, a report on which has recently appeared. In Part III. of the *Sixth Annual Report* (pp. 306 and 307) a brief reference was made to the Zuider-Zee fishings, and to the principal question which caused discontent and animosity among the

* *Report of the Fisheries Commission appointed by His Excellency the Governor in Council to investigate the Operations of Fisheries Departments in other Countries*, St John's, N.F., 1888.

† *Annual Report of the Newfoundland Fisheries Commission for the year* 1889, St John's, N.F., 1890.

fishing population; namely, whether the fishing with so-called 'kuil'-nets was injurious to the increase of the food-fishes, or whether the damage caused by those nets was of no consequence. The opinion of the fishermen was, and is, divided in regard to this point, and this partly at least might be ascribed to the circumstance that those nets are not used by all the fishermen to the same extent and in the same way. Three different forms of 'kuil'-nets are to be distinguished. There is the so-called 'wonder' kuil ('the marvellously-fishing trawl') which is slung between two ships; then there is the 'kwak' kuil, the same net as the 'wonder' kuil, attached behind the rudder to one vessel only, not taking so abundant catches as the 'wonder' kuil does, but used with success in the shrimp-fishery; finally, there is the 'dwars' kuil, smaller than the others and attached to a spar which projects transversely (whence the name 'dwars' = 'transverse' kuil) far beyond the sideboard of the vessel. The vessels using the 'dwars' kuil are smaller than those fishing with the aid of the 'wonder' and 'kwak' kuil; and the 'dwars' kuil itself is smaller than the other trawls. In one principal point, however, all the 'kuil'-nets are alike; they all take everything which enters their mouth, they do not choose their catch, and not only mature or full-grown fishes are taken, but also young and even very small ones. Originally the main use of the 'wonder' kuil was for catching anchovies (*Engraulis encrasicholus*), the 'kwak' kuil for catching shrimps (*Crangon vulgaris*), and the 'dwars' kuil for taking eels, and also for taking bait for the eel-bownets. With the decrease of the Zuider-Zee fishery, and in consequence of the difficulty to gain a living from their legitimate industry, many of the fishermen began to use the 'wonder' kuil and the 'kwak' kuil for taking young and very small fishes, only fit to be sold to the peasants, who use them as food for ducks and as manure.

It can hardly be doubted that the fish production of the Zuider-Zee has suffered severely from this practice, the more so as the number of the fishing boats has increased considerably during late years. Most probably the increase of the fishing fleet in the Zuider-Zee has even been more pernicious than the fishing with the 'kuil'. In this connection the term 'Zuider-Zee fishery' only means the fishing in that part of the Zuider-Zee which is south of the line Enkhuizen Staveren. This part has a surface of only about 300,000 hectares, while over 1000 boats from 16 to 35 tons burden, and perhaps 500 smaller ones are fishing there, and over 3000 fishermen, heads of families, try to gain a living from this limited area.

To understand the difficulty of the case it is necessary first of all to know which fish form the principal object of the Zuider-Zee fishing, and in the second place to be acquainted with the differences which exists between the fishermen of the west coast of the Zuider-Zee, and those inhabiting the south coast.

The herring, the flounder (*Pleuronectes flesus*), the anchovy, the smelt, and the eel are the principal fishes taken in the Zuider-Zee. Of those the first in every respect is the most important; the Zuider-Zee herring is rather small and not very fat, and in the smoked condition is highly esteemed, and so forms a valuable article of food not alone for the Dutch, for it is exported to Belgium and Germany in great quantities. This herring is caught in the Zuider-Zee in the early spring months, spawns in May and June, and begins to enter the Zuider-Zee in autumn. In mild winters it is taken in all months from October until May; it ceases to enter, however, as soon as the water becomes too cold, so that in most years there is no herring fishing in the Zuider-Zee during December and January. The fish is in superior condition in autumn, and then brings from 6s. to 10s. the 200; it is still in good condition in February and March, and brings then 3 to 5 shillings the 200. In April, when immense shoals begin to arrive, the value goes down very fast; and ships are finally loaded with them for a few shillings, and they are taken to poor sandy soils, there to serve as manure for cauliflowers or other vegetables. Of late years in the Zuider-Zee a good catch of herring had become an exception; the autumn herring had nearly quite disappeared,* and the spring herring only entered in great numbers in the latter part of the season, when the fish was worthless, partly in consequence of its condition, partly because then the fasting of the Roman Catholics ceased and the demand for smoked herring only is important during that period.

The principal question to be decided by scientific investigation was, whether the fishing with 'kuil'-nets in the Zuider-Zee might have exercised an injurious influence on the herring production of that sea. Now it was well-known that a small herring-like fish, called 'bliek' by the fishermen, was caught in immense quantities with these nets. It always forms the main part of the masses of immature fish, the so-called 'nest,' which are sold as food for ducks or as manure. Though these small fishes from about 8–12 centimetres in length had never been observed with their reproductive organs developed, those fishermen who inhabit the village of Vollendam, at the west coast of the Zuider-Zee, and who were accustomed to fishing with the 'wonder'-kuils always asserted that it was a distinct species of fish and that it had nothing to do with the herring. This assertion, of course, was hotly contradicted by the fishermen of the south coast, who did not so much practice the 'kuil-net' fishing. As the prosperity of the latter during the winter months always depends entirely on a successful herring fishing, while many of the fishermen from Volendam, accustomed to 'nest' fishing in the summer months, in winter time fish in the North Sea for plaice, cod, haddock, &c., it need hardly be said that a solution of the problem, whether the so-called 'zeebliek' was young Zuider-Zee herring or not, was a matter of high importance for the regulation of the Zuider-Zee fishing.

Dr Hoek's investigations cleared up this question. In the first place, he determined that the Zuider-Zee herring represents a distinct race of herrings, not quite identical with, but in most respects resembling the spring herring of the Baltic, so well-known to naturalists from the investigations of Dr Heincke of Oldenburg. In the next place, it was ascertained that this herring enters the Zuider-Zee for the purpose of spawning there, that it spawns in May in those parts of the Zuider-Zee where the water is nearly fresh, that its larvæ are a great deal smaller than are those of the herring of the open North Sea; that the young herring stays in the Zuider-Zee till it is 10 or 12 centimetres long and returns from the open sea either (1) as a half-grown herring of about 16 centimetres in length in that condition erroneously called sprat by the fishermen, or (2) as a full grown herring approaching maturity, or nearly or quite ripe, of a length of 20 to 25 centimetres. Through Dr Hoek's investigations it is made evident that the young herrings, which are killed in immense quantities by the kuil-nets, and the full-grown herrings which form the most important part of the fishing during the winter, are one and the same species, only differing in age. It was proved by these researches that the supposition on which the existing law rested prohibiting the fishing with 'Wonderkuilen during nine months of the year, was right. For various reasons, however, Dr Hoek did not decide on advising the Dutch government to extend the existing law. These reasons were, first, that this law permits the fishing

* In the autumn of 1889, for the first time for several years, a considerable catch of herring took place.

with these nets during the three months May to July, which are precisely those months in which these nets are in all probability by far the most injurious. In those months, also, nearly all the fishermen of the Zuider-Zee, use these nets for catching anchovies—for which reason none of them wished to have it prohibited at that time. Another reason was that the 'wonder'-kuil is practically the same net as the 'kwak'-kuil, used for catching shrimps. Both nets are nearly equally prejudicial; and even the third 'kuil'-net, the 'dwars'-kuil, though smaller than the others, in one important respect quite corresponds with them, inasmuch as it retains everything that enters it, and therefore catches immature fish as well as mature. The existing law, however, permits the fishing with the 'kwak'- and 'dwars'-kuil, only prohibiting the use of the 'wonder'-kuil, a very anomalous measure in the eyes of every one who looks at the question from a somewhat more general point of view.

Dr Hoek suggests in the conclusions to his report another method, viz. to limit the damage caused by the fishing with 'kuil-nets.' It is not possible here to enter in detail on his proposals, but a word or two may be said. According to Dr Hoek the Zuider-Zee is not a sea in the ordinary sense of the word; with its brackish water and limited area, it much more resembles an estuary, and in regard to the natural history of fishes it plays the part of a large spawning ground for some, and a nursery for others. The herring, anchovy, smelt and the flounder are accustomed to spawn there, while the plaice, though not spawning there, enters when very young to find protection and food during the first period of its existence, precisely as we have found on the East Coast of Scotland. The methods of fishing used in this sea should relate to this circumstance; those nets should be avoided which are specially destructive to immature fish. The ideal condition to be aimed at, at a not too distant future, would therefore be that all 'kuil' fishing should cease. Every 'kuil-net,' be its shape and mode of attachment what it may, should in time be driven from the Zuider-Zee. As it would be impossible, however, to introduce this ideal condition suddenly, as a preliminary measure Dr Hoek proposes to stop by law the free fishing in the Zuider-Zee for all nets and other fishing apparatus; to give annual concessions to the existing fishermen for using such nets as are judged harmless or nearly so, *gratis*; and to allow the fishing with 'kuil-nets' only to those fishermen who are willing to pay a relatively high sum for this allowance. This system would in time foster the use of harmless nets, as it would no doubt facilitate the purchase of harmless fishing apparatus by those fishermen who at present only possess 'kuil-nets.' By raising the amount of the allowance the Government would be able by degrees to prohibit all the 'kuil-nets.'

As yet only the general part of Dr Hoek's Report has been published; the appendices, containing tables of his observations, detailed lists of the herrings which were investigated &c., will be published with a reprint of the general part in the Annual Report on Dutch sea fisheries for 1889.

Other scientific investigations in regard to Dutch fisheries were not completed last year. Among the branches of the fishing industry to which most attention is paid I may mention the salmon fishery and the artificial propagation of salmon in the Rhine and the Maese; the coast fishery in the North Sea, and oyster fishing and oyster culture in the Zealand Waters.

6. SPAIN.

I am indebted to Señor Rafael Gutierren Vela, of the Fisheries Department, Madrid, for information as to the Spanish fisheries, and for sending a copy of the *Official Journal* for 1889, &c., and to Mr W. Anderson Smith, Ledaig, for the following epitome which he has kindly made.

It appears that hitherto very little special scientific work has been accomplished in connection with Spanish fisheries. Judging from the proposed fishery act presented to the Spanish Senate by the Minister of Marine, opinion in Spain is at present against the establishment of close times and restrictions for purely marine fishes. Close times, however, are established for sedentary crustaceans and shell-fish, as well as for anadromous fishes. In the new fishery act the question of prohibition of the capture or sale of certain marine fish under a fixed size is discussed. It appears there has been much division of opinion on this subject; the opponents of change urging that the destruction of young food-fishes by fishermen is very much less than by predaceous fishes which prey upon them. In the preamble to the proposed new act the Minister of Marine expresses himself thus:—'If these serious questions are considered from 'a scientific or technical point of view, we must acknowledge that at 'present the facts upon which a fishery act could be based on these prin-'ciples, are insufficient in Spain, as well as in other countries. Until we 'know in a more thorough manner the life and habits of marine creatures, 'and the physical geography of the coasts, a fishery act must be based 'mainly on what appears to suit the development of the industries to 'which it refers. It is to be hoped that in the future sufficient data will 'be obtained regarding the habits of marine species and of the character 'and conditions of the grounds, so that by the results of scientific investi-'gations we may be able to control them, and to extend such liberty of 'fishing as may be suited to the industry of maritime fisheries.'

The *Revista de Pesca Maritima* is the only Spanish publication connected with the fisheries. It is the recognised government medium for the publication of laws, decrees, orders, or regulations concerning the marine fisheries, and more especially all concessions. It has also been republishing Regnart's famous work published in 1796 entitled *Collection of Spanish Marine Products*, formed by order of His Majesty by D. Antonio Sáñez Regnart. A proposed codification of the fishery laws in 58 articles, submitted to the Cortes, is printed for consideration. These are general, leaving to the various localities to settle minor matters. A memoir is printed as presented to the Minister of Marine accompanying the zoological collection prepared and forwarded from Naples by the Spanish Scientific delegates D. Joaquin de Borja, Lieut. Nav.; and D. Dionisius Shelly, Naval Ensign. It describes the organisation of the Naples establishment; the instruction given to officials; the mode used; preparation of the marine species that are about to be studied; and the reagents used; and gives a catalogue of the numerous zoological preparations made; concluding with a list of fishes studied, and their spawning seasons. In an article on the salting and preserving establishments in the province of Coruña, we learn that these are factories for salted fish. In the other provinces most of the factories preserve, but in Galicia they mainly salt and press for export. Each factory employs say, 100 men and 20 women during 4 months of the year, at 5 reals (1s. 0½d.) a day for first hands, and 4 reals for second hands (10d.) Altogether they employ in this work 12,300 men, and 2460 women during 4 months, leaving in the country as wages more than 2 million pesetas (about £84,000). The manufacture of preserved fish also tends to increase here; a new manufactory having been established near Noya in 1887. This factory uses only the finest oils, when it has to compete against the products of Italy, Portugal, and France. The exportation of preserved fish was, during 1887, 201,665 kilos, value 328,714 pesetas (10d. each).

D. Antonio Cumplido of Seville has received authority from the Minister of Marine to employ a new apparatus and mode of fishing in the Guadalquivir, for which he has received a patent, which would never have been conceded in this country. It consists of six boats, each anchored to the bottom of the river; four form a large square kept apart with poles, with the net between them, and the mode of fishing is to raise the net when the fish are seen to be in it. 'Bridges' from the two other boats extend almost to the square, and thus the fish can be withdrawn readily from the net. The object is to work with few men, and the boats to require no handling. There seems to have been a serious disturbance amongst the fishermen over this concession.

The question of supplying barometers to the fishermen around the coast for the purpose of saving life is discussed; but it does not find favour owing to the multitude required for the many stations—while the necessity for the fisherman to make a living would send him to sea in spite of the glass.

In fixing their limits for trawl-fishing, which in some cases is 12 miles offshore, they say: 'The conventions recently completed by England, 'France, Holland, and other nations of the North, marking the 3 miles, 'in no way concerns us (Spain), nor can it cause complications with us in 'any international question in the future.' With regard to their fisheries they note; '. . . . The Nursery of Cañamizal (*Funiculina 'tetragona*) at six miles from the coast on the gulf of Valencia, so pro-'ductive that the fishing industry of many peoples is fed from that 'extensive region; and without referring to other facts, it is sufficient to 'record, ... that coral abounds in the Mediterranean; the pearl, the 'mother of pearl, the brilliant topaz, amber, and the banks of 'Crustaceans' (Turtles) employed in our industrial manufacturers are 'found in the waters of our West African possessions, and in Asia, America, 'Oceania. That the edible white fish are to be found 20 times more 'numerous in our Atlantic zones than in the most important fisheries 'of Europe and America, which are Norway, Newfoundland, and Canada.' They have made an effort in Spain to study the movements of whales, more especially *B. mysticetus*, on all the Spanish coasts of the world, and have received replies to questions from which they deduce many interesting results and, amongst others:—

(1) 'That those whales have not disappeared from our coasts that 'were an object of the chase or fishery to the ancient Basques.

(2) 'That if statistics had been kept of the whales (*B. mysticetus*) 'annually captured in that remote period they would not exceed in 'number those seen by our fishermen to-day cruising off, or temporarily 'stationed on, our coasts, and that consequently the opinion expressed is 'an error that on account of the persecution of the ancient Basques the 'race of these cetacea is almost extinct.'

After showing that they are migratory and regular in their migrations—that they do not end their southern course in the Cantabrian sea, but have been taken in the Mediterranean, and are suspected of going as far south as the Gulf of Guinea, the writer concludes:

(3) 'That it is a fact, that in spite of meeting on our Oceanic coast 'large cetaceans, at times gathered in considerable numbers, our fishermen '(Spanish) have absolutely abandoned their chase, their indifference 'being incomprehensible.'

In the port of Barcelona they have tested the apparatus for fishing with the electric light, invented by Baron de Tesalia. 'Two or three times 'the net was drawn, in which they had gathered some 2 arrobas (50lb.) 'of fish, the peculiarity being noted that the diminutive fishes were 'nearest to the focus—even to grazing it, whilst the larger ones always 'kept themselves at a regular distance, never penetrating within the 'luminous circle of the waters, so that, through the effect of the submerged 'electric light they gave the appearance as if the waters were discoloured 'with chalk.'

Figures of interest are given relative to the fisheries in the Bay of Manila, Philippine Island. They are mainly carried on by means of corrals, enclosures made of all kinds of materials as may be cheapest and most convenient on the spot. They are licensed and have to be renewed every six months, the required fee (or rental) being paid on each renewal. They are only permitted under 7 fathoms of depth, and the fee is according to the depth of water.

	1887.	1888.
Number of corrals,	342	596
Persons employed,	7,109	9,009
Value of boats and erections	883,575 pesetas	933,904 pesetas

Weight of fish taken.

	1887.	1888.
To be consumed fresh,	1,375 tons,	2,156 tons.
„ salted,	557 „	963 „
Total,	1,902 „	3,119 „

Total value in 1887,	818,791 pesetas	or £34,000
„ in 1888,	1,210,867 „	£50,000

The price having fallen apparently from £17, 17s. to £16 per ton.

In an article on the Sardine trade of Galicia, where there are 600 sardine factories, we are told that the trade is declining. They demand a revise of the commercial treaties with France and other countries, high duties doing them much injury. Added to which are the heavy import duties on salt which keep down the production. The export also diminishes owing to the inferior oils used. The writer asks, 'Is it possible to suppose that 'the merchants or proprietors can find themselves in a position to improve 'their industry, when, apart from the heavy contracts by which they find 'themselves bound, the duties imposed upon them are increased?

An interesting article on Turtles gives an account of the various species, and the decay to a serious extent of what up till a few years ago was a very productive fishing.

On the fishing in the Mar Menor in 1889; the writer describes this sea, or Albufera, as at present full of young; that the fish leave this sea in order to breed in the Mediterranean, but have not the requisite facilities for returning, or they would do so in still greater numbers; and that the vegetation which appeared owing to the storm of November 1869, increases every year and threatens to invade this water to such an extent that it is most advisable it should be removed.

There has been on the whole a great development of the fisheries of Spain during recent years, and the Government takes great care to spread a knowledge of the subject, and popularise the study

7. FRANCE.

At the Station Zoologique d' Endoume, Marseilles, the distinguished director Professor Marion and his assistants continue their valuable researches into the fisheries of the district.* This laboratory, while

* *Travaux de zoologique appliquée effectués sous la direction du Professor Marion, première année*, 1889, *Marseille*, 1890.

capable of purely scientific research, is adapted for investigations calculated to promote fishery industries, and under its wise and judicious management is accomplishing much and good work. In correspondence with what has been already accomplished in several fishery States, and with the general direction of effort in most, one of the main aims of the Marseilles establishment is to institute measures for the preservation and culture of sea fish, in order to replenish exhausted grounds. Hatcheries have now been in operation for several years in the United States and Norway; one was erected last year in Newfoundland, and several are projected; another was begun in 1888, at Grimsby, and was recently completed; and the authorities in Canada, and some other countries have been moving in the same direction. Professor Marion proposes that fishing should be entirely interdicted in certain defined areas for a few years, in order to allow of their becoming nurseries (*cantonnements de réserves*).

The researches carried on by Professor Marion are on the same general lines as those of the Scotch Board.

The destruction of immature fish has engaged the attention of Professor Marion, as it has recently engaged the attention of almost all fishery authorities. Millions of young of various species, such as the sardine, anchovy, &c., are annually and wastefully captured. In 1889, investigations were specially made on the sardine, the anchovy, and the mackerel, and on the food and reproduction of the edible fishes of the Gulf of Marseilles. Professor Marion's researches on the anchovy are referred to on p. 353. His researches on the sardine in the Mediterranean, do not in all respects agree with those of Professor Pouchet at Concarneau. Professor Marion discusses the migrations and habits of the sardine, and is of opinion that they spawn near the coast, especially in sheltered bays, and that the ova, like those of most food-fishes, are pelagic. The question of the pelagic or non-pelagic character of the ova is discussed at considerable length. The abundance at all times of Copepoda and the larvæ of various organisms, attracts and maintains the sardine in the Gulf of Marseilles. Among the forms found in their stomachs were *Calanus*, *Cyclops*, *Oithona*, *Dias*, *Thalestris*, *Temora*, &c. A description is given of the degree of development of the reproductive organs in individuals of various sizes at different times of the year (the females seem greatly to preponderate; in six hauls 122 were females, and only 12 males); and the distribution and rate of growth of the young are described. The very various sizes of the young at any given period is explained by the long duration of the spawning period. In a paper on the mackerel of the Mediterranean coasts, Professor Marion describes various points connected with its movements, life-history, reproduction, and the distribution of the immature individuals. Researches upon the condition of the reproductive organs of the mackerel have been carried on at Marseilles for three years. In a report on the food of the edible fishes by M. Elie Arnoux, reference is made to the work of the Scotch Board in this department of fishery research, and an account is given of the food found in the stomachs of a large number of species. M. Arnoux also gives an account of his investigations into the development of the reproductive organs of a considerable number of species found in the Gulf. Soles (*Solea vulgaris*) spawn in the Gulf of Marseilles in March.

The Report on the statistics of French and Algerian fisheries for 1887 was published last year.* It appears that in 1887 the total value of the fisheries amounted to 90,731,449 francs; there were 82,743 men engaged

* *Statistique des pêches maritimes et de l'ostreiculture pour l'annee* 1887, Paris, 1889.

in sea fisheries, 55,343 men, women, and children engaged in shore fisheries, and 201 foreign fishermen. The number of French boats was 24,196 (an increase of 316 over 1886), and there were 83 foreign boats, the total value of boats, nets and gear was 63,264,395 francs. In 1887, as compared with 1886, there was an increase in the catch of cod, herrings, and especially sardines, and an increased yield of oysters. There was a great decrease in anchovies, a decrease in mackerel, flat-fish (soles, turbot &c.), lobsters and mussels.

The Prince of Monaco has published an account of a new apparatus for the collection of pelagic organisms at great depths.* It consists of a specially constructed tow-net, fixed to a rectangular frame, which can be opened and closed at any depths by means of 'messengers.'

The Prince of Monaco who makes the improvement and invention of appliances for marine research a speciality has also given a description† of the special tow-nets and other apparatus employed on board his yacht "l'Hirondelle," in his marine researches, together with some of the results. The object was to obviate some of the disadvantages of the appliances generally used to obtain collections of the marine fauna. The descriptions are amply illustrated.

Concarneau.—In the Report for 1888,‡ to the Minister of Public Instruction, Professor Pouchet gives an account of the work done at the laboratory during that year, especially in relation to the sardine, which has for some years been made a special object of study in France. The investigations relating to its life-history and habits have been continued on the same lines as before.§

In 1887, Professor Pouchet expressed the opinion, from the investigations made, that the sardine would probably be found in abundance in 1888, and this opinion was justified by the result. These investigations on the sardine, as in the similar investigations carried on by the Scotch Board, necessitate the measurement of the fish got at different places at different times of the season, and also an examination of the reproductive organs to ascertain the degree of maturity. Lists are given of the results.

It has been shown that the so-called *sardine de rogue* is not a mature sardine ready to spawn, but a young one which disappears from French waters before the ovaries reach maturity. Professor Pouchet points out that among sardines the development of the testes and ovaries is very unequal, both among those of the same size taken at various periods of the season, and among individuals of different sizes captured at the same time of the year. This has also been observed with other fishes during the investigations of the Scotch Board (*vide*, p. 259).

As among most other fishes also, the testes are much more developed than the ovaries at the beginning of the season. An account, illustrated by figures, is given of the ova and ovaries of the sardine. The ova are from 1·20 to 1·30 mm. in diameter (thus larger than those of the herring, and about the size of the eggs of the whiting) and are transparent; those pressed from the female sink in sea water. After fertilisation they may possibly float; but M. Biétrix never obtained any pelagic eggs of the sardine in his tow-nettings during the time the females were ripe. The vitelline membrane is externally smooth, but on its inner surface it presents short projecting ribs, at various angles, giving it a general appearance

* *Comptes rendus des séances de la Soc. de Biologie, Séance du* 29 Juin 1889.

† *Comptes rendus des séances du Congres international de Zoologie.* Paris, 1889, p. 133.

‡ *Rapport au Ministre de l'Instruction publique sur le fonctionnement du Laboratoire de Concarneau en* 1888, *et sur le sardine,* 1889.

§ *Seventh Ann. Rept., Fishery Board Scot.*, part iii. p. 390.

like basket-work. There is also a chapter on the growth and age of the sardine, and one on the variations of the dimensions of the *sardine de rogue* at various places since 1864. M. Biétrix gives an account of the pelagic fauna of Concarneau Bay.

7. BELGIUM.

The destruction of immature fish by the operation of trawling around the coast has recently engaged the attention of the Association Commerciale Maritime d'Ostende.* The president of the section on fisheries (M. Aug. Hamman) has reported to the Association and recommends the international regulation of the fisheries off the coast during certain months of the year, and the prohibition of the capture of fish before they have reached maturity.

8. DENMARK.

The Danish Government recently published their annual Fishery Report for 1888–89.†

This report was prepared by Captain C. F. Drechsel, the superintendent of Danish fisheries. It contains the new Danish fishery law and a description of the arrangements made by the administration in relation thereto; reports from the commanders of the gunboats engaged in fishery duties; statistics of the fisheries and a description of the new biological station which the Government has established. The Danish fishery law was referred to in our last Report. I may add here the particulars as to the prohibition of the capture or sale of certain fish under a fixed size—These are as follows:—measured from the tip of the snout to the root of the tail.

1.	Eel, pike, and salmon, ...	under 12	inches.
2.	Tusk, whiting, plaice, turbot, brill, bream, tench, trout, and shad (*Hœlt*), . .	„ 8	„
3.	Dabs (*Skrubbe*, *Slette*), perch and bleak,	„ 6	„
4.	Crabs, ...	„ 3	„
5.	Lobsters, ...	„ 7	„

The biological station, which is under the charge of Dr C. G. Joh. Petersen, cost 34,000 kroner, and a sum of 8600 kroner will be annually set apart for its up-keep. Dr Petersen has continued his researches into the migrations of plaice. The method originally adopted of affixing a metallic label by means of a silk cord has been discontinued, and I am informed by Dr Petersen that his new method of branding a large sized number upon the fish is expected to yield better results.

9. NORWAY.

The well-known hatchery for seafish at Flödevig, Arendal, has recently undergone enlargement and reconstruction. Captain Dannevig, the director, has adopted a new plan of collecting the cod ova for hatching. Instead of keeping ripe fish and pressing the ova from them at intervals as described in our last Report,‡ and artificially fertilising them,

* *Bulletin mensuel*, No. 3, Mars, 1890.
† *Fiskeri-Beretning for Finantsaaret*, 1888–89, *Kjøbenhavn*, 1890.
‡ *Seventh Annual Report*, part iii. p. 402, 1889.

the ripe fish, males and females, are kept together in a very large tank where they spawn naturally, the floating fertilised ova being then removed from the surface of the water. This system has been found to answer much better than the old method, Captain Dannevig is preparing duplicates of the plans of his hatchery, and a description of it, for the use of the Scotch Board; but they have not yet come to hand. He informs me that lobster culture will shortly be begun at the new hatchery.

10. ITALY.

Professor Giglioli informs me that no new special scientific fishery investigations were undertaken last year in Italy; but the observations on spawning, breeding, and the food of sea fishes have been continued by Dr Raffaele at the Zoological Station, Naples. As was stated last year, on the suggestion of Professor Giglioli, at the last annual meeting of the Fishery Commission at Rome, in October, 1888, some experiments have been made at Naples on the effects of trawling. Professor Giglioli also 'gave an account of the excellent work you are doing towards the elucidation of that most important subject.' Last year the Italian Government undertook the restocking of lakes and rivers with trout and young eels. As a practical result, Professor Giglioli states that he saw a lake-trout from Lake Bracciano, 40 centimetres long; the result of fry placed in that lake, in which no trout previously existed, by Dr Vinciguerra two years before.

The Italian fishery law of 1877 has special articles regulating the size of lawfully saleable fish of different species; but no new departures on this subject have been made lately.

By the law above referred to I find that the minimum size is fixed for the lawful sale of 47 kinds of fish. The minimum legal size for soles (*Solca vnlgaris*), turbot, brill and whiting is 12 centimetres (about four and a half inches); for plaice 10 centimetres (about four inches); sizes are also fixed for the sardine, anchovy, mullet, eel, &c.*

11. GERMANY.

The sixth Report of the Kiel Commission was issed last year.† It consists of a single memoir by Reinke on the Algæ of the Western Baltic and is accompanied by an atlas of 25 plates.

* *Ministero di agricoltura, industria e commercio: Legge e regolamenti sulla pesca*, Rome, 1880.

† *Sechster Bericht der Kommission zur wissenschaftlichen Untersuchung der deutschen Meere, in Kiel, für die Jahre* 1887, *bis* 1889, Berlin 1889.

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