THIRTEENTH ANNUAL REPORT

OF THE

FISHERY BOARD FOR SCOTLAND,

Being for the Year 1894.

IN THREE PARTS.

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

PART II.—REPORT ON SALMON FISHERIES.

Presented to Parliament by Command of Her Majesty.

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

THIRTEENTH ANNUAL REPORT.

TO THE RIGHT HONOURABLE

SIR GEORGE O. TREVELYAN, BART.,

Her Majesty's Secretary for Scotland.

OFFICE OF THE FISHERY BOARD
FOR SCOTLAND,
EDINBURGH, 1*st May* 1895.

SIR,

In continuation of our Thirteenth Annual Report, we have the honour to submit—

PART II.—REPORT ON SALMON FISHERIES.

Salmon Fishing Season of 1894 below average.

The fishing season for 1894, judged by the number of boxes of salmon sent to Billingsgate, was below the average of the previous sixty-one years. During that period the greatest number of boxes sent in any one year was 42,330 in 1835; the smallest number being 11,593 in 1851. The number of boxes sent in 1894 was 15,489, or nearly 35 per cent. below the average of the previous ten years. In the following Table will be found the number of boxes of salmon sent to Billingsgate in each year since 1834, each box weighing about 1 cwt. :—

Table of Boxes of Scotch Salmon sent to Billingsgate from 1834 to 1894 inclusive.

Year.	Boxes of Salmon.	Year.	Boxes of Salmon.
1834	30,650	1865	19,009
1835	42,330	1866	21,725
1836	24,570	1867	23,006
1837	32,300	1868	28,020
1838	21,400	1869	20,474
1839	16,340	1870	20,648
1840	15,160	1871	23,390
1841	28,500	1872	24,404
1842	39,417	1873	30,181
1843	30,300	1874	32,180
1844	28,178	1875	20,375
1845	31,062	1876	34,655
1846	25,510	1877	28,189
1847	20,112	1878	26,465
1848	22,525	1879	13,929
1849	23,690	1880	17,457
1850	13,940	1881	23,905
1851	11,593	1882	22,968
1852	13,044	1883	35,506
1853	19,485	1884	27,219
1854	23,194	1885	30,362
1855	18,197	1886	23,407
1856	15,438	1887	26,907
1857	18,654	1888	22,857
1858	21,564	1889	21,101
1859	15,823	1890	18,931
1860	15,870	1891	25,889
1861	12,337	1892	21,919
1862	22,796	1893	18,903
1863	24,297	1894	15,489
1864	22,603		

Table of Boxes of Salmon sent to Billingsgate in each month from 1884 to 1894 inclusive.

We are indebted to the Fishmongers' Company for again furnishing us with information regarding the salmon received at Billingsgate, which enables us to compile the following Table, showing the number of boxes of Scotch salmon received there monthly, from February to September inclusive, during the years 1884 to 1894 inclusive, the average number of boxes received in each month, extending over a period of ten years, and the average price per lb. obtained monthly during 1893 and 1894 :—

Month.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	Average of 10 years 1884–93	Average Monthly Price p. lb. during 1893.		Average Monthly Price p. lb. during 1894.	
													s.	*d.*	*s.*	*d.*
February, .	1,335	879	841	717	535	691	612	934	1,078	557	327	*818*	1	7	1	$11\frac{2}{3}$
March, . .	1,402	1,116	1,008	797	899	1,006	902	1,116	1,688	773	692	*1,071*	1	9	1	$11\frac{17}{27}$
April, . .	1,973	1,886	1,744	1,456	1,096	1,152	952	1,403	1,657	845	887	*1,416*	1	8	1	$10\frac{8}{25}$
May, . .	3,162	2,257	2,485	2,432	2,603	1,859	1,844	2,591	2,125	1,997	1,745	*2,335*	1	5	1	$8\frac{7}{27}$
June, . .	3,821	3,863	2,896	3,531	3,953	3,827	3,127	4,140	2,438	3,802	3,078	*3,540*	1	1	1	$0\frac{19}{62}$
July, . .	8,765	10,582	8,045	9,544	7,943	7,414	7,148	8,007	6,259	5,786	4,464	*7,949*	0	11	1	$0\frac{35}{62}$
August, .	6,070	9,151	5,777	7,794	5,474	4,826	4,035	7,028	6,064	4,722	3,968	*6,094*	1	1	1	$2\frac{17}{27}$
September,	691	628	611	636	356	326	311	670	610	421	328	*526*	1	3	2	$1\frac{17}{60}$
Total, .	27,219	30,362	23,407	26,907	22,859	21,101	18,931	25,889	21,919	18,903	15,489	*23,749*	...		...	

This Table shows that the number of boxes of salmon sent to Billingsgate in 1894 was below the average of the last ten years in each month.

With regard to the average monthly price per lb. of salmon, it will be observed that it was higher during 1894 than during the previous year. If it is estimated that each box contains 1 cwt. of salmon, the value of the Scotch salmon delivered at Billingsgate during 1894 will be found to be £112,090, 2s. 9d., or on an average, £7, 4s. 9d. per cwt., whereas the value of that delivered in 1893 was £120,604, 7s. 9d. or £6, 7s. 7d. per cwt.

Boxes of Scotch Salmon forwarded from various stations, ports, &c

The Scottish railway companies and steamship owners have kindly furnished a statement showing the number, and in almost every case the weight,[1] of the boxes of salmon forwarded by them during 1894 from the various stations, ports, &c. This information, together with that derived from the same sources in 1892 and 1893, has been divided in the following manner:—

District.	1892.		1893.		1894.							
	Number of		Number of		Number of				Weight.			
	Boxes.	Half-Boxes.	Boxes.	Half-Boxes.	Boxes.	Half-Boxes.	Quarter Boxes.	Packages.	Tons.	Cwt	Qrs.	Lbs.
Berwick to Cairnbulg Point, .	16,779	370	16,309	772	11,153	557	141	..	944	10	2	13
Cairnbulg Point to Cape Wrath,	9,569	164	9,821	781	7,388	432	237	..	729	2	3	17
Cape Wrath to Glasgow, . .	4,007	...	5,101	...	6,728	..	..	94	471	13	3	4
Glasgow to the Border, . . .	4,832	..	4,773	..	3,886	..	..	..	225	16	1	18
Total, . . .	35,187	534	36,004	1,553	29,155	989	378	94	2,318	15	3	20

Replies to printed queries regarding the yield of the Salmon Fisheries in 1894.

The replies which have been received to the usual circular of printed queries issued at the close of the salmon fishing season, indicate that the season of 1894 was, as a rule, below the average. These queries are sent to Clerks of District Boards, or, where no Boards exist, to persons interested in the salmon fisheries, with a view of ascertaining, as far as possible, the state of the fisheries. The answers which have been received are given in Note I. of the Appendices to this Report. From eighteen of these replies it seems that the take of fish during 1894 has been below the average, from two that it was about an average, while of the remaining five two report that it was a fair or good average, and three that it was above the average.

In the following districts the take of fish is reported as being 'below the average,' or even in cases marked * 'much below the average':—

[1] The weight of 776 boxes and 94 packages was not returned. An estimate has been made of the weight of the boxes, but the weight of the packages has been omitted in the above table.

*Forth.	Conon.
Tay.	Kyle of Sutherland.
*South Esk.	The Rivers of the East Coast of Sutherland.
Don.	Lochy.
Ythan.	Girvan.
Ugie.	Cree.
Deveron.	Nith.
Spey.	Annan.
Findhorn.	
Nairn.	

The districts which report an average take of fish are those of the rivers Ness and Balgay. The return from the Balgay, however, refers only to the take of fish in fresh waters. A good or fair average fishing is reported from the districts of the rivers Dee in Aberdeenshire, and Stinchar in Ayrshire respectively. The only districts from which it is reported that the take of fish was above the average, are those of the rivers of the North and West Coasts of Sutherlandshire and of the River Dee in Kirkcudbrightshire. In the case of the latter district, however, it would appear that the fishing was only slightly above the average. From the district of the river Torridon it is stated that no means have been provided by the legislature for collecting statistics, and that nothing, therefore, is known as to the take of fish, except as regards fresh waters, where it is stated to have been rather below the average.

Rental of Tay Salmon Fishings.

The following is the rental of the Tay fishings since 1828 :—

Year.	Rental.			Year.	Rental.		
1828	£14,574	10	0	1862	£14,080	12	0
1829	14,529	10	0	1863	14,232	16	6
1830	13,747	8	0	1864	16,742	5	2
1831	13,874	0	0	1865	17,618	0	7
1832	11,629	0	0	1866	17,465	3	4
1833	11,577	0	0	1867	16,852	18	4
1834	10,907	10	0	1868	16,965	15	10
1835	10,856	10	0	1869	17,444	15	0
1836	10,211	10	0	1870	17,044	8	4
1837	10,150	6	0	1871	16,382	8	4
1838	10,285	0	0	1872	15,162	15	0
1839	10,498	0	0	1873	17,519	14	0
1840	11,058	0	0	1874	18,941	13	8
1841	10,846	5	0	1875	21,634	4	4
1842	10,235	15	0	1876	19,930	18	4
1843	10,512	5	0	1877	21,126	14	0
1844	10,386	10	0	1878	21,187	1	0
1845	10,751	15	0	1879	21,697	14	0
1846	10,099	15	0	1880	22,518	8	7
1847	11,421	10	0	1881	19,579	11	5
1848	12,057	10	0	1882	19,221	11	7
1849	10,729	16	0	1883	17,773	3	0
1850	9,491	11	0	1884	19,655	14	5
1851	9,530	0	0	1885	20,417	0	2
1852	7,973	5	0	1886	22,542	2	8
1853	8,715	17	6	1887	22,143	16	7
1854	9,269	6	5	1888	19,655	0	0
1855	9,977	13	5	1889	17,731	2	0
1856	10,199	10	4	1890	17,819	10	0
1857	10,772	0	5	1891	17,237	6	8
1858	11,487	2	5	1892	19,018	0	0
1859	11,884	14	0	1893	21,762	14	3
1860	13,827	10	7	1894	19,578	7	5
1861	14,009	15	7				

It will be observed from the above statement that the rental for 1894 is lower than that for the previous year.

Return of Fish caught at Salmon Fishings belonging to Aberdeen Harbour Commissioners.

The Aberdeen Harbour Commissioners have kindly furnished a statement of the number and weight of fish caught at their salmon fishings since 1872. This return shows that the falling-off in these fisheries last year was specially due to the very small number of salmon which were caught. Grilse were more numerous than in 1893, although considerably below the average of recent years. Sea trout, however, were very numerous, the take of these fish in 1894 only having been exceeded in three out of the twenty-three years for which statistics are available. The report for 1892 (pp. vii. and xi.) contains some interesting observations by Mr Ross, the Harbour Treasurer, on the yield of these fisheries since the formation of the Dee Salmon Fishing Improvement Association.

Salmon disease in 1894.

Salmon disease appears on the whole to have been less prevalent during 1894 than in the previous year. From the Forth it is reported that 248 fish were taken out of the river in the winter of 1893–4, as against about 800 in 1892–3, and 1600 in 1891–2; from the Tay that the usual number of fish were affected; from the South Esk that 70 fish were taken from the river in January, February, and November; from the Dee in Aberdeenshire that they numbered 329, and that they were mostly spent males; from the Don that the disease was practically non-existent; from the Ythan that 153 fish succumbed, of which 119 were males and 34 females; from the Ugie that there were 74; and from the Deveron that the fish which died numbered only 348, as against 1640 in the previous year. In the Spey the number of fish affected appears to have been the lowest on record. The disease showed itself to a slight extent in the Conon, Helmsdale, Girvan, and Nith; also, although it is not stated to what extent, in the Nairn and Cree. In the Annan the total number taken out of the river appears to have been only 67, of which 18 were males and 49 females, whereas 669 were reported in the previous year.

Inspections during 1894.

By the direction of the Board, Mr Archer visited the district of the River Cree regarding the petition from the District Board of that river, praying for an alteration of the annual close time. He held inquiries in the Tay and Forth districts on the question of hang and drift-net fishing in the estuaries of these rivers; he attended a conference of the Annan and Nith District Boards and the Liddle and Esk Fishery Association, held at Dumfries, for the discussion of proposals for the removal of the existing anomalies of the law in the Solway Firth; and he was also present at a meeting of the Deveron District Board, when the question of the cruive dyke on that river formed the subject of discussion. He further accompanied Mr Stafford Howard, H.M. Commissioner of Woods, on an inspection of the salmon fisheries on the East Coast, and subsequently completed the inspection of these fishings as far as Cape Wrath in Sutherlandshire. In his Report to the Board, which is given on page 5 of the Appendices to this Report, he describes this inspection, and indicates by means of red lines on a map of Scotland, appended to this Report, the approximate number of fixed nets on every ten miles of coast. The map further shows the limits of the salmon fishery districts, and of the estuary lines as defined by the bye-laws

STATEMENT OF NUMBER AND WEIGHT OF FISH CAUGHT AT SALMON FISHINGS BELONGING TO THE ABERDEEN HARBOUR COMMISSIONERS.

Season.	Salmon.				Grilse.				Sea-Trout.				Total.			
	No.	Weight in lbs.	Total Weight for each period of 7 Years.	* Percentage.	No.	Weight in lbs.	Total Weight for each period of 7 Years.	* Percentage.	No.	Weight in lbs.	Total Weight for each period of 7 Years.	* Percentage.	No.	Weight in lbs.	Total Weight for each period of 7 Years.	* Percentage.
1872	3,981	59,303	.	.	5,923	27,338	.	.	2,512	5,041	.	.	12,416	91,682	.	.
1873	4,200	48,895	.	.	7,239	34,598	.	.	2,518	4,755	.	.	13,957	88,248	.	.
1874	8,100	88,398	.	.	6,187	27,219	.	.	1,671	3,307	.	.	15,958	118,924	.	.
1875	5,961	63,987	.	.	4,714	20,501	.	.	1,163	1,922	.	.	11,838	86,410	.	.
1876	2,873	33,788	.	.	9,184	39,297	.	.	2,710	5,058	.	.	14,767	78,143	.	.
1877	4,811	55,086	.	.	7,737	37,556	.	.	1,320	2,540	.	.	13,868	95,182	.	.
1878	8,918	116,308	465,765	.	3,350	14,446	200,955	.	3,524	6,553	29,176	.	15,792	137,307	695,896	.
1879	1,897	22,964	.	.	7,284	31,141	.	.	1,606	2,785	.	.	10,787	56,890	.	.
1880	4,178	43,587	.	.	5,410	23,720	.	.	2,160	4,123	.	.	11,748	71,430	.	.
1881	4,873	47,191	.	.	11,400	49,349	.	.	3,518	6,627	.	.	19,791	103,167	.	.
1882	6,530	62,717	.	.	7,415	32,413	.	.	2,815	5,644	.	.	16,760	100,774	.	.
1883	6,886	70,384	.	.	13,852	70,555	.	.	4,330	7,969	.	.	25,068	148,908	.	.
1884	5,424	64,866	.	.	6,129	27,817	.	.	3,164	5,646	.	.	14,717	98,329	.	.
1885	4,597	53,989	365,698	78·5	15,129	73,958	308,953	153·7	5,424	9,529	42,323	145·1	25,150	137,476	716,974	103
1886	6,370	68,536	.	.	9,583	39,502	.	.	2,321	4,218	.	.	18,274	112,256	.	.
1887	5,052	55,535	.	.	14,847	60,644	.	.	3,341	5,498	.	.	23,240	121,677	.	.
1888	7,843	83,292	.	.	12,905	58,653	.	.	2,235	3,825	.	.	22,983	145,770	.	.
1889	5,623	60,573	.	.	9,336	38,379	.	.	1,282	2,199	.	.	16,241	101,151	.	.
1890	7,085	66,114	.	.	9,220	43,140	.	.	4,570	8,717	.	.	20,875	117,971	.	.
1891	9,477	107,566	.	.	11,775	58,318	.	.	2,702	4,531	.	.	23,954	170,415	.	.
1892	8,594	88,932	530,548	145·1	11,329	48,620	347,256	112·4	1,329	2,115	31,103	73·5	21,252	139,667	908,907	126·8
1893	6,795	71,185	.	.	5,068	18,131	.	.	3,513	5,294	.	.	15,376	94,610	.	.
1894	4,581	45,932	.	.	6,277	28,020	.	.	4,196	7,166	.	.	15,054	81,118	.	.

* The weight for the first septennial period is taken at 100, and for the later periods as proportional parts of the first.

made by the Commissioners appointed under the Salmon Fishery (Scotland) Act, 1862. In the case of the estuary lines, it has not been found possible, in every instance, to determine with certainty the position of the places named in the bye-laws. In a table of reference, accompanying the map, however, the bye-laws are given, and the authority or basis on which the estuary lines are drawn is stated.

Salmon Fishery Investigations.

Note II. of the Appendices contains a preliminary report, by Mr Tosh, on certain investigations which have been made into the life-history of salmon. These investigations, which were commenced last year under the direction of the Board by Mr R. H. Grey at Berwick-on-Tweed, are being continued. In the latter part of his Report to the Board, Mr Archer summarises what has been done in a similar direction in Holland, Switzerland, and Norway.

Bye-laws passed by Salmon Fishery Commissioners and Ancient Rights in Cruive Dykes.

In consequence of certain cruive dykes not being in accordance with the bye-law (Schedule F., 31 & 32 Vict. cap. 123) which regulates their construction, Mr Archer was directed to draw up, in consultation with Messrs Carmichael & Miller, W.S., a memorandum in regard to the law relating to the construction and use of cruives prior to the Salmon Fishery Act of 1862, and as to the effect of that Act thereon. This memorandum will be found in Note III. of the Appendices.

We have the honour to be,

Sir,

Your most obedient Servants,

ANGUS SUTHERLAND, *Chairman.*
GEORGE H. M. THOMS.
D. M'KECHNIE.
W. C. M'INTOSH.
W. ANDERSON SMITH.
WILLIAM BOYD.
JAMES JOHNSTON.
J. RITCHIE WELCH.

MAP
SHOWING THE
SALMON FISHERY DISTRICTS IN SCOTLAND
FORMED UNDER THE
SALMON FISHERY ACTS, 1862 TO 1868
ATLANTIC OCEAN
NORTH SEA
THE MINCH
SEA OF THE HEBRIDES
IRISH SEA
NORTH CHANNEL
FIRTH OF FORTH
DORNOCH FIRTH
MULLANAGEREN
GUNBEATH
BERRIEDALE
WICK
FLEET
KENNART
ULLAPOOL
KISHORN
CARRON
BEAULY
CONON
LUING
NESS
ARNISDALE
KILOCHAN
MORAR
AYLORT
MOIDART
SHIEL
SCADDLE
LEVEN
LOCHY
PENNYGOWN
NAIRN
FINDHORN
UGLE
YTHAN
DEVERON
DON
DEE
BERVIE
NORTH ESK
SOUTH ESK
GIRVAN
BLADENOCH
NOTE.
Fishery Districts with District Boards are printed in pink
Fishery Districts without District Boards are uncoloured.
Strong red lines denote the boundaries of the different Fishery Districts.

TABLE OF REFERENCE OF AUTHORITY ON WHICH ESTUARY LINES ARE DRAWN.

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing map were drawn.
ALINE . . .	A straight Line drawn 15 Degrees North of true West from Bolorkle Point on the East Shore to the Mainland on the West Shore.	Admiralty Chart.
ALNESS . . .	A straight Line drawn between the East and West Sutors of Cromarty.	Ordnance Survey.
APPLECROSS .	A straight Line drawn from Mouth of Burn on the North Shore outward, and distant 1,500 Yards from the Manse, to the outermost Pier on the South Shore, which is distant 900 Yards from the innermost Pier.	Ordnance Survey.
ARNISDALE .	A straight Line drawn from the West End of Dry Island on the North Side of Arnisdale River, through Skeir Laven, to the Ru on the South Side of that River.	Admiralty Chart, No. 2507.
AWE	The Point North-west of Dunstaffnage Castle on the South, and the South-west Point of Garbhart on the North.	Ordnance Survey.
AYLORT . . .	A straight Line drawn from the outermost Point of Aird Nish on the North Shore, through Goat Island, to the Mainland on the South.	Admiralty Chart, No. 2496.
AYR	A Segment of a Circle of 400 Yards Radius, drawn from a Centre placed Halfway between the outer End of the Breakwater and the outer End of the South Pier, with Tangents to the Circle extended to meet High-water Mark of Spring Tides in the Direction of the South End of Newton Lodge on the North, and in the Direction of the Seaward End of the Lane South of the Gasworks on the South.	
BALGAY . . .	*See* Torridon.	
BAA and GLENCOILLEADAR	As regards the River BAA,—a straight Line due North and South through the outer End of Eorsa Island. As regards the River GLENCOILLEADAR,—Ard Kilfinichen on the North, a straight Line thence in the Direction of the Free Church to the South Shore.	Ordnance Survey (spelt Ba). Ordnance Survey.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
BEAULY . . .	A straight Line, drawn due South-east, true Meridian, from the Centre of the Three Burns to the Southern Shore, thus cutting the Black Buoy, as at present placed on the North End of the Whiten Ness Sands.	Admiralty Chart, No. 2397A.
BADACHRO and KERRY	A straight Line drawn from the North-westernly Point of Stron-na-Ard on the East Shore, touching the outer End of Eilean Horrisdale, to the Mainland West.	Ordnance Survey.
BLADENOCH, CREE and FLEET	A straight Line drawn from Eggerness Point on the West, through the Centre of Barlocco Island, thence to the nearest Point of the Mainland on the East of that Island.	Ordnance Survey.
BERRIEDALE .	A straight Line of about 250 Yards in Length, drawn in a Direction a little to the East of true North from the most projecting Point of Rocks above Low Water, South-east of the old Castle, to the most projecting Point of Rock at Low Water, South-east of the Northern Extremity of the small Bay into which the River discharges, and the shortest Lines connecting those Rocks with the Shore.	
BERVIE . . .	A Portion of a Circle of 150 Yards Radius, to be drawn from a Centre placed Mid-channel in the River where it joins the Sea at Low Water at Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
BROOM and ULLAPOOL	A straight Line drawn from Ru-na-Caddal on the North to the Ru-Camas Voarach on the South.	Admiralty Chart, No. 2500.
BRORA . . .	A Portion of a Circle of 300 Yards Radius, having its Centre in Mid-channel of the River at Low Water of Spring Tides, and extended Shorewards by Tangents at Right Angles to (or to the nearest Point of) High-water Mark.	
CARRADALE .	From the outermost Point at Low Water of Spring Tides of the most projecting Point of Rocks on the South or Right Side of the River a straight line drawn Westward to the nearest Point of the Shore, and another straight Line drawn in the Direction of Carradale House, both Lines extending up to High-water Mark.	Ordnance Survey.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
CARRON . .	See Kishorn.	
CLAYBURN, FINNIS BAY, AVEN-NAN-GEREN, STRATHGRAVAT, NORTH LACASTILE, SCALLADALE, MAWRIG* (East Harris)	As regards the River CLAYBURN, a straight Line drawn between the Two outer Points across the Mouth of Bayhead.	———
	As regards FINNIS-BAY and AVEN-NAN-GEREN River, a straight Line from Cuidenish Point on the North to Ru Ardtulusish on the South.	(Spelt Finsbay). North Point taken as Rudha Quidnish; Ru Ardtulusish not on Ordnance Survey.
	As regards STRATHGRAVAT River, a straight Line drawn from Ru Ghoecrabb on the South, through the Centre of Stockinish Island, to the opposite Shore of the Bay.	Ru Ghoecrabb taken as point of Ard Mor, North East corner of Geocrab Bay.
	As regards NORTH LACASTILE River, a straight Line from the Ru Meanach on the East to Rhu Dhu on the West.	Ordnance Survey (called Laxadale). Ru Meanach taken to be Ardmhead-honach and Rhu Dhu taken to be Rudha Dubh.
	As regards SCALLADALE and MAWRIG Rivers, a straight Line drawn from the Mouth of the River forming the Boundary between Lewis and Harris at Low Water to the narrow Point of Rainigatel.	Ordnance Survey, point on South, viz.:—Rainigatel, taken as Rudha-nah - Uamha, near Rainigadale.
CLYDE, LEVEN, and ECKAIG	A straight Line drawn East from Toward Point Light.	Ordnance Survey.
CONON . . .	A straight Line drawn between the East and West Sutors of Cromarty.	Ordnance Survey.
CREED or STORNOWAY, and LAXAY	As regards the River CREED or STORNOWAY, a Line drawn due East from the Lighthouse.	Ordnance Survey.
	As regards the River LAXAY, a straight Line drawn from Eilean Chalabrigh on the North to the outer End of Eilean Chalam Ghille and a straight Line thence to the South Shore.	Admiralty Chart, No. 1154.
CRERAN . .	A Line drawn from the Southermostn Point of the Mainland immediately North of Ereska Island, and continued along the outer Face of that Island to the projecting Point of the Mainland nearest to the South-west Point of the said Island.	Ordnance Survey.
DEE (Aberdeenshire)	A Portion of a Circle of 400 Yards Radius, to be drawn from a Centre placed Midway between the outermost Point of the North Pier and the outermost Point of the Breakwater, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark of Equinoctial Spring Tides.	

* Spelt MAARUIG on Ordnance Survey.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
DEE (Kirkcudbright)	A straight Line drawn from Balinoc Head to the outer Point of Little Ross Island, and thence to the nearest Point on the Mainland.	Balinoc Head, taken for Balmac Head on Admiralty Chart, No. 1971.
DRUMMACHLOY or GLENMORE.	A straight Line drawn from Kildavannan Point to Island M'Neil.	Admiralty Chart, No. 2174.
DUNBEATH . .	On the North, the most projecting Point of Pitormie Head; on the South, the projecting Rock near the Castle, and between the Castle and the Harbour and Seaward a Semicircle drawn from a Centre placed Half Way between those Points.	Admiralty Chart No. 218. Pitormie Head taken for P. Ormane Head.
ECKAIG . . .	*See* Clyde and Leven.	
ESK (Kirkcudbright)	*See* Nith.	
ESK, NORTH (Forfar)	A Portion of a Circle of 400 Yards Radius, to be drawn from a Centre placed Midchannel in the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
ESK, SOUTH .	A straight Line drawn from the Tower of Scurdy Ness to the outermost Point of Scurdy Stone; thence a straight Line extending due North 500 Yards; and on the North a straight Line to be drawn from the last-named Point to a Point at High-water Mark, Spring Tides, 800 Yards distant from the Low Light House, the Distance to be measured in a straight Line.	Admiralty Chart No. 1407.
EWE	A straight Line drawn from Ru-na-Gavann on the West Shore to Ru Con on the East Shore.	Admiralty Chart No. 2509.
EUCHAR . .	*See* Nell and Feochan.	
FINCASTLE, MEAVEG, BALLANACHIST, SOUTH LACASTILE (called LAXADALE), BORVE, and OBB (West Harris)	As regards the FINCASTLE River, a straight Line from Ru More to Airdthurinish.	Ordnance Survey (Points given as Limits of the Estuary shown on map, but river not).
	As regards the MEAVEG River, a straight Line drawn from Airdmeaveg on the West to Airdtolmochan on the East.	Admiralty Chart No. 2841. Airdmeaveg taken for Mheabhag. Airdtolmochan for Gob Aird an Tolmachain.
	As regards the BALLANACHIST River, a straight Line from Hellenish Point on the West to Camp Point on the East.	Admiralty Chart No. 2841. Hellenish Point taken for S. E. end of Theilesnis Bay. Camp Point taken for Gob a Champ.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
	As regards the SOUTH LACASTILE River, a straight Line from Aird Nisibost on the South to Airdgrodernish on the North.	Admiralty Chart No. 2841. Aird Nisibost spelt Aird Nisaboist, Airdgrodernish taken for Aird Ghreodanis.
	As regards the River BORVE, a straight Line from Ru Romagi on the North to Sgeir-nan-Sgarb on the South.	Admiralty Chart No. 2841.
	And as regards the River Obb, a straight Line from Ru Harnan to Cormenish Point.	Ordnance Survey. Ru Harnan on Ordnance Survey, spelt Rudha Charnain, and on Admiralty Chart Ru Carnan. Cormenish Point taken for Point West of Carminish.
FINDHORN . .	A Line drawn due North from the outermost of the Two Shipping Piers of the Town of Findhorn as extends from High-water Mark outwards to 200 Yards below Low Water of Equinoctial Spring Tides ; on the West, a Line parallel with and One and a Half Miles distant from the foregoing described Line, and also extending outwards from High-water Mark to 200 Yards below Low Water of Equinoctial Spring Tides ; and on the North a Line of 200 Yards out from Low Water of Equinoctial Spring Tides, and connecting the outer Ends of the Two Lines hereinbefore described.	
FLEET (Sutherlandshire)	A Portion of a Circle of 1200 Yards Radius, having its Centre in Mid-channel of the River at the Lower Light, and continued to meet High-water Mark.	
FLEET (Kirkcudbright)	*See* Bladenoch.	
FORSS . . .	A straight Line drawn from the most North-westerly Point of the Shore on the West Side of the River to the projecting Point midway between Brimsness and Cross Kirk on the East Side of the River.	Ordnance Survey.
FORTH . . .	A straight Line drawn from the Hound Point on the South Shore to St. David's Point on the North.	Admiralty Chart No. 114B.
FYNE, SHIRA, and ARAY	Craigan's Ferry.	Admiralty Chart No. 2321.
GIRVAN . . .	A Portion of a Circle of 300 Yards Radius, drawn from a Centre placed Mid-channel of the River, where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued to the Shore at High-water Mark on the respective Sides of the River by Tangents to the Circle drawn at Right Angles with the Shore.	

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
GLENELG . .	A straight Line drawn from the East Side of the Rocks forming the Western Extremity of Bernera Bay on the North to the projecting Point of Land at High-water Mark immediately North of Eilean Reach or Glenbeg River, and Eilean Reach House on the South.	Admiralty Chart No. 2676.
GOUR . . .	*See* Lochy.	
GREISS, LAXDALE and TONG or THUNGA	As regards the Rivers LAXDALE and TONG or THUNGA, from the Rocks at Rudhuna-Monach at Low-water Line on the North to Gobnan Clach at High-water Line on the South.	Ordnance Survey.
	As regards the River GRIESS, from the outer Point of Sgeir Leathain Island a straight Line drawn North to Ston Ruadh and South-west to Creagh-Mhor-Bhataisgeir.	Ordnance Survey.
GRUDIE or DIONARD	A straight Line from Far Out Point on the East to Stoir Point on West (Admiralty Chart).	Admiralty Chart No. 1954.
GRUINARD and LITTLE GRUINARD	A straight Line drawn from the most projecting Point between Gruinard House and Douran Rocks on the North to the projecting Point West of Mill Bay on the South.	Admiralty Chart No. 2500.
HALLADALE .	A straight Line drawn due West across Melvert Bay from the most projecting Point of salmon rocks on East.	Line drawn due west across Melvich Bay, salmon rocks not being given.
HELMSDALE .	A Portion of a Circle of 300 Yards Radius, having its Centre in Mid-channel of the River at Low Water of Spring Tides, and extended Shorewards on the North Side by a Tangent drawn at Right Angles to (or the nearest Point of) High-water Mark, and on the South by a Tangent drawn to meet High-water Mark at the Distance of 300 Yards West of the Point of Land occupied by a Curing Yard on the West or Left Bank of the River at High Water.	
HOPE and POLLA or STRATHBEG	A straight Line from Grave Point on West, through outer End of Skeir Bhuie Island and continued East Shore (Admiralty Chart).	Admiralty Chart, No. 1954. (For Grave Point). Ordnance Survey. (For Skeir Bhuie Island).
INCHARD . .	A straight Line drawn from Kean Point on North to the outer Point of Land between Loch Inchard and Loch Kinsale on South.	Admiralty Chart, No. 2503.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
INNER (Jura) .	A Part of a Circle of 300 Yards Radius, having its Centre in the Middle of the principal Channel of the River at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
INVER . . .	A straight Line drawn from Kirkaig Point on South to Rue Roe on North (Admiralty Chart).	Admiralty Chart, No. 2386.
IORSA in Arran	A Portion of a Circle of 400 Yards Radius drawn from the Centre of the River at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
IRVINE and GARNOCK	A Portion of a Circle of 400 Yards Radius to be drawn from a Centre placed Mid-channel abreast of the Beacon, and continued to the Shore at High-water Mark on the respective Sides of the River by Tangents to the Circle drawn at Right Angles with the Shore.	
KENNART . .	A straight Line drawn from Ru Beg on the South to the Westernmost Point of Mealan Bhuie on the North.	Admiralty Chart, No. 2500. River's name spelt Kennort on Admiralty Chart, and Kannaird on Ordnance Survey.
KINLOCH . .	A straight Line from outer Point of Pier, Scullornie Harbour, on East, to most projecting Point of Ard Skuinee on West (Burnett and Scott's County Map).	For point of Pier of Scullornie Harbour, *see* Admiralty Chart, No. 1954. Ard Skuinee taken for Ard Sgianaich on Ordnance Survey.
KILCHOAN or INVERIE	A straight Line drawn from Scottis House on the North Side of the River to Creag Eilean on the South side of the River, and a Line from thence to the nearest Point of the Mainland.	Admiralty Chart, No. 2496.
KIRKAIG . .	A straight Line drawn from Weather Lump on the North Shore, through Big Rock, to the South Shore.	Admiralty Chart, No. 2501.
KISHORN and CARRON	A straight Line drawn from the most Northernly Point of Ru-More to the Outside of Garra Island, and a Line thence along the Outside of Kishorn Island to the nearest Point to that last-mentioned Island of the Mainland to the North.	Admiralty Chart, No. 2639.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
KYLE of SUTHERLAND.	On the North, a straight Line drawn from Dornoch Church in the Direction of Tarbet Ness Lighthouse; and on the East, a straight Line drawn due South, true Meridian, from the Village of Inver, to meet the before-mentioned Line, the Point of Meeting of the Two Lines being Three and a Quarter Statute Miles from High-water Mark at Dornoch, and a like Distance from High-water Mark at Inver.	Admiralty Chart, No. 2170. The word "South" in the bye-law taken to mean "North."
LAGGAN and SORN (Islay)	LAGGAN.—Part of a Circle of 400 Yards Radius, having its Centre in the Middle of the River at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides. SORN.—A straight Line from the Point of the Black Rocks on the West, to Penneycraig on the East, both Ends of the Line extending up to High-water Mark	 No trace of names given to be found. Line drawn across the Bay.
LAXFORD . .	From Dougal Head on the North-east, through Centre of Island Skein, to Mainland on South-west (Admiralty Chart).	Admiralty Chart, No. 2503.
LEVEN . . .	*See* Lochy.	
LITTLE LOCH BROOM	A straight Line drawn from Camus-na-Goal Point on the South to the nearest Point of Land on the Northern Shore.	Admiralty Chart, No. 2500.
LOCHY, LEVEN, SCADDLE, GOUR, and SANDA	A straight Line drawn due North-west, true Meridian, from the Westernmost Point of Land forming the Western Shore of Cail Bay, and lying North-east of Balnagowan Island to the Mainland on the North Shore of the Linnhe Loch.	Admiralty Chart, No. 1428. Balnagowan Island spelt Eiln Bailegobhain on Admiralty Chart.
LOCH DUICH and LOCH LUING	A straight Line drawn due South, true Meridian, from Scart Point on the North Shore to the Mainland on the South.	Admiralty Chart, No. 2676.
LOCH ROAG .	A straight Line drawn from Aird-Lamies-headar on the East to Sgeir-na-ha-on Chaorach on the West; also from Camus Ennaidh on the East to Eala Sheadha on the West.	*East*—Admiralty Chart, 2390. *West* — Ordnance Survey.
LUCE . . .	A straight Line drawn from a Point on the Shore at High-water Mark on the East Side of the River 650 Yards South of Stair Haven Pier to a Point on the	Ordnance Survey.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
	Shore at High-water Mark on the West side of the River 1,300 Yards South-west from Ringdon Point.	
LOSSIE . . .	A straight Line to be drawn from the North Pier Head to a Point at Low Water of Equinoctial Spring Tides 200 Yards, measured in a straight Line, East of the South Pier of the Old Harbour, and thence continued by a straight Line to the nearest Point of the Shore at High-water Mark of Equinoctial Spring Tides.	——
LUSSA (Mull), and river from LOCH UISK to LOCH BUY	As regards the River LUSSA, a straight Line between the most projecting Points of the Heads of the Mouth of Loch Spelve.	Admiralty Chart, 2813.
	As regards LOCH UISK River, a line North-west and South-east through the outer Side of Mor Island.	Admiralty Chart, 2813.
MOIDART and SHIEL	A straight Line drawn from Farquhar Point on the South Shore to the South-west Point of Eilean Shona, and a straight Line drawn from North-west Point of Eilean Shona to the nearest Point of the Mainland on the North.	Admiralty Chart, 531.
MORAR . . .	A straight Line drawn from Bonan Caraidich on the North Side of the River to the outermost Point of Fraoch Eilean on the South Admiralty Chart.	Admiralty Chart, 2496.
MULLANEGEREN, HORASARY, and LOCH-NA-CISTE (North Uist)	As regards the River MULLANAGEREN, the shortest Line from Dramanan Point and Valeque Point to Ornisay Island.	Dramanan Point, taken for Corran Ard a Bhoram, and Valeque Point taken for Corran Vallaquie. Ornisay Island, taken for Ornsay Island. River not named on Survey.
	As regards the River HORASARY, the shortest Lines from the Point of Arnal and from the Point of Canoch to the North End of Kirkibost Island.	Taken for Horisary River. Arnal taken for Lagan Arnal. Carnock not on Survey, estuary line, therefore drawn on the East from north end of Kirkibost Island to nearest point on mainland, called on Survey Rudha nam Brathaintain.
	And as regards LOCH-NA-CISTE River, from the Wooden Jetty near Lochmaddy Inn to the opposite Point of Camaird.	The wooden jetty near Lochmaddy Inn taken for Lochmaddy Pier, and Point of Camaird taken for Cam-ard-Mor.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
NAIRN . . .	A Portion of a Circle of 400 Yards Radius to be drawn from a Centre placed Mid-channel in the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
NAVER and BORGIE	A straight Line drawn from Aird-in-iaskich on East to Claishaidie on West. (Burnett and Scott's County Map.)	Aird-in-iaskich taken for Aird Point, on Admiralty Chart, 1954, and Claishaidie taken for Claisfhada.
NESS . . .	A straight Line drawn due South-east, true Meridian, from the Centre of the Three Burns to the Southern Shore, thus cutting the Black Buoy as at present placed on the North End of the Whiten Ness Sands.	Admiralty Chart, 2397A.
NELL, FEOCHAN, and EUCHAR	From Minard Point on the North to Eastern Extremity of Barnacaryn Bay on the South.	Admiralty Chart, 2476.
NITH, ANNAN, and ESK	A Straight Line drawn from the Hotel of Skinberness in the Parish of Abbey Holme in the County of Cumberland to the Large House at Carset House of Arbigland in the Stewartry of Kirkcudbright.	Admiralty Chart, 1346.
ORMSARY, LOCH HEAD (Loch Killisport), and STORNOWAY	From Knap Point on the North, a straight Line thence in the Direction of Kilmaluag on the South. STORNOWAY, the Two extreme projecting Points of Stornoway Bay, namely, about Half Way between Lergnahunseon and Point Gallon on the North, and between Lergnahunseon and Ardpatrick Point on the South.	Admiralty Chart, 2478. Admiralty Chart, 2477. Two projecting points of Stornoway Bay taken as the limits of the estuary. Lergnahunseon not on Survey.
PENNYGOWN or GLENFORSA, and AROS	A straight Line from Alasaid Head on the West on the Direction of the Bruying Ground to the projecting Point North-east of the Mouth of Pennygown River on the East.	Admiralty Chart, 2155.
RUEL . . .	From Runin-a-Crotch Point on the East, Line thence due West.	Admiralty Chart, 2174.
RESORT . . .	On the North Ru Carnach (Admiralty Chart), thence to the Seaward Side of Greine Sgeir Island, and on the North-west Point of the Promontory on which the Hill or Mountain Meilein is situated.	Admiralty Chart, 2841.
SANDA . . .	*See* Lochy.	

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
SCADDLE . .	*See* Lochy.	
SHIEL (Loch Shiel)	*See* Moidart.	
SLIGACHAN, BROADFORD, and PORTREE.	As regards the River SLIGACHAN, a straight Line from Bal-na-Roinn Point at Low Water on North to Ru-an-Fhaing on the South.	Admiralty Chart, 2551.
	As regards the River BROADFORD, a straight Line from Mr Mackinnon's Pier on the North to the Cottage on the Beach a little to the Eastward of the Lime Kiln and Pier on the South.	Ordnance Survey.
	As regards the River PORTREE, Skin Voire on the North to the Point on the South lying due South-east.	Admiralty Chart, 2498.
SNIZORT, ORLEY, OZE, and DRYNOCH.	As regards the River SNIZORT, a straight Line from Lyndale Point on the West to Aird-nan-Eirach on the East.	Admiralty Chart, 1202. (Aird-nan-Eirach spelt Ard-ne-nerrach.)
	As regards the Rivers ORLEY and OZE, Loch Bracadale, a straight Line from the most projecting Point between Callbost and Eabost on the East to the most projecting Point between Loch Caroy and Loch Roag on the West.	Ordnance Survey.
	As regards the River DRYNOCH, Loch Harport, a straight Line from the projecting Point between Struanmore and Struanbeg on the North to the projecting Point North of Dunard Kirk on the South.	Ordnance Survey. Point on the North taken as Bracadale Point. Point on the South taken as Ardtreck Point.
SPEY . . .	A Portion of a Circle of 400 Yards Radius to be drawn from a Centre placed Mid-channel in the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
STINCHAR . .	A Portion of a Circle of 350 Yards Radius drawn from a Centre placed Mid-Channel of the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued by Tangents to the Circle drawn at Right Angles with the Shore.	
STORNOWAY .	*See* Creed.	
STRATHY . .	A straight Line drawn across Strathy Bay from Point South of Geo Ghoulan on the West to North-west Point, Balligill Head on East.	Admiralty Chart, 1954. Line drawn across Strathy Bay from Balligill Head to point opposite, Geo Ghoulan not being given.

TABLE OF REFERENCE—*continued.*

Names of Rivers.	Limits of Estuary.	Authority or basis on which Estuary Lines shown on foregoing Map were drawn.
THURSO . . .	A Portion of a Circle of 400 Yards Radius drawn from a Centre placed Mid-channel at the Line of Low Water of Equinoctial Spring Tides, and continued to the Shore at High Water by Tangents, that on the East being to a Point 500 Yards North-east of Thurso Castle, and that on the West being in the Direction of the Toll House.	
TONG or THUNG	*See* Greiss.	
TORRIDON, BALGAY, and SHIELDAG	A straight Line drawn across the Narrows between Loch Shieldag and Outer Loch Torridon, where Diobaig Point and Ru Ardtishlic most nearly approach each other.	Admiralty Chart, 2638.
UGIE	A Portion of a Circle of 200 Yards Radius to be drawn from a Centre placed Mid-channel in the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	
ULLAPOOL . .	*See* Broom.	
URR	A straight Line drawn from Balcarry Point on the West, through the Outside of Hestan Island, to the Eastern Extremity of Gutcher's Island at Low Water, and thence Inshore to High-water Mark at the projecting Point distant One Mile from Castle Hill Point.	Ordnance Survey.
WICK . . .	The Line of the Breakwater now in course of Construction, and a straight Line drawn due North from the outer End of the said Breakwater to the North Shore.	Ordnance Survey.
YTHAN . . .	A Portion of a Circle of 300 Yards Radius to be drawn from a Centre placed Mid-channel in the River where it joins the Sea at Low Water of Equinoctial Spring Tides, and continued Shorewards by Tangents to the Circle drawn to the nearest Points of the Shore of the respective Sides of the River at High-water Mark, also of Equinoctial Spring Tides.	

APPENDIX.

THIRTEENTH ANNUAL REPORT TO THE FISHERY BOARD FOR SCOTLAND

ON THE

SCOTTISH SALMON FISHERIES IN 1894

BY

WALTER E. ARCHER, F.R.S.E.,
Inspector of Salmon Fisheries for Scotland.

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REPORT.

Inspection of salmon fishings on the east and north coasts of Scotland.

I HAVE the honour to report that in the early part of last summer, by the direction of the Fishery Board for Scotland, I accompanied Mr Stafford Howard, H.M. Commissioner of Woods, &c., on an inspection of the salmon fishings on the sea-coast between Aberdeen and Eyemouth, and subsequently continued this inspection from Aberdeen northwards to Strathy Point in Sutherlandshire.

Salmon fishing on the shores of the open sea in Scotland has, as is well known, for a number of years been prosecuted by means of fixed nets. These nets are of two descriptions—stake or fly nets, and bag-nets. The principle of fishing in each case is the same, viz.:—a net stretched from the shore seawards which serves to guide the fish into a bag or trap situated at its outer extremity; the difference between the nets being that the former, which are used in shallow water, are fixed to stakes driven into the ground, while the latter, which are used in deeper water, are floating nets fixed to buoys moored to large stones or anchors. These nets are in some places used singly, in others several are set in a line, the one beyond the other, outwards from the shore.

The inspection of the salmon fishings between Eyemouth and Aberdeen was made during the second and third week of June from the deck of the steam tug 'Empress of India.' Favoured by fine weather the steamer was able to keep close to the shore, thus enabling those nets which were set to be counted with considerable accuracy. Several of the tacksmen of the crown salmon fishings joined the steamer on this expedition, and assisted in pointing out the position of the nets, besides giving much valuable information regarding the cost and method of working them. The inspection of the fishings to the north of Aberdeen was made from the Fishery Cruiser 'Vigilant,' when on her way to take up her station on the west coast, and my thanks are due to Captain MacDonald, the commander, for the ready assistance he afforded me in my work. Owing to the 'Vigilant' being due at Stornoway by a fixed date, however, it was not possible to call at so many places, and meet so many of the tacksmen of the fisheries, as had been done to the south of Aberdeen. I had the advantage, however, of being accompanied by Mr George Davidson, a proprietor and tacksman of salmon fishings and well acquainted with the fishings along the coast. The coast line from Aberdeen to Strathy Point was followed, and the nets enumerated in the same way as had been done to the south of Aberdeen; and as this inspection was made during the first week in July—that is, almost at the height of the salmon fishing season—it is probable that the full number of nets it was intended to make use of during 1894 were then set.

Map of Scotland showing approximate number of net used.

On these inspections I took with me sheets of Bartholemew's reduced Ordnance Survey of Scotland (two miles to the inch) and laid down on them, as nearly as possible while steaming along the coast, the position of the various lines of fixed nets. This position was numbered on the map, and a corresponding number entered in a note-book, against which was noted the number of nets in each line. These maps and notes are available at any time for reference, but are on too large a scale to be reproduced in this report. In order, however, to give a general idea of the salmon fishing industry on the sea-coast, I have indicated graphically on a map of Scotland (ten miles to the inch), appended to the Board's Report, the approximate number of nets on every ten miles of coast, the map being on too small a scale to permit the position of each net being shown. A glance at this map * will show that the coast line from Berwick-on-Tweed to Cape Wrath is divided into equal sections by means of black lines, and that in most of these sections one or more red lines are drawn parallel with the coast. The number of red lines represent the number of fixed nets in each section, one red line denoting less than twenty nets, and every additional red line denoting twenty or part of twenty additional nets, the absence of such lines indicating the absence of nets. The red lines do not show the position, but the number, of nets in each section. It may further be mentioned that, except in the cases of the Tay and Forth, the estuary lines, which are indicated by blue lines, are included in measuring the ten-mile sections; and that within those lines no fixed nets are used—such nets in river and estuaries having been prohibited by statute from the earliest times.

Berwick on-Tweed to Fife Ness.

The red lines indicating the number of nets in each section or division show that in the section south of St Abbs Head there are from forty to sixty fixed nets. Proceeding westwards the number of nets decreases; from St Abbs Head to Cockburnspath there are from twenty to forty; along the shores of Haddingtonshire there are less than twenty; while from the western boundary of that county to the eastern boundary of Linlithgowshire there are none. Proceeding eastwards from St David's Point along the northern shore of the Firth of Forth they gradually become more numerous, the greatest number being found to the east of the town of Leven; indeed, round Largo Bay, past Elie Ness, and along the low rocky shore as far as Fife Ness, are erected about four-fifths of the fixed nets in the whole district of the river Forth—a district, it will be observed, which extends from Fife Ness to the eastern boundary of the county of Haddingtonshire. The unusual position of the nets in the district of the river Forth is worthy of note. Generally such nets become more numerous the nearer the estuary lines are approached. This is not so in the district of the river Forth, the estuary limits of which are Hound Point on the south and St David's Point on the north; on the contrary, with the exception of a line of nets off Hound Point, no nets are set within a distance of more than fifteen miles of the estuary line on the southern shore of the Firth; while on the northern shore the nearest nets are set some eight miles distant from St David's Point, and are not numerous within some twenty miles of that Point.

Fife Ness to Buchan Ness.

On the coast between Fife Ness and Buchan Ness, a distance of about 100 miles, where the rivers Tay, North and South Esks, Dee, Don, and Ythan empty themselves into the sea, nets have been erected on every available place, except for a short distance to the south of Stonehaven; in fact the number of nets between these points is greater than on the remainder of the coast from Berwick-on-Tweed to Cape Wrath, and it will be observed that they are most numerous in Montrose Bay. The number of nets in this bay, however, it would appear, is not due alone to the abundance of salmon, but also to the fact that the fishings are in a

* I am indebted to Messrs J. Johnston & Sons, Montrose, for information regarding the Scotch salmon fishings to the south of Eyemouth; and to Mr Box, factor to the proprietor of the salmon fishings on the north coast of Sutherlandshire, for similar information regarding the fishings on that coast.

number of different hands, and that each salmon fisher endeavours to place his nets rather further out to sea than those of his neighbours. It should be mentioned that between St Andrews and the mouth of the Tay, and again for a short distance to the north of that river, the steamer was not able to approach sufficiently near to the shore to enable the number of nets to be counted. In the former case, however, their approximate number has since been furnished me by the clerks of the Tay District Board, and in the latter by the tacksman of the fisheries, who was on board the 'Empress of India.'

Buchan Ness to Rosehearty.

There are very few nets on the coast between Buchan Ness and Rosehearty. Owing to the shoals off the greater part of this coast it was necessary to keep a wide distance from the shore, which prevented the nets being seen from the deck of the steamer, and I am indebted to Mr Boyd, Peterhead, for information regarding their number and position. From this information it appears that there are a few nets on the north side of the river Ugie, and one immediately to the north of Scotstown Head. The latter is the only net in the section south of Cairnbulg Point, while there are but two in the section immediately west of that point.

Moray and Pentland Firths.

Proceeding westwards along the southern shore of the Moray Firth the nets gradually become more numerous. In the ten-mile division between Gamrie Head and Portsoy, where the river Deveron enters the sea, their number is just sufficient to enable a double red line to be drawn, and as the river Spey is approached their number is again indicated by the same sign. The proprietor of the coast fishings on both sides of the river Spey allows no fixed nets to be erected within two and a half miles to the east, and three and a half miles to the west of that river's mouth. To the west of the river, both on the southern shores of the Moray Firth as well as on the northern shores as far as Tarbet Ness, these nets are erected in very large numbers. On the east coast of Sutherlandshire the proprietor of the fishings makes use of no fixed nets. On the shores of Caithness-shire fixed nets are fairly numerous between Dunbeath and Clyth Ness, and in Sinclair, Dunnet, and Thurso Bays, but on other parts of this coast, and on the north coast of Sutherlandshire, this method of fishing is restricted almost entirely to the erection of a few nets as near the mouths of the rivers as the law will permit. From Duncansbay Head to Dunnet Head I was unable to inspect the coast, as on arriving at the former headland a strong adverse tide was encountered, and it being already late in the evening, the 'Vigilant's' course was directed to Hoy in Orkney, where she anchored for the night, and the following morning she proceeded direct to Dunnet Head. I was informed, however, at Thurso, that no fixed nets were erected along that shore; indeed, that the strength of the tide made it impossible for any net to stand. Time would not permit of an inspection being made of the deeply indented coast between Strathy Point and Cape Wrath. This omission, however, is of the less consequence, as information regarding the number of nets used on that coast has, as already mentioned, been furnished me by the factor to the proprietor of those fishings. From this information it appears that there are now no bag-nets between Armadale and Cape Wrath. From Strathy Point the 'Vigilant' proceeded direct to Stornoway, and from thence to Tobermory, in Mull. At Tobermory I left her, and returned to Edinburgh.

Number of nets and cost of fishing.

So far as I was able to ascertain, 1444 fixed nets were erected on the coast between Berwick-on-Tweed and Cape Wrath, of which 1174 were bag-nets and 270 fly-nets. It would be impossible, however, without direct communication with the proprietors and lessees, to state with accuracy the total number of nets used at these fishings, as although great care was taken to enumerate correctly those which were set, it is possible that the full complement may not have been in use at the time of my inspection. It is probable that this source of error is reduced to a minimum on account of the season of the year at which my inspection was made; at the same time, it should be mentioned that some of the lessees south of Aberdeen stated that in seasons when fish were more numerous they made use of a greater number of nets. The difficulty of correctly estimating the value of the plant, and the number of fishermen employed at these fishings, arises from the fact that the conditions under which bag-nets are used are so diverse that the expense of fixing and fishing them varies greatly in different localities.

The actual cost of a bag-net, I was informed, varies from £12 to £17, 10s., and the length of time it remains in a serviceable condition, from two to three years, according to the position in which it is placed. The cost of equipment, however, depends to a great extent on the kind of moorings which are used. These again differ according to the character of the coast, the depth of the water, and the nature of the bottom. When a net is placed on a headland where it is exposed to strong tides and the full force of the waves of the open sea, the moorings must naturally be very much heavier and stronger than when set in some more sheltered bay; a greater length of mooring ropes or warps is required to hold the net in deep than in shallow water; and such rope or warp are fastened to large stones, in place of anchors, where the bottom is rocky. Owing to these very varying conditions, the estimates given of the cost of moorings differ very considerably, the lowest price being £5, the highest nearly £20.

The number of fishermen required to work these nets depends on the position of the nets. On deep rocky shores, where bag-nets are used singly and at some distance apart, considerable time is occupied in rowing from one net to another, which is not the case on some shores, where, the water being shallow, a number are set in a line and the lines are placed close to one another. In some localities it was estimated that it required four men to work five bag-nets, in others that the same number of men could work nine bag-nets.

A further item of expense in connection with bag-net fishing is the cost of the boats or cobles. As has already been explained, the bag-net is a floating net which does not dry at low tide, and a boat therefore is necessary to enable the fishermen to attend to it. The fish which have been caught have to be brought ashore; the leaders to be removed and taken out of the water during the weekly close time; and the nets to be changed occasionally, as one of the conditions which contributes principally to success in fishing is that the nets should be kept clean; therefore, for every bag-net in use it is customary to have one on shore, and to change them from time to time. Special boats are built for the purpose of attending to these nets. These boats, I am informed, are of two sizes, viz.:—21 feet and 23 feet long; the former, which are four-oared boats, costing £17, 6s. 6d., and the latter, which are six-oared boats, £20, 2s. 6d.

So far as I am able to learn there is not the same variation in the expense of fishing with stake or fly nets as with bag-nets. The former being fixed to stakes driven into the ground, and not held like the latter by moorings in varying depths of water, are not subject to such varying conditions. A fly-net with ropes, stakes, pins, &c., fixed on the sands, together with an extra fly to change from time to time as the one in use becomes foul, costs about £35, and it requires, on an average two men to work every three nets.

It will be observed from these explanations that the conditions under which bag-nets are used are too various to enable a general estimate of the value and importance of this industry to be based on the evidence given above; it may, however, be worthy of note that a salmon fisher of long and varied experience in this method of fishing gave as his opinion that on an average a pair of bag-nets, that is to say, one net on shore and the other in use, fully equipped and in fishing order, might be estimated to cost about £33; that about half as much again must be spent annually to keep them in fishing order; and that five men, whose wages with fish money averaged about 22s. a week, would be required to work nine nets. If this estimate is correct, and if the cost of fly-nets and boats be taken as already stated, the amount of capital involved in nets and boats employed at the fixed net fishings between Berwick-on-Tweed and Cape Wrath may be stated in round numbers at about fifty thousand pounds, the annual cost of maintaining and fishing them at a similar sum, and the number of fishermen employed at about 850.

Inspection of dams on river Till.

Besides inspecting the salmon fisheries on the east and north coasts of Scotland, I visited, by the direction of the Board, several other localities during the year. At the request of the Police Committee of the Tweed Commissioners I was authorised by the Fishery Board to inspect the dams or caulds at Twizel, Heaton, Etal, and Ford Forge on the river Till, a tributary of the Tweed, for the purpose of advising the Commissioners as to certain fish-passes which it was proposed to make over these dams. Plans of the proposed fish-passes, which I subsequently drew up, were forwarded, together with an explanatory report, to Messrs James & David W. B. Tait, W.S., Kelso, Clerks to the Tweed Commissioners.

Variation of Annual Close Time in district of river Cree.

On the 28th February, by the direction of the Board, I held an inquiry at Newton-Stewart on the question of the variation of the annual close time in the district of the river Cree. With regard to this inquiry, on the result of which I have already submitted a special report to the Board, it may be mentioned that the District Board of the river Cree had petitioned the Secretary for Scotland to vary such close time in terms of the 9th section of the Salmon Fisheries (Scotland) Act, 1868 (31 & 32 Vict., c. 123), but that this petition was presented on the understanding that a similar petition was being presented regarding the variation of the annual close time in the district of the river Bladenoch. No Board, however, had been formed for the Bladenoch district, and the Earl of Galloway, by whom the petition was made, not being sole proprietor of the salmon fisheries in the district, could not exercise the powers of a District Board, and his petition, therefore, could not be entertained. Under these circumstances the petitioners, who were of opinion it would not be expedient to vary the annual close time in one district without at the same time varying it in the other, requested that the consideration of their petition might be delayed.

Use of hang or drift nets in estuaries of Tay and Forth.

The use of hang or drift nets in the estuaries of the rivers Tay and Forth formed the subject of a memorial by the Tay District Board to the Secretary for Scotland, and I was directed by the Fishery Board, to whom the memorial was remitted, to visit these districts for the purpose of inquiring into the matter. The result of my inquiries I have already had the honour of making known to the Board in two special reports.

Conference of Annan and Nith District Boards.

A communication was received from the Chairman of the Annan and Nith District Boards, intimating that it was proposed to hold a conference for the consideration and discussion of proposals with a view of promoting legislation for the removal of the many anomalies which exist and render the administration of the law on the Solway both difficult and costly, and asking the advice and assistance of the Board in the matter. The Board, therefore, directed me to visit the Solway, to attend the conference, and to report to them regarding the nature of the grievances complained of. My report on this matter has already been submitted for the information of the Board.

Inspection of Strathlachlan river.

On the 14th December I visited the Strathlachlan, a small river of Argyleshire, which rises near Tom a Bhiorain and enters Loch Fyne close to Castle Lachlan. The course of the river, where it flows through the grounds of Castle Lachlan, has been artificially straightened and widened. The result of these alterations has been to make the river so shallow that salmon and sea trout cannot ascend to the upper spawning streams except in heavy floods. At the request of the proprietor I was authorised by the Board to visit the river and to recommend some scheme for facilitating the ascent of the fish. The suggestions I made have since been carried out and, it is satisfactory to learn from the proprietor, are proving successful.

Cruive dyke on river Deveron.

By the direction of the Fishery Board I attended a meeting of the District Board of the river Deveron held at Banff on the 22nd December, when the cruive dyke on that river formed the subject of consideration. After considerable discussion, the following motion was agreed to :—'The 'suggestion having been made that the differences of opinion regarding 'the cruive might be removed by the purchase of the cruive dyke by 'the Board under the powers of section 13 of the Act of 1868, and the 'same having been favourably considered, the Board resolve to communi-'cate this view to the Duke of Fife, and invite him to state a price for 'which he would be willing to dispose of the cruives and dyke to the 'Board, and to explain that they put this question in view of the diffi-'culties of obtaining the necessary consent of four-fifths value of the 'fishings on the roll without this information.' In connection with this question I was instructed by the late Chairman of the Board to draw up, in consultation with Messrs Carmichael & Miller, W.S., a memorandum in regard to the law relating to the construction and use of cruives prior to the Salmon Fishery Act of 1862, and as to the effect of that Act and relative bye-laws thereon. This memorandum is appended as Note III. to the present report.

Salmon Fishery Investigations.

With the kind assistance of the Berwick Salmon Fishing Company, and of Mr Steele, fish dealer, Kelso, certain specific investigations into the life-history and habits of salmon were conducted last year at Berwick-on-Tweed and Kelso. The information which was collected, although necessarily limited at present, has been tabulated by Mr Tosh and is given in Note II. appended to this report. It will be seen from Mr Tosh's report that the points which formed the subject of investigation were (1) the rate of growth of the genital organs ; (2) the food of salmon ; and (3) the proportion of male to female salmon taken in each month. Besides the investigations made on the above points the question of the migration, growth, &c., of salmon was made the subject of inquiry, and with this object a number of salmon were marked.

Observations on these points have been made in Switzerland, Holland, and Norway, and have led to the accumulation of much valuable information. In Switzerland investigations were made by Professor Meischer Ruesch of Basle, with a view of ascertaining the influence which a lengthened sojourn in fresh water exercises on the condition of salmon, and more particularly on that of their genital organs. The specimens examined were caught in the neighbourhood of Basle, over 500 miles from the sea, and had consequently passed some time (estimated at about two months) in the river. The value of Professor Meischer Ruesch's paper,* which in other respects is probably one of the most valuable contributions hitherto published on the life-history of the salmon, is somewhat impaired owing to the fact that he does not appear to have possessed sufficient data as to the condition of salmon taken in, or just after leaving, the sea. This want has been supplied by Dr Hoek,† Scientific Adviser on fisheries to the Dutch Government, who may be said to have completed these investigations by examining a large number of salmon taken in Holland.

Rate of growth of sexual organs.

As a means of comparing the rate of growth of the sexual organs at different periods throughout the year, these observers calculated the proportion of the weight of these organs to the weight of the body of the fish. Professor Meischer Ruesch further studied their growth and progress of development by the help of the microscope. Dr Hoek is of opinion that these proportions, which he averaged over ten-day periods, show clearly that their development advances with great regularity. He points out that, although the differences are at first small and almost insignificant, it can hardly be accidental that, considering the very large number of observations from which the averages are computed, the average proportion of the weight of the ovaries to that of the body is greater for every succeeding period of ten days than for that of the preceding ten days. These averages show that from the first ten days of January, when the average weight of the ovaries of the clean salmon was only 0·35 per cent. of the weight of the body, to the first ten days of November, when the average weight of the ovary was 20 per cent. that of the body, the weight gradually increases. The increase up to the 10th of May is almost imperceptible, from that date onwards to the end of July it proceeds at a somewhat quicker rate, throughout August rapidly, and from the beginning of September very rapidly. To assist an estimate to be formed of the difference in the degree of development of the genitalia of fish caught in Holland to those of fish caught near Basle, Dr Hoek gives a diagram showing, by means of two curves, the proportion of the weight of the genitalia to the weight of the fish, one in regard to fish caught in Holland, the other in regard to fish caught near Basle. He points out that up to the beginning of June these curves run at an almost equal distance from one another, only that the ovaries of fish caught near Basle are about 0·5 per cent. further advanced than those of fish which have only just left the sea. After the beginning of June both begin to show somewhat greater energy in the growth of their sexual organs. These organs, however, develop more rapidly in salmon of the upper Rhine. From the beginning of August the sexual organs of the latter approach development about twenty days in advance of those taken in Holland. By the beginning of October, however, the condition of both fish is the same. The ovaries of the fish taken in the upper Rhine reached about one-fifth of their ripe weight during the first ten days of August, those of the lower Rhine being about twenty days later. This would appear to be an important stage in their development, as Professor Meischer Ruesch states that he found, according to numerous investigations, that the intestinal fat had at this time entirely disappeared, and that as the

* Statistische und biologische Beiträge zur Kenntniss von Leben des Rheinlachses im Susswasser. Dr F. Meischer Ruesch, Prof. d. Physiol. in Basel. A contribution to the literature of the Berlin Fisheries Exhibition of 1880. Publishers, Druck von Metzger & Wittig, Leipsic.

† Rapport over Statistische en biologische onderzoekingen ingesteld met behulp van in Nederland gevangen Zalmen. Dr P. P. C. Hoek, Wetenschappelijk Adviseur in Visscherijzaken.

other organs of the viscera showed from this time forward no great variation in weight, the flesh of the fish, assuming they do not feed in fresh water, must subsequently be the source from which the material is taken for the construction of the ovary. In order to ascertain whether this was the case, he conducted a series of most careful investigations. He states that the results of these investigations show that for every lb. that the ovaries increase in weight, between the beginning of August and the 12th October, more than a lb. of flesh disappears; and that the loss of albumen from the lateral muscles, during this period, is sufficient to supply the last four-fifths of the growing ovary.

Food of Salmon.

During the four years in which Professor Meischer Ruesch was conducting his investigations he looked almost in vain for signs of any food in the stomachs of salmon. Only in the case of one small spent male did he find the remains of two partly digested fish, probably roach. Dr Hoek's experience seems to have been somewhat similar. Out of 2000 specimens examined he found the remains of food in only seven. These seven fish were taken in March and April, and had their genital organs very slightly developed. Both observers found that the stomach walls of the salmon taken in the river were contracted and wrinkled, and presented a strong contrast to the wide distended stomach of the North Sea or Baltic salmon. They both, therefore, formed the opinion that salmon ceased to feed after they entered fresh water. Professor Meischer Ruesch was further of opinion that his chemical investigations of the condition of the stomach fully established this theory, although he admits that 'necessity, which can break iron, may teach an occasional male salmon to 'feed, while the female, whose return journey has commenced (December 'to the beginning of February), finds a kind of nourishment in the absorp-'tion of numerous (sometimes several hundred) not yet ejected eggs.' With regard to the nourishment of salmon when in fresh water, some very interesting investigations were made. If it is the case that salmon remain in fresh water, without taking food, from the time they enter the river until the following autumn or winter, as Professor Meischer Ruesch considers his investigations prove, those entering in winter, when their ovaries are only one-sixtieth of their ripe weight, must have in themselves a greater reserve of food to sustain life during their long sojourn in the river than those entering in the summer or autumn; that is to say, fish of the same length would weigh more or less according to whether they were taken entering the river early or late in the season. To ascertain whether this was the case, Dr Hoek weighed and measured a number of female salmon taken in Holland about the 8th January, and divided them into groups according to their length—the difference in length of the fish in each group not exceeding one centimetre. The average weight of each group was then calculated. He repeated the same observations with salmon of precisely the same length taken about the 8th June. A comparison of these observations show that salmon taken in June were, on an average, 7 per cent. lighter than those of the same length taken in January. Professor Meischer Ruesch's investigations in this direction show that the salmon taken near Basle about the middle of October were, on an average, about 6 per cent. lighter than those of the same length taken in the beginning of August.

Sex of salmon taken in different months.

Professor Meischer Ruesch noted the sex of the salmon he examined during July and the four following months in 1878 and 1879. He refers to the fact that, among clean salmon taken in the early part of the year, males can hardly be distinguished from females, as males at that time have bright shining scales, roundness of body, and short snouts without a trace of hook-like form. He considers that it is not until April or May that the lengthening of the jaws of the male makes it possible to distinguish the sex of the fish. He made a number of observations on the growth of the snout of fish of both sexes. The average length of the snout of the female he found remained the same throughout, but, that of the snout of the male, which among the earliest fish is about 4·5 per cent. the length of the body (measured from the nasal opening to the root of the tail), increases in length two-fold during the season. For this reason, in measuring male salmon, he took his measurements from the nasal opening to the root of the tail as being the most reliable points. The salmon which he examined were chosen without reference to sex. He considers, therefore, that they may be taken to represent the proportion of the sex of the salmon caught near Basle. The actual number of fish examined were 1029 females and 609 males. He found that females were more numerous than males to the end of August; during September the excess in the number of females diminished; in October the number of either sex was nearly equal; and in November females were again more numerous than males. With regard to the relatively large proportion of males taken in September and October it should be mentioned that it is in these months, more particularly in the latter, that the few 'St Jakob's 'Zalm,' presumably grilse, which reach the neighbourhood of Basle are principally taken, and that among these fish it was found that males are relatively much more numerous than among salmon. Dr Hoek also kept records on this point. His observations were made on fish taken between the 1st October and the 30th August during five years, and included 1217 females and 605 males. He does not claim, however, that these figures can be taken as an altogether fair representation of the proportion of males and females caught in Holland. The fish he examined had been selected for their size, and might possibly, therefore, include an undue proportion of females, as he found that, on an average, females are larger than males. With regard to the proportion of the sexes among nearly ripe salmon ascending the river in October, November, and December, he mentions that, out of 959 taken in those months in 1884, 493 were males and 466 females; of the males 450 were 'St Jakob's Zalm,' while among the females the latter numbered only 86.

Migration, growth, &c., of Salmon.

The result of the investigations made in Norway with regard to the migration, growth, &c. of salmon by means of marking was given in Note II. of the Eleventh Annual Report of the Fishery Board for Scotland. On the Rhine it has been considered, however, that more valuable results are likely to be arrived at by means of statistical records of the length of the fish caught. Such a method, it is contended, will eliminate the numberless variations and exceptions which must always appear in the life-history of these fish, and enable the principal laws which govern their migration, growth, &c. to be ascertained. For this purpose Professor Meischer Ruesch drew up a table showing the relative frequency of the occurrence of the different sizes. In this table the salmon which were taken in the upper Rhine in 1878 and 1879 were divided into groups according to length, the length of the fish in each group not varying more than 20 mm. Dr Hoek collated similar information regarding 4653 salmon taken in Holland in 1893 from March to December inclusive. The most striking fact with regard to these statistics is that certain sizes, occurring at three regular intervals, are represented relatively by a very small number of fish, while midway between these sizes those of the greatest frequency occur; further, that from the sizes which occur with the least frequency to those which are most numerous the numbers gradually increase until the maximum is reached and decrease again at a similar ratio. A diagram is given by both observers, showing by means of a curve the relative frequency with which the different sizes occur. In this diagram the length of the fish in each group is shown by horizontal measurements, and their number by vertical measurements. The great regularity with which these curves rise and fall would seem to show that the Swiss Professor has good foundation for believing that the principal laws which govern the migration, growth, &c. of salmon may be investigated on these lines. For, as far as Rhine salmon are concerned, the clearly defined elevations in the diagram (which represent the great majority of the fish) occurring at three regular intervals would seem to show three distinct stages of life at which the fish seek the fresh water, while the depressions, which do not quite touch the zero line, represent the few exceptional variations which must always occur in the growth of every description of animal.

Co-operation of District Boards in Salmon Fishery Investigation.

It would be premature at present to compare the result of the investigations made on the Tweed with those conducted on the Rhine. It is a subject, however, to which I hope to devote my attention on a future occasion, as these investigations are being continued and extended over a wider area. With a view of extending them to a number of rivers in Scotland the following circular has recently been issued by the direction of the Fishery Board to the District Boards inviting their co-operation and assistance :—

Sir,—I am directed by the Fishery Board for Scotland to inform you that the Board propose conducting certain specified investigations into the life-history and habits of salmon, and to invite the co-operation and assistance of your Board.

It is now generally recognised in every country where the fisheries form an important industry, that, in order to advance their development, it is necessary that the life-history and habits of the fish should be made the subject of careful and systematic inquiry. Such inquiries, with regard to salmon, are being carried on in Holland, Switzerland, and Norway, and are resulting in the accumulation of much knowledge regarding the fisheries in those countries.

In Scotland, investigations have, from time to time, been made on different rivers ; but it has been found that such investigations, however accurately made on single rivers, lose their value from want of standards with which to compare them. Similar questions should be made the subject of systematic investigation at the same time over the widest area. It is, however, only by the co-operation and assistance of Salmon Fishery District Boards, that such investigations can be made on a sufficiently large scale.

The points which it is proposed shall form the subject of the present inquiry, are as follows :—(1) the development of the milt and roe at different seasons of the year ; (2) the food of salmon in the sea and in the fresh water ; (3) the proportion of male to female salmon taken in each month ; and (4) the migration, growth, &c. of salmon by means of marking.

Some information has already been collected on these points during last year by a trained observer employed under the direction of the Fishery Board for Scotland at Berwick-on-Tweed, with the permission of the Berwick Salmon Fishing Company. The information collected by the Board's observer at Berwick, as well as that collected in foreign countries, seems to justify continued progress being made in the investigation of these points. For this purpose, the Board have engaged the services of Mr Tosh, M.A., B.Sc., Fisheries (Woodall) Prizeman, University of St Andrews, a trained naturalist who will devote his whole time to the work of inquiry.

In order that Mr Tosh's services may be turned to the best account, it is necessary that he should be furnished with a large quantity of material from a number of different districts. Those District Boards, therefore, who are willing to co-operate in these investigations, are invited to do so in two ways. First, by collecting and forwarding the viscera of salmon to Mr Tosh for examination, and second, by applying to the Board for marks when opportunities of marking salmon occur.

It is requested that the whole mass of viscera may be sent intact with a label attached, stating the weight, and, when possible, the length of the fish, together with the name of the place where it was caught. Such viscera, which should be addressed to Jas. R. Tosh, The Berwick Salmon Fishing Company's Fish-house, Berwick-on-Tweed, may be sent fresh, in stone jars or other receptacles, so long as the cool weather continues. In view of the limited amount which the Fishery Board are able to devote to the investigations in question they would be unable to pay the carriage of any viscera which the District Board were good enough to send them, and it would, therefore, be very obliging, if this outlay could be prepaid.

Opportunities of marking salmon may occur when collecting their eggs for artificial hatching, or when kelts are present in the river in large numbers. It is, however, particularly requested that care will be taken to entrust the work of fixing the marks on the salmon only to responsible and trustworthy persons.

I have the honour to be,

Your obedient Servant,

WALTER E. ARCHER.

THE FISHERY BOARD FOR SCOTLAND,
1*st May* 1895.

NOTE I.

THE FOLLOWING QUERIES HAVE BEEN SENT TO CLERKS OF DISTRICT BOARDS:—

Take of Fish—

1. Has the take of fish in your district in 1894 been above, about, or below the average.
   (*a*) In tidal waters ?
   (*b*) In fresh waters ?
   (*c*) In fixed engines ?
   (*d*) Generally throughout the district ?

2. Can you give the number of fish caught in your district, exactly or approximately ?
   (*a*) By net and coble ?
   (*b*) By fixed engines ?
   (*c*) By rods ?

3. At what period of the year in your district during 1894—
   (*a*) Were the first clean fish taken ?
   (*b*) When was the main take of salmon ?
   (*c*) When did the grilse and sea-trout run ?

4. In order that accurate records be kept as to whether the run of salmon in your district is becoming earlier or later, it is desirable that you should, if possible, obtain and furnish me with statistics of the percentage of fish taken in each month—
   (*a*) By net and coble ?
   (*b*) By fixed engines ?

5. What was the weight of the heaviest salmon or trout caught in your district in 1894—
   (*a*) By net and coble ?
   (*b*) By fixed engines ?
   (*c*) By rods ?

Protection—

1. Please state the amount of the assessable rental of your district in 1894 ?
2. What was the assessment levied thereon during this year ?
3. State the number of water bailiffs employed in your district in 1894 ?
4. Were any prosecutions instituted under the Salmon Fishery Acts in 1894 ? If so, for what offences were they instituted and what was the result ?

Obstructions to the Passage of Fish—

1. Give full particulars of any dams destroyed or given up in your district in 1894 ; or any new dams built or old dams altered ?
2. Have any cruives in your district not been fished during 1894 ?
3. Are the dams and cruives in your district worked in accordance with the provisions of the bye-laws (Schedule F and G) regulating the same ?
4. Have any fish-passes been built or altered in 1894 ?

5. Do the existing fish-passes afford at all, or any, or at what times a free passage to salmon wishing to ascend?
6. Have any natural obstructions been opened up during 1894?
7. Generally, have any acts been done either by new fisheries being started, old fisheries not being used, or in any other way whereby the ascent of fish has been influenced? If so, state fully what changes have taken place.

Pollutions—

1. Were there any fresh causes of river pollution introduced in your district in 1894?
2. Were any steps taken in 1894 to remove causes of pollutions; and if so, were they attended with success?

The Salmon Disease—

1. Has the salmon disease shown itself in your district this year? If so, when did it first make its appearance? When was it at its height? When did it disappear?
2. What was the level of the river during the prevalence of the salmon disease?
3. Can you state the number of diseased salmon taken from the river in each month, specifying what proportion was male and what female, what kelts, and what clean fish?
4. Generally, have you any remarks or suggestions to make with regard to the salmon disease?

The Spawning Season—

1. What was the earliest date, during the season of 1893–94, on which salmon were noticed spawning?
2. Between what dates did the greatest number spawn?
3. When did the spawning season finish?
4. What was the level of the river during the spawning season?
5. Were the numbers of spawning fish more or less than usual?
6. Which are the principal spawning streams in your district?

Kelts—

1. On what date, during last season, were kelts first noticed migrating seawards?
2. When did the chief migration take place?
3. When was the river free from kelts?
4. What was the level of the river during the period kelts were migrating?

Smolts—

1. On which dates, during the year, were smolts noticed migrating?
2. Was it a good smolt year?

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.

Proportion of Male to Female Salmon—

Can you state the proportion of the male to the female salmon in your district or river, specifying whether your return, so far as it goes, is based upon an estimate or on actual enumeration?

Marking Salmon—

Have any observations been made in your district on the migration, growth, &c. of salmon by means of marking them? If so, please state where details are recorded.

Temperature of Water—

Have any observations been made in your district on the temperature of river water?

Fluctuations in the River Level—

Do you base your observations as regards the level of the river on records obtained by means of a standard gauge or by general terms such as 'flood,' 'half-flood,' or 'low'?

Wild Birds' Protection Act, 1880—

Do you think that the 'Wild Birds' Protection Act,' 1880, which preserves a variety of birds—specified in the Schedule attached to the Act—which destroy salmon and trout ova and fry, should be repealed as regards Scotland?

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?

ANSWERS TO THE FOREGOING QUESTIONS.

In those cases where the answers to any of the above questions consists of a simple negative, it has been omitted from the following return.

THE DISTRICT OF THE RIVER FORTH.

Take of Fish—

1. (*d*) Much below the average.
3. (*a*) 11th of February when fishing opened; (*b*) July and August; (*c*) grilse in June, and thereafter till end of season; sea-trout all the season
5. A salmon of 40 lbs. weight, caught by drift-net at Alloa.

Protection—

1. 1893–94, £3806, 3s. 7d.
2. 2s. 6. per £.
3. A superintendent and 12 bailiffs.
4. 23 prosecutions, with convictions in 22 of them, and in 1 complaint not proved. The offences included fishing with nets in close time, Section 15 (1); fishing for or taking salmon by cleeks, Section 15 (2); dragging for salmon (jiggering), Section 17; using fish roe for fishing, Section 18,—of the 1868 Act.

Obstructions to the Passage of Fish—

1. None destroyed or given up. Information has recently been received of an old mill dam on the Ardoch, a tributary of the Teith, having been heightened and that salmon are thereby prevented getting up the stream except in floods. Inquiries are being made on the subject.
3. Yes.
5. Yes.
7. No, except it may be the dam referred to in the answer to Query 1.

The Salmon Disease—

1. Yes. It made its appearance in the beginning of November 1893; it was at its height in January 1894; and disappeared about the middle of March 1894.
2. There are no gauges to show the level of the rivers, but the river was high during the prevalence of the salmon disease in December 1893 and January and February 1894.

3. 128 salmon diseased (salmon disease). Of these 80 males and 48 females. The rest of the information asked cannot be given. Besides the 128 salmon mentioned, 120 salmon died from ordinary causes, were taken out of the rivers, making in all 248 dead salmon.
4. The number of salmon found dead in the rivers has been gradually getting less in recent years. In 1891–92, 1600 or thereby ; 1892–93, 800 or thereby ; 1893–94, 248 as above, but in the current year, 1894–95, the numbers of dead salmon are on the increase again. It has been suggested by the Superintendent of the Fisheries that the disease may have been caused by the great numbers of salmon congregated in the fresh water of the River Forth from Craigforth cruives downwards, which were unable, from the low state of the rivers in September and October 1894, to get up and disperse in the Teith and Allan, and other tributaries of the Forth.

The Spawning Season—
1. 25th of November 1893.
2. In November and December 1893.
3. In the end of January 1894.
4. High.
5. Less.
6. Teith and Allan.

Kelts—
1. In the latter end of December 1893.
2. January and February 1894.
3. The end of April 1894.
4. High most of the time.

Smolts—
1. In the month of April 1894.
2. Yes.

Fluctuations in the River Level—

No gauges. Such terms as flood, high flood, ordinary, low are used with reference to the river as affected by rain or without rain for a time.

General Question—

Drift-nets are much complained of by the proprietors and tenants of fishings above the place where such nets are fished.

THE DISTRICT OF THE RIVER TAY.

Take of Fish —
1. (*a*), (*b*) and (*c*) Below ; (*d*) Yes.
3. (*a*) 11th of February when fishing opens; (*b*) fairly good second week in August ; (*c*) June, July, and August (grilse).
4. Generally supposed that fish are getting slightly later.
5. (*a*) 62 lbs. ; (*c*) 40 lbs.

Protection—

1. Upper Proprietors,	£ 6953	0	0
Lower Proprietors,	12,625	7	5
Total Rental,	£19,578	7	5
Assessment at 6½ per cent.			
2. Upper Proprietors,	£451	18	5
Lower Proprietors,	820	12	2
Total,	£1272	10	7

3. Twenty.
4. General offences during close time ; a good many not proven owing to them being tried before Justices of Peace instead of a trained Judge.

Obstructions to the Passage of Fish—
3. Yes.
5. No.

Pollutions—
2. County Council have been speaking of doing something at Stanley, but it is a small matter.

The Salmon Disease—
1. Began end of October ; it was very bad in December up to present floods ; since then not so much seen.
3. No record kept this season, but about the usual amount, say 800, nearly 500 of them male salmon.

The Spawning Season—
1. First week in November.
2. 15th and 26th of November.
3. About end of December .
5. Less last season.
6. Earn, Tay, Lyon, and Isla.

Kelts—
1. January.
2. April.
3. June.
4. Generally a slight rise or bright sunshine, both act in same way.

Smolts—
1. March, April, and May.
2. Fairly.

Artificial Propagation of Salmon—
There is a hatchery at Dupplin on Earn belonging to the District Board ; 570,000 last season.

Fluctuations in the River Level—
General terms.

THE DISTRICT OF THE RIVER SOUTH ESK.

Take of Fish—
1. (*a*), (*b*), (*c*) and (*d*) Far below—especially salmon.
3. (*a*) 16th of February ; (*b*) July and August ; (*c*) July.
4. No change in spawning time.
5. (*a*) 23 lbs. ; (*b*) 43 lbs. ; (*c*) 30 lbs.

Protection—
1. £3002.
2. Eight per cent.
3. Nine.
4. Prosecutions, viz :—

For dragging, ...	3
„ gaffing, ...	2
„ netting, ...	3
„ trespass poaching without proprietor's permission,	1
Total, . . .	9

All convicted, except one case found not proven.

Obstructions to the Passage of Fish—
1. None.
3. Dams worked in terms of bye-laws.
4. Yes. New goil put in dam dyke, East Mill at Bridge of Brechin.
5. Yes.

The Salmon Disease—
1. Yes. First appeared 20th of September ; not yet at its height.
2. Low.
3. Seventy kelts taken from river—mostly males. No clean fish taken out, and all fish taken out January and February and November 1894.
4. Disease disappears before spawning, and continues a few months later on.

The Spawning Season—
1. 21st of November 1893.
2. December 1893 and January 1894.
3. End of January 1894—a few later, chiefly baggots.
4. About 12 inches over ordinary size of river.
5. More.
6. River at Kinnaird, Tannadice, Cortachy, and the Prosen Stream or Tributary.

Kelts—
1. 3rd of February 1894.
2. About beginning of February when flood carried them down.
3. About end of March.
4. Flooded condition.

Smolts—
1. 17th of March 1894.
2. Yes. Very good.

Proportion of Male to Female Salmon—
Judging from dead fish, got more males than females. Can give no enumeration.

Fluctuations in the River Level—
General terms.

Wild Birds' Protection Act, 1880—
No. In April and May birds should be scared as they, to some extent, destroy smolt.

THE DISTRICT OF THE RIVER DEE (ABERDEENSHIRE).

Take of Fish—
1. (*a*), (*b*), (*c*), and (*d*) A good average over the whole district ; but best fishing with fixed engines at mouth of river and two sea stations south thereof.
3. (*a*) 11th of February; (*b*) in the month of July ; (*c*) in the beginning of April.
4. (*a*) Run of salmon a little earlier than some years ago.
5. (*a*) 43 lbs. in river; (*b*) 51 lbs. in sea ; (*c*) 42 lbs.

Protection—
1. £13,911.
2. £1112, 16s. 4d., or 8 per cent. on rental.
3. Twenty-three.
4. Seven prosecutions, chiefly for being found on the river banks with poaching implements, and for being in possession of unseasonable salmon. All convicted and fined in sums varying from £1 to £5, with expenses. But few fines recovered—individuals convicted mostly went to prison.

Obstructions to the Passage of Fish—
No dams or dykes in the Dee.

The Salmon Disease—
1. Not to a very great extent; appeared first about middle of November; river became flooded at end of year, and disease disappeared.
2. Low, till flooding, referred to in last answer.
3. November, 32, December, 297—mostly male fish and spent kelts; no clean fish.

The Spawning Season—
1. 15th of October.
2. Between 15th of October and end of December.
3. Practically about 1st of February.
4. Average winter level.
5. Average.
6. In the river about Aboyne and Ballater, and in tributaries of Gairn, Clunie, and Feugh.

Kelts—
1. 1st of December.
2. April and May.
3. Probably never quite free, but freest in July.
4. Average level.

Smolts—
1. Smolts first observed in quantity about 1st of April.
2. Yes.

Artificial Propagation of Salmon—
Two hatcheries which are carried on by Dee and Don Boards jointly—one at Fish Street in Aberdeen, can receive 15,000 to 20,000 ova; the other at Drum, about 11 miles from Aberdeen, can receive 1,000,000. Both stocked every year, and results are satisfactory.

Proportion of Male to Female Salmon—
The male fish are believed to be about twice as numerous as female fish, but this is only an estimate and not based on actual enumeration which could not be done.

Fluctuations in the River Level—
No standard gauge, but general terms.

THE DISTRICT OF THE RIVER DON.

Take of Fish—
1. (*a*), (*b*), (*c*), and (*d*) Below the average in all; but best with fixed engines to the south of the river mouth.
3. (*a*) 11th of February; (*b*) in the beginning of August; (*c*) first grilse got on the first day of May.
4. (*a*) and (*b*) The run of salmon is *not* becoming earlier in the Don; but no monthly percentage can be given.
5. (*a*) 28 lbs. in river; (*b*) 45 lbs.; (*c*) 42 lbs.

Protection—
1. £3963.
2. £792, 14s., or 20 per cent.
3. Sixteen.
4. Ten prosecutions, chiefly for being found on the river banks with poaching implements in their possession, and for having unseasonable fish in their keeping. All convicted and fined from £1 to £5, or so many days' imprisonment and nearly all went to prison.

Obstructions to the Passage of Fish—
3. Yes.
5. Passes are sufficient when plenty of water, but when mills are in operation so much water is withdrawn from them that they become dry when water is low, and thus become a serious obstruction.

Pollutions—
1. As the portion of the town of Aberdeen called Woodside increases in size, the sewarage therefrom tends to increase the pollution.
2. Pollution has occupied the attention of the District Board a good deal, but, as yet, no active measures to cure the evil taken in 1894. The obstacles are the expense and the non-co-operation of other bodies. Negotiations are passing with County Council and city of Aberdeen as to proposed system of pollution drainage.

The Salmon Disease—
1. Disease has practically been non-existent in 1894—only 4 fish seen having any symptoms of disease.

The Spawning Season—
1. 4th of October.
2. Between 17th and 25th of December.
3. Practically about the end of January.
4. Unusually low for winter.
5. Less than usual.
6. Spawning beds mostly in the river itself, and the best spawning places are at Alford, Kildrummy, and Strathdon.

Kelts—
1. About 15th of December.
2. April and May.
3. Probably never quite free, but most so in July.
4. Generally low.

Smolts—
1. Smolts first observed in quantity middle of April.
2. Extra good.

Artificial Propagation of Salmon—
Two hatcheries carried on by Don and Dee Boards jointly : one at Fish Street, Aberdeen, can receive 15,000 to 20,000 ova ; the other at Drum, about 11 miles up Deeside, can receive 1,000,000. Both stocked every year, and ova for this purpose got chiefly from the Don.

Proportion of Male to Female Salmon—
Male fish are believed largely to predominate, but no reliable data.

Fluctuations in the River Level—
Not by any standard gauge, but by general terms.

THE DISTRICT OF THE RIVER YTHAN.

Take of Fish—
1. (*a*), (*b*), (*c*) and (*d*) Below the average.
2. (*a*) and (*b*) The lessees refuse to supply particulars ; (*c*) About 100.
3. (*a*) 26th of February ; (*c*) August.
4. The lessees will not furnish these statistics.
5. (*a*) Sea-trout, $12\frac{3}{4}$ lbs. ; (*b*) Salmon, 38 lbs. ; (*c*) Salmon, 25 lbs

Protection—
1. £1003, 16s. 8d.
2. £142, 13s. 8d., being ·142,138 or 2s. 10d. $\frac{682}{6023}$ per £.
3. One all the year round, and four additional from November to March.

4. Two men were prosecuted for being in possession of unclean salmon, but the complaint was dismissed. A firm of tacksmen of sea fishings were prosecuted for having their leaders in after the statutory time, on a Saturday afternoon, and were convicted and fined £3 each of the two partners, and £3 of expenses.

Obstructions to the Passage of Fish—

2. and 3. We have no cruives.
5. Yes.
6. There can hardly be said to be any.

The Salmon Disease—

1. Yes. It made its appearance in January ; was at its height in February ; and disappeared in May.
2. About its average during these months.

3.

Month.	Number of diseased salmon taken from the river.	Number of male fish.	Number of female fish.	Number of kelts.	Number of. clean fish
January, . .	15	12	3	14	1
February, . .	59	53	6	59	–
March, . .	55	38	17	55	–
April, . .	19	14	5	19	–
May, . .	5	2	3	5	–
Total, . .	153	119	34	152	1

The Spawning Season—

1. November.
2. Between 16th of December and 1st of February.
3. About 1st of February.
4. About the average.
5. Less than usual.
6. Ythan, Little Water, Ebrie.

Kelts—

1. Cannot be answered. There are no passes to see them going over.
2. April.
3. May.
4. Not observed.

Smolts—

1. On 12th of May.
2. Yes.

Proportion of Male to Female Salmon—

A very rough estimate, might give 3 males to 2 females.

Fluctuations in the River Level—

By general terms.

THE DISTRICT OF THE RIVER UGIE.

Take of Fish—

1. (*a*), (*b*), (*c*) and (*d*) The take of fish has been below the average generally throughout the district.
2. The number of fish caught is approximately as follows :— 1200 salmon, 3000 grilse, and 1700 sea-trout.
3. (*a*) First clean fish taken 9th of March ; (*b*) the main take of salmon occurredbetween 23rd of August and 9th of September ; (*c*) in August and September.
5. (*a*) Sea-trout, 7½ lbs. ; (*b*) salmon, 46 lbs. ; (*c*) salmon, 16 lbs., and sea-trout, 14½ lbs.

Protection—

1. Assessable rental, £355, 10s.
2. The assessment to be levied during this year will be £27, 10s. 4d., being at the rate of 1s. 6d. ·577 in the £.
3. Six.

Obstructions to the Passage of Fish—

2. Cruives, unless for the purpose of catching salmon for breeding purposes, are not fished.
3. I believe so.
5. I believe they practically do so, although some of them may afford a perfectly free passage only during half-flood.

Pollutions—

1. and 2. The chief sources of pollution to an extent complained of are certain woollen manufacturies. Certain operations are in progress with the stated object of removing or lessening, to a satisfactory extent, one of these sources (the most important), but they are not yet completed.

The Salmon Disease—

1. Disease first made its appearance in December 1893, and was then to be seen slightly ; it was at its height in March 1894 ; and disappeared in May following.
2. Low.
3. In December 1893, 2 males and 1 female ; January 1894, 7 males and 3 females ; February, 6 males and 4 females ; March, 27 males and 13 females ; April, 11 males—all kelts.

The Spawning Season—

1. 15th of December 1893.
2. Between 20th of December and 20th of January.
3. In the end of January.
4. Half-flood.
5. Less than usual.
6. The North and South Ugie.

Kelts—

1. 13th of February.
2. During March.
3. In May.
4. Half-flood.

Smolts—

1. In April and May.
2. Yes.

Artificial Propagation of Salmon—

1. There is a small hatchery on the Ugie, at Inverugie, which is conducted by private enterprise, and about 60,000 are hatched annually. It is worked on the redd system.

Proportion of Male to Female Salmon—

1. Reliable information on the point cannot be obtained, but it is estimated that the proportion is about 5 males to 3 females.

Temperature of Water—

I have had to discontinue my observations for several years. The record of those made previously extending over a considerable number of years are in the hands of the Scottish Meteorological Society.

Fluctuations in the River Level—

By 'flood,' 'half-flood,' and 'low.'

Wild Birds' Protection Act, 1880—

I think it should be repealed in so far as it relates to the tarrock and merganser.

THE DISTRICT OF THE RIVER DEVERON.

Take of Fish—

1. (*d*) Below the average.
3. (*a*) 11th of February; (*b*) August; (*c*) July.
5. (*a*) 37 lbs.; (*b*) 42 lbs.; (*c*) 33 lbs.

Protection—

1. £2137, 10s.
2. 2s. 11d. per £.
3. Nine watchers.

Obstructions to the Passage of Fish—

3. Except when held under Royal Charter.
5. When river is low.

The Salmon Disease—

1. December, April, June.
2. Low.
3. There were no clean fish affected.

Sex.	December.	January.	February.	March.	April.	May.
Male, . .	34	69	18	23	32	12
Female, .	6	14	9	14	50	67
Total, . .	40	83	27	37	82	79

The Spawning Season—

1. 17th of October 1893.
2. November and December.
3. April.
4. 'Flood,' 'half-flood,' and 'low.'
5. About an average.
6. Well distributed over the river.

Kelts—

1. December.
2. April and May.
3. June.
4. Half-flood.

Smolts—
1. 14th of May.
2. Fair.

Artificial Propagation of Salmon—
There is a hatchery within the policies of Duffhouse capable of hatching 100,000.

Proportion of Male to Female Salmon—
Fish killed by net and coble, 1 male to 5 females.

Fluctuation in the River Level—
'Flood,' 'half-flood,' and 'low.'

Wild Birds' Protection Act, 1880—
Yes.

THE DISTRICT OF THE RIVER SPEY.

Take of Fish—
1. (*a*) and (*b*) Below the average ; (*c*) about one-half average ; (*d*) below the average, disappointing.
3. (*a*) 12th of February (Monday), the opening day being upon Sunday 11th ; (*c*) grilse from 1st of July till middle of August; sea-trout all the season.
5. (*a*) 60 lbs. ; (*b*) 45 lbs. ; (*c*) 44 lbs.

Protection—
1. £9315, 15s.
2. 2s. 8d. per £.
3. One superintendent, 1 inspector, and 43 constables.
4. See Report.

Obstructions to the Passage of Fish—
2. No cruives used in district during last year.
3. Yes.
4. One rebuilt on Dullan Stream, Dufftown Distillery, during summer of 1894.
5. A free passage all the year round.

Pollutions—
1. A new distillery or two discharging their refuse into rivers.
2. Yes, same pending.

The Salmon Disease—
1 See Report.
2. Various.
3. See Report.

The Spawning Season—
1. 6th of October 1893.
2. 15th of October and 30th of November 1893.
3. End of February 1894.
4. Various.
5. See Report.
6. Fiddick, Avon, and tributaries, Dulnain, Nethy, Druie, Feshie, Tromie, and Truim.

Kelts—
1. Early in November.
2. From December to end of January.
3. June or July.
4. Various.

Smolts—
1. From middle of April to middle of June.
2. Very good.

Artificial Propagation of Salmon—
Private hatchery belonging to His Grace the Duke of Richmond and Gordon. See Report.

Proportion of Male to Female Salmon—
See Report.

The following is a copy of the Superintendent's Annual Report, for the year ending 26th August 1894, submitted to the meeting of the Spey District Board, held at Elgin on the 19th October 1894 :—

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 three spawning seasons of 1891–92, 1892–93, and 1893–94 on the following named streams or tributaries :—

1891–92.

Name of Stream.	Spawning Commenced.	No. of Beds for Season.
Fiddich - - -	5th October 1891	933
Avon - - - -	20th ,,	1040
Livet - - - -	8th ,,	275
Conglass - - -	10th ,,	135
Lochy - - -	12th ,,	21
Dulnan - - -	12th ,,	767
Nethy - - -	17th ,,	264
Druie - - -	12th ,,	292
Feshie - - -	13th ,,	544
Tromie - - -	20th ,,	109
Truim - -	13th ,,	82
Spey (above Laggan, Badenoch)	9th ,,	129
Total	-	4591 Spawning Beds.

1892–93.

Name of Stream.	Spawning Commenced.	No. of Beds for Season.
Fiddich - - -	26th September 1892	548
Avon - - -	19th October	1440
Livet - - -	19th ,,	432
Conglass - - -	17th ,,	196
Lochy - - -	18th ,,	97
Dulnan - - -	17th ,,	694
Nethy - - -	20th ,,	274
Druie - - -	17th ,,	424
Feshie - - -	17th ,,	728
Tromie - - -	20th ,,	123
Truim - - -	10th ,,	83
Spey (above Laggan, Badenoch)	6th ,,	104
Tulchan Burn - -	20th ,,	132
Aberlour Burn - -		12
Total - - -		5287 Spawning Beds.

1893–94.

Name of Stream.	Spawning Commenced.	No. of Beds for Season.
Fiddich	6th October, 1893	566
Avon	17th ,,	957
Livet	11th ,,	619
Conglass	12th ,,	267
Lochy	12th ,,	69
Dulnan	13th ,,	616
Nethy	18th ,,	183
Druie	14th ,,	244
Freshie	14th ,,	770
Tromie	14th ,,	168
Truim	11th ,,	75
Spey (above Laggan, Badenoch)	3rd ,,	101
Total		4635 Spawning Beds.
Decrease in Spawning Beds from last year's number		652 ,,

The past salmon spawning season of 1893–94 on the Spey district gave very good results notwithstanding a decrease of 652 spawning beds when compared with the previous season of 1892–93. The River Fiddich, which was wont to be the leading tributary for spawning fish, was, during the last season, as also the previous one, most disappointing in regard to the very small number of salmon that spawned therein. The total number of beds counted on the Fiddich last season was 566. For the previous season (1892–93) the number was 18 beds below that of last season. Last season on this stream there was an increase of about 50 per cent. of sea-trout beds when compared with the previous season ; consequently when we deduct the sea-trout beds, which numbered 210, from the grilse and salmon beds, the real grilse and salmon beds for last season will only count 356. The average number of sea-trout beds on Fiddich during previous years would run to about 100 for the season. The best season's spawning that I have seen on this stream was during the season of 1888–89, when the total number of beds was 1045. During the two following seasons—1889–90 and 1890–91—the total number of spawning beds counted on the Fiddich was even behind that of last season, but, on these occasions, the deficiency was easily explained and understood by the fact that the other tributaries were proportionally behind in numbers. There are now 5 distilleries on the banks of Fiddich in the Dufftown district, all of which discharge their spent wash, spent lees, washings, and 'steep water' into said stream, thus polluting the stream from Dufftown down to Spey, a distance of upwards of four miles. Three of these distilleries—Parkmore, Balvenie, and Convalmore—have commenced work within the last 18 months. It is not unreasonable to assume that the deficiency in the salmon spawning on this stream during the last two seasons is attributable wholly to the pollution of the stream by said distilleries. That the refuse thus allowed to run into the stream from the distilleries is of a deleterious nature to fish was clearly demonstrated by experiments I carried out during the month of June last. I took four samples of water from the Fiddich below the distilleries during the time that a discharge of refuse was running, corked and sealed the bottles ; then took sample from Fiddich above distilleries, and corked and sealed that also. I then took all the samples to Fochaber's Salmon Hatchery, and filled four tumblers with the polluted water and one with the clean sample. From the hatchery boxes I took 25 fine healthy salmon fry, putting 5 into each glass. Result—fry in polluted water died in from one to two and a half hours, while the fry in the clean sample seemed as much at home as if in hatchery boxes.

As in the season 1890–91, from about the middle of October till end of December last, all the tributaries ran high in size, and continued dark or brown-coloured during the height of the spawning over the tributaries, and it was on rare occasions that the spawning fish could be seen by the bailiffs, and by the time the streams returned to their normal size, the fish had spawned and left their 'redds,' which were then to be seen and counted by the bailiffs, although the fish had by this time finished their redds and drawn into the pools. When spawning beds are counted in this way by the bailiffs, after a continued period of brown-coloured water, the men are very cautious not to give in a list of anything but what they are prepared to swear were proper spawning beds, each of which had been spawned upon by at least one pair of fish, consequently doubtful beds are left out of count, although these may have been properly formed and spawned upon had a sight of them been attainable when they were being wrought. On the River Spey the spawning seemed to be fairly good, and when the size of the river permitted the spawning fords being examined, there were good signs of fish and redds. From Grantown to Boat of Bridge fish were to be seen on the spawning beds up to the end of February. No damage was done through spates or ice to the spawning beds during the season.

II.—*Smolt Season.*

Descending smolts during the last spring and early summer were, like the previous year, seen very early in the season. This was caused no doubt by the mild and genial weather experienced during the months of March and April. As to numbers, the appearance was similar to the average of former seasons. Eight bailiffs were stationed, as follows, to protect the smolts and salmon fry for six weeks, commencing 30th April, viz. :—One man at Garmouth, one man at Fochabers, one man at Dufftown, one man at Aberlour, one man at Ballindalloch, one man on Upper Avon and Livet, one man at Grantown, and one man at Duthil. Twelve dozen of printed notices cautioning persons against taking or killing smolts, salmon fry, or parr were posted up at conspicuous places along the sides of the river and tributaries over the whole district from Speymouth to Laggan, Badenoch. The superintendent, inspector, and two constables continued after end of said six weeks' duty to protect the salmon fry up till 30th July, on which date other four men were put on duty to continue protection of said fry during the months of August and September. No persons were found with smolts in their possession during the season. The usual mode of cautioning persons *once* and taking down their names and addresses, as cautioned against killing parr or salmon fry, has been continued this season. The number of persons so warned and shown parr by the bailiffs during the spring and summer of 1891 was 500. The number for 1892 was 385. The number for 1893 was 237, and the number for the present summer amounts to 373 persons warned and shown parr and not previously warned.

III.—*Disease among Fish.*

I have as usual taken the River Fiddich to work and report upon anent 'fungoid,' or disease among salmon in Spey district during the last season of 1893–94. During the season the number of dead or dying fish removed and buried by the bailiffs was 46. Only two of this number were females. The disease and deaths occurred as follows :—From 18th November till 31st December 1893, 9 dead fish removed ; from 1st till 31st of January 1894, 32 removed ; and from 1st till 24th February, 5 were removed. Calculating the percentage of fish dying from the disease to the number of spawning beds counted upon the stream during the seasons back as far as five years, Fiddich has given the following percentages :—During the season of 1889–90, 13 per cent. ; 1890–91, 18 per cent. ; 1891–92, 16 per cent. ; 1892–93, 19 per cent. Last season the number of spawning beds was 566, and the number of dead and diseased fish removed and buried was 46, thus making the deaths about 8 per cent. Last season's percentage is the lowest on record, but then it must be noted that upwards of 100 sea-trout beds above the usual have to be taken into account on this stream, and disease among sea-trout is of a very rare occurrence. No excess in males over females was observable in this stream during the spawning season. On 14th September, 1893, Alexander Craik, gamekeeper, Buchromb, while out with Mr Grey, a gentleman from London, trout angling on Fiddich on a pool near Buchromb, landed two parr which were slightly marked with fungoid disease. They returned them to the river. No other case of fry showing marks of disease was reported to me during the year.

IV.—*Poaching during the Year.*

Eight persons were brought before the Sheriff Court for trial, and all convicted for poaching offences during the year.

V.—*Bye-Laws.*

The Bye-Laws relating to Dam Dykes, Mill-lades, Sluices, Hecks, &c. were well kept and maintained throughout the year over the whole district, with one exception. The miller at Nethy-Bridge was prosecuted for having had his fish-pass closed in October last year, but the Sheriff, at Inverness, found the charge not proven because there was no evidence that he had committed the offence with his own hands.

General Remarks.

The 11th February last being Sunday, the sea coast and river salmon net fishing opened on Monday, 12th February ; and the yearly close of the same—26th August—falling upon a Sunday, and during the weekly close time, the net fishing termintated upon the 25th of August. With the exception of the case brought before the Board at their last meeting held at Elgin on the 24th of August last, there was no other hitch met with during the season, and no other matter requiring reporting was met with either by myself or the inspector during our frequent visits to the coast during the net fishing season.

The salmon hatchery at Fochabers, belonging to His Grace the Duke of Richmond and Gordon, was again, during last spawning season, stocked with salmon ova to the number of nearly half a million, and under the splendid design and construction of this hatchery, along with the able care and attention which it receives, nearly half a million of fine healthy and strong salmon fry, six or seven weeks old, were turned adrift from said building into the River Spey during the month of June last, to go and join their half-a-million predecessors turned into the river from the same interesting and important building last year. As last year, I had the pleasure of visiting and seeing the fry in all their different stages in the hatchery.

The full force of bailiffs or Spey police is constituted as follows :—The superintendent, stationed at Aberlour ; the inspector, stationed at Grantown ; eight sergeants, and thirty-six constables.

GEORGE K. MACGREGOR, *Superintendent.*

THE DISTRICT OF THE RIVER FINDHORN.

Take of Fish—
1. (*a*) and (*b*) About an average ; (*c*) and (*d*) Below an average.
3. (*a*) 11th of February ; (*b*) April and May ; (*c*) June and July. A few trout can be got throughout season.
5. (*a*) 37 lbs. ; (*b*) 41 lbs. ; (*c*) 19 lbs.

Protection—
1. £3501.
2. £330.
3. Three permanent watchers, and 15 watchers during spawning season.

Obstructions to the Passage of Fish—
No obstruction to passage of fish on the Findhorn.

Pollutions—
No pollution.

The Salmon Disease—
No salmon disease.

The Spawning Season—
1. Upper district, 16th of October; lower district, 15th of November.
2. Upper district between 20th of October and 22nd of November; lower district between 10th of December and 10th of January.
3. Upper district, 30th of November; lower district end of February.
4. Sometimes 'flood,' 'half-flood,' and 'low.'
5. More.
6. Very little spawning done in any of the tributaries of the Findhorn.

Kelts—
1. Kelts begin to migrate seaward from upper district and lower district immediately after spawning.
2. January and February.
3. May.
4. 'Flood,' 'half-flood,' and 'low.'

Smolts—
1. From the end of March to the end of May.
2. Pretty good.

Fluctuations in the River Level—
By general terms.

Wild Birds' Protection Act, 1880—
Great numbers of smolts are destroyed within the estuary by wild birds.

THE DISTRICT OF THE RIVER NAIRN.

Take of Fish—
1. (*a*) Below the average; (*b*) a full average
2. (*b*) Approximately, 4250; (*c*) approximately, 230.
3. (*a*) 13th of February; (*b*) in April; (*c*) first run of sea-trout in June, of grilse in July.
5. (*b*) 35 lbs.; (*c*) 19½ lbs.

Protection—
1. £1342, 10s.
2. £78, 6s. 3d.
3. Two.
4. One case of poaching with rake-hook, the result being a fine.

Obstructions to the Passage of Fish—
5. There is a free run at all times unless the river is in a low state.

The Salmon Disease—
1. The salmon disease made its appearance in the month of September; has not yet disappeared.
2. Very low.

The Spawning Season—
1. 2nd of November 1893.
2. Between 15th of November and 20th of December.
3. About 20th of January.
4. Between 'low' and 'half-flood.'
5. More.
6. The Nairn River and Inverurie Burn.

Kelts—
1. February.
2. March.
3. About the middle of April.
4. 'Half-flood.'

Smolts—
1. From about the 20th of April to the 10th of June.
2. Yes.

Proportion of Male to Female Salmon—
As far as can be judged from observation the male and female are very equal.

Fluctuations in the River Level—
By general terms such as 'flood,' 'half-flood,' and 'low.'

Wild Birds' Protection Act, 1880—
I think that the 'Wild Birds' Protection Act' ought to be repealed. The birds are most destructive upon salmon and trout fry.

THE DISTRICT OF THE RIVER NESS.

Take of Fish—
1. (*a*) About the average; (*b*) about the average; (*c*) above the average; and (*d*) about the average.
3. (*a*) February; (*b*) August; (*c*) July and August.
5. (*a*) Net and coble, 40 lbs.; (*c*) salmon, 35 lbs.

Protection—
3. Four permanent and four temporary.

Obstruction to the Passage of Fish—
1. One dam repaired on the Ness.
5. Always.

The Spawning Season—
1. On the River Ness from the middle of December to the middle of January, on the upper rivers that feed Lochness from the middle of October to to the middle of November.
2. The end of December.
3. The end of January.
5. More.
6. The upper part of the River Ness and the small rivers that feed Lochness.

Kelts—
1. February.
2. March and April.
3. By the first day of May.

Smolts—
1. April, May, and June.
2. Very good.

Artificial Propagation of Salmon—
Lord Burton possesses a hatchery at Glenquoich.

Fluctuations in the River Level—
By a standard gauge.

Wild Birds' Protection Act, 1880—
It should be repealed.

THE DISTRICT OF THE RIVER CONON.

Take of Fish—
1. (*a*), (*b*), (*c*), and (*d*) Take of salmon below the average; take of grilse about the average.

2. (*a*) 6,000; (*b*) 10,000; (*c*) 650.
3. (*a*) 11th of February; (*b*) April and first two weeks in May; (*c*) grilse run from middle of April till the end of season. Principal run of sea-trout is in March.
4. (*a*) February 60, March 200, April 340, May 300, June 200, July 2700, August 2200; (*b*) February 100, March 250, April 300, May 350, June 200, July 5500, August 3200.
5. (*a*) 19 lbs.; (*b*) 25 lbs.; (*c*) 24 lbs.

Protection—

3. One inspector for whole year, and 8 temporary watchers during the spring months.
4. There was one prosecution instituted under the Salmon Fishery Act in 1894, involving 5 persons for fishing with a small meshed trawl-net and caught and killed 33 sea-trout, one was fined, including expenses, £5, 6s.; two, £2, 16s. each; two, 16s. each.

Obstructions to the Passage of Fish—

2. The cruives in this district have not been fished in 1894.
3. There is one dam in this district. It is not worked in accordance with the bye-law, 'Schedule F.' There are two cruives in this district, they are worked in accordance with the provisions of the bye-law, 'Schedule G' regulating the same.
5. Yes, at all times.
7. The Brahan-net and cruive fishings have not been worked during the last five fishing seasons, whereby large numbers of salmon have ascended to the angling waters, and, in consequence, have improved the sport in the angling waters.

The Salmon Disease—

1. The salmon disease has shown itself in this district this year. I noticed a few male salmon slightly touched in the middle of October and in the first week of December. A flood in the second week of December cleared the diseased fish out of the river.
2. During the month of October the River Conon has not been seen at such a low level by the oldest inhabitant in the Conon district.
3. During November, I took 10 diseased salmon from the river, and 11 diseased salmon in the first week of December, all of which were male salmon and half spawned out.
4. I am of opinion that the exceptionally low level of the River Conon during the months of September and October, and the exceptionally crowded state of all the salmon pools in all parts of the river, was the cause of the disease among the male salmon. I never saw so many fish in the pools, nor the river so low, nor the bottom of the river so filthy with green weed as during September and October last.

The Spawning Season—

1. On the 21st of November.
2. Between the 6th of November and 18th of same month.
3. About the end of November.
4. Half-flood.
5. More than I ever saw in the Conon and tributaries. A larger number run into the river in Autumn than I ever saw.
6. Fourteen in the Conon, 10 Blackwater, 9 Orron, 14 Meig.

Kelts—

1. About 50 per cent. male salmon die and are carried to the sea in December. Kelts seen migrating seawards first week in March.
2. In April.
3. In the end of May.
4. 'Half-flood' and ordinary.

Smolts—

1. March, April, and May.
2. Fairly good.

Artificial Propagation of Salmon—

There is a hatchery in this district for the artificial propagation of salmon. It partly belongs to the District Board and partly to Seaforth. It is situated on the north bank of the Conon, near the railway bridge that spans the river. It is capable of hatching out at the same time 200,000 salmon. But, in consequence of the river being in 'half-flood' during the spawning season, I was unable to net the river for ova.

During the last spawning season there was in the river about 60 per cent. of males and 40 per cent. of females. My return, so far as it goes, is based upon an estimate.

Fluctuations in the River Level—

By general terms.

Wild Birds' Protection Act, 1880—

I would be in favour of repealing the Wild Birds' Protection Act, 1880, as to all wild ducks, with the exception of the mallard, widgon, and teal, and would be in favour of repealing in regard to the common sea-gull.

THE DISTRICT OF THE KYLE OF SUTHERLAND.

Take of Fish—

1. (*a*), (*b*), (*c*), and (*d*) Below the average.
3. (*c*) June and July.
4. I cannot say. The lessees will not tell.

Protection—

2. 1s. 9d. in the £.
3. There are 15 bailiffs.
4. There was one prosecution and a conviction obtained.

Obstructions to the Passage of Fish—

1. There is part of a new dam on the River Esclese, which I consider is an obstruction, I have reported it often.
3. There are no cruives in this district.

The Spawning Season—

1. There are always fish spawning here in September, say about the middle.
2. From 15th of October up to 1st of December.
3. About 1st of January.
4. Rivers all in medium size.
5. More than usual.
6. Caron, Cassley, and Oykell.

Kelts—

1. January.
2. February and March.
3. May.
4. Sometimes big, other times low.

Smolts—

1. May and June.
2. Yes.

SUTHERLAND, EAST COAST DISTRICT.

Take of Fish—

1. Below average in both tidal and fresh waters.

2. (*a*) Helmsdale—salmon, 1132 (weight, 11,884 lbs.); grilse, 1080 (4913 lbs.); trout, 124 (207 lbs.). Brora—salmon, 1289 (weight, 12,905 lbs.); grilse, 1033 (5048 lbs.); trout, 321 (532 lbs.). Fleet—salmon, 20; (*c*) No returns from Brora, but on 3 rivers from 1000 to 1100 salmon.
3. (*a*) First clean fish caught on Helmsdale 12th of January, Brora, February; (*b*) By nets, May; rods, March and April; (*c*) Somewhat earlier than usual this year. End of May and through June.
4. (*a*) March, 18, April, 25, May, 30, June, 12, July, 8, August, 7.
5. (*a*) 35 lbs.; (*c*) 28 lbs.

Protection—
1 and 2. £1855. All belong to the Duke of Sutherland. No assessment.
3. Three employed by proprietor. Keepers also assist in watching.

Obstructions to the Passage of Fish—
5. The only fish-pass in the district is on the Carnach, a tributary of the Fleet. It is generally in good order and affords free passage.

The Salmon Disease—
1. To a very small extent on the Helmsdale. Showed first in April; at its height June; disappeared August.
2. Very low indeed.
3. Seventeen in April, 14 in May, 23 in June—all clean fish, and nearly all female.
4. Hardly ever any sign of disease except when water low and pools overcrowded with fish.

The Spawning Season—
1. 12th of October.
2. 20th of October to 20th of November.
3. Early in December.
4. About average height. In very good condition for spawning.
5. Considerably more.
6. The upper reaches of the Helmsdale and Brora with their several tributaries.

Kelts—
1. End of February.
2. End of March to middle of April.
3. End of May.
4. Low.

Smolts—
1. 29th of April to 1st of June.
2. Helmsdale not good, Brora fair.

Artificial Propagation of Salmon—
Small hatchery near Loch Brora belonging to the Duke of Sutherland—150,000 to 200,000. For last three or four years only used for Loch Leven trout.

Proportion of Male to Female Salmon—
River bailiffs state that more female salmon are caught by rods. The net fishers say that males predominate.

Fluctuations in the River Level—
General terms.

SUTHERLAND, NORTH COAST DISTRICT.

Take of Fish—
1. (*a*), (*b*), (*c*) and (*d*) Above.
2. (*a*) and (*b*) 13,670. Cannot separate—about ¾ths (*b*); (*c*) about 850 fish.

3. (*a*) First fresh fish taken early in February, but clean fish run in Halladale and Naver all winter ; (*b*) April and May ; (*c*) Sea-trout, May, grilse, June.
5. (*a*) 40 lbs. ; (*b*) 35 lbs. ; (*c*) 30 lbs.

Protection—
1 and 2. No assessment levied.
3. Five bailiffs besides numerous keepers all paid by the proprietor.

Obstructions to the Passage of Fish—
5. Yes.

The Spawning Season—
1. 22nd of October.
2. 26th of October and 15th of November.
3. End of November.
4. Good. Very regular.
5. More.
6. Halladale, Strathy, Naver, Borgie, and Kinloch.

Kelts—
1. April. Naver was earlier than usual (March).
2. Latter end of March and early April.
3. Naver end of April, others later.
4. Low.

Smolts—
1. 1st of May to 15th. Naver late this year, into June.
2. Yes.

Artificial Propagation of Salmon—
Seventy thousand fry put into rivers in this district from other rivers—principally the Helmsdale.

Proportion of Male to Female Salmon—
Males predominate—from actual observation.

Wild Birds' Protection Act, 1880—
Mergansers should not be protected.

SUTHERLAND, WEST COAST DISTRICT.

Take of Fish—
1. (*b*), (*c*) and (*d*) Above the average.
2. (*b*) 10,238 salmon and grilse ; (*c*) About 500 salmon and grilse.
3. (*a*) June ; (*b*) and (*c*) July and August.
4. (*b*) The answers given last year apply to this year without any perceptible change.
5. (*b*) and (*c*) No fish over 30 lbs. was reported.

Protection—
1. £1235.
2. All expenses of watching paid by the proprietor or tenants. There is no board nor assessment imposed.
3. Every river is watched and protected.

Obstructions to the Passage of Fish—
7. The bag-nets along the coast outside the estuary of the Laxford River have been wholly removed.

The Spawning Season—
1. The last week of October.
2. Between 14th of November and 20th of December.

3. First and second week of January.
4. From 'half-flood' to 'flood.'
5. Reported more numerous this season.
6. Inver and Laxford.

Kelts—

1. About middle of March.
2. April.
3. About middle of May.
4. 'Half-flood,' generally.

Hatcheries—

There are two hatcheries in this district, one at Inchnadamph and the other at Geisgill, both maintained by the Duke of Sutherland. About 50,000 ova could be placed in each of them.

Proportion of Male to Female Salmon—

There are generally more male than female salmon observed.

Fluctuations in the River Level—

'Flood,' 'half-flood,' or 'low.'

Wild Birds' Protection Act, 1880—

There is no doubt that herons, cormorants, and gulls do considerable damage by destruction of young fish and ova.

THE DISTRICT OF THE RIVER BALGAY.

Take of Fish—

1. About the average in fresh waters; with rod both sea-trout and salmon.
3. Two clean salmon taken with rod in Lochdoub—weight 13 lbs. and 7 lbs. respectively—on or about 15th of July. The first general run of sea-trout was this year, about 8th of July, earlier than last year by a week; but sea-trout were visible in the sea at the mouth of the river three weeks previously. They could not ascend the rivers earlier than above date owing to want of spate in the rivers.

Protection—

1. £40.
2. £24.
3. One assisted by keepers.

The Salmon Disease—

1. One sea-trout all covered with *fungus disease*, and living when taken out of Kinloch River about the middle of June 1894. The trout weighed about 5 lbs.
2. River very low.

The Spawning Season—

1. Sea-trout were observed both in 1893 and 1894 on the spawning grounds about 10th of October. Salmon are about a month later.
2. The greatest number of sea-trout spawn from the middle of October to 1st of November.
3. Both salmon and sea-trout are through with spawning by 20th of November.
4. The rivers were high as a rule during the spawning season.
5. The number of fish spawned were about the average.
6. The principal spawning streams are the Balgay and Kinloch or Glen Shieldaig rivers.

Kelts—

Kelts were noticed going seawards last season about 30th of November. Rivers pretty high.

Wild Birds' Protection Act, 1880—
We can testify that the heron for one makes unaccountable damage on salmon and trout fry, and we are confident that the water-ousal does the same with regard to the spawn. Cormorants are also most destructive among sea-trout, especially in lochs, and mergansers or saw-bills make havoc among smolts in the brackish water.

THE DISTRICT OF THE RIVER TORRIDON.

Take of Fish—
1. (*a*) Unknown. No means provided by the Legislature for ascertaining; (*b*) below the average—slightly; (*c*) and (*d*) unknown (see *a*).
2. (*a*) and (*b*) Unknown (see 1*a*); (*c*) Four salmon.
4. Unknown (see 1*a*)
5. (*a*) and(*b*) Unknown (see 1*a*); (*c*) 9½ lbs.

Protection—
1. £40.
2. £7, 10s.
3. No special bailiffs. The proprietors' keepers did any watching.

General Question—
The inspector is referred to the paper furnished by Mr Danoch, the proprietor of Torridon, to the Third Annual Fishery Board Report for 1884, App. G., pp. 136-140. It seems extraordinary that the Fishery Board should not be taking any steps to arrest the utter ruin which is coming on to north-western rivers, owing to the present state of the law which permits, or rather has initiated, a state of matters so unjust to the breeders of the fish, and so destructive to the supply of fish to the nation.

THE DISTRICT OF THE RIVER LOCHY.

Take of Fish—
1. (*b*) Rather below average, owing to draught in Autumn, but plenty of fish in river; (*d*) somewhat below average.
3. (*a*) April; (*b*) and (*c*) July.
5. (*c*) 39 lbs.

Protection—
1. £2122.
2. 1d. per £, and a contribution by Lord Abinger of £764.
3. Twenty-three.
4. Yes. A prosecution against three persons for illegally fishing for salmon in Loch Linnhe. Found not proven, but no expenses awarded to either party.

The Salmon Disease—
1. No.
4. No. Other than that, in my opinion, river pollution is a fruitful cause of disease.

The Spawning Season—
2. Between second week of November and second week of December.
3. Last week in December.
4. Very high.
5. More.
6. Lochy, Spean, Roy, Cour, Loy, Nevis.

Kelts—
1. March and April.
2. May.
4. Low

THE DISTRICT OF THE RIVER AWE.

Protection—
1. £723.
3. One.
4. (1.) Yes. Four persons were charged with (*a*) contravening 7 and 8 Victoria Cap. 95, Sect. 1; (*b*) contravening 31 and 32 Victoria Cap. 123, Subsection 4 of Sect. 15, and the Bye-law E. of the commissioners; (*c*) contravening 31 and 32 Victoria Cap. 123, Sect. 19 thereof.

The complaint against one of the defenders was not called on account of it not having been served on him through his leaving the town. The other three were convicted of each offence, and were fined 10s. each for each offence. They were further fined 1d. for each fish caught in contravention of the Bye-law E.,—there were 150 fish. They were also ordered to pay the cost, £1, 19s. The boats and nets were also declared forfeited.

(2.) One person was charged with (*a*) a contravention of 25 and 26 Victoria Cap. 97, Sect. 7, 31 and 32 Victoria Cap. 123, and the Bye-law D. of the commissioners; (*b*) with contravening 31 and 32 Victoria Cap. 123, Subsection 4 of Sect. 15, and the Bye-law E. of the commissioners.

MacArthur pled guilty and was fined £1, with £1, 1s. of costs.

(3.) Two persons who were working the Kerrera Crown fishings, were charged with contravening 31 and 32 Victoria Cap. 123, Sect. 19.

The charge was withdrawn against one of the defenders on account of his having gone to England. The other pled not guilty, but was convicted on evidence being led, and fined £5, with £1, 7s. 6d. of costs.

On 15th of June 1894, a box of fish (smolts) were seized by the police in Glasgow on the instructions of this Board, but no prosecution followed on account of evidence being defective.

THE DISTRICT OF THE RIVER GIRVAN.

Take of Fish—
1. Below average in all respects.
3. (*a*) April; (*b*) September and October; (*c*) June and July.
4. Very little change, but somewhat late.
5. (*a*) 28 lbs.; (*c*) 22 lbs.

Protection—
£554. None at present. Gamekeepers do the duty.

Obstructions to the Passage of Fish—
3. Yes.
5. Yes, fairly well.

Pollutions—
2. Sewage from Maybole enters the river and does damage, but this is being remedied. Noxious water from the coal pits at Dailly does damage. The Board got an opinion of Counsel that under a clause in the River Pollution Act they could not interfere.

The Salmon Disease—
1. Almost none.
3. Almost none.

The Spawning Season—
1. December and January.
2. January.
3. February.
5. Less.
6. The Girvan and tributaries.

Kelts—
1. and 2. January and February.
3. March.

Smolts—
1. February.
2. No.

Wild Birds' Protection Act, 1880—
A very great number of salmon fry, &c. are killed by wild birds in summer when river is low.

THE DISTRICT OF THE RIVER STINCHAR.

Take of Fish—
1. (*a*), (*b*), (*c*) and (*d*) Supposed to be a fair average.
2. (*c*) 191.
3. (*a*) April ; (*b*) August and September ; (*c*) June.
5. (*c*) 43 lbs.

Obstructions to the Passage of Fish—
5. Yes.

The Spawning Season—
1. December 1893.
2. Latter end of December.
3. End of January.
5. More.
6. To all the pools there are fine spawning beds.

Kelts—
1. March.
2. Middle of March.
3. May.
4. If anything a higher level than other years.

Smolts—
1. May.
2. Yes.

Fluctuations in the River Level—
Weather and eye.

Wild Birds' Protection Act, 1880—
Yes.

THE DISTRICT OF THE RIVER CREE.

Take of Fish—
1. (*a*), (*b*) and (*c*) Below.

3. (*a*) 3rd of March; (*b*) July ; (*c*) 28th of May.
4. July and August. 70 per cent. by fixed engines.
5. (*a*) 24 lbs ; (*b*) 16th of May, 46 lbs.

Protection—
1. £553, 18s.
2. £41, 10s. 10d., viz. :—assessed at 1s. 6d. per £.
3. One in upper and one in lower waters
4. There are complaints that at Minniegaff Meal Mill fish are taken off the fish-pass into the mill race by a board being put in the fish-pass which shuts off the fish from going up the pass. This is the report of one of the fishing tenants.
5. Except as above, and in very dry weather.

The Salmon Disease—
1. A very little in end of March ; second week of April ; and middle of May.
2. When the river is in flood it brings down the kelts, which are the only diseased fish in the district.
4. The salt water is the only cure for diseased fish, and if the disease is not far advanced the fish soon recover in salt water.

The Spawning Season—
5. Less.

Kelts—
1. End of March.
2. Second week of April.
3. June.

Smolts—
1. All year.
2. No.

Proportion of Male to Female Salmon—
1. About ⅔rds are female.
2. Based on an estimate.

Wild Birds' Protection Act, 1880.
1. The opinion I have received is affirmative.

General Question—

As the salmon in this district are in excellent condition at the end of August, I would suggest varying the annual close time a fortnight later, nigh to the 10th of September, with a fortnight later in opening in spring, which would be the same close time as is observed in the Solway.

THE DISTRICT OF THE RIVER DEE, KIRKCUDBRIGHT.

Take of Fish—
1. (*a*), (*b*) and (*c*) Rather above ; (*d*) Understood to be so.
3. (*a*) 15th of February ; (*b*) June ; (*c*) From 18th of June to 15th of August.
5. (*a*) Salmon, 27 lbs., grilse, 11 lbs., trout, 6 lbs. ; (*b*) salmon, 24 lbs., grilse, 12 lbs., trout, 4 lbs. ; (*c*) salmon, 20 lbs., grilse, 9 lbs., trout, 2 lbs.

Protection—
1 £1463.
2. 5 per cent.
3. 7 to 9.

Obstruction to the Passage of Fish—
3. Yes.
5. Yes, 24 hours open weekly

Pollutions—
1. Yes.
2. Yes.

The Spawning Season—
1. 10th of November.
2. 15th of November till 6th of December.
3. About 6th of January.
4. High.
5. Less.
6. Dee and Tarff.

Kelts—
1. March.
2. May.
3. June.
4. Low.

Smolts—
1. March.
2. Yes.

Artificial Propagation of Salmon—
Yes, being increased to 500,000. Private enterprise.

Proportion of Male to Female Salmon—
Males about 2 to 1. Estimate.

Marking Salmon—
Yes. Tongland Fishery.

Temperature of Water—
Yes.

Fluctuations in the River Level—
High, medium, low.

THE DISTRICT OF THE RIVER NITH.

Take of fish—
1. (*a*), (*b*), (*c*) and (*d*) Below the average, and worse than the previous year.
3. (*a*) When fishings opened, 25th of February ; (*b*) in July ; (*c*) there was a good run of grilse in July. Sea-trout were running in May and June, but very scarce.
5. (*a*) 35 lbs. ; (*c*) 32 lbs.

Protection—
1. £774, 10s.
2. Nil.
3. Three paid watchers and nine unpaid (Gamekeepers).
4. Four prosecutions :—(1) Contravention of Section 21 of 1868 Act, having salmon in possession in close time, three men fined £7, or 1 month. (2) Contravention of Section 19, killing smolts, admonished. (3) Contravention of Section 15, using shackle-net in close time, fined £4, 2s., or 1 month. (4) Contravention of Section 17, using drag-hooks, fined £3, 13s., or 1 month.

Obstructions to the Passage of Fish—
2. Have been fished as usual.
3. The cruives are but not the dams ; most of the latter have neither passes, hecks, nor sluices in accordance with Schedules.
5. Dumfries fish pass affords passage except when water at summer level.

The Salmon Disease—
1. Very little disease observed this year.
2. Mostly low.
3. No, but more males than females.

The Spawning Season—
1. In October 1893.
2. Between December and January.
3. In February.
4. High or in flood.
5. Less.
6. No large streams. There are small streams all over district.

Kelts—
1. About beginning of February.
2. About beginning of March.
3. In May, excepting that an odd fish was now and then observed all through the season.
4. River was just beginning to rise to flood when the largest number came away. They will not run when river low.

Smolts—
1. In April and May, but in end of August or beginning of September a number were seen at Dumfries Caul going to sea.
2. There was an average run of smolts.

Artificial Propagation of Salmon—

The Board have no hatchery, but there is one in the district belonging to a private individual. Mr J. J. Armistead's Solway Fishery at New Abbey.

Fluctuations in the River Level.

By the general terms 'flood,' &c.

General Question—

That amendment or consolidation of the different Acts of Parliament which now govern the Solway Salmon Fisheries is urgently required, and that in the direction of constituting a joint Board of Scotch and English Representatives who should administer the Laws under one Statute.

THE DISTRICT OF THE RIVER ANNAN.

Take of Fish—
1. (*a*) Below the average ; looked upon as being the worst season the oldest fishermen remembers both in Solway Firth and the River Annan ; (*b*), (*c*) and (*d*) Below the average.
2. The lessees of the different salmon fisheries say they do not keep notes of number caught, therefore number cannot be given.
3. (*a*) 25th or 26th of February first open days ; (*b*) during August and up to end of season on 9th of September ; (*c*) grilse commenced to run last week in June ; main run from middle to end of July ; takes of grilse this season above average of last few years. Sea-trout commenced to run about middle of April ; main run towards end of June ; takes below average, both in Solway and in the river.
4. The run of salmon is becoming later, but no record is kept of number caught.
5. (*a*) No net and coble fishing in this district ; (*b*) 39½ lbs. (at Newbie Fishery) ; (*c*) 27 lbs. (in Mount Annan, portion of the Annan).

Protection—
1. £2778.
2. £416, 14s.
3. Four (3 at Annan and 1 at Lochmaben). There are also 26 gamekeepers sworn in as special water bailiffs
4. Twenty-nine persons convicted as follows :—Two contraventions 17th Section of Act, 1868, fined each £3, or a month. Two contraventions 20th Section of said Act, one fined £3, the other £2, or a month imprisionment. Four for contraventions Section 33 of Annan Act, 1841,

two of which were fined £1, 5s. 9d., or 14 days, other two £1, 0s. 9d., or 7 days. Four for contraventions Section 15 (Subsection 4) and Bye-law Schedule E. of 1868 Act, one of which fined £3, 12s. 9d., two £2, 12s. 9d., other £1, 12s. 9d., or a month. And six contraventions Section 21 of Act 1868, two of which were fined £5, 12s. 9d., or 2 months, one £3, 13s., two £2, 12s. 9d., and one £2, 13s., or a month. Also one under Section 17, fined £4, including expenses, or 1 month. Two under Section 19, £1, 4s., including expenses. Eight under Section 21, one £8, including expenses, or 2 months, two £6, 17s. each, including expenses, or 1 month, one £6, including expenses, or 2 months, one £5, 9s., including expenses, or 30 days, two £2, 2s. 6d. each, or 30 days, and one admonished, all at Sheriff Court, Dumfries.

Obstructions to the Passage of Fish.

1. Mill race at Brydekirk dam, on the Annan, has been made wider to drive a larger wheel. Beltenmount Mill dam, on the Kirtle, was broken down by flood, and a new one has been put in similar to the old one.
2. None in district.
3. No, there are no cruives in district. Dams on the Annan, at Welldale Mill, has no heck at intake or tail of race. At Newbie has no heck at intake of race, and at Brydekirk Mill has no heck at tail of race. There are three dams on the Kirtle, Rigg, Beltenmount, and Kirtlebridge Mills, in neither of which are a fish-pass, nor hecks at intakes or tail of race, and never has been.
5. Yes, in the Annan, but not in the Kirtle.

The Salmon Disease—

1. Yes, appeared in middle of January ; at its height during March ; and disappeared in beginning of May.
2. Low, particularly in March and April.
3. In January, 5, February, 10, March, 31, April, 21, of these 54 were kelts and 13 clean salmon— 18 males and 49 females.

The Spawning Season—

1. Beginning of October.
2. During December, up to middle of January.
3. About middle of February.
4. High, frequently in flood.
5. Less.
6. Northfield, Mount Annan, Luce, Meinfoot, Turushawhead, Hoddam-Bridge, Mainholm, and Rotchell in the Annan.

Kelts—

1. About beginning of February
2. About beginning of March.
3. In May.
4. High during principal migration.

Smolts—

1. During April and May.
2. No, below the average.

Proportion of Male to Female Salmon—

1. This cannot be accurately given, as notes are not taken at the different fisheries, but may be estimated at 3 or 4 females to every male.

Fluctuations in the River Level—

'Flood,' 'half-flood,' and 'low' only.

General Question—

I would suggest that the attention of the Board be drawn to the Acts referring to the Solway Firth. A great number of men fish for salmon with both haaf and whammel-nets between low water mark and mid-channel without permission, which have increased of late years, giving great dissatisfaction to owners and occupiers of the different fishings, and is an encouragement to poachers, while on the English side of mid-channel no one can fish for salmon without a licence from Eden Fishery Board. On the English side of the Solway the weekly and annual close times differ from those on Scotch side, which also encourages poaching. It would be a great advantage for the fishings if the law was altered to prevent fishing between low water mark and mid-channel on the Scotch side of the Solway without permission, and to make both the weekly and annual close times the same. It may be added that fishing between low water and mid-channel by parties having no permission from the Scotch proprietors, while quite illegal according to existing statutes, is done with comparative impunity owing to the great difficulty of detection, and so poaching is systematically carried on by licencees of the Eden Fishery Board who obtain their licences not for the purpose of fishing in the Eden District but to enable them to carry out their poaching practices in Scotch waters.

NOTE II.

REPORT ON CERTAIN SALMON INVESTIGATIONS conducted on the River Tweed during the Netting and Rod Seasons of the year 1894. By James R. Tosh, M.A., B.Sc.

During the netting season of last year on the Tweed, a number of investigations into salmon questions were carried on for the Fishery Board at Berwick, by Mr R. H. Grey, of the Royal Welsh Fusiliers. Shortly after the close of the netting season he was ordered to join his regiment, and was unable to prepare a report on his work. His papers were handed over to me by Mr Archer, Inspector of Salmon Fisheries for Scotland. Mr Grey's work on the rate of growth of the genitalia of salmon was continued by me at Kelso during the last six weeks of the rod season.

Rate of Growth of Genital Organs of Salmon

The genital organs of all the salmon and grilse, that were opened at the Berwick Salmon Company's Fish House, were measured and weighed. To determine the rate of growth of these organs their weight has been calculated in percentage of the body weight of the fish. The percentages have been averaged over almost equal (ten-day) periods in each month, the last period extending from the 21st to the end of the month, after the method of Dr P. P. C. Hoek. These averages may be taken as an indication of the rate of growth. In the case of male fish, the ducts were always weighed with the testes. From one male, 7 lbs. weight, caught on 28th March, three testes were extracted, all of the same size and weighing together just over ¼ oz. The additional gland, which occupied a median position, had no duct, but was otherwise normal in structure. Up to the end of May, the testes of the male salmon are very small. During the succeeding two months they increase very little in size, but in the month of August there is a very rapid growth, after which there is again a gradual increase, until maturity is reached. Unfortunately very few fish could be examined in September and October. The rod season on the Tweed in the neighbourhood of Kelso was very poor. Throughout October the river was very low, no fish could get up, and those in the river were only taken with much difficulty; while a series of floods in the beginning of November enabled the fish to get far up the river at once. These exceptional circumstances caused a break in the observations, which in a normal season would never have occurred. Ordinarily I should have seen about 200 fish per week at Mr Steel's curing establishment in Kelso, whereas only 74 were got during the whole season. The genitalia of the female salmon increase from less than 1 per cent. of the body weight in March to about 20 per cent. at the spawning time. Up to the end of

June the rate of growth is very slow, in the earlier months almost imperceptible, but from July onwards an ever increasing energy of growth is maintained. Fittingly enough the last fish examined on the last day of November was spawned out, but from 24th to 29th November four ripe males were taken, as noted in Table I. A perfectly ripe female was not obtained. The genital organs of the male grilse appear to grow at nearly the same rate as those of the male salmon, while the ovaries of the female grilse lag a little way behind those of the female salmon.

My best thanks are due to Mr Steel, fishdealer, Kelso, for his uniform kindness in affording me every facility in examining his fish.

TABLE I.

Rate of growth of genitalia of Salmon and Grilse.

Male Salmon.								
Date.	Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
	inches.	inches.	lbs.	oz.	oz.			
March 12	30	5¾	8	0	¼	·19	·19	1
,, 19	26½	6½	11	12	< ¼	..	...	...
,, 28	31½	6	9	12	< ¼	...	...	...
,, ,,	28	5¼	7	0	¼ +	...	...	...
,, 31	26½	5	5	12	< ¼	...	...	...
April 12	30	5¾	8	8	¼ +	...	...	...
,, ,,	...	...	8	0	< ¼	..	...	...
,, 25	28	5	6	12	< ¼	...	...	...
,, 26	28¾	5½	7	0	< ¼	...	...	...
,, 28	27	5	5	4	< ¼	...	...	...
May 7	30	5	8	8	< ¼	...	...	...
,, 9	30	9	0	6	< ¼	...	...	...
,, 10	32	7	12	0	¼ +	...	...	...
,, 11	30	6	9	0	< ¼	...	...	...
,, 14	29½	5½	8	8	¼ +	...	...	...
,, ,,	29	5¼	7	0	< ¼	...	...	...
,, 16	29	6	8	0	< ¼	...	...	...
,, 17	30	5½	8	8	¼ +	..	...	...
,, ,,	31	6	9	0	¼ +	...	...	...
,, ,,	27½	5	6	0	< ¼	...	...	...
,, 21	28	5¼	6	8	< ¼	...	...	...
,, 22	29½	6	8	8	¼ +	...	...	...
,, 24	30½	6	8	12	¼	·17	...	...
,, ,,	29½	5½	6	12	¼	·23	...	...
,, ,,	30	6	8	12	¼	·17	...	...
,, 25	32	6½	10	12	⅜	·21	...	...
,, ,,	28½	5	7	0	< ¼	...	...	...
,, 26	32¾	6¼	10	8	⅜	·22	...	...
,, 28	29½	6	9	0	⅜	·26	·21	6
,, 29	31½	6¼	10	4	¼ +	...	...	...
,, 31	30	5¾	9	0	< ¼	...	...	...
June 1	31	6	9	4	⅜	·25	...	...
,, 2	30	5½	7	8	⅜	·31	...	...
,, 4	31	6½	10	0	¼	·15	...	...
,, 5	31½	6¼	10	4	⅜	·22	...	...
,, ,,	29	5	8	8	< ¼	...	...	...
,, 8	32	6½	11	8	⅜	·20	...	...
,, ,,	29	5½	8	4	⅜	·28	...	...
,, ,,	28	5	6	8	⅜	·36	·25	7
,, ,,	29½	6	8	0	< ¼	...	...	...
,, 9	28	5	6	8	< ¼	...	...	...
,, 11	30	5½	9	8	⅜	·24	...	...
,, 13	30	6½	9	12	⅜	·24	...	...
,, 15	30	6¼	10	0	⅜	·23	...	...
,, 16	30	6¼	8	12	⅜	·26	·24	4
,, 30	31½	6	10	0	⅜	·23	·23	1

+ = greater than. < = less than.

Male Salmon.									
Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
July	2	36½	6¾	14	8	¾	·32	...	...
,,	3	29	5¾	8	4	¼ +	...	...	...
,,	4	30½	6	9	0	⅝	·43	...	...
,,	,,	30½	5¾	8	12	½	·35	...	...
,,	5	31	6¼	10	8	⅜	·22	...	...
,,	,,	33½	7	14	0	¾	·33	...	...
,,	6	34	6½	12	8	¾	·37	...	...
,,	,,	31	6	10	4	⅜	·22	...	...
,,	9	31	5½	9	0	½	·34	·32	8
,,	10	29	6	8	12	¼ +	...	...	...
,,	,,	31	6	9	0	¼ +	...	...	...
,,	11	29½	5¾	8	4	⅜	·28	...	...
,,	,,	31	5¼	8	8	½	·36	...	...
,,	12	31½	6½	11	0	½	·28	...	...
,,	,,	32	6¼	11	0	⅜	·21	...	...
,,	13	31½	6	9	4	⅜	·25	...	...
,,	14	31	6¼	10	8	⅜	·22	...	...
,,	,,	32½	6½	11	8	⅜	·20	...	...
,,	,,	32	6¼	11	12	⅝	·33	...	...
,,	,,	31	6½	10	8	⅝	·37	...	...
,,	18	32	6½	10	12	1½	·87	...	...
,,	19	31½	5¾	10	0	⅜	·23	·32	11
,,	21	30½	5½	9	8	¾	·49	...	...
,,	24	31	5	8	0	¾	·58	...	...
,,	25	29	5¾	8	0	½	·38	...	...
,,	26	27½	5¾	8	0	½	·38	...	...
,,	27	30	6	9	8	⅝	·41	...	...
,,	28	33	6	11	8	⅝	·33	·42	6
Aug.	4	32½	6½	13	8	1⅜	·63	·63	1
,,	11	32½	6½	11	8	¾	·40	...	...
,,	,,	34½	6¾	13	12	2¼	1·02	...	...
,,	15	33½	7	14	0	4¾	2·12	...	..
,,	16	30½	6¼	10	4	1⅛	·68	...	...
,,	17	33½	6	11	8	3⅜	1·83	...	...
,,	18	34½	6½	14	0	4⅜	1·95	...	...
,,	20	30	5½	8	0	4¼	3·32	1·61	7
,,	21	32	6	11	0	4⅜	2·48	...	...
,,	,,	32	6½	12	0	2½	1·30	...	...
,,	23	33	6½	11	8	2	1·08	...	...
,,	24	33	6½	11	8	3⅞	2·10	...	...
,,	,,	31	7	12	0	5⅞	3·05	...	...
,,	,,	32	6½	11	8	7	3·80	...	...
,,	25	32½	6½	11	8	2¾	1·49	...	...
,,	27	28	6½	9	8	3½	2·65	...	...
,,	29	33	6½	12	12	1¾	·84	...	...
,,	,,	30½	6	10	12	2¾	1·59	...	...
,,	31	33	7	13	0	6⅞	3·30	...	...
,,	,,	33	6½	12	12	7¼	3·55	2·26	12
Sept.	7	32	6½	12	0	7⅜	3·84	...	...
,,	8	33¼	6¼	12	12	6½	3·18	3·51	2
,,	12	34	6½	13	0	3¼	1·56	...	...
,,	,,	34	7	14	4	5½	2·41	...	...
,,	,,	29½	6	10	8	3½	2·08	...	...
,,	13	32½	6½	11	8	6⅛	3·32	2·34	4
Oct.	23	32¼	6	6	12	5½	5·09	5·09	1

Male Salmon.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
Nov.	1	42½	9	26	8	11¾	2·77	2·77	1
,,	12	37	8	17	0	5¼	1·93	...	...
,,	,,	41	8¾	23	12	11¾	3·09	...	...
,,	,,	39½	8½	23	7	10¼	2·73	...	...
,,	13	34¾	7¾	15	8	7	2·82	...	...
,,	,,	39	7¾	19	0	9½	3·12	...	...
,,	,,	37	8	21	8	11½	3·34	...	...
,,	15	43½	9	27	0	12¼	2·83	...	...
,,	,,	41½	9½	25	14	11¾	2·83	...	..
,,	,,	37	7¾	16	14	11	4·07	...	...
,,	19	41	9	25	8	11¾	2·88	...	...
,,	,,	36	8¼	15	8	7	2·82	...	...
,,	,,	30	5¾	8	4	5¼	3·97	...	...
,,	,,	29¼	6½	9	4	6½	4·39	...	...
,,	,,	29½	6¾	10	4	7½	4·57	...	...
,,	,,	38¾	8½	20	2	13½	4·19	...	...
,,	,,	37	7	17	4	11¾	3·12	3·29	16
,,	21	37½	8¾	18	12	7¼	2·41	...	...
,,	,,	36½	7½	17	0	6¾	2·48	...	...
,,	,,	42	8¼	18	12	8	2·66	...	...
,,	,,	39	8½	20	0	8¾	2·73	...	...
,,	24	27½	5½	8	6	6¼	4·66	...	...
,,	,,	36½	7¾	18	4	8 [1]	2·71	...	...
,,	,,	35½	6¾	14	14	7¼	3·04	...	...
,,	,,	36	8	17	4	10¼	3·71	...	...
,,	,,	36½	7½	15	4	6½	2·66	...	...
,,	,,	40	9¾	26	12	13	3·03	...	...
,,	,,	37½	8½	22	12	9¾	2·67	...	...
,,	,,	36¾	8	19	0	7¼ [2]	2·38	...	...
,,	26	38	8¾	19	12	10½ [3]	3·32	...	...
,,	29	39	8	22	0	10¼	2·91	...	...
,,	,,	37½	7¾	19	0	9¾ [4]	3·20	...	...
,,	30	37½	8	17	12	9¼	3·25	...	...
,,	,,	38½	8	19	12	11¼	3·56	3·02	17

FEMALE SALMON.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
Mar.	3	35⅜	7⅛	15	4	1¾	·71	...	...
,,	6	33½	6½	12	0	2	1·04	...	...
,,	,,	27	4½	5	4	1	1·19	...	...
,,	,,	30	5¾	8	0	1¾	1·36	...	...
,,	9	29½	5½	7	8	1	·83	...	...
,,	10	29	4½	8	8	1¼	·91	1·00	6
,,	13	30¾	6	9	8	1¼	·82	...	...
,,	,,	28½	5½	7	8	¾	·62	...	...
,,	,,	29	5½	7	4	⅞	·75	...	...
,,	14	30	5¼	8	4	¾	·56	...	...
,,	15	27	5	6	0	⅞	·91	...	...
,,	,,	27½	5	5	12	¾	·81	...	...
,,	,,	30½	5½	8	8	1¼	·91	...	...
,,	17	24½	6½	13	8	1¾	·81	...	...
,,	,,	31½	6¾	10	0	1⅝	1·01	...	...
,,	19	26	5¼	7	0	⅞	·78	...	...
,,	20	30½	6½	10	4	1⅜	·83	·80	11

[1] Ripe—beginning to shed. [2] Ripe—half spent. [3] Ripe—beginning to shed.
[4] Both lobes of testis ripe—the left one half spent.

Female Salmon.

Date.	Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
	inches	inches.	lbs.	oz.	oz.			
Mar. 21	27½	6	6	4	¾	·75	...	...
,, ,,	29½	6	8	8	1⅜	1·01	...	...
,, 24	29½	5¾	8	8	¾	·55	...	...
,, ,,	28	5½	7	8	1	·83	...	...
,, 27	28½	5¼	7	0	1¼	1·11	...	...
,, 28	27½	5	6	4	¾	·75	...	...
,, 30	35	7	15	4	2¼	·92	...	...
,, ,,	28	5½	6	12	½	·46	...	...
,, ,,	26	4¾	5	0	⅞	1·09	...	...
,, ,,	28¾	5¾	8	8	¾	·55	...	...
,, 31	31½	6¼	10	4	1¼	·76	·79	11
April 2	29½	5¼	7	8	⅞	·72	...	...
,, 3	29½	5¾	8	12	¾	·46	...	...
,, ,,	38	8	19	0	4⅛	1·35	...	...
,, ,,	29	5½	7	12	⅞	·70	...	...
,, 4	35	6¾	14	0	2¼	1·00	...	..
,, ,,	30½	7	16	0	2½	·97	...	...
,, ,,	27	5	6	0	¾	·78	...	...
,, 6	30	5½	8	8	1½	1·10	...	...
,, 7	34½	6½	12	8	2¼	1·12	...	...
,, 9	29	5	7	0	⅞	·78	...	...
,, ,,	29	6	9	0	1⅜	·95	...	...
,, 10	29½	6	8	8	1	·73	·88	12
,, 11	29½	5½	8	0	1⅝	1·26	...	...
,, ,,	28½	5½	7	4	¾	·64	...	...
,, 12	31	6	10	0	1¾	1·09	...	...
,, ,,	30¾	6	9	0	1¼	·86	..	...
,, ,,	31½	6	10	0	1½	·93	...	...
,, ,,	30	5¾	8	8	1⅝	1·19	...	...
,, 13	30	6	8	12	1¼	·78	...	...
,, ,,	27¼	5¼	6	8	¾	·72	...	...
,, 14	29	6	8	8	¾	·55	...	...
,, 16	29	5	8	0	1¼	·97	...	...
,, 17	28½	5½	8	0	1¼	·97	...	...
,, 18	28	5	6	8	¾	·72	...	...
,, 20	29½	5½	7	8	1¼	1·04	·90	13
,, 21	27½	5½	6	12	1¼	1·15	...	...
,, 23	29½	5½	7	12	1⅛	·90	...	...
,, ,,	30½	6	10	0	1⅝	1·01	...	...
,, ,,	30½	6	9	8	1¼	·82	...	...
,, ,,	27½	5½	7	0	¾	·66	...	...
,, ,,	29½	5½	8	0	1¼	·97	...	...
,, 24	30	5¾	9	0	1½	1·04	...	...
,, ,,	30½	6½	10	8	1⅜	·81	...	...
,, 25	30	6	9	0	1¾	1·21	...	...
,, ,,	30	6	10	0	1¼	·78	...	...
,, ,,	38	7¾	20	4	2¼	·69	...	...
,, ,,	29½	5½	7	8	1¾	1·44	...	...
,, 26	28	5½	8	0	1¼	·97	...	...
,, 27	30	6	9	0	1½	1·04	...	...
,, 28	30½	5½	9	0	1½	1·04	...	...
,, 30	30¾	6	9	4	1½	1·01	...	...
,, ,,	29½	5½	7	0	¾	·66	·95	17
May 1	29	5½	7	8	1⅛	·93	...	...
,, ,,	31½	6	10	0	1¼	·78	...	...
,, ,,	27½	5¾	6	12	1⅝	1·5	...	...

Female Salmon.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
May	1	29	5½	8	0	1⅝	1·26	...	...
,,	,,	30½	5¾	9	0	1⅛	·78	...	...
,,	,,	31½	6½	11	12	1⅛	·59	...	...
,,	,,	31	6	10	0	1½	·93	...	...
,,	2	30	5½	8	8	1½	1·10	...	...
,,	3	30½	6	9	12	1⅝	1·04	...	...
,,	,,	30½	6	9	0	1½	1·04	...	...
,,	,,	29½	5½	8	0	1¼	·97	...	...
,,	,,	27	5	6	0	1½	1·56	...	...
,,	4	34	6½	12	0	2	1·04	...	...
,,	,,	30½	6¼	10	8	1¼	·74	...	...
,,	5	30½	6	9	0	1⅛	·78	...	...
,,	,,	28½	5	7	0	1⅛	1·	...	...
,,	7	30	6	9	8	1⅞	1·23	...	...
,,	8	31	6	9	8	1½	·98	...	...
,,	,,	30	5¾	8	12	⅞	·62	...	...
,,	,,	30½	6	10	4	1¾	1·06	...	...
,,	9	31	6	9	8	1½	·98	...	...
,,	10	26	5	5	8	1⅛	1·27	...	...
,,	,,	30	5½	8	8	2	1·47	...	...
,,	,,	31½	6½	11	8	1¾	·95	1·02	24
,,	11	30½	6	9	0	1⅝	1·12	...	...
,,	,,	28	5½	7	12	1¼	1·	...	...
,,	12	29½	6	9	0	1¼	·86	...	...
,,	,,	30½	6	9	0	1¼	·86	...	...
,,	,,	26½	5	6	8	1⅝	1·56	...	...
,,	14	31½	6	11	0	1¼	·71	...	...
,,	15	31½	6	10	0	1¼	·78	...	...
,,	16	31	6	9	8	1¼	·82	...	...
,,	17	29½	6	9	0	1¼	·86	...	...
,,	,,	30	6	9	8	2	1·31	...	...
,,	18	30	5½	8	8	1¾	1·28	...	...
,,	19	32	6½	11	0	2½	1·42	...	...
,,	,,	28	5	7	0	1½	1·33	...	...
,,	,,	31	6	10	0	1⅞	1·17	1·07	14
,,	21	29½	5¾	8	8	1¾	1·28	...	...
,,	22	31	6½	10	8	1⅜	·8	...	...
,,	23	30½	6	9	4	1¾	1·18	...	...
,,	,,	28	5½	6	8	¾	·72	...	...
,,	,,	30¼	6	9	4	1¼	·84	...	...
,,	,,	31½	6	10	0	1½	·93	...	...
,,	24	29½	5½	8	0	1¼	·97	...	...
,,	25	29	5½	8	0	1¼	·97	...	...
,,	,,	29	5¼	6	12	1¼	1·15	...	...
,,	26	32½	6½	12	0	1¾	·91	...	...
,,	28	30	5½	8	4	1½	1·13	...	...
,,	29	29½	6	9	0	2	1·38	...	...
,,	,,	31	6½	10	8	1¾	1·04	...	...
,,	30	29½	6½	8	8	1¾	1·28	...	...
,,	31	31¾	5½	9	4	2¼	1·52	1·07	15
June	2	29½	5¾	8	12	1⅞	1·33	...	...
,,	,,	30½	6	10	8	1¼	·74	...	...
,,	,,	28½	5½	8	4	2	1·51	...	...
,,	4	30½	6	9	12	2¼	1·44	...	...
,,	,,	29	5¾	8	4	2½	1·89	...	...
,,	,,	26¾	6	6	0	¾	·78	...	...
,,	,,	32	6	9	12	2½	1·60	...	...

Female Salmon.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
June	4	29½	6	9	4	1⅞	1·26	...	...
,,	5	30	6	9	0	2	1·38	...	...
,,	,,	31	6½	10	8	3	1·78	...	...
,,	,,	31	6	9	8	2	1·31	...	...
,,	,,	29	6	9	8	2⅜	1·56	...	...
,,	,,	29	5¾	7	8	1¾	1·45	...	...
,,	,,	28	5½	8	4	2¼	1·70	...	...
,,	,,	27	4¾	5	12	1¼	1·90	...	...
,,	6	29½	6	9	0	1¾	1·21	...	...
,,	7	29½	5¾	8	0	2	1·56	...	...
,,	,,	31	6	10	4	2⅜	1·44	...	...
,,	,,	30	5¾	8	0	1½	1·17	...	...
,,	,,	31	6	9	8	3½	2·3	...	...
,,	8	31½	6¾	10	8	1¾	1·04	...	...
,,	,,	29½	6	8	8	1⅞	1·37	...	...
,,	,,	32½	6¼	11	8	2⅞	1·56	...	...
,,	,,	32	6½	11	12	2	1·06	...	...
,,	9	30	6¼	9	8	1⅝	1·06	...	...
,,	,,	30½	6	9	8	2¼	1·48	1·41	26
,,	11	30½	5½	8	4	2½	1·89	...	...
,,	12	28½	5½	7	4	1¾	1·5	...	...
,,	,,	29	8	5	8	2⅛	2·41	...	...
,,	,,	32	6½	11	8	2¾	1·49	...	...
,,	,,	30½	6	9	8	1¾	1·15	...	...
,,	,,	31	6¼	10	8	2⅞	1·71	...	...
,,	13	28	5¾	8	0	1¾	1·36	...	...
,,	,,	28½	5½	6	8	1¼	1·2	...	...
,,	14	28	5½	7	0	1⅝	1·45	...	...
,,	,,	30½	6	9	8	2¼	1·48	...	...
,,	,,	32½	6¾	12	0	3	1·56	...	...
,,	,,	29¾	5½	8	0	1½	1·17	...	...
,,	15	30½	6	10	0	2¼	1·46	...	...
,,	,,	30	6	9	0	2¼	1·56	...	...
,,	,,	28½	5¼	7	0	1⅜	1·22	...	...
,,	16	32	6	10	0	2¼	1·46	...	...
,,	,,	32	6	10	8	1¾	1·04	...	...
,,	,,	31½	6½	10	12	3	1·74	...	...
,,	,,	28	5	6	8	1¾	1·68	...	...
,,	,,	29	5¾	8	12	2⅛	1·51	...	...
,,	,,	31½	6	10	12	2¾	1·59	...	...
,,	,,	31	6½	11	0	3⅝	2·08	...	...
,,	,,	28	5½	7	8	1¾	1·45	...	...
,,	18	31½	6¼	11	0	2⅝	1·49	...	...
,,	,,	29½	5½	8	0	1½	1·17	...	...
,,	,,	32½	6½	11	8	3½	1·90	...	...
,,	,,	29	5½	8	0	2¼	1·75	...	...
,,	,,	32	6¼	11	4	3	1·66	...	...
,,	,,	30½	6	9	12	2⅞	1·84	...	...
,,	19	32½	6¾	12	8	3⅞	1·92	...	...
,,	,,	30	6	9	8	2½	1·64	...	...
,,	,,	30	6¼	10	8	1½	·89	...	...
,,	,,	31	6	9	0	2½	1·73	...	...
,,	,,	31	6	9	0	2	1·38	...	...
,,	20	32	6¼	11	8	3½	1·90	...	...
,,	,,	31	6	9	12	2½	1·60	...	...
,,	,,	28½	5¼	7	8	1⅜	1·14	...	...
,,	,,	31½	6	10	8	2½	1·48	...	...
,,	,,	28½	5½	8	0	2⅛	1·66	1·54	39

Female Salmon.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
June	21	32	6½	10	12	2½	1·45	...	...
,,	,,	30¾	6	9	0	2⅛	1·47	...	...
,,	,,	31½	6	9	8	2¼	1·48	...	...
,,	,,	30	6	9	4	1¾	1·18	...	...
,,	,,	28	5¼	6	4	1¾	1·75	...	...
,,	,,	30½	6	9	4	1½	1·01	...	...
,,	22	33	6¾	12	0	5	2·60	...	...
,,	,,	32½	6¼	10	4	4⅛	2·51	...	...
,,	,,	30½	6	10	0	3⅜	2·10	...	...
,,	,,	32½	5¾	10	8	4	2·37	...	...
,,	,,	31	6	10	12	3¾	2·20	...	...
,,	,,	30	6	9	8	3½	2·30	...	...
,,	23	31	6	10	0	2⅜	1·48	...	...
,,	,,	31½	6½	11	0	3	1·70	...	...
,,	,,	28	5½	7	8	2	1·66	...	...
,,	,,	30	6	9	8	2½	1·64	...	...
,,	30	32	6½	11	8	3¾	2·03	...	...
,,	,,	30	5¾	9	8	2⅜	1·56	1·80	18
July	2	28½	5½	8	0	2½	1·95	...	...
,,	3	30½	6¼	10	0	3	1·87	...	...
,,	,,	33	7	13	0	3¼	1·56	...	...
,,	,,	32	6	10	4	3½	2·13	...	...
,,	,,	30	5½	7	12	2¾	2·21	...	...
,,	,,	30	6	9	4	2¾	1·85	...	...
,,	4	30	6	9	8	3¾	2·46	...	...
,,	,,	30	6	10	4	3⅛	1·90	...	...
,,	,,	31½	6¾	11	0	4⅞	2·77	...	...
,,	5	33½	6½	13	4	4¼	2·00	...	...
,,	,,	30½	6	9	4	2½	1·67	...	...
,,	,,	29	5½	7	12	1⅜	1·10	...	...
,,	,,	28½	5¾	7	12	2⅝	2·11	...	...
,,	,,	29½	6	9	4	3¼	2·19	...	...
,,	,,	32	6¼	11	8	4⅞	2·64	...	...
,,	,,	31	6½	10	8	4⅝	2·75	...	...
,,	,,	30½	6	9	8	3⅝	2·38	...	...
,,	,,	30	6	9	0	3½	2·43	...	...
,,	6	29	5½	8	8	2¾	2·02	...	...
,,	7	30	5½	8	0	3¼	2·53	...	...
,,	9	32	6	11	0	5¼	2·95	...	...
,,	,,	33½	6	11	0	4½	2·55	...	...
,,	,,	29½	5½	9	0	2¾	1·90	...	...
,,	,,	31½	6	10	8	4¾	2·82	...	...
,,	10	30	5¾	9	8	3¾	2·46	2·20	25
,,	11	33½	6½	12	8	4⅞	2·43	...	...
,,	,,	29½	5½	8	0	3¼	2·54	...	...
,	,,	29½	5	8	0	3	2·34	...	...
,,	,,	31	6	10	0	3	1·87	...	...
,,	12	31½	5½	9	0	3½	2·43	...	...
,,	,,	30½	5½	8	0	3⅝	2·83	...	...
,,	,,	30½	5¾	9	4	2½	1·68	...	...
,,	,,	32	6¼	11	4	4⅜	2·43	...	...
,,	13	32	6½	12	8	5¼	2·62	...	...
,,	,,	29½	5½	8	12	3⅜	2·41	...	...
,,	,,	33½	7	13	12	4	1·81	...	...
,,	,,	30½	6¼	10	4	4	2·43	...	...
,,	,,	31	6	9	4	4	2·70	...	...
,,	14	32	7	11	12	4½	2·39	...	...

Female Salmon.									
Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
July	14	31	5¾	9	8	5⅝	3·37	...	...
,,	,,	31½	6	9	8	3⅞	2·54	...	...
,,	,,	29½	5¾	8	12	3¼	2·32	...	...
,,	,,	31	6	10	8	3¼	1·93	...	...
,,	,,	29½	6	8	8	4¼	3·12	...	...
,,	,,	31	6½	10	8	3½	2·08	...	...
,,	,,	30	5¾	9	8	2¾	1·80	...	...
,,	,,	29	5½	8	8	3	2·20	...	...
,,	16	30	5½	8	8	2½	1·83	...	...
,,	,,	30½	5¾	9	4	3½	2·35	...	...
,,	,,	31½	6¼	9	8	3½	2·30	...	...
,,	17	33	6½	12	8	6	3·	...	...
,,	,,	31	6½	11	8	3⅞	2·08	...	...
,,	,,	30	5½	9	0	3¼	2·25	...	...
,,	,,	32	6¼	10	8	4¼	2·53	...	...
,,	18	31	6	10	0	5⅜	2·36	...	...
,,	,,	29	5¾	8	8	3½	2·57	...	...
,,	19	31½	6	10	4	5⅝	3·43	...	...
,,	,,	31	6½	11	8	5¾	3·12	...	...
,,	,,	30	5¾	8	12	2¾	1·71	...	...
,,	,,	32	6¼	11	4	7	3·88	...	...
,,	,,	26	5¾	8	8	4⅛	3·05	2·46	36
,,	23	...	...	13	0	4½	2·16	...	...
,,	,,	31½	5¾	10	0	3⅞	2·42	...	...
,,	,,	35½	7	14	12	7½	3·17	...	...
,,	,,	32½	6½	11	8	5⅛	2·78	...	...
,,	24	39½	6½	14	0	6⅞	3·06	...	...
,,	,,	31	6¼	11	4	3½	1·94	...	...
,,	,,	32¾	6	11	0	4⅜	2·48	...	...
,,	25	33½	6¼	12	12	4¾	2·32	...	...
,,	,,	33½	6½	12	12	5¼	2·57	...	...
,,	26	30	5½	9	12	3⅝	2·32	...	...
,,	,,	32½	6	11	8	2¼	1·22	...	...
,,	,,	30	6	10	0	2¾	1·71	...	...
,,	,,	32½	6½	12	8	4	2·	...	...
,,	27	31½	6	10	4	3¾	2·28	...	...
,,	,,	32	6	10	12	7½	4·41	...	...
,,	,,	31	5½	9	0	5⅛	3·55	...	...
,,	28	32½	6½	12	12	4⅝	2·26	...	...
,,	,,	31½	6	10	8	3¾	2·23	...	...
,,	,,	29	5½	8	0	2⅞	2·24	...	...
,,	,,	30	5½	9	4	5⅝	3·80	...	...
,,	30	31	5½	8	12	4½	3·21	...	...
,,	,,	32½	6¾	12	12	7¼	3·55	...	...
,,	,,	32½	6	11	0	6⅜	3·62	...	...
,,	31	32	6	12	0	6⅞	3·58	2·70	24
Aug.	2	28½	5	9	0	2¾	1·90	...	...
,,	,,	32½	6½	12	8	7¼	3·62	...	...
,,	,,	33½	6½	12	8	6¾	3·37	...	...
,,	,,	32	6¼	11	4	6¼	3·47	...	...
,,	,,	30½	6	10	4	5⅝	3·43	...	...
,,	3	38	8¼	22	8	8⅞	2·46	...	...
,,	,,	32½	6	11	0	3½	1·98	..	...
,,	,,	32½	6½	15	0	6½	2·70	...	...
,,	4	32	6	10	0	6	3·75	...	...
,,	,,	30½	5½	9	0	6⅝	4·61	...	...
,,	,,	32	6¼	12	0	4¼	2·21	...	...

Female Salmon.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
Aug.	4	30½	6¼	10	8	6½	3·87	...	...
,,	6	33	6½	13	0	9½	4·56	...	...
,,	,,	34	7¼	16	8	12⅞	4·87	...	...
,,	7	31½	6½	10	12	6⅛	3·56	...	...
,,	,,	30½	5½	9	4	5¾	3·88	...	...
,,	10	35	6	12	8	8¼	4·12	...	...
,,	,,	32	6	10	8	8⅝	5·13	...	...
,,	,,	33	7	14	0	8¾	3·90	3·54	19
,,	11	32½	5¾	10	0	6⅛	3·82	...	...
,,	,,	35	6¾	14	0	7½	3·34	...	...
,,	,,	31½	6	10	0	6½	4·06	...	...
,,	14	34	6½	14	0	6½	2·90	...	...
,,	,,	35	6	11	0	8¾	4·97	...	...
,,	15	32	5¾	9	12	7⅞	5·05	...	...
,,	16	31½	5½	9	0	2¼	1·56	...	...
,,	,,	33	6	11	8	9¾	5·29	...	...
,,	,,	33½	6¾	14	4	6⅝	2·90	...	...
,,	17	33	7	13	0	5¾	2·76	...	...
,,	,,	34	6¾	13	0	9	4·32	...	...
,,	,,	33¾	6½	12	8	7⅛	3·56	...	...
,,	,,	32½	7	13	4	6⅛	2·88	...	...
,,	,,	31½	6	10	8	6¼	3·72	...	...
,,	18	31	5½	9	0	6⅝	4·60	...	...
,,	20	32½	6¼	12	4	5	2·55	...	...
,,	,,	33½	6¾	12	4	14½	7·40	...	...
,,	,,	31	6	10	4	7	4·26	3·88	18
,,	21	34	6½	15	0	6⅝	2·76	...	...
,,	,,	29	6	9	0	3	2·08	...	...
,,	,,	32½	6½	11	8	7½	4·07	...	...
,,	,,	38½	8	21	0	14¼	4·24	...	...
,,	,,	30	5¾	8	12	4¾	3·39	...	...
,,	,,	32½	6	11	8	12⅛	6·52	...	...
,,	22	32	6½	11	8	7⅛	3·87	...	...
,,	23	33	6½	12	4	9⅝	4·22	...	...
,,	24	34	7	13	12	15	6·82	...	...
,,	25	31	6	10	8	10⅛	6·02	...	...
,,	27	32½	6¼	12	4	13½	6·88	...	..
,,	28	31	6½	10	12	9¼	5·37	...	...
,,	,,	34	6¾	13	12	7⅛	3·23	...	...
,,	,,	35	7	15	8	10½	4·23	...	...
,,	30	34	7	14	8	7¼	3·12	4·45	15
Sept.	1	32	6	12	8	5¼	2·62	...	...
,,	,,	33	5½	10	8	11⅝	6·91	...	...
,,	,,	33	6½	11	8	8	4·34	...	...
,,	,,	28	5½	8	4	4¾	3·59	...	...
,,	3	33½	6¼	11	12	4¾	2·52	...	...
,,	5	33	6	10	12	8¼	4·79	...	...
,,	6	34	6¾	14	4	14⅜	6·30	...	...
,,	7	33	5	10	0	13⅛	8·20	...	...
,,	10	31½	6¼	11	0	17¼	9·80	...	...
,,	,,	31	6	10	0	11¾	7·34	...	...
,,	,,	30	6	10	4	4	2·43	5·34	11
,,	11	33½	6½	13	8	12⅝	5·84	...	...
,,	,,	33	6	11	0	7¼	4·12	...	...
,,	12	36	6½	14	0	11⅝	5·24	...	...
,,	,,	32	6	10	8	13⅛	7·81	...	...
,,	,,	32½	6½	11	12	13¼	7·05	...	...

Female Salmon.

Date.	Length of fish.	Breadth of fish.	Weight of fish.	Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
	inches.	inches.	lbs. oz.	oz.			
Sept. 12	33½	6¼	12 8	9¾	4·87	...	...
,, ,,	33	6	11 12	8⅝	4·60	...	...
,, 14	31½	7½	11 8	9½	5·17	...	...
,, ,,	34	6½	12 8	12¼	6·12	5·64	9
Nov. 8	34½	7½	14 12	3 0¾	20·66	20·66	1
,, 12	38	8¼	17 8	2 7½	14·14	...	...
,, ,,	33½	7¼	13 8	1 8½	11·36	...	...
,, ,,	40½	9½	24 10	5 6¾	22·02	...	...
,, ,,	36	7¾	15 6	2 10	17·09	...	...
,, ,,	35	8	17 9½	2 2	12·09	...	...
,, ,,	35½	8	17 0	3 5¼	19·60	...	...
,, 13	34½	7½	16 0	2 4¼	14·16	...	...
,, ,,	42½	9	27 8	4 11¾	17·24	...	...
,, ,,	38	8	18 4	3 12½	20·74	...	...
,, ,,	38½	8½	23 8	3 11½	15·84	...	...
,, ,,	40½	9	25 12	3 0	11·65	...	...
,, 14	33¼	6¼	12 8	2 12½	21·21	...	...
,, 15	34½	7½	14 4	4 7	31·15	...	...
,, 19	32½	7½	13 12	2 3¼	16·02	...	...
,, ,,	34½	7½	15 4	2 1	13·53	...	...
,, ,,	38½	8½	17 12	3 12½	21·32	17·44	16
,, 21	34	7½	14 8	2 12	18·97	...	...
,, ,,	41	8¾	25 0	4 10¼	18·58	...	...
,, ,,	32	7	12 4	2 2½	17·60	...	...
,, ,,	32½	7½	14 3	2 3½	15·64	...	...
,, ,,	33½	7¼	13 12	2 1¼	15·12	...	...
,, 24	35	5⅝	15 0	2 7½	16·47	...	...
,, 26	42	9½	29 4	4 7½	15·29	...	...
,, ,,	32	6¾	13 0	2 8¾	19·60	...	...
,, 29	38	8	21 0	3 5¾	16·	...	...
,, ,,	35	6¾	14 4	2 13¾	20·08	...	...
,, ,,	35½	8½	16 8	3 0	18·18	...	...
,, 30	33¾	7	13 0	2 3½	17·09	...	...
,, ,,	33	7	14 4	2 11¾	19·19	...	...
,, ,,	36½	7¾	16 8	3 1½	18·76	...	...
,, ,,	34½	7¼	15 0	2 5	15·43	...	...
,, ,,	32½	6¼	11 4	2 0¼	17·92	...	...
,, ,,	31½	6½	10 0	2 6½	24·09	...	...
,, ,,	34	7	13 0	2 6¼	18·41	...	...
,, ,,	36½	7½	16 0	2 12¾	17·48	17·88	19
,, ,,	31½	5¾	9¾ [1]	...	...	...	...

Male Grilse.

Date.	Length of fish.	Breadth of fish.	Weight of fish.	Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
June 2	23¼	4¼	3 12	< ¼	...	...	...
,, ,,	19	3½	2 4	< ¼	...	...	...
,, 12	24	4½	3 4	< ¼	...	...	...
,, ,,	22	4½	3 8	< ¼	...	...	...
,, 14	21½	4¼	3 8	< ¼	...	...	...
,, 18	25	4¾	5 4	< ¼	...	...	...
,, 19	26	4½	4 12	< ¼	...	...	...
,, 20	24½	4¾	5 0	< ¼	...	...	...
,, 30	26	5	6 0	< ¼	...	...	..

[1] Spawned.

Male Grilse.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
July	6	24	4½	4	12	¼	·32	...	...
,,	7	28	5½	7	0	¼	·22	...	...
,,	,,	25½	5	5	12	¼	·27	·27	3
,,	10	22½	4½	4	0	< ¼	...	...	...
,,	12	26	4¾	5	8	< ¼	...	...	...
,,	19	25	5½	6	4	< ¼	...	...	...
,,	21	24	4½	4	8	½	·69	...	...
,,	,,	21½	5	6	0	< ¼	...	...	...
,,	23	24½	4¾	5	4	¼	·29	...	...
,,	26	26½	6	7	8	⅜	·31	...	...
,,	,,	25¼	4¾	5	4	½	·59	...	...
,,	27	24½	4¾	5	0	< ¼	...	..	...
,,	,,	26	4½	5	0	⅜	·46	...	...
,,	,,	26½	5½	6	8	¼	·24	...	...
,,	28	25	4½	4	12	¼ +	...	...	...
,,	,,	23½	4½	4	8	⅜	·52	...	...
,,	,,	25½	4½	5	8	¼	·28	...	...
,,	,,	24	5	5	8	< ¼	..	...	...
,,	30	30	5	7	8	1¼	1·04	...	...
,,	,,	30	5	7	4	2½	2·15	·65	10
,,	,,	25½	5¼	5	12	¼ +	...	...	...
,,	31	26½	5½	7	0	¼ +	...	...	...
,,	,,	26	5½	6	0	¼ +	...	...	...
August	2	27	5½	7	0	¼ +	...	...	...
,,	,,	26	5	6	0	¼ +	...	...	...
,,	,,	26½	5½	6	4	¼ +	...	...	...
,,	4	27½	5½	7	0	¼ +	...	...	...
,,	,,	27	5½	6	12	1	·92	...	...
,,	,,	25¼	5¼	5	12	¾	·81	...	...
,,	,,	26	5½	5	12	⅝	·67	...	...
,,	,,	25	5	5	8	¼ +	...	...	...
,,	,,	25	5	5	0	¼ +	...	...	...
,,	6	27	5	6	8	⅜	·36	...	...
,,	7	27½	5½	7	0	¾	·66	·68	5
,,	10	26	4½	5	0	¼ +	...	...	...
,,	11	26	5	7	0	2¼	2·00	...	..
,,	14	28	5½	7	8	¼ +	...	...	...
,,	16	26	5½	7	8	1¼	1·04	...	...
,,	,,	28	6	8	0	1⅜	1·07	...	...
,,	,,	27	5	6	0	¾	·78	...	...
,,	,,	27	6	7	0	2	1·78	...	...
,,	18	25	4½	5	8	¾	·85	...	...
,,	,,	27	5	6	4	½	·5	...	...
,,	20	26	5	5	12	⅝	·67	...	...
,,	,,	28	5¾	8	0	¾	·58	1·03	9
,,	21	28½	6	8	4	1¾	1·32	...	...
,,	,,	30	5	7	4	1¼	1·07	...	...
,,	,,	27	6	7	4	6⅞	6·13	...	...
,,	22	26½	5	6	8	2¾	2·64	...	...
,,	,,	27½	5½	7	8	4¼	3·54	...	...
,,	23	27	5½	7	0	¾	·66	...	...
,,	24	26	5½	6	12	¾	·69	...	...
,,	,,	29	6	7	4	¾	·64	...	...
,,	,,	26	5½	6	8	1½	1·44	...	...
,,	,,	26	5½	6	4	¾	·75	...	...
,,	25	29½	6½	9	0	3¼	2·25	...	...
,,	,,	24	5	5	0	1⅝	2·03	...	...

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
Male Grilse.									
		inches.	inches.	lbs.	oz.	oz.			
Aug.	25	$26\frac{1}{2}$	5	5	8	$1\frac{1}{4}$	1·41	...	...
,,	28	26	5	6	8	$1\frac{1}{4}$	1·20	...	...
,,	,,	27	$5\frac{1}{2}$	5	12	$\frac{1}{2}$	·54	...	...
,,	31	27	$5\frac{1}{2}$	7	0	$1\frac{1}{4}$	1·11	1·71	16
Sept.	5	27	$5\frac{1}{4}$	6	8	$3\frac{1}{2}$	3·36	...	...
,,	,,	26	$4\frac{1}{2}$	6	0	$1\frac{5}{8}$	1·69	...	...
,,	7	25	$5\frac{1}{2}$	6	0	$1\frac{5}{8}$	1·69	...	...
,,	8	27	6	7	4	$4\frac{3}{4}$	4·09	...	...
,,	,,	29	5	9	0	$7\frac{1}{2}$	5·20	...	...
,,	,,	25	5	6	0	$1\frac{3}{4}$	1·82	...	...
,,	10	$27\frac{1}{2}$	$5\frac{1}{4}$	7	4	$2\frac{5}{8}$	2·26	2·87	7
,,	11	27	5	7	0	$\frac{3}{4}$	·66	...	...
,,	12	28	6	weight not given		$5\frac{3}{4}$	...	...	...
,,	13	28	$5\frac{1}{2}$	6	12	$3\frac{5}{8}$	3·35	...	...
,,	,,	28	$5\frac{1}{2}$	7	0	$3\frac{1}{4}$	2·90	...	...
,,	14	$24\frac{1}{2}$	$4\frac{1}{2}$	4	0	$2\frac{3}{8}$	3·71	...	...
,,	,,	$29\frac{1}{2}$	6	8	0	$3\frac{1}{8}$	2·44	...	...
,,	,,	29	5	6	0	$2\frac{7}{8}$	2·99	2·67	6
Female Grilse.									
May	19	$21\frac{1}{2}$	4	3	0	$<\frac{1}{4}$	...	...	...
,,	25	22	$4\frac{1}{2}$	3	4	$\frac{1}{4}$	·48	·48	1
June	2	$22\frac{3}{4}$	$4\frac{1}{4}$	3	12	$<\frac{1}{4}$	...	...	...
,,	4	$21\frac{1}{2}$	$3\frac{1}{4}$	3	4	$\frac{1}{4}$	·48	·48	1
,,	12	22	$4\frac{1}{4}$	3	0	$\frac{3}{8}$	·78	...	...
,,	13	25	$4\frac{1}{4}$	4	0	$\frac{3}{8}$	·58	·68	2
,,	21	29	$4\frac{1}{2}$	4	0	$\frac{3}{4}$	1·17	...	...
,,	,,	25	$4\frac{1}{2}$	5	0	$\frac{3}{4}$	·93	...	...
,,	29	$23\frac{1}{2}$	$4\frac{1}{2}$	3	12	$<\frac{1}{4}$	...	...	...
,,	30	$24\frac{1}{2}$	$4\frac{3}{4}$	5	0	$\frac{3}{4}$	·93	...	...
,,	,,	$24\frac{1}{2}$	$4\frac{3}{4}$	5	0	$\frac{3}{4}$	·93	...	...
,,	,,	$26\frac{1}{2}$	$5\frac{1}{2}$	7	0	$1\frac{1}{4}$	1·11	1·01	5
July	2	$24\frac{1}{2}$	$5\frac{1}{2}$	5	8	$\frac{5}{8}$	·71	...	...
,,	,,	$23\frac{1}{2}$	$4\frac{1}{2}$	4	8	$1\frac{3}{4}$	2·43	...	...
,,	,,	$23\frac{1}{2}$	5	5	4	$\frac{3}{4}$	·89	...	...
,,	3	26	5	5	8	$\frac{3}{4}$	·85	...	...
,,	,,	$25\frac{1}{2}$	5	8	8	1	·73	...	...
,,	4	25	$5\frac{1}{2}$	6	8	$\frac{3}{4}$	·72	...	...
,,	,,	26	$5\frac{1}{4}$	6	0	$1\frac{1}{4}$	1·30	...	...
,,	,,	$24\frac{1}{2}$	5	5	8	$\frac{3}{4}$	·85	...	..
,,	5	26	5	5	12	$\frac{3}{4}$	·81	...	...
,,	6	26	5	6	0	$1\frac{1}{4}$	1·30	...	...
,,	,,	24	$4\frac{1}{2}$	4	12	1	1·31	...	...
,,	,,	25	$4\frac{3}{4}$	5	4	$\frac{3}{4}$	·89	...	...
,,	7	26	5	5	8	$\frac{7}{8}$	·99	...	...
,,	9	$26\frac{1}{2}$	$5\frac{3}{4}$	6	12	$1\frac{3}{4}$	1·62	...	...
,,	,,	$24\frac{1}{2}$	$4\frac{3}{4}$	5	4	$1\frac{5}{8}$	1·93	...	...
,,	,,	26	$5\frac{1}{2}$	6	8	$1\frac{1}{4}$	1·20	...	...
,,	10	24	$4\frac{3}{4}$	5	0	$\frac{3}{4}$	·93	1·14	17

Female Grilse.

Date.		Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
		inches.	inches.	lbs.	oz.	oz.			
July	11	25	5½	5	8	1¼	1·42	...	...
,,	,,	25½	5¾	5	0	1¼	1·56	...	...
,,	,,	32	5	6	8	1¼	1·20	...	...
,,	12	25	3	5	8	⅞	·99	...	...
,,	,,	26	5	5	8	1¼	1·42	...	...
,,	,,	26	5	6	4	1¼	1·25	...	...
,,	,,	26	5½	6	4	1¼	1·25	...	...
,,	13	24	5	5	12	1¾	1·90	...	...
,,	14	24½	5	5	4	¾	·89	...	...
,,	,,	27	5	6	4	1¼	1·25	...	...
,,	,,	26	4½	5	8	¾	·85	...	...
,,	17	25½	5	6	4	1½	1·50	...	...
,,	18	29	5	7	4	2½	2·15	...	...
,,	,,	26	5¼	6	4	1¼	1·25	...	...
,,	19	25	5	5	12	1⅛	1·22	...	...
,,	,,	25	5	5	4	1⅜	1·63	1·35	16
,,	21	24½	5½	5	0	1¼	1·56	...	...
,,	23	25	5	5	12	1¼	1·35	...	...
,,	,,	24½	4¾	4	12	¾	·98	...	...
,,	,,	25	5½	4	12	1⅛	1·47	...	...
,,	,,	25	4¾	5	4	1¼	1·48	...	...
,,	24	24	4½	4	8	1⅜	1·90	...	...
,,	,,	25	5	5	8	1⅛	1·27	...	...
,,	,,	21	4½	5	0	¾	·93	...	...
,,	28	25	4½	5	0	2¼	2·81	...	...
,,	,,	27	5	6	8	2	1·92	...	...
,,	,,	26	5	6	0	1½	1·56	...	...
,,	,,	27½	6	7	12	1¼	1·00	...	...
,,	,,	25½	4¾	5	4	⅝	·74	...	...
,,	,,	26½	4¾	6	4	1¾	1·80	...	...
,,	,,	26	5	5	12	2¼	2·44	...	...
,,	31	26	5	5	8	1¾	1·98	1·57	16
Aug.	3	25½	5	5	12	2¼	2·44	...	...
,,	4	25	5	5	12	1½	1·63	...	...
,,	,,	27¾	5½	7	8	3¼	2·70	...	...
,,	,,	25½	5	5	12	3⅛	3·39	...	...
,,	,,	25	5¼	6	4	1¼	1·25	...	...
,,	6	26	5	6	0	1⅜	1·43	...	...
,,	7	27½	6	8	4	2	1·51	...	...
,,	,,	25½	5	6	8	1½	1·44	1·97	8
,,	14	29	5½	8	0	3¼	2·53	...	...
,,	,,	25	4½	5	0	1¼	1·56	...	...
,,	,,	26	5½	6	0	1¾	1·82	...	...
,,	,,	26	5	6	0	2⅛	2·21	...	...
,,	15	25	5¼	5	12	1⅝	1·76	...	...
,,	,,	27	5	5	8	2¼	2·55	...	...
,,	,,	26	5	5	0	2¼	2·81	...	...
,,	16	27	5½	5	0	3¼	4·06	...	...
,,	,,	27½	5½	7	8	3⅝	3·02	...	...
,,	17	26	5¼	6	8	2⅞	2·76	...	...
,,	,,	26	5	6	0	2¾	2·86	...	...
,,	,,	26½	5¼	6	0	5¾	5·99	...	...
,,	18	30	5¼	7	8	5½	4·58	...	...
,,	,,	23	4	4	8	1¾	2·43	...	...
,,	20	28	5½	7	8	2¼	1·87	2·85	15
,,	21	29½	6	9	0	2⅜	1·64	...	...
,,	,,	25	5½	5	4	2⅛	2·53	...	...

Female Grilse.								
Date.	Length of fish.	Breadth of fish.	Weight of fish.		Weight of genitalia.	Percentage of weight of genitalia to weight of fish.	Averages over 10 day periods.	Number of fish on which average based.
	inches.	inches.	lbs.	oz.	oz.			
Aug. 21	25	5	5	0	$3\frac{1}{8}$	3·90	...	...
,, ,,	$27\frac{1}{2}$	$5\frac{1}{2}$	7	0	$3\frac{1}{2}$	3·12	...	...
,, 22	24	$4\frac{1}{2}$	4	8	$1\frac{1}{2}$	2·08	...	...
,, ,,	27	6	7	0	2	1·78	...	...
,, ,,	25	$5\frac{1}{2}$	6	0	$1\frac{3}{8}$	1·43	...	...
,, ,,	27	$5\frac{1}{2}$	7	0	$2\frac{1}{2}$	2·23	...	...
,, 23	25	5	6	8	$2\frac{1}{2}$	2·40	...	...
,, 24	27	6	8	0	$3\frac{1}{4}$	2·53	...	...
,, 25	$27\frac{1}{2}$	6	7	0	$3\frac{1}{4}$	2·66	...	...
,, 27	27	$5\frac{1}{2}$	7	8	3	2·5	...	...
,, ,,	25	5	5	8	$1\frac{1}{4}$	1·42	...	...
,, ,,	28	$5\frac{1}{2}$	7	8	$3\frac{1}{2}$	2·91	...	...
,, 29	$26\frac{1}{2}$	$5\frac{1}{4}$	6	0	$2\frac{3}{4}$	2·86	...	...
,, 30	27	6	7	8	5	4·16	...	...
,, ,,	26	5	6	4	$2\frac{1}{4}$	2·25	...	...
,, 31	25	$5\frac{1}{2}$	6	0	3	3·12	...	..
,, ,,	$27\frac{1}{2}$	$5\frac{1}{2}$	6	8	$2\frac{7}{8}$	2·76	2·54	19
Sept. 1	27	$5\frac{1}{2}$	6	0	$3\frac{1}{2}$	3·64	...	...
,, ,,	25	$5\frac{3}{4}$	5	4	$2\frac{1}{2}$	2·97	...	...
,, ,,	$26\frac{1}{2}$	$5\frac{1}{4}$	6	8	$3\frac{3}{8}$	3·24	...	...
,, 4	27	6	7	8	$4\frac{1}{4}$	3·54	...	...
,, 5	...	...	8	0	5	3·47	...	...
,, 8	26	$5\frac{1}{2}$	6	4	$4\frac{3}{4}$	4·75	3·60	6
,, 12	$28\frac{1}{2}$	6	8	12	$7\frac{3}{8}$	5·26	...	...
, ,,	27	5	7	0	6	5·35	...	...
,, 13	$27\frac{1}{2}$	$5\frac{1}{4}$	7	0	$3\frac{7}{8}$	3·46	...	...
,, 14	$27\frac{1}{2}$	$5\frac{1}{2}$	7	8	$3\frac{1}{2}$	2·91	4·24	4

Salmon Food.

The stomachs of 727 fish were opened at the Company's Fish House. Of this number only 45 contained food recognisable as such. The food was preserved and was handed to Mr H. C. Williamson, M.A., B.Sc., at the Marine Laboratory, St Andrews, for examination. The stomachs of 74 salmon examined at Kelso during the rod season contained no food, but all had a quantity of yellow mucus in which was usually a number of tapeworms.

Mr Williamson's determination of the food is as follows :—

Fishes.

Herring, tail gone, $6\frac{1}{2}$ inches long; the muscles for about 1 inch in front of the tail are digested off. The skin alone of the remainder of the fish has disappeared.

Herring, head gone, $6\frac{7}{8}$ inches long; the muscles of the anterior fifth of the trunk have been completely digested, the remainder partially digested.

Herring, tail gone, $7\frac{5}{8}$ inches long; the muscles of the posterior half of the body have been digested; the muscles of the anterior half of the body and the head are half digested.

Herring, portion of head and portion of tail gone, $7\frac{5}{8}$ inches long; the muscles of the posterior half of the body have been digested; the muscles of the anterior half of the body are partially digested.

Herring, $3\frac{3}{8}$ inches long ; some of the skin has been digested off.

Herring, portion of the backbone of, $2\frac{1}{4}$ inches long ; very little muscle left on it.

Herring, head and tail gone, $4\frac{1}{4}$ inches long ; small portion of muscle left anteriorly in the neck region ; the rest reduced to a skeleton.

Clupeoid, backbone of, head and tail gone, 3 inches long ; skeleton.

Clupeoid, backbone of, tail and portion of head gone, $6\frac{3}{8}$ inches long ; skeleton.

Herring, head and part of tail gone, $6\frac{3}{8}$ inches long ; all the muscles have been digested off, except a patch of muscle about 1 inch long in the neck region.

Herring, back bone of, head and tail gone, 5 inches long, all the muscles have been digested off, except a small portion in the neck region.

Herring, backbone of, head and tail gone, $3\frac{5}{8}$ inches long ; skeleton.

Herring, backbone of, head and tail gone, $7\frac{1}{8}$ inches long ; a small portion only of the muscle left undigested anteriorly.

Herring, backbone of, head and tail gone, $5\frac{7}{8}$ inches long ; a small portion only of the muscle left undigested anteriorly.

Herring, backbone of, head and tail gone, $5\frac{3}{4}$ inches long ; skeleton.

Herring, backbone of, head and tail gone ; a trace of muscle left upon it.

Clupeoid (Herring ?), backbone of, head and tail gone, 4 inches long ; skeleton.

Herring, backbone of, head and portion of tail gone, 5 inches long ; skeleton.

Herring, anterior portion of backbone of, head gone, $2\frac{1}{2}$ inches long ; traces of muscle left in the neck region only.

Herring, backbone of, head gone, 4 inches long ; skeleton.

Herring, portion of head of what appears to be a, $\frac{3}{4}$ inch long.

Structure resembling portion of a partially digested head of a herring (?).

Herring, posterior portion of backbone of, tail gone, $1\frac{3}{4}$ inches long ; muscles half digested.

Herring, a few vertebræ of, $1\frac{7}{8}$ inches long.

Herring, a few vertebræ of, $1\frac{1}{2}$ inches long.

Greater sand-eel, tail gone, $7\frac{3}{4}$ inches long ; the posterior half of the body is reduced to a skeleton ; the muscles of the anterior half are partially digested.

Lesser sand-eel, tail gone, $4\frac{1}{2}$ inches long ; the skin and a little of the muscle have been digested off.

Lesser Sand-eel, $2\frac{5}{8}$ inches long ; skin alone partially digested off.

Sand-eel, *sp*, tail gone, 3 inches long ; skeleton.

Sand-eel, *sp*, head and portion of back bone of, $2\frac{7}{8}$ inches long ; traces only of muscle left.

Sand-eel, *sp*, tail gone $3\frac{1}{8}$ inches long ; muscles almost wholly digested.

Sand-eel (?), portion of backbone and portion of head of, $2\frac{1}{8}$ inches long ; skeleton.

Sand-eel (greater ?), portion of head and backbone of, tail gone, 6 inches long ; traces of muscle left in the neck region.

Smelt, $4\frac{7}{8}$ inches long ; almost entire.

Wolffish, post larval, $\frac{8}{10}$ inch long ; entire.

Crustacea.

Amphipoda, 11 examples of *Parathemisto oblivia.*

Copepoda, 3 examples of Cyclops ; Caligus (*sp.*) one example.

Schizopoda, 8 examples of Mysis (?).

Decapod Crustacean, one young example.

Annelids.

Heteronereis, two examples, $4\frac{5}{8}$ inches long.

It is very probable that the Crustacea were contained in the stomachs of the fishes captured by the salmon. The horny investments of the Amphipoda &c. would render the digestion of these forms in the stomach of the salmon much slower than the digestion of the herring or sand-eel, which had in the first place swallowed them.

The Proportion of Male and Female Fish taken at Berwick in each Month of the Season.

This investigation throws some light on the habits of salmon. From an examination of Table II. showing the sex of the fish opened at Berwick during the last nine years, it will be seen that the proportion of male to female fish seeking the river varies throughout the season. Approximately there is one male for every three females in February, one for every four in April, then an increase to two males for every five females at the close of the netting season. To judge from the number of fish taken during the rod season, the proportion of males to females then in the river would appear to be nearly equal, though the females are still in the majority. But, as Mr Archer suggests, there is no saying how long some of these fish may have been in the river, nor is it certain that either sex will take the angler's lure with equal readiness.

The sex of a large number of the fish not opened was estimated. The figures thus obtained will be found in the last two columns of the salmon table. The percentages agree in the main with those derived from the totals of fish opened during the years 1886–94. The figures for 1894 include returns of fish (both salmon and grilse) opened by dealers supplied by the Company. The figures for the years 1886–93 cannot be taken as an accurate indication of the proportion in which male and female fish frequent the river during the season, because the fish opened at the Company's Fish House are selected for their appearance, and since the female salmon is generally the better-looking fish, it is evident that the proportion of female fish is overstated, while that of male fish is understated. For grilse the proportion of males to females is fairly constant, the greatest number of males occurring in July. Over all, the females are in a majority of about 13%. The Salmon Company did not permit an examination of the unopened grilse,—hence there is no estimation of sex for grilse as in the case of salmon.

TABLE II.

The Sex of Salmon and Grilse opened at the Berwick Salmon Company's Fish House during each month of the season for the years 1886–94.[1]

SALMON.

	1886.		1887.		1888.		1889.		1890.		1891.		1892.		1893.		1894.		Total for nine years, 1886–94.		Percentage over nine years.		Estimated number of each Sex of unopened Fish, 1894.		Percentage of estimated numbers.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
February, (last 14 days)	7	21	12	21	...	...	8	26	7	21	7	23	6	24	7	9	3	11	57	156	26·7	73·2	15	25	37·5	62·5
March,	6	19	11	41	11	35	10	37	11	31	8	34	8	31	10	20	9	35	84	283	22·8	77·1	19	74	20·4	79·5
April,	11	56	16	59	8	42	13	48	10	36	17	53	12	48	13	21	11	67	111	430	20·5	79·4	45	198	18·5	81·4
May,	18	74	16	71	12	64	14	51	10	43	16	81	21	89	24	46	58	138	189	657	22·3	77·6	136	267	33·8	66·2
June,	10	49	13	62	16	59	11	45	21	68	27	81	20	71	29	45	50	199	197	679	22·5	77·5	129	431	23	76·9
July,	12	53	15	72	22	61	22	71	19	53	40	75	27	66	45	65	58	176	260	692	27·3	72·6	174	637	21·4	78·5
August,	18	72	11	52	17	57	15	53	14	39	31	98	20	63	63	106	69	189	258	729	26·1	73·8	198	644	23·5	76·4
September, (first 14 days)	7	21	2	15	5	22	5	19	8	22	45	75	19	39	10	16	33	89	134	318	29·6	70·3	183	591	23·6	76·3
	89	365	96	393	91	340	98	350	100	313	191	520	133	431	201	328	291	904	1290	3944	24·6	75·3	899	2867	23·8	76·1

[1] In these Tables the figures for the years 1886–93 inclusive are not compiled from observations made by Mr Grey, but from records kept by the Berwick Salmon Fishing Company, which the Company kindly placed at his disposal.

TABLE II.—*continued.*

GRILSE.

	1886.		1887.		1888.		1889.		1890.		1891.		1892.		1893.		1894.		Total for nine years 1886–94.		Percentage over nine years.	
	M.	F.	M.	F.	M.	F.	M.	F.	M	F.	M.	F.	M.	F.	M.	F.	M.	F.			M.	F.
May,	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...	...
June,	10	12	8	10	8	10	...	...	...	...	...	...	...	...	...	...	51	68	77	100	43·5	56·4
July,	62	68	33	36	30	32	41	39	36	39	75	100	51	59	35	45	60	112	423	530	44·3	55·6
August,	32	38	21	23	33	31	25	26	23	25	76	74	41	42	45	69	75	166	371	494	42·8	57·1
September, (first 14 days)	8	10	10	14	7	10	6	7	10	12	82	35	33	18	...	...	36	144	192	250	43·4	56·5
	112	128	72	83	78	83	72	72	69	76	233	209	125	119	80	114	222	492	1063	1376	43·5	56·4

NOTE III.

MEMORANDUM by the Inspector of Salmon Fisheries, in consultation with Messrs Carmichael & Miller, W.S., in regard to the Law relating to the Construction and Regulation of Cruives prior to the Salmon Fishery Act of 1862, and as to the effect of that Act thereon.

Cruives have been subjected from an extremely early period to various restrictions which have been enacted more or less consistently in a long series of statutes. A summary of these is given below, the marginal references being to Thomson's collection of the Scots Acts.

By an Act in the time of Alexander II.—by some authorities attributed to the time of William the Lion,—the mid stream was required to be left free for a space 'in sa mekill that ane swine of thre zeir auld and 'weill fed is of length, and may turn him within it, in sic ane manner 'that nather his grunzie nor his tail tuich ony of the sides of the cruives 'that are biggit on ilk side of the water.' It also required the water to be free, so that no one might take fish from Saturday at noon till sunrise on Monday. This Act in one case was referred to as mythical, but it was admitted that an Act to this effect must have existed prior to Robert First's Act. In another case in 1828 (Kintore *v.* Forbes, 4 Shaw, 641) the Act was founded on, and the word 'aqua' in it was interpreted to apply to rivers and not to the sea. Will. c. 10, I. 374.

The Act, Robert I. cap. 12, contained regulations in regard to cruives in waters where the sea 'comes and goes and where the young salmon or 'smolts come and go.' It enacted that such cruives and the mechanical arrangements placed therein should be at least two inches in length and in breadth three, so that no fish fry might be prevented from ascending or descending, but be able to ascend and descend freely everywhere. The regulation as to length is somewhat difficult to understand, and the provision does not reappear in the later Acts. It cannot mean height, and, if length in the direction of the stream is meant, one would naturally have expected that, instead of saying 'at least,' the Act would have provided for 'not more than' two inches. 1318, c. 11, I. 469.

The Act of James I. 1424, cap. 11, enacted that cruives and yairs in *fresh* waters where the sea ebbs and flows should be destroyed and put away for evermore, 'not again standing any privilege and freedom given 'in the contrary.' In regard to cruives in fresh waters, it was enacted that the law should be observed in regard to the Saturday's slop, and that they should not be allowed to stand in forbidden time, and that each heck should be three inches wide as the 'auld statute requires.' The word 'fresh' *italicised* above seems to be an error, and no doubt what was intended was to make the prohibition apply to the tidal waters in estuaries and not to the sea proper. (Kintore *v.* Forbes ; Athole *v.* Maule, 7th March, 1424, c. 12, I. 5.

1812, Faculty Collection 537). When the statute was re-enacted in 1477 the word 'fresh,' applying to tidal waters, was omitted.

1424, c. 11, I. 5. The Act, James I. 1424, cap. 35, ordained a close time for salmon from the feast of Assumption of the Virgin to the feast of St Andrews in winter, 'nouther with nettes nor cruves, nor nane utherwaies.' This Act was repealed in 1828 by Home-Drummond's Act (9 Geo. IV. cap. 39).

1427, c. 6, II. 16. By the Act, James I. 1427, cap. 6, the King continued the statute for the putting away and destroying cruives in 'waters that fill and ebb, for three 'years to come' in form and to effect as was enacted by the first parliament.

1430, c. 22, II. 19. The Act, James I. 1431, cap. 131, ordained that the statute of fishing of salmon made by the King that 'now is' should be firmly kept 'out 'takand the waters of Solway and Tweede, quhilkis sall be reddie to ale 'Scottish men ale times of the year, als lang as Berwick and Roxburgh 'are in the English minnis handes.'

1457, c. 33, II. 33. The Act, James II. 1457, cap. 85, fixed penalties for the slaughter of red fish in forbidden time.

1457, c. 34. II. 51. The Act, James II. 1457, cap. 86, ordained that no man in smolt time 'set veschelles, creilles, weires, or ony ither ingine to let the smolts to 'goe to the sea,' and 'that the Sheriff of the land destroy them that 'are maid.'

1469, c. 13, II. 96. The Act, James III. 1469, cap. 37, did not apply to cruives, but it enacted that all 'cowpes and pyrnes' set in rivers that had course to the sea or set within the flood mark of the sea should be destroyed and put away for three years, and that those who held them up should be punished after the tenor of the Act of slaughter of red fish (1457, cap. 85). In Kintore *v.* Forbes case this Act was held not to apply to the ordinary sea-shore.

1478, c. 6, II. 119. By the Act, James III. 1477, cap. 73, the statute of James I. 1424, cap. 11, was re-enacted and made perpetual, but in quoting that Act two discrepancies occur. One, the omission of the word 'fresh' in referring to the waters where the tide ebbs and flows (this omission, as already pointed out, no doubt correcting an error in the quoted statute), and the other, the addition of the provision for a mid-stream. After providing for the total destruction of cruives where the tide ebbs and flows, the Act proceeds, 'and that they that has cruives in fresh 'waters, that they goe and keep the laws anent Satterdaie's slop, and 'suffer them not to stand in forbidden time under the samin paine. 'And that ilk heck of the cruives be three inch wide, as the auld statute 'requiris maid by King David, and that the mid streme be left free the 'space of six fute.'

1488, c. 16, II. 211. By the Act, James IV. 1488, cap. 16, all cruives and fish dams in salt waters where the sea ebbs and flows were ordered to be utterly destroyed and put down, 'as well as those belonging to the King as to others' through all the realm; and, as to cruives in fresh waters, that they 'should be made of such largeness, and such days kept,' as was ordered by former statutes.

1489, c. 16, II. 221. The Act, James IV. 1489, cap. 15, ordained that the Acts and statutes made before anent cruives should be observed and 'keiped.' After making provision for the destruction of illegal cruives, the Act proceeds, 'and anent the cruves that stands in freshe waters, that they 'stand not in forbidden time; and let the mid-streame be always free, 'be the space of five fute. And that the Satterdaie's slop be observed 'and keiped as the Acte and statute maid by King David requires. 'And that ilk heck of the cruves be five inches wide, according to the 'samin statute.' This Act further prohibited millers and others from setting nets, &c., in mill dams, &c.

It will be noticed that there are two material alterations between this and the preceding statutes. One, that the mid-stream is only to be 5 feet, and the other, that the hecks are to be *five* instead of *three* inches wide. These differences are probably due to careless draughtsmanship, and the increase of the width of the hecks has been so decided, and has been disregarded as a clerical error (Heritors of Don *v.* Town of Aberdeen, M. 10,840). The reference to the old statute as being King David's ought to have been King Alexander's.

The Act, James V. cap. 17 ordained that the Acts made by the King's 1535, c. 17,
father and his progenitors anent the holding of cruives and fish yairs be II. 345.
observed, and kept, and put in execution, and that resetters and assisters should incur the same penalties as principals.

The Act of Mary, 1563, cap. 3, professed to ratify an Act made by 1563, c. 3,
James III., but the Act quoted is clearly the Act of James IV. 1488, II, 537.
cap. 16. The statute further ordained that all cruives and yairs that were set of late upon sand and shoals far within the water, where they were not before, should be taken down, and, that the remaining cruives that were set upon the water sands should stand until 1st October then next and then be put away. The Solway was excepted from this Act.

The Act, James VI. 1579, cap. 89, renewed the earlier statutes. The 1579, c. 27,
preamble bore that—'Considering the hurt that has cummin to the III. 147.
'commoun weill of this Realm, and lieges thereof, be having and 'keeping of cruves and zaires, slauchter of reid fische in forbidden time, 'and Smoltes, and that divers Acts and constitutions have beene maid 'by his Hienes maist noble progenitors, in time by gane, toward the 'destruction and away taking of the said cruves and zaires, and eschewing 'of slaying of reid fische and Smoltes, quhilkes has not received due 'execution in time by gone, bot hes bene neglected and over seene, 'therefore ordains the said Actes to be extended, and have effect and 'execution in time cumming against the transgressors thereof, after 'the forme and tenour of the same.' The Act, after prohibiting certain things, proceeds to ordain that the landlord and owners of the said cruives and yairs, before the first day of March then next, put down and hold down the said cruives and yairs conform to the 'saidis Actes,' and under the pains therein contained. The Act then provides for procedure in enforcing the prohibitions.

It will be noticed that no new provision is made, but that the old 1581, c. 15,
Acts are renewed and thus prevented from becoming obsolete. This III. 217.
Act was evidently not sufficient for the purpose intended, for, by the Act, James VI. 1581, cap. 111, all former Acts made by 'his Hienes 'and his maist noble progenitors anent the destruction of cruves and 'yairs, slauchter of reid fische, smoltes, and frye,' were ratified and confirmed, and authority was given to Sheriffs, and others individually named, to enforce the Acts and exact the penalties. The statute closes with this important qualification, 'be it alwaies understand that this 'present Act, nor nathing therein conteined, shall be prejudicial to his 'Hienes subjectes being dewlie infeft and in possession of holding of 'cruves, lines, or loupes, within fresche waters, bot that they may use, 'joise, bruik, and occupie the same in time cumming, according to their 'richtes, keepand the Setterdaye's slop and sik distance betwixt every 'heck, as the Actes of Parliament appointes.'

In the Heritors of Don *v.* Town of Aberdeen (1655, M. 14,286), stress was laid on the omission of the provision for the mid-stream being left free, and too much would almost seem to have been made of the omission, seeing the Act does not profess to enact anything new, but merely to give effect to the old statutes. Strictly, if any alteration or modification of the old Acts was to have been made it should have been expressly mentioned.

1639, V. App. 613, b. In the minutes of the Parliaments of Charles I. the following occurs :—'Act anent cruves togidder with the supplicatione presented therewith 'craving that the Acts anent Setterdaies slop, mid-streame, and distance of 'heckis may be ratified with some additions. The Lord Halkertone and 'Craigievar being hard for the Act and supplicatione red and refuised in 'Articles.'

1661, c. 320, VII. 292. The Act, Charles II. 1661, cap. 320, re-enacted the earlier statutes. The preamble referred to the Acts 16, Alexander II., 11th Act of 1st Parliament of James I., 73 Act of 10th Parliament of James III., the 15th Act of 2nd Parliament of James IV., 16th Act of 4th Parliament of James V., 68th Act of 9th Parliament of Mary, and the 111th Act of 7th Parliament of James VI., as ordaining that all who have cruives and yairs in fresh waters should not suffer them to stand in forbidden time, and should observe the Saturday's slop, the mid-stream, and such a distance and largeness between the hecks of the said cruives as is contained at more length in said Acts. The preamble then goes on to explain that, notwithstanding these Acts, the owners of the said cruives and yairs, taking advantage of the trouble of the times, and the neglect of the Sheriffs in not putting the Acts in execution, did not observe the said Acts, to the great prejudice of those having right to salmon fishing above the said cruives. Accordingly, the King and Estates not only ratified and approved the whole said statutes, but also declared the same to stand and to be of full force and strength and to receive due execution. The Act further enacted additional penalties.

This Act re-enacted all the old laws in a most complete and satisfactory manner, and *ex facie* is perfectly regular. In the case of Heritors of Don *v.* Town of Aberdeen (M. 10,840), in the year 1667, this Act was founded on, and in answer it was stated that it had been impetrated by the pursuers in the case and had never been passed in the articles, nor been noticed by Parliament but as an ordinary confirmation. In judgment, the Lords, 'considering that the mid-stream has been long in desuetude, and that 'this late ratification was passed without notice, therefore ordained the 'parties to adduce witnesses whether the middle streams was accustomed 'in any cruives in Scotland.' This seems a high-handed way of riding over an Act of Parliament, but, in point of fact, the statute would seem to have been totally disregarded in the law courts.

1685, c. 24, VIII. 476, a. By Act, James VII. 1685, cap. 24, passed for the preservation of game, reference was made to salmon fishing as follows :—'Whereas by 'the 11th Act Parliament first King James I., cruives and zairs set 'on fresh water, without express infeftment of salmond fishing, are 'ordained to be destroyed and put away for ever, and that where cruves 'are allowed by infeftments that ilk heck be three inch wide, which is 'ratified by the 73rd Act of Parliament 10 James III., and by the 87th 'Act of Parliament 14 James II., it is statute that no man set vessels, 'creiles, weires, nets, or any other engine to hinder smolts from going 'to the sea, and that coups, masses, nets, prins, set on waters that has 'course to the sea, be destroyed. . . .'

Item. 'That all millers that slays smoltes or trouts with creiles or 'any other engyne, or any who have dams or laves, shall be punishable 'as slayers of red fish conform to the (thirty-seven) Act of Parliament '5 James III., and, where the transgressors have no means, they are 'appointed to be put in prison irons, . . . conform to 89 Act of 'Parliament 6 James VI. . . . Which good and antient laws, yet 'standing unrepealed or innovat, we have thought fit hereby to revive 'and ordain to be put in execution. Ordaining hereby the masters of 'our game to require all heretors and others to throw down all cruives 'and zairs set on fresh waters, without express infeftment of salmond 'fishing, betwixt and the first day of July next.'

This Act does not expressly deal with cruives held under infeftment, but it ratifies Acts which do deal with such cruives; and further on in it Sheriffs and others are instructed to be diligent and vigilant in time coming in putting the said Acts and laws therein contained in full and due execution.

The first Act referred to, 11 Act 1 James I., does not contain the provision regarding the mid-stream, but such a provision is found in the 73rd Act of Parliament, 10 James III., which is referred to as ratifying the former Act.

In 1707 an Act anent cruives was read a first time, but not enacted.

The Act I. William cap. 33 (1696) only deals with cruives incidentally. 1696, c. 35, X. 76.
It proceeded on the narrative that the great advantage from salmon fishing was being 'prejudged' by the killing of black fish in forbidden times, and by destroying the fry and smolts of salmon with creels and mill dams and other engines, and accordingly His Majesty ratified, confirmed, and approved 'the haill former laws and Actes of Parliament made anent the killing of 'salmon, kipper, and black fish in forbidden times, and the killing and 'destroying of the fry and smolts of salmon.' After making provision against the illegal killing of fish, the Act proceeds:—'And in respect that 'the salmon fishing within this kingdom is much prejudged by the height 'of mill dams that are carried through the rivers where salmon are taken, 'His Majesty . . . ordains a constant slop in the mid-stream of each mill 'dam dyke, and if the dyke be settled in several *grains* of the river, that 'there be a slop in each grain (except in such rivers where cruves are 'settled), and that the said slop be as big as conveniently can be allowed, 'providing always that the said slop prejudge not the going of the mills 'situate upon any such rivers.'

It may be matter of doubt whether the description of the statutes ratified is wide enough to embrace the Acts relating to cruives, but they probably are included, as the Acts relating to cruives have been enacted with the view of preventing the destruction of fry. The provision as to the exception of the slop in mill dams or rivers where there are cruives leads to the necessary inference that the legislature regarded the mid-streams as in desuetude.

All the foregoing statutes have been referred to and founded on in many cases, and in some so late as the middle of this century (*e.g.*, Kintore *v.* Forbes, 31st May 1826, 4 S. 641; Horne *v.* Mackenzie 1838, 16 S. 1286; and in House of Lords 1839, Maclean's Reports 977; and Sutherland *v.* Ross 1844, 6 S. 425). With the exception of Charles II.'s statute, none of them can be said to have been entirely in desuetude at the passing of the Salmon Fisheries (Scotland) Act, 1862. They are, indeed, referred to generally in the 1828 Salmon Act, and in that Act the 1477 Act is specially referred to, and the provisions in it in regard to the keeping of the laws anent 'Saturdaie's slop,' suffering cruives not to stand in forbidden time, and requiring that the heck of each cruive should be three inches wide, are quoted, and the penalties provided by the 1477 Act are augmented. The provision as to the mid-stream, however, is not embraced in the quotation.

By the Salmon Fisheries (Scotland) Act, 1862, power was given (section 6) to the Commissioners appointed under the Act 'to make general 'regulations' with respect to 'the construction and use of cruives.' This power, however, is subject to the important qualification 'that such 'regulations shall not interfere with any rights held, at the time of the 'passing of this Act, under royal grant or charter, or possessed for time im-'memorial.' As there are no cruives which are not held under royal grant or through immemorial possession, it would at first sight appear that, if this qualification received a literal interpretation, no regulations could be passed regulating cruives; and, as the legislature can hardly be conceived as giving a power and taking it away again in the same section, it may be argued that the qualification only applies to other matters as to which regulations were also allowed to be made. Such an argument might possibly be considered as not going farther than the construction of the Married Women's Property (Scotland) Act, 1881, adopted in the case of Poe *v.* Paterson (10 Rettie, H.L. 73), where a provision in the middle of the Act, that the Act was only to apply in the case of marriages contracted after the date of the Act, was held not to prevent the subsequent sections of the statute applying to all marriages. Mr Stewart in his treatise on fishing adopts this construction of the Act, holding that the qualification does not qualify the regulations in regard to cruives, but must be held only to qualify the regulations on other matters. Such a construction, however, can only be justified if the qualification of the power to issue regulations can only be read as destroying and nullifying the regulations. If it is possible to allow both to have effect, then such a reading must be adopted, and it would rather appear that what the legislature contemplated was that the regulations might codify the existing law, and generally regulate the construction and use of cruives, without seriously interfering with the rights of the proprietors. Following upon the power given by the Act, the Commissioners issued certain bye-laws in regard to the construction and use of cruives, and it is to be regretted that the effect of these regulations has never been judicially decided. A guide to the proper interpretation of the statute can, however, be obtained from the case of Kennedy *v.* Murray (1869, 7 Macph. 1001). The Commissioners, in virtue of powers given under the same section of the 1862 Act issued regulations in regard to mill dam dykes, &c., *inter alia*, orderin, the erection of hecks on mill lades; and the main question in the case was, whether or not the Commissioners had power to order the proprietor of the mill to erect hecks at his own cost. The case was deemed of sufficient importance to be submitted to seven judges, and a number of queries were put to them. The two which mainly affect this subject were, whether the mill proprietor had to erect the hecks at his own cost, and, 'assuming that additional trouble and some cost will be imposed by 'the additional hecks, whether the case of the advocator, who has had 'immemorial possession of the mills, is within the provision that such 'regulations shall not interfere with any rights held at the time of the 'passing of the Act under royal grant or charter, or possessed for time 'immemorial.'

By a majority of four to three, the Court held that the hecks had to be erected at the owner's cost. The majority were Lords Deas, Benholme, Neaves, and Kinloch, and the minority, the Justice Clerk (Patton), Lord Cowan, and the Lord President (Inglis). On the last question, the Lord President and Lord Benholme gave no opinion, but the other judges answered it in the negative, though the only one who gave any grounds for his answer was the Lord Justice Clerk. He said that:—'Mere additional 'inconvenience would not be a ground upon which the operation of the 'Act should not hold, because there is no case in which there would not 'be more or less inconvenience in the case of mills which existed for a 'considerable time; and, if we were to hold otherwise, the operation of 'the statute would be so hindered and tramelled as to be confined to a 'limited class of cases, which I do not think would be giving fair effect 'to the Act.' In the judgment it was stated that the case of the advocator was not within the provision that such regulations should not interfere with any right held at the passing of the Act under royal grant or charter, or possessed for time immemorial.

It will thus be seen that the case of Kennedy *v.* Murray tends to confirm the opinion on the construction of the statute expressed above, though it does not definitely settle the point.

The Secretary for Scotland has also power, under the 1868 Act, on the application of a district board, to alter 'the regulations with respect to the 'construction and use of cruives, and cruive dykes or weirs within such 'district, provided such alterations do not injure the supply of water to any person entitled to use any existing cruive dyke as a dam dyke.' The power is also subject to the same qualifications as were the Commissioners' regulations under the Act of 1862.

If the construction, above expressed, of the 1862 Act is correct, it is extremely important to see how the law stood prior to the passing of that Act, and how the earlier statutes were interpreted by the courts, in order that it may be learned how far the regulations exceed or fail to come up to these decisions. If the regulations do not exhaust the decisions, it does not necessarily follow that what they laid down has not now effect, simply because the regulations do not deal with the matter. For instance, the Commissioners had no express, though they may have had an implied, power to regulate the construction of cruive dykes, and they have not dealt with this matter in their bye-laws. The old decisions on this point will, therefore, probably have effect still, unless and until the Secretary for Scotland alters the regulations by inserting regulations in the bye-laws in regard to the construction of the dykes, in virtue of his powers above-mentioned.

If also the bye-laws have impaired, or the Secretary for Scotland's alterations shall impair, the value of the cruives to their owners, to an extent materially exceeding that entailed by the old law, then to such extent the bye-laws or the alterations will probably be held to exceed the qualification prescribed by the Act.

An examination of the bye-laws issued by the Commissioners at once reveals the fact that they are, generally speaking, extremely moderate; and that, while they may entail some cost and some inconvenience to the owner, not put upon him by any legal decision, they do not materially prejudice his rights. In some cases the regulations relax the old law, and, as above-mentioned, they do not touch on the construction of the dykes. Further, they contain no regulation for the enforcement of the statutory provision of the mid-stream, but this point will be dealt with after.

Bye-law I. provides that the upper surface of the sill of the cruive shall not be higher than 12 inches above the natural bed of the river; and, in the event of the sill being placed any higher than the natural bed of the river, it provides for a paved floor of certain dimensions being made down stream.

By legal decisions, cruives had to be placed on the level of the bed of the stream, so that the Commissioners cannot be said to have exceeded their powers in prescribing the conditions on which the sill of the cruive can be placed higher. In the case of Fishers of Northesk *v.* Scott of Brotherton (1746 Morison 14,264), it was laid down that 'the cruives 'should be built in the channel of the water and not above the same;' and again, in the subsequent case of Halkerton *v.* Scott (1769, Morison 14,268), it was decided that the cruives 'must be built upon the channel 'or bottom of the river,' and that the defender was bound 'to remove 'the nob or sole at the bottom of the mouth of the cruive.' The same rule was laid down in Grant *v.* Duke of Gordon (1777, 5 Brown's Supplement 477). In the second of these cases, however, the Court ordered some shoeing or causewaying in the river farther down than the lower end of the keying stones to be removed.

Bye-law II. provides for the cruives being four feet wide, and, if they have a centre post, the width, exclusive of the post, must be four feet.

In the cases of the Fishers of Northesk *v.* Scott and the Heritors of Don (Stair II. 3. 70), the Saturday's slop was laid down as 'one ell' wide of a sluice in each cruive. A Scotch ell is 37 inches, and therefore this bye-law goes somewhat farther than the former practice.

Bye-law III. provides that the hecks and inscales shall be capable of being removed, and shall be removed during the annual close time. That during the weekly close time the hecks shall be removed and the inscales removed or kept open for the space of four feet.

This bye-law is in conformity, generally, with the authorities, though scarcely so strict as some. In the case of the Fishers of Northesk, it was laid down that 'the teeth and rungs of the hecks ought to be entirely 'removed in forbidden times to fish, and the same kept clear and void, 'and that, during the Saturday's slop, the defender ought to lay by 'the inscales in all and every one of his cruives.' In the case of Halkerton *v.* Scott, it was decided as to inscales, that the owner was 'not 'bound to take the same out from the cruives in times of flood,' but that it was 'sufficient at such times to fix them back, so that they remain 'open for the purpose of Saturday's slop.' In Grant *v.* Duke of Gordon, the Court found that the inscales behoved to be taken out during Saturday's slop, except in time of flood, when that could not be done, but that at that time they should be fixed back, and a similar decision was given by the Court of Session in 1802 in Johnston *v.* Stotts case. In the case of Lord Banff and Earl of Fife (1783, Morison 14,299) it was decided that it 'was not necessary to remove the sole trees or side posts of the 'cruive boxes in forbidden time, the removing of the hecks and inscales 'being sufficient to answer the purposes of law.' And in Fishers of Northesk *v.* Scott it was also decided that the hecks and inscales should be taken out and laid aside in forbidden time.

Bye-law IV. provides that the hecks shall be perpendicular, not less than three inches apart, and that they shall not be more than two inches thick, nor more than four inches broad in the up and down way of the stream, and that their edges shall be rounded off so that they shall be only one and a half inches broad at the up and down sides.

That the hecks must be perpendicular was decided in the cases of Earl of Moray *v.* Callendar (1762, Morison 14,291), and Johnston *v.* Stotts (House of Lords, 1802, 4 Paton's Appeals 274).

The statutory width of three inches was affirmed in the Fishers of Northesk *v.* Scott, Heritors of Don *v.* Town of Aberdeen (1665, Morison 14,286), Barclay *v.* Scott (1684, Morison 14,286), Falconer *v.* Scott (1701, Morison 14,283), and Grant *v.* Duke of Gordon. An interesting point arises as to the difference between Scotch and English measure, and, as if to guard against error in the case of the Heritors of Don, the distance between the hecks was ordered to be 'three inches Scots measure, 'whereof 27 make an ell.' This would seem to be a misprint for 37, as there are practically 37 inches in a Scotch ell, and, so far as can be learned, any difference between a Scotch and English inch is fractional.

In the case of Johnston *v.* Stotts the construction of cruives was most precisely dealt with. The Court of Session ordained that the hecks should not only be three inches apart, but should themselves be of an oval shape with the edges rounded off. This was affirmed by the House of Lords, but the case was remitted back to the Court of Session that precise directions might be given to the parties. Following upon this the Court of Session ordered, *inter alia*, that the spars of the hecks should be perpendicular, not exceeding the existing dimensions, which were five inches in depth in the direction of the stream, and two and a half inches across the stream, that the lower edge should be one inch thicker than the upper, and that they should be rounded to a semicircle, both at the upper edge and the lower.

Bye-law V. lays down that the bars of the inscales shall not be of larger dimensions than the hecks, nor less than two inches apart.

This is a matter not dealt with by the authorities.

Bye-law VI. lays down the length of the inscales, and the nearness to which they may approach each other.

There seems to be no authority for this either; but, in Grant *v.* Duke of Gordon, it was found that the inscales behoved to be placed at the extremities of the cruive box, and to afford an entry into the cruives equal in width to the side of the cruive box next the sea.

Bye-law VII. provides that no net or other contrivance shall be placed over any cruive, nor any device employed to prevent or scare fish from passing through. It, however, allows a cloth or blind to be placed over the cruive while the fish are being taken out.

The prohibition in this bye-law is quite in accordance with the spirit of the statutes and the decisions in Carnegy *v.* Magistrates of Brechin (1704, Morison 14,283), and Halkerton *v.* Scott.

Bye-law No. VIII. provides that no cruive shall be so inclosed or covered as to prevent duly authorised persons inspecting it.

Bye-law IX. provides that no cruive shall be so altered as to create a greater obstruction to the free passage of fish than at present exists.

These bye-laws are all moderate, are quite in the spirit of the Acts, and are on the lines of judicial decisions, with the possible exception of the last. They do not interfere with the privileges of the owners of cruives, beyond putting them to some slight inconvenience and additional expense, and making them conform to what was practically the former law. But the last bye-law goes further than this. It is true that in many of the decisions parties were prevented from altering the construction of their cruives and dykes,—as, for instance, in the case of Halkerton *v.* Scott, in which Scott having reduced his cruives to three was made to restore them to the original number of seven,—but this bye-law would prevent a man who had his hecks four inches wide from narrowing them to three. It may thus infringe the qualification imposed by the Act, but, on the other hand, the owners may not have been acting within their rights, and this bye-law may prevent parties getting benefit from the other bye-laws, if these should be held to supersede and now to compose the whole law on the construction of cruives, even though they do not deal with all the points that are dealt with in the cases.

On comparing the bye-laws with the statutes and the case law, it is found that there are few points with which they do not deal, with the important exception that they are entirely silent on the question of construction of the cruive dykes. This possibly arises from no mention of the dykes in the powers given to the Commissioners in the 1862 Act; but as the construction of the dykes is a matter on which the Secretary for Scotland can alter the regulations in virtue of the 1868 Act, it may be of importance to see how the law stands on this subject.

In the case of the Heritors of Don *v.* Town of Aberdeen (1667), it was pleaded that the cruives ought to be no higher than the water in its ordinary course neither in time of flood nor of drought, and that the dyke should not be built perpendicular, but sloping from the ground to the top; but the Court held that, as there was no particular law as to the height of cruives, and these parties had suffered the others to enjoy the cruives above 40 years, the same should be, *uti possidebantur*, no higher than the old cruives.

In the case of Barclay *v.* Scott in 1684, the defender's cruive dyke was ordered to be an ell and a half above the water as it runs in an ordinary current from 15th April to 15th May, and to be sloping and not perpendicular. In the subsequent case of Falconer *v.* Scott (1701), relating to the same cruives, it was declared that the defender's cruive dyke ought to be only three ells broad, and a foot and a half above the water as at ordinary times from 15th April to May.

In the Fishers of Northesk *v.* Scott in 1746, the Lord Ordinary held that the defender's cruive dyke should only be half an ell Scots broad at the top, and only one foot and a half above the surface of the water in its common course as it runs from 15th April to 1st May, and that the said dyke ought to be built sloping from the top till it was two feet under the water, and that below that the defender could build his dyke as broad as he pleased, and either sloping or perpendicular. On appeal, while adhering to other parts of the Lord Ordinary's judgment, the Lords found that the defender might keep up his cruive dyke as to height and breadth 'as now possessed by him.' What the height and breadth were does not appear. Again, in the case of Halkerton *v.* Scott in 1769, it was found that the defender was not bound to alter the height and breadth of his cruive dyke.

In the case of Johnston *v.* Stotts in 1802, it was found that the cruive dyke should be of the same height as formerly, built of rough stones in a compact and substantial manner, without loose or projecting stones. Indeed, the cases practically decide that each cruive dyke was to remain as it had been in the past, and no general rule affecting the construction of all cruive dykes was laid down.

In connection with the construction of the dykes, there arises the question of the mid-stream. This question has been brought up in a great many of the cases, and in all it has been decided that the provision is in desuetude. At first sight it is not easy to reconcile this with another series of cases in which illegal methods of fishing, though practised for time immemorial, were stopped, as in the case of Fraser *v.* Duke of Gordon (1765, Morison 14,298), where it was decided that the laws made for the improvement of salmon fishing could not be abrogated *non utendo.* The distinction between the two series of cases, however, is that the one applies to individual instances, and the other to a universal neglect of the statute. But it is difficult to understand how the Acts could have gone into desuetude so soon after they were enacted, and it would almost seem as if they had never been recognised at all. The matter is thus referred to by Lord Chancellor Eldon (Johnston *v.* Stotts, 4 Patton's App. 274): '—We see here, too, that a Scotch statute may be lost by *desuetude*, as it 'is termed; that the ancient statutory regulation of a mid-stream in all 'cruive dykes is entirely gone and no longer remaining part of the law. 'The English lawyer feels himself much at a loss here; he cannot conceive at what period of time a statute can be held as commencing to 'grow into desuetude, nor when it can be held to be worn out. All he 'can do is to submit to what great authorities have declared the law of 'Scotland to be.'

If the construction of the qualification in the 1862 and 1868 Acts above expressed is correct, it would have been beyond the powers of the Commissioners to have revived the mid-stream in their bye-laws, or to have required cruives to be materially altered from their usual construction, and it will be beyond the power of the Secretary for Scotland, on the application of a District Board, to make such provisions now. On the other hand, if the views expressed by Mr Stewart in his Treatise on the Law of Fishing (page 199) are sound, it would seem to follow that the Secretary for Scotland, on proper application being made to him, can alter the bye-laws by inserting in them provisions materially altering the formation of cruives and cruive dykes. Probably the simplest way of getting the question settled would be by a District Board petitioning the Secretary for Scotland to alter the bye-laws by restoring the ancient provision as to a mid-stream, or otherwise materially modifying the construction of cruives. If the Secretary for Scotland did this, the matter would probably come before the Courts; if he did not, he would no doubt be acting under the advice of the law officers of the Crown.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 23*rd January* 1894.

NOTE IV.

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.
Clayburn, Finnisbay, Avennangeren, Strathgravat, North Lacastile, Scalladale and Mawrig (*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.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
Fincastle, Meaveg, Ballanachist, South Lacastile, Borve, and Obb (*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.
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 Oct. 1 to Jan. 10.
Helmsdale, . . .	From Aug. 27 to Feb. 10.	Close time for rod-fishing from Oct. 1 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.
Mullanageren, Horasary, and Lochnaciste (*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. 31.
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. 14.
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 of Cantire*),	From Aug. 27 to Feb. 10.	From Aug. 27 to Oct. 31.

Name of River.	Annual Close Time.	Extension of Time for Rod-fishing.
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 Nov. 15.
Tay, ...	From Aug. 27 to Feb. 10.	From Jan. 15 to Feb. 10, and from Aug. 27 to Oct. 15.
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 V.

List of Chairmen and Clerks of Salmon Fishery District Boards, with their Addresses. Based on information obtained by Circular from Sheriff-Clerks, &c., in obedience to request from Secretary for Scotland.

DISTRICT.	Chairman.		Clerk.	
	Name.	Address.	Name.	Address.
Alness, . . .	Col. J. C. Warrand,	Ryefield House, Conon Bridge, by Dingwall.	William J. Duncan, Esq.,	Solicitor, Dingwall.
Annan, . . .	A. Johnstone Douglas, Esq.,	Comlongan Castle, Ruthwell, Dumfries.	J. F. Cormack, Esq.,	Writer, Lockerbie.
Awe, ...	Marquis of Breadalbane,	Taymouth Castle.	Alex. M'Arthur, Esq.,	Solicitor, Oban.
Balgay, . . .	C. R. Manners, Esq., C.E.,	12 Lombard St., Inverness.	Duncan Shaw, Esq., W.S.,	42 High Street, Inverness.
Bervic, . . .	James Farquhar, Esq., of Hallgreen, per his factor Patrick Dickson,	Solicitor, Laurencekirk.	Arthur Dickson, Esq.,	Solicitor, Montrose.
Conon, . . .	Sir J. D. Brodie, W.S.,	5 Thistle St., Edinburgh.	Edmund J. Gunn, Esq.,	Solicitor, Dingwall.
Cree, ...	James Drew, Esq., of Craigencallie,	Newton-Stewart.	A. B. Matthews, Esq.,	Writer, Newton-Stewart.
Dee (Solway), .	H. G. Murray Stewart, Esq., of Broughton,	Gatehouse.	W. Nicholson, Esq.,	Sheriff - Clerk, Kirkcudbright.
Dee (Aberdeen),	Lord Provost of Aberdeen,	Aberdeen.	Thomas Wilsone, Esq.,	Solicitor, Aberdeen.
Deveron, . .	A. F. Leslie, Esq., of Montcoffer,	Banff.	F. George, Esq.,	Writer, Banff.
Don, ...	George Falconer, Esq., as mandatory for the Aberdeen Shipmasters Society,	Advocate, Aberdeen.	Thomas Wilsone, Esq.,	Solicitor, Aberdeen.
Esk (North), .	Rev. J. S. More Gordon, of Charleton and Kinnaber,	Vicar of St John's, Redhill, Surrey.	Arthur Dickson, Esq.,	Solicitor, Montrose.
Esk (South), .	James Johnston, Esq.,	Montrose.	Messrs Shiell & Don,	Solicitors, Brechin.
Findhorn, . .	J. J. R. Littlejohn, Esq., factor for R. C. Munro-Ferguson, Esq., M.P.,	Kirkcaldy, Fifeshire.	W. Grant, Esq.,	National Bank Buildings, Forres.
Forth, . . .	Mandatory of Commissioners of Woods and Forests,	...	T. L. Galbraith, Esq.,	Town-Clerk, Stirling.
Girvan, . . .	Earl of Stair,	Lochinch, Wigtownshire.	William Murray, Esq.,	Writer, Girvan.
Kyle of Sutherland,	Sir Charles H. A. F. L. Ross, Bart., of Balnagown,	Balnagowan.	John Leslie, Esq.,	Solicitor, Dornoch.
Lochy, . . .	Lord Abinger,	Inverlochy Castle, Kingussie.	N. B. Mackenzie, Esq.,	Writer, Fort William.
Nairn, . . .	Brodie of Brodie,	Brodie Castle, Forres.	H. T. Donaldson, Esq.,	Writer, Nairn.
Ness, ...	Charles Inness, Esq.,	Solicitor, Inverness.	A. Macdonald, Esq.	Writer, 51 Church St., Inverness.
Nith, ...	A. Johnstone Douglas, Esq.,	Comlongan Castle, Ruthwell, Dumfries.	C. Stewart Phyn, Esq.,	Procurator-Fiscal, Dumfries.
Spey, . . .	Duke of Richmond and Gordon,	Gordon Castle, Fochabers.	Cooper & Wink,	Solicitors, Elgin.
Stinchar, . .	Vacant.	...	T. C. Greig, Esq.,	Rephad, Stranraer.
Tay, ...	Sir Robert Moncrieffe, of Moncrieffe, Bart.,	Moncrieffe House, Bridge of Earn, N.B.	Mackenzie & Dickson,	Writers, Perth.
Torridon, . .	C. R. Manners, Esq., C.E.,	12 Lombard St., Inverness.	Duncan Shaw, Esq., W.S.,	42 High St., Inverness.
Ugie, . . .	Lieut.-Col. Ferguson, of Pitfour,	Mintlaw.	William Boyd, Esq.,	Solicitor, Peterhead.
Ythan, . . .	Earl of Errol,	Slains Castle, Aberdeenshire.	D. M. A. Chalmers, Esq.,	18 Golden Square, Aberdeen.
Tweed Commissioners,	Sir William Crossman,	Cheswick House, Beal, Northumberland.	Messrs James & David W. B. Tait, W.S.	Kelso.

Note.—In addition to the districts specified above, the Duke of Sutherland is sole proprietor of the districts of the following rivers, viz.:—Helmsdale, Brora, Fleet (under the charge of his factor, Mr Donald M'Lean, Dunrobin Office, Golspie); Kirkaig, Inver, Laxford, Inchard, Grudie or Dionard and Polla or Strathbeg (under the charge of his factor, Mr Evander M'Iver, Scourie, by Lairg); Halladale, Strathy, Naver and Borgie, Kinloch, and Hope (under the charge of his factor, Mr John Box, Tongue, Sutherland), and the Earl of Cromartie is sole proprietor of the district of the river Kennart (under the charge of his factor, Mr William Gunn, Cromartie Estate Office, Strathpeffer).

NOTE VI.

NATURAL HISTORY NOTES IN NORWAY. By Mr W. E. Archer, F.R.S.E., Inspector of Salmon Fisheries of Scotland.

In the following table will be found a continuation of the statistics regarding my fishery at Sand in Norway described in Notes II. and IX. respectively of the Board's Eleventh and Twelfth Annual Reports. The statistics of the river fishings, as previously explained, are taken from my own records; those of the sea fishings are kindly furnished by Herr A. Landmark, Inspector of Salmon Fishings of Norway.

Year.	Yield of Sand's River.	Average of 4 Years.	Yield of Bagnets.	Average of 4 Years.	Number of Bag-nets.	Average Yield per Net.	Average Yield per Net.	Remarks.
	lbs.	lbs.	lbs.	lbs.		lbs.	lbs.	
1880	3,410		20,620		97	212		Fixed engines in river and sea, fishing 6 days a week.
1881	6,402		28,010		85	329		
1882	6,635		13,103		72	182		Fixed engines in river and sea, fishing 4 days a week.
1883	6,701	5,787	21,934	20,917	76	288	253	
1884	3,212		23,729		82	289		Angling in river. Bag-nets in sea, fishing 4 days a week.
1885	6,170		48,859		107	455		
1886	4,478		39,371		108	364		
1887	5,626	4,871	35,483	36,860	149	238	336	
1888	4,231		52,353		180	290		
1889	2,697		48,336		172	281		
1890	3,638		35,492		165	215		
1891	5,873	4,110	94,292	57,618	209	451	309	
1892	3,146		80,643		246	328		
1893	3,778		60,909		279	218		

In view of the information given in my report to the Board for 1894 regarding the method and cost of fishing by means of bag-nets in Scotland, it would seem desirable for the purposes of comparison, to refer to the conditions under which such nets are fished in Norway. In the still and almost tideless waters of the Norwegian fjords there is not the same wear and tear of material as in Scotland, and it is not customary to have one net on shore for every net in use, one net being considered sufficient. The precipitous nature of the shores necessitates very short leaders being used; and the cost of working the nets is inappreciable, as they are fished, for the most part by the peasant proprietors off their own lands and form part of the daily work of the farm. Further, these nets are only used for about twelve weeks in the year. The conditions under which they are used vary in different localities; and as the district to which these statistics refer is a large one, I have thought it advisable to refer to the Norwegian authorities for official information on the subject rather than to give the cost of fishing at the few stations which come within my own knowledge. In reply to the inquiries made, the Inspector of Salmon Fisheries of Norway states that the cost of working and maintaining such nets among the islands off the coast may be estimated at fifty to seventy kroner (£2 15s. 6d. to £3 17s. 9d.) per annum, and in the inner fjords at forty to sixty kroner (£2, 3s. 4d. to £3, 6s. 8d.) per annum.

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THIRTEENTH ANNUAL REPORT.

TO THE RIGHT HONOURABLE

LORD BALFOUR OF BURLEIGH.

Her Majesty's Secretary for Scotland.

OFFICE OF THE FISHERY BOARD
FOR SCOTLAND,
EDINBURGH, 18*th July* 1895.

MY LORD,

In continuation of our Thirteenth Annual Report, we have the honour to submit—

PART III.—SCIENTIFIC INVESTIGATIONS.

GENERAL STATEMENT.

THIS part of the Thirteenth Annual Report deals with the principal scientific investigations carried on by the Board in 1894, in connection with the sea fisheries under their charge. An account is also given of the scientific fishery work and the condition and regulation of the sea fisheries in other countries possessing sea fisheries, and of the principal means being employed to protect and develop them.

In the course of 1894, the investigations, which were carried out under the supervision of Dr T. Wemyss Fulton, the Superintendent of Scientific Investigations, were prosecuted on the same general lines as in previous years, and have resulted in further extensions of knowledge respecting the life-histories and habits of the fishes which form the basis of the fishing industry, and of the operation of certain methods of fishing in relation to the food supply. Besides such inquiries, which are necessary for the proper conservation and regulation of sea fisheries, the operations in the hatching and artificial propagation of some of the more important food fishes have been continued at Dunbar Marine Hatchery, which was completed last year, and which have resulted in the addition of over forty-five millions of the fry of plaice, turbot and cod to the fishing-grounds along the neighbouring coast. Similar establishments are now in operation in the United States, Canada, Newfoundland and Norway, and others are in process of being formed in France and in Lancashire.

As in previous years a large part of the scientific inquiries, both biological and physical, have been carried on or rendered possible by means of the 'Garland,' the small steamer obtained by the Board for this work; but as has been mentioned in previous reports her small size has curtailed the extent and usefulness of the investigations. The registered tonnage of the 'Garland' is 36·4 tons, her length 84 feet 7 inches between perpendiculars, breadth 15 feet, and depth 8 feet 5 inches; her utmost speed is between eight and nine knots an hour, while an ordinary steam trawler can go from ten to twelve knots, and she is only adapted to carry a 25-feet beam trawl.

In consequence of the inability of the 'Garland' to face anything but moderate weather, or venture far from land, the work has been in great measure restricted to limited portions of the territorial waters and certain firths and bays. It has not been possible, with the means at disposal, to carry on adequate investigations as to the results of the prohibition of beam-trawl fishing in the Moray Firth and the Firth of Clyde in addition to the investigations in the areas of the Firth of Forth and St Andrews Bay; nor to extend the inquiries which have already yielded valuable results in the inshore waters in relation to the areas within which beam-trawling is prohibited, to the great breeding-grounds situated at some distance from the shore, and which form the principal source of fish supply to the territorial seas. Were the 'Garland' replaced by an efficient sea-going vessel of the type recommended by the Parliamentary Committee on Sea Fisheries, in 1893, capable of visiting the fishing-grounds when trawlers and ordinary fishing-boats can carry on their work, it would be possible to conduct the investigations referred to in the offshore waters.

Part of the scientific work was also carried on at the marine laboratories at St Andrews and Dunbar; at the latter, on the influence of temperature on the development of fish eggs, and at the former, under the direction of Professor M'Intosh, F.R.S., on the eggs, larvæ, and development of the food fishes, the distribution of pelagic eggs, on the rate of growth of fishes, &c. These are referred to more fully below.

Physical observations on the temperature and density of the sea have been made daily at a number of fixed stations on the east and west coasts, and on board the 'Garland,' the 'Vigilant,' and H.M.S. 'Jackal.' A report on the physical observations is included in the present report (p. 302).

The Hatching and Rearing of Food Fishes.

In last year's Report the reasons which induced the Board to establish a hatchery for sea-fishes at Dunbar were given, together with a detailed description and plans of the building, and an account of the work during the first season it was in operation. In the present report will be found an account by Mr Harald Dannevig, who is in charge of the hatching work, of what has been accomplished during the current season, and of the work now in progress. It is satisfactory to be able to state that the various pumping and incubating apparatus have continued to work well and without any hitch, and that the number of fry of the food fishes which have been successfully dealt with this season considerably exceeds the number turned out last year.

The total number of fry distributed from the hatchery last year was 26,560,000, consisting of 26,060,000 fry of the plaice, and about half-a-million fry of the cod. This season, so far as it has gone, the total number of fry produced and distributed on the fishing grounds in the neighbourhood has amounted to 46,225,000, making a total for the two years of 72,785,000.

The great majority of the young food-fishes which have been thus propagated have consisted of plaice, of which 44,085,000 eggs were obtained from the spawning pond, yielding 38,615,000 fry. The number of cod hatched numbered 2,760,000, and the number of turbot 3,800,000. It is the first time to our knowledge that the eggs of the turbot have been hatched at any hatchery, and the success in this respect has enabled the development of this important fish to be studied and described by Professor M'Intosh, whose paper dealing with the development of the turbot is included in the present report (p. 224). The output of the hatchery for the two seasons it has been in operation is as follows:—

	Plaice.	Cod.	Turbot.	Others.	Total.
1894,	26,060,000	500,000			26,560,000
1895,	38,615,000	2,760,000	3,800,000	1,050,000	46,225,000
					72,785,000

In fish-hatching operations it is important to collect and acclimatise the adult fishes to be used as spawners some time before the spawning period begins, so that it may be possible on the one hand to select from them the most vigorous and suitable fishes, and to weed out those which may have been injured, and, on the other hand, to accustom them to confinement.

Such an arrangement is the only one by which the work can be carried out on the largest scale and with the greatest security in regard to the results. Many years' experience at the hatchery in Norway has led to the same conclusion; there it has always been found that spawners kept in confinement for years are by far the best for breeding purposes. In consequence of this, hundreds of fishes are there constantly retained, although the severe winters cause difficulties that would not be met with in Scotland.

The space at present available at Dunbar is insufficient to allow this gradual collection to be made on a scale adequate to the requirements of the hatchery, and the collection of the spawners was also interfered with by reason of the stormy weather which prevailed in the early months of the year. The majority of the spawning plaice, when they were procured, had accordingly to be placed in the spawning pond, the rest being transferred to the small tidal creek. At first an irregular emission of unfertilised eggs occurred, but, when the temperature of the water, which, in the early part of the season, was exceptionally low, had risen to the point at which spawning began last year and the fishes had become more accustomed to their new quarters, a regular spawning took place. The unfertilised eggs at first obtained from the pond were separated as much as possible; but a number were also mixed up with the fertilised eggs when they were measured, and in this way included in the total of eggs collected. This accounts for the higher apparent death-rate in the boxes, or the proportion which succumbed during the process of incubation,—amounting to about fourteen per cent. Last year, when practically no unfertilised eggs were collected, the proportion was only 4·4 per cent. The total number in the hatching apparatus was sometimes considerable; from April 21st to May 13th more than 20,000,000 eggs were undergoing development, and during 13 days above 25,000,000. On such occasions it was necessary to crowd the eggs in the boxes—sometimes to the extent of about 400,000 per cubic foot of water.

As stated in the Twelfth Annual Report experiments were begun last year with the turbot and sole, the two most valuable species of the marine food-fishes, but no actual spawning took place in the pond, although unfertilised eggs of both forms were obtained, and it was found later that the adults had injured themselves by friction on the wooden flooring. It was, therefore, evident that the system which had succeeded so well with the plaice required modification, and the experiment of substituting a sandy bottom is being tried. It would appear that these fishes transferred from the fishing grounds to the hatchery do not spawn with the same freedom as do the plaice and cod, and require special measures; the sole in particular seems to be very susceptible of injury. It is noteworthy that the soles confined and thoroughly acclimatised in the tanks of the marine laboratory at Plymouth spawned last season, and all the information and experience available point to the necessity of thoroughly acclimatising these species before they are used as spawners for hatching purposes.

In regard to the practical results of marine pisciculture in adding to the fish supply, it may be stated that in the United States, Newfoundland and Norway—where cod alone has been propagated on a large scale—according to the Official Reports published in these countries the abundance of young cod has been materially increased. In the neighbourhood of the hatchery on Dildo Island, Newfoundland, the shoals of this fish were so numerous during the past season that they were described as a "solid thick mass covering the bottom for long distances on both sides of the island," and it is stated that fishermen from other parts, on hearing of the abundance of cod, came to Dildo to fish. Sufficient time has not, of course, elapsed since active operations were begun at Dunbar to afford any indication as to the influence of the work in increasing the fish supply, but there are some points of importance that may be considered in connection with the subject. There can be no doubt that the great majority of the fry distributed on the fishing grounds are destroyed from natural causes, but if only a fraction of one per cent. survive, the resulting benefit would far exceed the expenditure upon the work. If one in a hundred of the fry distributed from the hatchery survived, and if the price of the marketable fish be placed at sixpence, the resulting value to the fisheries would be about £18,000. It would require the survival of only one in a thousand, and the marketable fish to be sold at only one penny each, to cover the expenses of the work.

During the year the hatchery has been visited by, among others, representatives from the Cornwall Sea Fisheries Committee, the North Eastern Sea Fisheries Committee, the Northumberland Sea Fisheries Committee and the Sea Fisheries Committee of Lancashire; also, under the instructions of their Governments, by Dr Roché, the Chief Inspector of the Fisheries of France, Mr Berry, the Danish Consul-General, Dr Hoek, the Scientific Fishery Adviser to the Netherlands, Dr. Canu of the Marine Station, Boulogne, and M. Malard of the marine laboratory, St Vaast la Hougue, Normandy. The Italian Government was also furnished, at their request, with a detailed description and plans of the establishment.

The Influence of Beam-Trawling.

The results of the trawling experiments and observations of the "Garland" respecting the relative abundance of the food fishes in certain portions of the territorial waters where beam-trawling is prohibited, and on the influence of this prohibition on the fish supply are given in a special Report in Section A. (p. 17).

In the course of the year the various trawling stations in the Firth of Forth and St Andrews Bay were examined once a month, so far as circumstances permitted; those in the Moray Firth and off the Coasts of Forfarshire and the stations at the Orkney Isles, on two occasions, and off Aberdeenshire once. The number of ordinary trawlings or periodic examinations of the stations in the course of the year was 150, of which 76 were in the Firth of Forth area, 35 in the Moray Firth, and 24 in St Andrews Bay.

In the area of the Firth of Forth and St Andrews Bay, where the trawling experiments were conducted with most regularity, the stations were examined on one hundred occasions. In the Firth of Forth, where seventy-six hauls were made, it was found that, compared with the previous year, a slight increase occurred in the general abundance of the food fishes within the waters from which beam-trawling is excluded, and a more considerable decrease in the open waters outside, where beam-trawling is freely carried on. Both in the protected and in the open area a diminution in the average abundance of round-fishes was indicated, while flat-fishes, which were caught in somewhat greater numbers in the closed waters, were obtained in diminished quantities in the open waters.

At the stations in the closed area the general average number of fishes of all kinds taken in each haul of the net was 290·5 as compared with 287·6 in the previous year. The average number of the round-fishes captured was 139·6 as against 162·4, and the average number of flat-fishes 145·3 as against 120·5. The greatest increase was among long rough dabs, the average in 1893 being 17·9 and last year 31·5.

In the St. Andrew's Bay area the examination of the various stations showed that within the closed waters a considerable increase in the general average had occurred, from 148·2 in 1893 to 179·2 last year. The increase was chiefly in flat-fishes, the average catch of which was 102·8 in 1893, compared with 154·4 last year. There was a considerable decrease in the average for round-fish, namely, 21·5 as against 43·9 in 1893. At the stations in the open area the average per haul in 1893 was 93·3, while last year it was 170·6. This increase took place both in flat-fish and in round-fish; the average catch of the latter was 100·5, as against 61·5 in the previous year; flat-fishes increased from an average per 'shot' of 30·5 in 1893 to 68 last year.

The statistics of the 'Garland's' trawling experiments in the combined areas of the Firth of Forth and St Andrews Bay, since the investigations were begun, give the following results for the protected waters from which beam-trawling is excluded :—

	Flat Fish.	Round Fish.	Total.
1886, . . .	131·1	79·6	213·9
1887, . . .	270·6	115·9	390·1
1888, . . .	163·9	80·5	248·7
1889, . . .	148·2	34·5	187·1
1890, . . .	201·9	80·9	288·0
1891, . . .	112·2	43·7	161·6
1892, . . .	95·1	53.9	156·4
1893, . . .	129·0	149·0	282·4
1894, . . .	147·3	113·0	265·4

These figures indicate considerable fluctuations from year to year, arising largely from natural causes which affect the yield of the fisheries generally; and it has to be noted that the exceptionally high averages for round-fishes during the past two years are due to the extraordinary abundance of haddocks which characterised the fishings along the East Coast, especially in 1893. In order that comparison may be made between the results obtained during the first few years following the prohibition of trawling in the Firth of Forth and St Andrews Bay, and those obtained during the last few years they have been reduced to averages as follows :—

	Flat Fish.	Round Fish.	Total.
1886–1889, . .	178·5	77·8	260·0
1891–1894, . .	120·7	89·9	216·5

The general average for flat-fishes, it will be observed, is very much lower for the second period than for the first. As stated in last year's Report it is probable that the falling off in flat fishes within the protected area is in great measure due to increased trawling in the extra-territorial spawning areas from which the inshore grounds receive their normal supplies of floating fish-eggs and young fishes.

During last year the sixteen trawling stations in the important area of the Moray Firth, which were fully described in the Twelfth Annual Report, were examined on two occasions, once in July and once in October; the time thus fairly corresponding to the period of examination in 1893, namely May and October. When the averages of the 37 hauls made in 1893 are compared with those of the 35 hauls last year, it is found that a considerable increase in the abundance of the food fishes took place. In 1893 the average of the total number of fishes of all kinds per haul was 259·9, while last year it reached 292·1. There was an increase both in round-fishes and flat-fishes. The average for the former rose from 106·3 to 129·1, and the average for the latter from 146·2 to 157·6. The average for all kinds of flat-fishes, except plaice, was higher than in 1893, the abundance of long rough dabs being considerbly greater. The observations in the Moray Firth have, however, not been sufficiently numerous, or continued over a sufficiently long period, to yield satisfactory conclusions as to the results of the closure. Special statistics are being collected along the coasts of the Moray Firth, showing the quantities of fish caught each month by line-fishermen within the closed waters. Those for last year are given in the present Report (p. 115), and they show very clearly how important this area is to the line fishermen of the adjoining coasts, who obtain by far the largest portion of their catches from within its waters.

Seine-Net Fishing for Herrings at Ballantrae Bank.

Arrangements were again made in the Spring of the present year, before the time that the herring fishing on Ballantrae Bank usually begins, to make an investigation as to the action of the seine-net in capturing herrings on that spawning ground, particularly with reference to the main allegations against its use, namely, the destruction of herring-spawn and the capture of large quantities of immature herrings. Unfortunately, as was the case during the two previous seasons when similar arrangements were made, the fishing was a comparative failure, and hence the opportunity was not afforded of carrying on the investigation.

Scottish Mackerel Fishing.

It was stated in last year's Report that considerable public attention had been directed during the last year or two towards the feasibility of establishing a fishing for mackerel on the West Coast of Scotland, and particularly in the neighbourhood of Barra; and reasons were given for the belief that mackerel were generally present in large shoals to the west and north west of Barra in the early part of Summer. During the herring fishing at Barra in the present year, large numbers of mackerel were met with by the herring fishermen in the region referred to, and so abundant were they on some occasions in June, that the fishermen refrained from shooting their nets. It has been shown that the Barra mackerel are of large size and superior quality, and there is little doubt that a market could readily be found for them in the fresh state in England, and as pickled fish in the United States of America, where cured mackerel are in great demand and bring high prices. While the Board have not been in a position to carry on experimental fishing on a scale of sufficient magnitude to prove that the undertaking would be commercially successful, all the information available points in this direction, and it is well worthy of the consideration of fish-curers whether an association could not be formed to give it a thorough trial.

The Influence of Marine Currents in Transporting Floating Eggs and Larvæ from Offshore Spawning Areas.

Previous investigations of the Board have shown that the inshore waters are destitute of spawning grounds for the great majority of the food fishes, and that they receive their supplies from the spawning areas situated at some distance from shore. In the present Report a preliminary account is given by Dr T. Wemyss Fulton of experiments which have been made to determine the influence of marine currents in transporting the floating eggs and young fishes to various parts of the coast. It is shown that they may be carried in the course of their development long distances in a definite direction, to other parts of the coast, and that the fish supply of a given area of the territorial waters on the East Coast may be derived, not from the spawning areas *ex adverso*, but from those situated further north.

The Capture of immature fish by hooks.

Experiments have been carried on, the results of which are given in the present Report, with the view of determining the proportion of immature fish caught by hooks, the proportion that would be likely to survive if returned to the sea, and the possibility of diminishing their capture by a modification of the size of hook used. The experiments serve to show that while the smaller hooks catch larger numbers of small fish, no precise relation subsists between the size of hook used and the size of the fish captured; and that the capture of immature fish by this mode of fishing could not be dealt with by varying the size of the hook.

The Life-Histories and Development of the Food Fishes.

In the present Report will be found an important paper by Professor M'Intosh (p. 220), giving the results of his continued investigations on the eggs, young, and development of several of the food fishes, the work having been carried on, as in previous years, at St. Andrews Marine Laboratory. The principal investigations relates to the development of the turbot, which has now for the first time been elucidated, fertilised eggs having been procured from the hatchery. The ripe egg of the turbot has an average diameter of 1·0287 mm., and is perfectly buoyant, floating at the surface of still water or suspended midway, and it possesses a prominent oil-globule. The embryonic fish, which is of a reddish colour, emerges from the egg about the sixth or seventh day, so that the period is short before hatching occurs. The larvæ in a few days become active and dart rapidly through the water, and they are hardy; the yolk-sac becomes absorbed about the seventh day, and thereafter they feed for themselves, being extremely quick in noticing the movements of the minute crustaceous and other forms in the water around them. Professor M'Intosh states that no form hitherto observed at St. Andrews appeared to be more hardy, or to undergo the vicissitudes of temperature and manipulation with greater impunity than the young turbot; there are grounds, therefore, for expressing the hope that they may yet be reared in great numbers from the post-larval to the adolescent and adult condition in suitable enclosures. The various stages in the development of this valuable form are described and figured. Another species whose development is described is the long rough dab, the pelagic eggs of which are found in considerable abundance in March and April.

Mr H. Charles Williamson, M.A., B.Sc., also contributes an elaborate paper on the reproduction of the common eel, which has been, and still is, in many respects, involved in considerable obscurity. He gives a very full account of the reproductive organs, both as described by other naturalists, and as observed by himself in a number of specimens examined at St Andrews; and the paper includes a description of the migrations of the eel, and all that has been ascertained about its spawning. It is a remarkable fact that the ripe egg of the eel has never yet been discovered.

Mr Williamson also gives a detailed account of the distribution of the pelagic eggs and larvæ of the various species of food-fishes, obtained in the tow-nets of the 'Garland' and the boat 'Dalhousie,' including those of the plaice, haddock, cod, whiting, saithe, sprat, dab, turbot, gurnard, long rough dab, flounder, &c. In another paper the same naturalist describes the variation in the size of the eggs of a number of the food-fishes. Dr Fullarton has also furnished an elaborate description of the larval and post-larval development of the brain in the lesser sand-eel (*Ammodytes tobianus*), accompanied by illustrations. The important subject of the rate of growth of fishes is at present receiving considerable attention in connection with fishing questions. In the present report Mr Arthur T. Masterman, B.A., gives the result of his researches on the subject at St Andrews, dealing especially with the rate of growth of the plaice.

Mr Harald Dannevig also furnishes, in the present report, an account of the experiments he has made in regard to the influence of variations of temperature in accelerating or retarding the development of the eggs of fishes. The species dealt with were the plaice, cod, haddock, whiting and flounder.

The Fauna of the Firth of Forth and of Inland Waters.

Mr Thomas Scott, F.L.S., who has done so much to elucidate the marine fauna, especially on the East Coast, contributes to the present report a paper dealing with his continued observations on the fauna of the Firth of Forth area, which has resulted in the discovery of other 28 species of Copepoda, several of which have been described and figured for the first time. In other papers Mr Scott describes his researches on the fauna of the lakes of Barra and North Uist, and on the inland waters of the Shetland Isles; the latter in conjunction with Mr Robert Duthie, the assistant Fishery Officer of the district. It is shown that in the Shetland lochs there is an ample food supply for trout, and that what is wanted is protection for the fish by the cultivation of aquatic plants.

Physical Investigations.

In the present report will be found an elaborate paper, accompanied by numerous tables, by Mr A. J. Herbertson, F.R.G.S., dealing with the physical observations on the temperature and density of the sea, carried on during 1893, at various fixed stations on the east and west coasts, on board the 'Garland,' the 'Vigilant,' and H.M.S. 'Jackal.' In 1893 the extremes of sea temperature were greater than usual, but the average temperature of the surface water for the year is near the mean value derived from observations of the past years since the investigations were begun. The mean annual temperature of the water at the east coast stations during 1893 was considerably higher than in 1892, being almost the same as in 1891 and lower than 1890.

Contemporary Fishery Work.

An account is given in Section D, by Dr T. Wemyss Fulton, Superintendent of Scientific Investigations, of the contemporary fishery work in this country, and in a number of foreign states.

The Board is indebted to a large number of foreign fishery authorities and others for co-operation in connection with their scientific work. Among these may be mentioned Dr P. P. C. Hoek, Scientific Superintendent of Dutch Fisheries; Captain Drechsel, the Superintendent of Danish Fisheries, and the Naturalist, Dr Petersen; M. Raveret-Wattel, Secretary to the Societé d'Acclimitation de France; Dr Roché, the Chief Inspector of the Sea Fisheries of France; Professor Marion, the Director of the Laboratoire d'Endoume, Marseille; Captain Dannevig, the Superintendent of the hatchery at Flödevig; Señor Rafael Gutierran Vela, of the Spanish Fisheries Department; Professor E. E. Prince, Commissioner of Fisheries, Canada; Mr Nielsen, the Superintendent of the Newfoundland Fisheries; Professor Giglioli of Florence, Fishery Commissioner; His Highness Prince Albert of Monaco; Baron Jules de Guerne and M. Jules Richard; Drs Malm and Lundberg, the Inspectors of Swedish Fisheries; Dr Sauvage, Director of the Marine Station, Boulogne-sur-Mer and Dr Canu of the same Institution; Professor Heincke, Director of the Biological Institute, Heligoland, and Dr Ehrenbaum, the Zoologist; and Kloster-Kammer Director, Herwig, of the Deutscher Seefischerei-Verein.

We have the honour to be,

Sir,

Your most obedient Servants,

ANGUS SUTHERLAND, *Chairman.*
GEORGE H. M. THOMS.
W. C. M'INTOSH.
W. ANDERSON SMITH.
WILLIAM BOYD.
JAMES JOHNSTON.
J. RITCHIE WELCH.

SECTION A.—GENERAL REPORTS.

I.—REPORT ON THE TRAWLING EXPERIMENTS OF THE 'GARLAND,' AND ON THE STATISTICS OF THE EAST COAST FISHERIES RELATING THERETO.

INTRODUCTORY.

During last year the trawling experiments of the 'Garland' were carried on at the various stations on the East Coast of Scotland, as in former years. The stations in the Firth of Forth and St Andrews Bay were examined once a month, so far as circumstances permitted; those in the Moray Firth and off the coasts of Forfarshire and the stations at the Orkney Isles, on two occasions, and off Aberdeenshire once. The number of ordinary trawlings or periodic examinations of the stations in the course of the year was 150, of which 76 were in the Firth of Forth area, 35 in the Moray Firth, and 24 in St Andrews Bay. The stations in the Firth of Clyde, where the waters were closed by the Herring Fishery (Scotland) Act of 1889, were not examined during the year from want of means. The detailed results of the trawling observations will be found in the various tables annexed to this Report.

In addition to the systematic inquiry into the influence of beam-trawling on the abundance of the fish supply, the 'Garland' carried on throughout the year a series of observations on other important fishery questions. Visits were made, when the weather was sufficiently favourable, to some of the fishing-grounds lying off the shore, and investigations concerning the spawning and spawning-grounds of the food fishes, the nature and distribution of fish-food, the relative abundance and distribution of pelagic fish eggs and young fishes, &c., were continued. Experiments in line-fishing with various kinds of hooks were also carried on. The study and description of the collections of pelagic eggs, and larval and post-larval fishes have, as in previous years, been under the supervision of Professor M'Intosh, F.R.S., and some of the results are given in the present Report. In connection with the sea fish hatchery at Dunbar the 'Garland' was also employed in procuring adult flat-fishes and in transporting the fry to the fishing-grounds.

Continuous physical observations on the temperature, salinity, and transparency of the sea have also been made at the various trawling stations, and occasionally along selected lines in the Firth of Forth.

Owing to the closure of the whole of the Moray Firth within a line from Rattray Point to Duncansbay Head to beam-trawling, which came into force on the 22nd November 1892, the 'Garland' has been engaged there in the trawling investigations to a greater extent than previously, and as far as circumstances would allow. The special stations selected, with the view of testing the influence of the closure on the abundance of the fishes within its waters are described in last year's Report (p. 27). Special statistics have also been collected as to the quantities of the various kinds of fish caught within the closed waters by line fishermen.

From the great area of the Moray Firth, and the fact that it contains extensive spawning-grounds of white fish, the most important of which is the well-known Smith Bank, the experiment of closing it to beam-trawling will be watched with much interest.

The statistics collected in connection with the trawling experiments, showing the quantities obtained by line fishermen from the territorial waters, where trawling is prohibited, &c., 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, the late Mr John Murray, Newhaven; Mr Mair, Anstruther; Mr Duff, Montrose; Mr Bain, Stonehaven; and Mr Couper, Aberdeen. The trawling returns were almost all kept by Mr Thomas Scott, F.L.S. I have also to acknowledge the assistance of Mr J. G. Anderson in the tabulation of the statistics, and the care and zeal with which Captain R. Campbell, in command of the 'Garland,' has discharged his duties.

THE TRAWLING EXPERIMENTS OF THE 'GARLAND.'

1. The Firth of Forth.

The various trawling stations in the Firth of Forth area were examined last year on eight occasions. The total number of ordinary trawlings at these stations was 76, of which 60 were made at the stations within the closed waters, and 16 at the two stations outside. The tables giving these observations will be found at p. 37, and the analyses of the figures at p. 34. Dealing, first of all with the stations in the closed area (I.–VII.), it will be found that a slight increase occurred in the total abundance of fish as compared with 1893. In the latter year the average per 'shot,' or haul of the net, for all kinds of fish, was 287·6, while last year the average was 290·5. In 1892 the corresponding average was 184·4. This increase was due principally to an increase in flat-fish, which in 1893 yielded an average per 'shot' of 120·5, as compared with 145·3 last year. There was a decrease in the abundance of round-fishes, namely, from an average number per 'shot' of 162·4 in 1893, to an average of 139·6 in 1894. At the stations outside the limits of the closed waters (VIII. and IX.), where beam-trawling is actively carried on, there was a decrease both of round-fishes and of flat-fishes. The average catch of round-fishes in 1893 was 208·8, while last year it was 157·3. In the former year the average for flat-fishes was 55·4, as compared with 53·1 in 1894. The results of the trawling experiments in the Firth of Forth area last year therefore show a considerable decrease of round-fishes both in the closed and in the open waters, a slight decrease of flat-fishes in the open waters, and a slight increase in the closed waters.

The figures representing the mean average catch of flat-fishes and round-fishes per 'shot' of the trawl, at the seven stations within the closed area, and at the two stations in the open area, in each year since these experiments were begun, are given in the following tables :—

CLOSED AREA.

Year.	No. of Hauls.	Average Catch per Haul.		
		Flat Fish.	Round Fish.	All Fish.
1886	22	115·2	131·7	251·1
1887	28	200·6	144·4	351·5
1888	40	114·6	92·1	211·4
1889	70	109·1	49·8	164·8
1890	63	100·9	121·9	228·9
1891	84	115·0	67·7	189·4
1892	77	106·3	71·3	184·4
1893	77	120·5	162·4	287·6
1894	60	145·3	139·6	290·5

OPEN AREA.

Year.	No. of Hauls.	Average Catch per Haul.		
		Flat Fish.	Round Fish.	All Fish.
1886	5	44·0	36·4	85·4
1887	6	88·7	123·4	213·7
1888	10	32·6	114·7	151·2
1889	20	38·3	68·6	111·9
1890	16	53·7	184·7	241·6
1891	24	50·8	38·6	93·0
1892	22	43·0	73·0	119·4
1893	19	55·4	208·8	267·6
1894	16	41·3	125·3	172·0

With reference to the relative abundance of the various kinds of fish within the closed area, the tables show that among flat-fish there was an increase of all kinds, except lemon soles, turbot, and brill. The greatest increase was in long rough dabs, the average in 1893 being 17·9, and last year 31·5. Among round-fish there was a decrease in haddocks and gurnards, and an increase in whitings and cod. Haddocks, although less abundant than in 1893, were still more numerous than in most preceding years. At the stations in the open area, the decrease in the flat-fishes was common to all kinds except common dabs. Among round-fishes there was a decrease in haddocks and gurnards.

2. St Andrews Bay.

During 1894, 24 hauls of the trawl were made at the stations in St Andrews Bay—16 at those within the closed area, and 8 outside. In the closed waters there was an increase in the general average of fish captured per 'shot'—from 148·2 in 1893, to 179·2 in 1894. The increase was chiefly in flat-fishes, the average catch of which was 102·8 in 1893, compared with 154·4 last year. There was a considerable decrease in the average for round-fish, namely, 21·5 as against 43·9 in 1893. At the stations in the open area the results show an increase in the abundance of fish, the average per haul in 1893 being 93·3, while last year it was 170·6. This increase took place both in flat-fish and in round-fish; the average catch of the latter year was 100·5, as against 61·5 in the previous year. Flat-fishes increased from an average per 'shot' of 30·5 in 1893 to 68 last year. The averages for each year since the trawling experiments were initiated are given in the following table:—

CLOSED AREA.

Year.	No. of Hauls.	Average Catch per Haul.		
		Flat Fish.	Round Fish.	All Fish.
1886	15	147·0	27·6	176·8
1887	16	340·7	87·5	428·8
1888	20	213·2	68·9	286·0
1889	28	187·4	19·2	209·5
1890	24	302·9	40·0	347·2
1891	27	109·4	19·8	133·8
1892	32	84·0	36·6	128·4
1893	24	102·8	43·9	148·2
1894	16	154·4	21·5	179·2

OPEN AREA.

Year.	No. of Hauls.	Average Catch per Haul.		
		Flat Fish.	Round Fish.	All Fish.
1886	3	97·2	72·8	171·6
1887	4	129·4	173·3	308·4
1888	5	148·3	72·4	221·2
1889	7	151·4	29·8	183·1
1890	6	29·8	35·6	66·8
1891	6	261·8	30·8	300·1
1892	8	50·3	53·6	105·7
1893	6	30·5	61·5	93·3
1894	8	68·0	100·5	170·6

With regard to the increase or decrease of the various kinds of fish within the closed waters, the tables show that there was a large increase in common dabs and flounders, and a decrease of plaice, cod, haddocks, and whitings. At the stations in the open area there was an increase in plaice, common dabs, long rough dabs, whitings, cod, and haddocks.

3. The Moray Firth.

In last year's Report, the situation and the physical conditions of the sixteen trawling stations selected in the Moray Firth were described. Some of them lie within the three-mile limit, and therefore comparatively close to the shore, and others are situated on or near the great spawning ground, Smith Bank, at a considerable distance from the coast. During last year each of the stations was examined on two occasions, once in July and once in October; the time thus fairly corresponding to the period of examination in 1893, namely May and October. When the averages of the 37 hauls made in 1893 are compared with those of the 35 hauls last year, it is found that a considerable increase in the abundance of the food fishes took place. In 1893 the average of the total number of fishes of all kinds, per haul was 257·9, while last year it reached 292·1. There was an increase both in round-fishes and flat-fishes. The average for the former rose from 106·3 to 129·1, and the average for the latter from 146·2 to 157·6. The average for all kinds of flat-fishes, except plaice, was higher than in 1893, the abundance of long rough dabs being considerably greater. There was also an increase in the numbers of round-fishes, except cod and gurnard. The observations in the Moray Firth have, however, not been sufficiently numerous, or continued over a sufficiently long period to yield any satisfactory conclusions as to the results of the closure. The special statistics collected along the coasts of the Moray Firth, showing the quantities of fish caught each month within the closed waters are referred to below.

4. The Firth of Clyde.

In the Firth of Clyde, which was closed in 1889 to beam-trawling within a line from the Mull of Cantyre, Argyleshire, to Corsewall Point in Wigtownshire, comprising over 600 square miles, twelve stations, for carrying on experiments as to the influence of the closure of the water, were selected in 1887. These stations have been examined on two occasions, once in 1887 and once in 1890, but have not been examined since the latter year. There is not, therefore, any information available as to the results of the prohibition of beam-trawling on the fishing-grounds in the area of the Firth of Clyde.

SPECIAL STATISTICS OF FISH CAUGHT BY LINE FISHERMEN.

1. Statistics showing the Quantities of Line-Caught Fish obtained from Territorial Waters.

Special statistics are given in Table E. (p. 94) showing the quantities of fish caught by liners in the territorial waters of the East Coast, from North Berwick in the south to Skateraw, a few miles south of Aberdeen. The monthly and yearly averages per 'shot' for each kind of fish captured are also given; and Table F. (p. 112) indicates the quantities and averages for each district for the last three years.

An examination of the various tables shows that during 1894 there was an increase in the number of 'shots' in the portion of the territorial waters under consideration, namely, 37,219 as against 34,631 in the previous year. There was also an increase in the quantity of fish caught, both absolutely and in proportion to the number of shots, the average per 'shot' for the year being 2·219 cwts., as compared with 1·703 cwts. in

1893 The quantity of fish taken, and also the average catch per 'shot,' were greater last year than in the two preceding years, but less than in the years previous to 1892. The figures for the various years are as follows :—

Year.	Total Trips or Shots.	Quantity of White Fish caught.	Average Quantity per Shot.
		cwts.	cwts.
1888	43,077	109,396¼	2·539
1889	42,898	107,029¼	2·494
1890	34,501	83,692¼	2·425
1891	37,928	92,469	2·438
1892	32,543	63,420¼	1·94
1893	34,631	59,949	1·703
1894	37,219	82,623½	2·219

The increase in the quantity of fish taken in the territorial waters was common to all kinds except skate and turbot and 'other white fish;' the increase in haddocks and flat-fish was specially noticeable.

In each of the four districts from which these special statistics are obtained, haddocks were caught in increased numbers, as was also the case with whitings. The quantity of cod was less in two of the four districts, but the general average was greater. In the same way, the group of flat-fishes included under the heading 'lemon soles, flounders, and dabs,' and which to a large extent comprises plaice, showed a slight increase in two of the districts, and a slight decrease at the other two. In the following table, which has been furnished by Mr Mair, the Fishery Officer of the Anstruther District, the quantities of haddocks and whitings captured by line fishermen within the closed and open waters, and landed in his district in each of the last six years, are given :—

Year.	Caught within the Closed Area.		Caught outside the Closed 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
1890	12,418	1,994	10,338	1,595	22,756	3,589
1891	11,981	1,577	11,255	1,244	23,236	2,821
1892	11,718	936	16,647	862	28,365	1,798
1893	12,318	767	9,719	318	22,037	1,085
1894	18,321	1,120	6,299	685	24,620	1,305

2. Buckhaven Haddock and Cod Line Fishing.

The statistics of the cod and haddock line fishing of Buckhaven, specially collected by Mr Mair, the Fishery Officer of the district, since 1884, are given in Table D. for 1893 and 1894. The number of 'shots' or visits to the fishing-grounds in 1894 was considerably greater than in the previous year, apparently indicating that the falling off, which began in 1887, has been arrested. The number of 'shots' was 5,164 as against 3,101 in 1893, and 7,869 in 1886.

While the number of 'shots' was greater than in the previous year, the quantity of cod captured was relatively somewhat less, giving an average of 0·88 per shot, as compared with 1·00 in the previous year. Small haddocks were caught in much greater numbers the average number per shot being 338·9, as against 289·4 in 1893, and 176·9 in 1892. On the other hand, large haddocks decreased in abundance, the average being 18·8, as compared with 42·7 in 1893, and 50·13 in 1892. The figures for the last eleven years are as follows:—

Year.	Total Number of 'Shots' during the Year.	Average Number of Cod per 'Shot.'	Average Number of Large Haddocks per 'Shot.'	Average Number of Small Haddocks and Whitings per 'Shot.'
1884	4524	0·34	22·1	38·3
1885	4542	0·50	23·4	221·5
1886	7869	0·32	31·8	147·0
1887	6270	0·23	42·8	208·9
1888	5548	0·45	62·6	228·4
1889	4535	0·46	80·1	68·4
1890	3396	0·72	78·8	130·5
1891	3296	0·91	103·8	92·8
1892	3112	0·44	50·1	76·9
1893	3101	1·00	42·7	289·4
1894	5164	0·88	18·8	338·9

As in previous years, the largest proportions of cod were taken in November, December and January, and of small haddocks and whitings during the summer months.

3. Statistics showing the Quantities of Fish caught by Line-Fishermen within the Moray Firth.

As stated above, special statistics have been collected from the various fishing ports and villages along the coasts of the Moray Firth, to show the quantities of fish caught by line-fishermen within the closed waters.

These are given for each month of last year in Table H. (p. 115), and they are being continued. They show that a surprisingly large quantity of fish are caught by line within the waters of the Moray Firth; and if the totals given for each district in the table referred to are compared with the gross totals of all line fish landed in the respective districts, wherever caught, it will be found that in most of them the great bulk of the catches are got within the closed area. No returns have been collected in Fraserburgh district, owing to the difficulty there would be in differentiating the quantities caught within the line from Duncansby Head and Rattray Point, from the quantities caught outside it; this district lying at the southern extremity of the Firth, partly within it and partly without it. It was therefore thought better to exclude it. At the opposite extremity of the Firth this difficulty does not arise, and the fishing stations on the Moray Firth coast of the Wick district have been included. The total quantity of fish caught by line within the closed waters during last year amounted to 218,495 cwts., or an average of 3·5 cwt. per shot. The number of "shots" of the line made by large boats was 7,082, and of small boats 54,866, or a total of 61,948. By far the larger quantity of fish caught consisted of haddocks, which amounted to 153,529 cwts; only about 5,737 cwts. of flat fish were captured. Comparison of similar statistics of the quantities of fish caught, and the number of shots of the line in future years, will furnish valuable information respecting the results of the closure of this important area.

Summary.

The results of the trawling experiments in the Firth of Forth and St Andrews Bay areas in 1894 indicate a considerable increase in flat-fishes and a slight decrease in round-fishes within the waters from which beam-trawling is prohibited, and a similar, although less noteworthy change in the open waters outside. On examination of the figures relating to the different kinds of round-fishes it is apparent that the decrease is largely accounted for by the falling off in the abundance of haddocks. Last year it was pointed out that a special feature of the year 1893 was the enormous numbers of haddocks which were obtained on the east coast. Although the averages for this important food fish were much lower in 1894, they were still considerably above the averages of recent years. Cod and whiting, on the other hand, were caught in increased numbers.

Turning to flat-fishes, we find that they were caught in greater numbers in 1894 than in the year before, both in the closed and open waters, and in the Firth of Forth, as well as in St Andrews Bay. The increase is not, however, comparable to the abundance of these fishes which marked the years following the closure of the waters. But the average last year, in the closed area, ranks above the average of four of the preceding eight years. In the Firth of Forth it was 144·3, compared with 120·5 in 1893; in St Andrews Bay it was 155·4, against 102·8 in the previous year. In the closed area the average for 1894 was greater than in three of the preceding eight years.

The statistics of the 'Garland's' trawling experiments during the last nine years in the combined areas of the Firth of Forth and St Andrews Bay are as follows, the figures indicating the average number of fishes obtained in each haul of the net in each of the years mentioned :—

Year.	Closed Area.			Open Area.		
	Flat Fish.	Round Fish.	Total.	Flat Fish.	Round Fish.	Total.
1886	131·1	79·6	213·9	70·6	54·6	128·5
1887	270·6	115·9	390·1	109·0	148·3	261·0
1888	163·9	80·5	248·7	90·4	93·5	186·2
1889	148·2	34·5	187·1	94·8	49·2	147·5
1890	201·9	80·9	288·0	41·7	110·1	154·2
1891	112·2	43·7	161·6	156·3	34·7	196·5
1892	95·1	53·9	156·4	46·6	63·3	112·5
1893	129·0	149·0	282·4	49·4	173·5	225·8
1894	147·3	113·0	265·4	58·0	138·4	199·8

In order that comparison may be made between the results obtained in the few years following the prohibition of trawling, and those obtained in the last few years, the numbers of fishes captured have been reduced to averages for the two periods, each comprising four years. They are as follows :—

Years.	Closed Area.			Open Area.		
	Flat Fish.	Round Fish.	Total.	Flat Fish.	Round Fish.	Total.
1886–1889	178·5	77·8	260·0	91·2	86·4	180·8
1891–1894	120·9	89·9	216·5	77·6	102·5	183·7

These figures show that the average number of round-fishes captured during the last four years exceeds the average number taken during the first four years ; a result due to the unusual numbers of small haddocks which characterised the fishing of 1893, and their great abundance in 1894. On the other hand, notwithstanding the increase last year and in 1893 in the quantity of flat-fish taken, the average for this group is considerably less for the latter of the two periods than for the first.

In regard to the closure of the Moray Firth to beam-trawling, the information is as yet insufficient to show to what extent it is likely to be followed by an increased abundance of the food fishes in the closed waters. The sixteen trawling stations within the limits of the Firth were examined twice last year. When the averages of the 37 hauls made in 1893 are contrasted with those of the 35 hauls last year, it appears that a considerable increase in the abundance of the food fishes took place. In the former year, the general average for all species was 257·9, while last year it was 292·1. An increase occurred both in round-fishes and flat-fishes ; the average of the former rising from 106·3 to 129·1, and that of the latter from 146·2 to 157·6. From the very large area closed to beam-trawling—comprising over 2,000 square miles of the sea bottom—and the presence within it of extensive spawning-grounds, it would be of the greatest value if a systematic examination of the fishing-grounds could be made at brief intervals, a duty for which the 'Garland' is, however, but ill-fitted. Special statistics are being collected along the coasts of the Firth, in order to determine from year to year the quantities of round-fishes and flat-fishes captured within it by line-fishermen.

T. WEMYSS FULTON,
Superintendent of Scientific Investigations.

TABLE A.—SHOWING SUMMARY OF FISH TAKEN BY THE 'GARLAND' IN TRAWLING OPERATIONS IN 1894.

Station and Date.	Flat Fish.									Round Fish.							
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.	Skate.	Other Fish.	Total.
FIRTH OF FORTH—																	
Station I.																	
Jan. 22, .	2	6	.	5	15	.	.	.	28	106	62	58	.	226	1	5	260
Feb. 16, .	1	10	.	2	21	.	.	.	34	39	6	6	.	51	1	9	95
Mar. 20 .	8	15	.	16	6	3	.	.	48	23	1	9	.	33	.	10	91
April 16, .	20	35	.	17	11	3	.	.	86	32	16	12	24	84	1	19	190
June 22, .	50	24	.	60	26	.	.	.	160	33	51	18	27	129	.	1	290
Aug. 24, .	47	57	.	16	16	.	.	.	136	41	28	25	5	99	1	.	236
Sept. 11, .	33	53	.	55	34	.	.	.	175	22	51	61	24	158	.	6	339
Dec. 4, .	3	12	.	8	49	.	.	.	72	19	1	33	.	53	1	3	129
	164	212	.	179	178	6	.	.	739	315	216	222	80	833	5	53	1630
Station II.																	
Jan. 26, .	1	1	.	3	9	.	.	.	14	30	2	3	.	35	3	2	54
Feb. 16, .	15	1	.	11	14	.	.	.	41	.	.	.	.	.	2	2	45
Mar. 21, .	12	1	.	39	15	26	.	.	93	2	.	.	.	2	1	2	98
April 20, .	14	10	.	67	7	3	.	.	101	1	.	.	28	29	.	2	132
June 26, .	12	5	.	32	12	.	.	.	61	6	5	16	33	60	.	2	123
Aug. 30, .	64	43	.	148	41	.	.	.	296	9	228	147	37	421	1	4	722
Sept. 11, .	65	34	.	212	36	.	.	.	347	2	108	63	11	184	.	2	533
Dec. 6, .	2	1	.	6	44	.	.	.	53	4	7	8	.	19	1	1	74
,, 26, .	1	2	.	2	56	.	.	.	61	7	1	2	.	10	1	4	76
	186	98	.	520	234	29	.	.	1067	61	351	239	109	760	9	21	1857
Station III.																	
Feb. 20, .	3	13	.	2	30	1	.	.	49	197	12	34	.	243	1	8	301
Mar. 20, .	15	10	.	59	21	5	.	.	110	13	.	4	.	17	3	4	134
April 16, .	22	19	.	65	85	3	.	.	194	22	.	41	14	77	1	4	276
June 21, .	38	41	.	44	20	.	.	.	143	21	32	7	42	102	1	3	249
Aug. 24, .	47	93	.	122	105	.	.	.	367	52	169	175	24	420	1	8	796
Sept. 19, .	41	40	.	76	54	.	.	.	211	35	65	.	4	104	7	5	327
Dec. 10, .	4	7	.	51	89	.	.	.	151	14	7	41	.	62	5	8	226
,, 27, .	2	4	.	7	27	.	.	.	40	7	1	10	.	18	.	5	
	172	227	.	426	431	9	.	.	1265	361	286	312	84	1043	19	45	2372

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1894—*continued.*

Station and Date.	Flat-Fish.									Round-Fish.							
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.	Skate.	Other Fish.	Total.
FIRTH OF FORTH—*continued.*																	
Station IV.																	
Jan. 17, .	230	.	.	2	3	1	.	.	236	.	.	.	.	.	.	.	236
Feb. 15, .	392	.	.	30	.	1	.	.	423	13	.	2	.	15	.	.	438
Mar. 21, .	216	.	.	6	.	8	.	.	230	.	.	.	.	.	.	2	232
April 13, .	141	.	.	52	14	3	.	.	210	.	.	1	.	1	1	1	213
June 21, .	90	5	.	10	3	1	.	.	109	11	14	21	25	71	1	2	183
Aug. 23, .	263	25	.	58	4	.	2	.	352	6	11	5	16	38	16	1	407
Sept. 19, .	173	7	.	96	.	1	.	.	277	40	3	5	13	61	.	.	338
Nov. 23, .	128	2	.	58	14	.	.	.	202	23	.	4	.	27	1	14	244
	1633	39	.	312	38	15	2	.	2039	93	28	38	54	213	19	20	2291
Station V.																	
Feb. 22, .	3	3	4	7	56	.	.	.	73	39	480	51	.	570	.	5	648
Mar. 30, .	8	6	6	22	70	1	.	.	113	22	170	8	3	203	1	5	322
April 19, .	9	13	5	15	57	.	.	.	99	35	432	31	6	504	7	.	610
June 20, .	20	4	1	3	50	.	.	.	78	27	500	18	7	552	.	1	631
Aug. 30, .	23	17	10	22	102	.	.	.	174	18	629	118	35	800	1	2	977
Sept. 13, .	39	11	10	43	7	.	.	.	110	11	470	85	18	584	1	3	698
Nov. 30, .	15	2	8	11	96	.	.	.	132	14	165	29	1	209	1	2	344
	117	56	44	123	438	1	.	.	779	166	2846	340	70	3422	11	18	4230
Station VI.																	
Feb. 22, .	45	1	.	10	.	.	.	1	57	3	.	.	.	3	.	.	60
Mar. 30, .	23	5	.	4	.	.	.	.	32	.	.	.	2	2	.	2	36
April 19, .	6	24	.	5	3	.	.	.	38	7	1	.	7	15	.	.	53
June 20, .	16	22	.	35	1	.	.	2	76	5	3	2	28	38	.	9	123
Aug. 30, .	32	35	.	57	4	.	.	1	129	1	12	24	26	63	.	7	199
Sept. 13, .	32	57	.	62	35	.	.	1	187	6	32	14	15	67	.	2	256
Nov. 30, .	14	4	.	10	13	.	.	.	41	2	3	17	2	24	2	3	70
	168	148	.	183	56	.	.	5	560	24	51	57	80	212	2	23	797
Station VII.																	
Jan. 18, .	2	.	.	1	20	.	1	.	24	2	46	6	.	54	.	2	80
Feb. 23, .	2	1	9	3	14	1	.	.	30	19	279	39	.	337	3	1	371
Mar. 29, .	5	2	3	76	38	10	.	.	134	.	38	2	4	44	4	2	184
April 13, .	7	1	3	11	22	.	.	.	44	9	145	13	9	176	.	1	221
June 20, .	31	16	6	109	25	.	.	.	187	1	88	33	53	175	2	1	365
Aug. 23, .	57	35	4	503	125	.	.	.	724	.	179	45	30	254	7	13	998
Sept. 13, .	33	4	9	210	63	.	.	.	319	.	91	12	15	118	.	15	452
Nov. 30, .	5	1	6	14	52	.	.	.	78	3	12	22	2	39	5	6	128
	142	60	40	927	359	11	1	.	1540	34	878	172	113	1197	21	41	2799

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1894—*continued.*

Station and Date.	Flat-Fish.									Round-Fish.					Skate.	Other Fish.	Total.
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.			
Firth of Forth—*continued.*																	
Station VIII.																	
Jan. 18, .	.	1	.	3	3	.	.	.	7	5	27	.	.	32	.	3	42
Feb. 21, .	2	.	3	7	20	.	.	.	32	3	93	4	.	100	7	1	140
Mar. 14, .	1	3	.	4	3	1	.	.	12	3	1	1	1	6	2	5	25
April 18, .	5	3	2	41	40	3	1	.	95	17	204	24	.	245	.	9	349
June 19, .	8	20	5	16	18	.	.	.	67	13	36	19	22	90	.	4	161
Aug. 29, .	7	11	6	17	41	.	.	.	82	13	269	45	29	356	1	1	440
Sept. 12, .	11	2	13	34	77	.	.	.	137	13	217	48	11	289	1	4	431
Nov. 28, .	4	4	4	31	18	.	1	.	62	1	31	6	4	42	5	4	113
	38	44	33	153	220	4	2	.	494	68	878	137	67	1160	16	31	1701
Station IX.																	
Jan. 19, .	.	1	.	4	13	.	.	.	18	1	75	23	.	99	.	1	118
Feb. 21, .	.	1	1	11	28	.	.	.	41	5	372	34	.	411	.	3	455
Mar. 14, .	.	1	.	6	1	2	1	.	11	.	3	1	.	4	.	.	15
Apr. 18, .	1	.	.	8	10	.	.	.	19	3	45	32	4	84	1	1	105
June 19, .	2	2	1	5	20	.	.	.	30	6	142	14	10	172	.	.	202
Aug. 29, .	2	1	1	.	20	.	.	.	24	8	169	44	11	232	2	.	258
Sept. 12, .	3	1	.	3	52	.	.	.	59	2	185	21	13	221	2	2	284
Nov. 28, .	.	.	3	139	12	.	.	.	154	5	76	50	3	134	2	3	293
	8	7	6	176	156	2	1	.	356	30	1067	219	41	1357	7	10	1730
Station X.																	
Jan. 25, .	.	2	.	.	.	.	.	.	2	10	.	5	.	15	1	1	19
Feb. 17, .	1	2	.	1	2	.	.	.	6	39	.	16	.	55	6	2	69
Aug. 31, .	.	1	.	.	.	1	.	.	2	8	.	18	.	26	10	2	40
Sept. 15, .	2	2	.	.	.	.	.	.	4	12	.	10	.	22	17	4	47
Dec. 8, .	.	2	.	1	1	.	.	.	4	10	.	7	.	17	4	1	26
	3	9	.	2	3	1	.	.	18	79	.	56	.	135	38	10	201
St Andrews Bay—																	
Station I.																	
Feb. 14, .	3	.	.	2	1	1	.	.	7	.	.	.	.	.	2	4	13
April 6, .	25	.	.	19	.	47	1	.	92	.	5	.	28	33	.	.	125
Sept. 6, .	153	.	.	290	3	.	.	.	446	.	13	1	23	37	4	4	491
Dec. 21, .	2	.	.	2	2	.	.	.	6	1	.	.	.	1	1	.	8
	183	.	.	313	6	48	1	.	551	1	18	1	51	71	7	8	637
Station II.																	
Feb. 13, .	4	.	.	3	.	.	.	.	7	.	1	9	.	10	.	4	21
April 6, .	15	1	.	66	1	1	.	.	84	.	.	1	5	6	.	.	90
Sept. 6, .	94	.	.	236	13	.	.	.	343	1	19	3	5	28	2	6	379
Dec. 19, .	1	.	.	4	.	.	.	.	5	1	.	3	4	8	1	1	15
	114	1	.	309	14	1	.	.	439	2	20	16	14	52	3	11	505

TABLE A.—SHOWING SUMMARY OF FISH TAKEN BY THE 'GARLAND' IN TRAWLING OPERATIONS IN 1894—*continued.*

Station and Date.	Flat-Fish.									Round-Fish.					Skate.	Other Fish.	Total.
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.			
ST ANDREWS BAY—*continued.*																	
Station III.																	
Feb. 13, .	2	.	.	3	5	1	.	.	11	6	.	11	.	17	2	3	33
April 6, .	46	.	.	10	2	5	.	.	63	.	2	2	.	4	.	.	67
Sept. 6, .	168	1	.	244	2	.	.	.	415	.	10	2	39	51	2	2	470
Dec. 19, .	1	.	.	1	3	.	.	.	5	.	.	.	2	2	.	.	7
	217	1	.	258	12	6	.	.	494	6	12	15	41	74	4	5	577
Station IV.																	
Feb. 13, .	64	.	.	2	.	.	.	.	66	.	.	3	.	3	.	1	70
April 6, .	120	.	.	58	.	17	.	.	195	.	.	1	1	2	3	1	201
Sept. 6, .	380	.	.	335	.	1	.	.	716	.	105	1	34	140	2	5	863
Dec. 19, .	5	.	.	5	.	.	.	.	10	2	.	.	.	2	2	1	15
	569	.	.	400	.	18	.	.	987	2	105	5	35	147	7	8	1149
Station V.																	
Feb. 12, .	.	.	.	7	5	.	.	.	12	2	38	12	1	53	.	2	67
April 5, .	7	.	.	19	4	16	.	.	46	2	211	28	17	258	.	1	305
Sept. 7, .	46	1	.	121	10	.	.	.	178	.	8	7	18	33	2	1	214
Dec. 17, .	7	.	.	6	11	.	.	1	25	2	7	4	2	15	1	.	41
	60	1	.	153	30	16	.	1	261	6	264	51	38	359	3	4	627
Station VI.																	
Feb. 14. .	5	.	.	2	63	.	.	.	70	8	140	42	.	190	2	.	262
April 5, .	.	2	.	55	21	24	1	.	103	.	138	37	52	227	.	3	333
Sept. 7, .	8	3	.	51	4	.	.	.	66	.	3	1	14	18	.	2	86
Dec. 12, .	1	.	.	9	34	.	.	.	44	.	5	3	2	10	1	2	57
	14	5	.	117	122	24	1	.	283	8	286	83	68	445	3	7	738
MONTROSE—																	
Station I.																	
Sept. 21, .	87	1	.	147	11	.	.	.	246	.	4	7	15	26	2	1	275
Dec. 20, .	4	.	.	.	19	.	.	.	23	12	20	.	.	32	5	1	61
	91	1	.	147	30	.	.	.	269	12	24	7	15	58	7	2	336
Station II.																	
Sept. 21, .	100	.	.	106	3	.	.	.	209	.	23	6	44	73	2	2	282
Dec. 20, .	7	.	.	.	5	.	.	.	12	4	7	.	.	11	4	.	27
	107	.	.	106	8	.	.	.	221	4	30	6	44	84	6	2	313

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1894—*continued.*

Station and Date.	Flat-Fish.									Round Fish.							
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.	Skate.	Other Fish.	Total.
ABERDEEN—BAY.																	
Station I.																	
Sept. 25, .	44	4	.	131	65	.	.	1	245	.	3	6	3	12	1	2	260
Station II.																	
Sept. 25, .	11	.	.	51	8	.	.	.	70	.	.	.	7	7	.	1	78
Station III.																	
Sept. 25, .	55	.	.	101	50	.	1	.	207	.	10	8	5	23	.	.	230
Station IV.																	
Sept. 27, .	70	1	.	76	72	.	.	.	219	1	266	212	24	503	.	5	727
Station V.																	
Sept. 27, .	46	.	.	48	2	.	.	.	96	1	332	191	10	534	1	1	632
Station VI.																	
Sept. 27, .	17	1	.	36	1	.	1	.	56	.	169	391	10	570	.	1	627
Station VII.																	
Sept. 26, .	50	.	.	104	.	.	1	.	155	.	23	4	11	38	.	1	194
	293	6	.	547	198	.	3	1	1048	2	803	812	70	1687	2	11	2748
MORAY FIRTH—																	
Station I.																	
July 3, .	8	1	.	16	.	.	.	.	25	.	1	.	3	4	1	.	30
Oct. 5, .	41	.	.	148	.	.	.	1	190	.	1	.	19	20	1	2	213
	49	1	.	164	.	.	.	1	215	.	2	.	22	24	2	2	243
Station II.																	
July 3, .	34	2	4	72	41	.	.	.	153	3	6	.	8	17	.	5	175
Oct. 4, .	38	2	3	94	.	.	.	.	137	2	7	.	5	14	6	9	166
	72	4	7	166	41	.	.	.	290	5	15	.	13	31	6	14	341
Station III.																	
July 7, .	66	12	.	10	.	.	.	.	88	9	5	1	12	27	9	1	125
Oct. 6, .	51	15	.	10	.	.	.	.	76	9	.	.	.	9	5	3	93
	117	27	.	20	.	.	.	.	164	18	5	1	12	36	14	4	218

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1894—*continued.*

Station and Date.	Flat-Fish.									Round-Fish.							
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.	Skate.	Other Fish.	Total.
Moray Firth —*continued.*																	
Station IV.																	
July 4, .	268	.	.	163	1	2	.	.	434	.	8	.	62	70	.	.	504
Oct. 22, .	276	.	.	139	.	.	.	5	420	2	9	.	1	12	8	4	444
	544	.	.	302	1	2	.	5	854	2	17	.	63	82	8	4	948
Station V.																	
July 4, .	18	6	.	87	.	.	.	.	111	.	3	1	39	43	.	.	154
Oct. 22, .	121	1	.	236	.	.	.	1	359	2	26	.	.	28	1	.	388
	139	7	.	323	.	.	.	1	470	2	29	1	39	71	1	.	542
Station VI.																	
July 5, .	31	31	.	150	.	.	.	.	212	.	3	1	12	16	.	3	231
Oct. 22, .	179	4	.	218	.	.	.	.	401	6	54	1	6	67	5	2	475
	216	35	.	368	.	.	.	.	613	6	57	2	18	83	5	5	706
Station VII.																	
July 5, .	.	10	.	66	51	.	.	.	127	.	14	2	20	36	2	3	168
Oct. 9, .	1	1	1	170	95	.	.	.	268	1	405	37	78	521	1	4	794
	1	11	1	236	146	.	.	.	395	1	419	39	98	557	3	7	962
Station VIII.																	
July 9, .	1	5	11	73	138	.	.	.	228	.	319	9	32	360	1	2	591
Oct. 23, .	2	4	29	111	111	.	.	.	257	5	358	14	16	393	1	7	658
	3	9	40	184	249	.	.	.	485	5	677	23	48	753	2	9	1249
Station IX.																	
July 9, .	.	2	19	45	69	.	.	.	135	1	260	15	10	286	.	2	423
Oct. 23, .	2	6	7	194	84	.	.	.	293	2	357	43	45	447	1	1	742
	2	8	26	239	153	.	.	.	428	3	617	58	55	733	1	3	1165
Station X.																	
July 13, .	8	1	.	5	.	.	.	.	14	2	13	1	1	17	2	2	35
Oct. 5, .	7	17	.	88	40	.	.	.	152	3	244	13	110	370	4	6	532
	15	18	.	93	40	.	.	.	166	5	257	14	111	387	6	8	567
Station XI.																	
July 16, .	13	2	.	16	.	.	.	.	31	2	.	.	23	25	3	2	61
July 16,* .	.	2	.	11	.	.	.	.	13	7	3	.	7	17	.	13	43
Oct. 11, .	5	1	.	7	.	.	.	.	13	4	36	1	22	63	.	4	80
	18	5	.	34	.	.	.	.	57	13	39	1	52	105	3	19	184

* Shrimp-nets.

TABLE A.—Showing Summary of Fish taken by the 'Garland' in Trawling Operations in 1894—*continued.*

Station and Date.	Flat-Fish.									Round-Fish.							
	Plaice.	Lemon Soles.	Witch Soles.	Common Dabs.	Long Rough Dabs.	Flounders.	Turbot.	Brill.	Total.	Cod.	Haddocks.	Whitings.	Gurnards.	Total.	Skate.	Other Fish.	Total.
Moray Firth —*continued.*																	
Station XII.																	
July 16, .	11	2	.	4	.	.	.	1	18	.	6	.	27	33	1	1	53
Oct. 11, .	11	7	.	20	.	.	.	1	39	9	23	.	6	38	.	6	83
	22	9	.	24	.	.	.	2	57	9	29	.	33	71	1	7	136
Station XIII.																	
July 17, .	8	16	.	63	.	.	.	.	87	3	10	.	23	36	.	3	126
July 17,* .	.	.	.	.	.	.	.	.	.	.	5	1	5	11	.	.	11
Oct. 11, .	15	5	.	79	9	.	.	.	108	2	153	8	26	189	1	4	302
	23	21	.	142	9	.	.	.	195	5	168	9	54	236	1	7	439
Station XIV.																	
July 17, .	7	17	.	92	31	2	.	1	150	.	1	.	44	45	4	1	200
Oct. 11, .	.	27	.	20	25	1	.	.	73	.	500	81	46	627	4	1	705
	7	44	.	112	56	3	.	1	223	.	501	81	90	672	8	2	905
Station XV.																	
July 17, .	2	13	.	205	20	.	.	.	240	.	.	.	31	31	1	6	278
Oct. 11, .	15	10	.	259	17	.	.	.	301	6	188	16	85	295	2	4	602
	17	23	.	464	37	.	.	.	541	6	188	16	116	326	3	10	880
Station XVI.																	
July 17, .	4	5	.	40	11	.	.	.	60	.	4	.	23	27	.	1	88
July 17, .	.	3	.	1	.	.	.	.	4	1	.	.	2	3	.	6	13
Oct. 12, .	1	15	17	205	60	2	.	.	300	2	281	39	.	322	5	7	634
	5	23	17	246	71	2	.	.	364	3	285	39	25	352	5	14	735
Orkney.																	
Station I.	8	26	.	39	.	1	.	.	74	4	45	.	8	57	1	1	133
Station II.	1	.	.	9	.	.	.	.	10	.	4	.	13	17	2	.	29
Station III.	90	10	.	.	.	.	.	.	100	.	.	.	3	3	3	3	109
Station IV.	7	14	14	44	.	.	.	.	79	.	1	.	5	6	2	2	89
	106	50	14	92	.	1	.	.	263	4	50	.	29	83	8	6	360

* Shrimp-nets.

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.					Skate.	Other Fish.	Total.
	Plaice.	Lemon Sole.	WitchSole.	Common Dabs.	Long Roughs.	Flounder.	Turbot.	Brill.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.			
I. *Firth of Forth.*																	
Closed Area.																	
I.	20·5	26·5	–	22·4	22·7	0·75	–	–	92·4	39·4	27·0	27·8	10·0	104·1	0·62	6·6	213·8
II.	20·7	10·9	–	57·8	26·0	3·2	–	–	119·6	6·8	39·0	26·6	12·1	84·4	1·0	2·3	206·3
III.	21·5	28·4	–	53·3	53·9	1·1	–	–	158·1	45·1	35·8	38·0	10·5	130·4	2·4	5·6	296·5
IV.	204·1	4·9	–	39·0	4·8	1·9	0·12	–	254·9	11·6	3·5	4·8	6·8	26·6	2·4	2·5	286·4
V.	16·7	8·0	6·3	17·6	62·6	0·14	–	–	111·3	23·7	406·5	48·6	10·0	488·8	1·6	2·6	604·3
VI.	24·0	21·1	–	26·1	8·0	–	–	0·71	80·0	3·4	7·3	8·1	11·4	30·3	0·3	3·3	113·9
VII.	17·7	7·5	5·0	115·8	44·8	1·4	0·13	–	192·5	4·1	109·7	21·5	14·1	149·6	2·6	5·1	349·8
Average per shot of 55 shots.	46·9	15·3	1·5	48·5	31·5	1·3	·02	0·09	145·3	19·2	84·6	25·1	10·7	139·6	1·6	4·0	290·5
Unclosed Area.																	
VIII.	4·7	5·5	4·1	19·1	27·5	0·5	0·25	–	61·7	8·5	109·7	17·1	8·4	145·0	2·0	3·9	212·6
IX.	1·0	0·9	0·75	22·0	19·5	0·25	0·12	–	44·5	3·7	133·4	27·4	5· 1	169·6	0·9	1·25	216·3
Average per shot of 16 shots.	2·9	3·2	2·4	20·5	23·5	0·4	0·18	–	53·1	6·1	121·5	22·2	6·7	157·3	1·4	2·5	214·4
II. *St Andrews Bay.*																	
Closed Area.																	
I.	45·7	–	–	78·2	1·5	12·0	0·25	–	137·7	0·25	4·5	0·25	12·7	17·7	1·7	2·0	159·2
II.	38·0	0·25	–	77·2	3·5	0·25	–	–	109·7	0·5	5·0	4·0	3·5	13·0	0·7	2·7	126·2
III.	54·2	0·25	–	64·5	3·0	1·5	–	–	123·5	1·5	3·0	3·7	10·2	18·5	1·0	1·2	144·2
IV.	142·2	–	–	100·0	–	4·5	–	–	246·7	0·5	26·2	1·2	8·7	36·7	1·7	2·0	287·2
Average per shot of 16 shots.	67·6	0·1	–	80·0	2·0	4·6	0·06	–	154·4	0·69	9·7	2·3	8·8	21·5	1·3	2·0	179·2
Unclosed Area.																	
V.	15·0	0·25	–	38·2	7·5	4·0	–	0·25	65·2	1·5	66·0	12·7	9·5	89·7	0·75	1·0	156·7
VI.	3·5	1·2	–	29·2	30·5	6·0	0·25	–	70·7	2·0	71·5	20·7	17·0	111·2	0·75	1·7	184·5
Average of 8 shots.	9·2	0·75	–	33·7	19·0	5·0	0·12	0·12	68·0	1·75	68·7	16·7	13·5	100·5	0·75	1·4	170·6

A. Showing the Average per 'Shot' of each kind of Fish taken—*continued.*

Station.	Flat-Fish.									Round-Fish.					Skate.	Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Turbot.	Brill.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.			
III. *Montrose.*																	
I.	45·5	0·5	–	73·5	15·0	–	–	–	134·5	6·0	12·0	3·5	7·5	29·0	3·5	1·0	168·0
II.	53·5	–	–	106·0	4·0	–	–	–	110·5	2·0	15·0	3·0	22·0	42·0	3·0	1·0	156·5
Average of 4 shots.	49·5	0·25	–	89·7	9·5	–	–	–	122·5	4·0	13·5	3·2	14·7	35·5	3·2	1·0	162·2
IV. *Aberdeen.*																	
Average per shot of 7 shots.	41·8	0·85	–	78·1	28·3	–	0·43	0·14	149·7	0·3	114·7	116·0	10·0	241·0	0·28	1·6	392·6
V. *Moray Firth.*																	
I.	24·5	0·5	–	82·0	–	–	–	0·5	107·5	–	1·0	–	11·0	12·0	1·0	1·0	121·5
II.	36·0	2·0	3·5	83·0	20·5	–	–	–	145·0	2·5	6·5	–	6·5	15·5	3·0	7·0	170·5
III.	58·5	13·5	–	10·0	–	–	–	–	82·8	9·0	2·5	0·5	6·0	18·0	7·0	2·0	109·0
IV.	272·0	–	–	151·0	0·5	1·0	–	2·5	427·0	1·0	8·5	–	31·5	41·0	4·0	2·0	474·0
V.	69·5	3·5	–	161·5	–	–	–	0·5	235·0	1·0	14·5	0·5	19·5	35·5	0·5	–	271·0
VI.	105·0	17·5	–	184·0	–	–	–	–	306·5	3·0	28·5	1·0	9·0	41·5	2·5	2·5	353·0
VII.	0·5	5·5	0·5	128·0	73·0	–	–	–	197·5	0·5	209·5	19·5	49·0	278·5	1·5	3·5	481·0
VIII.	1·5	4·5	20·0	92·0	124·5	–	–	–	242·5	2·5	338·5	11·5	24·0	376·5	1·0	4·5	624·5
IX.	1·0	4·0	13·0	119·5	76·5	–	–	–	214·0	1·5	308·5	29·0	27·5	366·5	0·5	1·5	582·5
X.	7·5	9·0	–	46·5	20·0	–	–	–	83·0	2·5	128·5	7·0	55·5	193·5	3·0	4·0	283·5
XI.	6·0	1·6	–	11·3	–	–	–	–	19·0	4·3	13·0	0·33	17·3	35·0	1·0	6·3	61·3
XII.	11·0	4·5	–	12·0	–	–	–	1·0	28·5	4·5	14·5	–	16·5	35·5	0·5	3·5	68·0
XIII.	7·6	7·0	–	47·3	3·0	–	–	–	65·0	1·7	56·0	3·0	18·0	78·7	0·33	2·3	146·3
XIV.	3·5	22·0	–	56·0	28·0	1·5	–	0·5	111·5	–	250·5	40·5	45·0	386·0	4·0	1·0	452·5
XV.	8·5	11·5	–	232·0	18·5	–	–	–	270·5	3·0	94·0	8·0	58·0	163·0	1·5	5·0	440·0
XVI.	1·7	7·7	5·7	82·0	23·7	0·7	–	–	121·3	1·0	95·0	13·0	8·3	117·3	1·7	4·7	245·0
Average per shot of 35 shots.	35·5	7·0	2·6	89·1	25·8	0·2	–	0·28	157·6	2·4	94·4	8·1	24·3	129·1	1·9	3·3	292·1
VI. *Orkney.*																	
Average of 4 shots.	26·5	12·5	3·5	23·0	–	0·25	–	–	65·7	1·0	12·5	–	7·2	20·7	2·0	1·5	90·0

B. Showing the Monthly Average per 'Shot' of each kind of Fish taken in 1894.

Date.	Flat-Fish.									Round-Fish.					Skate.	Other Fish.	Total.
	Plaice.	Lemon Sole.	Witch Sole.	Common Dabs.	Long Roughs.	Flounder.	Turbot.	Brill.	Total.	Cod.	Haddock.	Whiting.	Gurnard.	Total.			
									I. Firth of Forth.								
Closed Area.																	
Jan.	33·6	1·0	1·6	1·6	6·7	0·14	0·14	–	43·1	19·7	15·7	9·6	–	45·0	0·6	1·3	90·0
Feb.	65·9	4·1	1·9	9·3	19·3	0·4	–	0·14	101·0	44·3	111·0	18·9	–	174·1	1·0	3·6	279·7
Mar.	41·0	5·6	1·3	31·7	21·4	7·6	–	–	108·6	8·6	29·9	3·3	1·3	43·0	1·3	3·9	146·7
April	31·3	14·6	1·1	33·1	28·4	1·7	–	–	110·3	15·1	84·9	14·0	12·6	126·6	1·4	3·9	242·1
June	36·7	16·7	1·0	41·9	19·6	0·14	–	0·3	116·3	14·9	99·0	16·4	30·7	161·0	0·57	2·7	280·6
Aug.	76·1	43·6	2·0	132·3	56·7	–	0·3	0·14	311·1	18·1	179·4	77·0	24·7	299·3	3·9	5·0	619·3
Sept.	59·4	29·4	2·7	107·7	32·7	0·14	–	0·14	232·3	16·6	117·1	34·3	14·3	182·6	1·1	4·7	420·4
Nov.	40·5	2·2	3·5	23·2	43·7	–	–	–	113·2	10·5	45·0	18·0	1·2	74·7	2·2	6·2	196·5
Dec.	3·0	6·5	–	18·5	66·2	–	–	–	94·2	12·7	4·2	23·5	–	40·5	2·0	5·2	142·0
Unclosed Area.																	
Jan.	–	1·0	–	3·5	8·0	–	–	–	12·5	3·0	51·0	12·5	–	65·5	–	2·0	80·0
Feb.	1·0	0·5	2·0	9·0	24·0	–	–	–	36·5	4·0	232·5	19·0	–	255·5	3·5	2·0	297·5
Mar.	0·5	2·0	–	5·0	2·0	1·5	0·5	–	11·5	1·5	2·0	1·0	0·5	5·0	1·0	2·5	20·0
April	3·0	1·5	1·0	24·5	25·0	1·5	0·5	–	57·0	10·0	124·5	28·0	2·0	164·5	0·5	5·0	227·0
June	5·0	11·0	3·0	10·5	19·0	–	–	–	48·5	9·5	89·0	16·5	16·0	131·0	–	2·0	181·5
Aug.	4·5	6·0	3·5	8·5	30·5	–	–	–	53·0	10·5	219·0	44·5	20·0	294·0	1·5	0·5	349·0
Sept.	7·0	1·5	6·5	18·5	64·5	–	–	–	98·0	7·5	201·0	34·5	12·0	255·0	1·5	3·0	357·5
Nov.	2·0	2·0	3·5	85·0	15·0	–	0·5	–	108·0	3·0	53·5	28·0	3·5	88·0	3·5	3·5	203·0
									II. St Andrews Bay.								
Closed Area.																	
Feb.	18·2	–	–	2·5	1·5	0·5	–	–	22·7	1·5	0·2	5·7	–	7·5	1·0	3·0	34·2
April	51·2	0·2	–	38·2	0·7	17·5	0·2	–	108·5	–	1·75	1·0	8·5	11·2	0·7	0·25	120·7
Sept.	179·0	0·5	–	233·7	1·5	0·5	–	–	415·2	–	32·0	1·25	25·2	58·5	2·0	2·7	478·5
Dec.	2·2	–	–	3·0	1·2	–	–	–	6·5	1·0	–	0·75	1·5	3·2	1·0	0·5	11·2
Unclosed Area.																	
Feb.	2·5	–	–	4·5	34·0	–	–	–	41·0	5·0	89·0	27·0	0·5	121·5	1·0	1·0	164·5
April	3·5	1·0	–	37·0	12·5	20·0	0·5	–	74·5	1·0	174·5	32·5	34·5	242·5	–	2·0	319·0
Sept.	27·0	2·0	–	86·0	7·0	–	–	–	122·0	–	5·5	4·0	16·0	25·5	1·0	1·5	150·0
Dec.	4·0	–	–	7·5	22·5	–	–	0·5	34·5	1·0	6·0	3·5	2·0	12·5	1·0	1·0	49·0

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth.

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station I. 1894. Jan. 22. 2.5 p.m. to 4 p.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Plaice,	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2
	Lemon soles,	.	.	.	2	.	.	.	3	.	.	1	.	.	.	.	.	.	.	.	.	6
	Common dabs,	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Long rough dabs,	.	2	.	6	.	.	6	1	.	.	.	.	.	.	.	.	.	.	.	.	15
	Haddocks,	.	.	.	.	34	.	.	28	.	.	.	.	.	.	.	.	.	.	.	.	62
	Cod,	.	.	51	.	31	.	.	9	.	.	.	7	.	.	.	.	.	.	5	3	106
	Whitings,	.	.	.	.	49	.	3	.	.	4	.	.	2	.	.	.	.	.	.	.	58
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3*	3
	Herring,	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						260
Feb. 16. 2.25 p.m. to 4.20 p.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Lemon soles,	.	.	.	.	.	1	.	6	.	.	3	.	.	.	.	.	.	.	.	.	10
	Common dabs,	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Long rough dabs,	8	8	.	.	4	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	21
	Haddocks,	.	.	.	.	5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Cod,	.	2	3	3	8	8	.	.	10	3	.	.	.	.	.	.	.	.	2	.	39
	Whitings,	.	.	.	3	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8†	8
	Goby,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1‡
																						95
Mar. 20. 2.40 p.m. to 4.30 p.m.	Plaice,	.	.	.	.	2	.	1	.	1	4	.	.	.	.	.	.	.	.	.	.	8
	Lemon soles,	.	.	5	.	.	.	.	.	7	.	3	.	.	.	.	.	.	.	.	.	15
	Common dabs,	.	.	9	.	4	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Flounders,	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	2	.	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Haddock,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Cod,	.	.	5	.	6	.	.	4	.	.	.	4	.	.	.	2	.	.	.	2	23
	Whitings,	.	.	.	7	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8§	8
	Herring,	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						91
April 16. 11 a.m. to 12.45 p.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Plaice,	.	.	.	.	.	3	.	9	.	8	.	.	.	.	.	.	.	.	.	.	20
	Lemon soles,	.	.	10	8	.	6	10	.	1	.	.	.	.	.	.	.	.	.	.	.	35
	Common dabs,	.	.	6	9	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
	Flounders,	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	.	4	.	1	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	11
	Haddocks,	.	.	.	5	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Cod,	.	.	16	.	.	.	6	5	.	.	4	.	.	1	.	.	.	.	.	.	32
	Whitings,	.	.	1	.	6	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
	Gurnards,	.	.	.	.	3	.	10	.	6	.	5	.	.	.	.	.	.	.	.	.	24
	Anglers,	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	14‖	17
																						190
June 22. 10.35 a.m. to 12.30 p.m.	Plaice,	.	.	.	.	3	20	14	2	7	2	2	.	.	.	.	.	.	.	.	.	50
	Lemon soles,	.	.	4	10	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24
	Common dabs,	.	3	30	16	7	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	60
	Long rough dabs,	.	3	14	4	2	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	26
	Haddocks,	.	.	.	.	4	24	21	2	.	.	.	.	.	.	.	.	.	.	.	.	51
	Cod,	.	.	3	.	15	.	6	4	3	.	.	.	1	1	.	.	.	.	.	.	33
	Whitings,	.	.	.	.	4	10	4	.	.	.	.	.	.	.	.	.	.	.	.	.	18
	Gurnards,	.	.	.	9	12	.	.	4	2	.	.	.	.	.	.	.	.	.	.	.	27
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
																						290

* One 40 inches. † Five over 30 inches, one over 35 inches. ‡ 2 inches.
§ Three over 30 inches, two over 35 inches. ‖ Three over 35 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Aug. 24.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
1.30 p.m.	Plaice,	.	.	.	.	.	2	11	.	11	7	.	15	1	.	.	.	.	.	.	.	47
to	Lemon soles,	.	3	.	8	10	5	5	6	11	4	5	.	.	.	.	.	.	.	.	.	57
3.30 p.m.	Common dabs,	.	.	1	6	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Long rough dabs,	.	3	.	7	5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Haddocks,	.	.	.	.	2	.	15	11	.	.	.	.	.	.	.	.	.	.	.	.	28
	Cod,	.	.	.	.	8	11	.	9	1	.	7	3	.	.	.	.	.	2	.	.	41
	Whitings,	.	.	.	.	4	.	13	8	.	.	.	.	.	.	.	.	.	.	.	.	25
	Gurnards,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	.	.	2	5
																						236
Sept. 11.	Plaice,	.	.	.	.	.	2	1	9	10	3	5	3	.	.	.	.	.	.	.	.	33
1.7 p.m. to	Lemon soles,	.	.	3	6	17	9	4	8	.	3	2	1	.	.	.	.	.	.	.	.	53
3.3 p.m.	Common dabs,	.	.	5	19	13	16	2	.	.	.	.	.	.	.	.	.	.	.	.	.	55
	Long rough dabs,	.	1	6	13	12	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	34
	Haddocks,	.	.	.	.	.	10	16	13	12	.	.	.	.	.	.	.	.	.	.	.	51
	Cod,	.	.	.	.	.	7	.	8	.	.	.	5	1	.	1	.	.	.	.	.	22
	Whitings,	.	.	.	.	6	.	38	17	.	.	.	.	.	.	.	.	.	.	.	.	61
	Gurnards,	.	1	.	3	15	.	.	2	.	.	.	3	.	.	.	.	.	.	.	.	24
	Anglers,	.	.	.	.	.	1	2	.	.	.	1	.	1	.	.	.	.	.	.	1	6
																						339
Dec. 4.	Thornback ray,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
12.30 p.m.	Plaice,	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	3
to	Lemon soles,	.	.	.	3	.	5	.	.	4	.	.	.	.	.	.	.	.	.	.	.	12
2.10 p.m.	Common dabs,	.	.	2	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
	Long rough dabs,	.	2	25	15	.	5	1	.	.	1	.	.	.	.	.	.	.	.	.	.	49
	Haddock,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Cod,	.	.	3	1	.	.	.	5	.	.	.	6	.	1	.	.	.	.	2	1	19
	Whitings,	.	.	.	.	5	8	9	5	6	.	.	.	.	.	.	.	.	.	.	.	33
	Angler,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	1	3
																						129
Station II.																						
1894. Jan. 26.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
11 a.m. to	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
12.40 p.m.	Starry ray,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Lemon soles,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	3	.	4	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	9
	Haddocks,	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	2
	Cod,	.	.	.	5	.	6	4	.	2	2	.	.	3	.	.	.	2	.	.	6*	30
	Whitings,	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	3
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
	Herring,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						54
Feb. 16.	Grey skate,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
11.10 a.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
to	Plaice,	.	1	.	.	.	.	1	.	4	.	9	.	.	.	.	.	.	.	.	.	15
12.55 p.m.	Lemon soles,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Common dabs,	5	.	4	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
	Long rough dabs,	.	5	1	4	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Lumpsucker,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
																						45
March 21.	Starry ray,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	·1
11.30 a.m.	Plaice,	.	.	.	.	6	.	.	2	.	3	.	.	.	.	.	.	.	1	.	.	12
to	Lemon soles,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
1.10 p.m.	Common dabs,	9	.	.	24	.	4	.	2	.	.	.	.	.	.	.	.	.	.	.	.	39
	Flounders,	.	.	.	.	7	.	9	.	8	.	.	.	2	.	.	.	.	.	.	.	26
	Long rough dabs,	5	.	.	8	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	15
	Cod,	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	2
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
																						98

* Three over 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. April 20.	Plaice,	.	.	.	.	.	.	2	5	5	.	.	2	.	.	.	.	.	.	.	.	14
12.55 p.m.	Lemon soles,	.	.	2	.	.	.	3	2	.	.	3	.	.	.	.	.	.	.	.	.	10
to	Common dabs,	17	20	25	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	67
2.20 p.m.	Flounders,	.	.	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	.	5	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Gurnards,	.	.	9	.	9	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	28
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Dragonet,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						132
June 26.	Plaice,	.	.	.	1	1	2	2	1	3	1	.	1	.	.	.	.	.	.	.	.	12
7.50 a.m.	Lemon soles,	.	.	.	1	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
to	Common dabs,	1	6	11	13	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	32
9.35 a.m.	Long rough dabs,	.	1	4	6	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
	Haddocks,	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Cod,	.	.	.	1	3	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	6
	Whitings,	.	.	8	.	3	.	.	4	.	1	.	.	.	.	.	.	.	.	.	.	16
	Gurnards,	.	.	5	22	5	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	33
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2
																						123
Aug. 30.	Thornback ray,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
1.10 p.m.	Plaice,	.	.	.	1	3	24	24	9	.	1	1	.	.	1	.	.	.	.	.	.	64
to	Lemon soles,	.	.	4	13	6	5	4	6	.	4	1	.	.	.	.	.	.	.	.	.	43
2.45 p.m.	Common dabs,	.	34	76	133	20	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	148
	Long rough dabs,	.	.	3	30	4	1	2	.	1	.	.	.	.	.	.	.	.	.	.	.	41
	Haddocks,	.	.	.	.	1	113	60	45	9	.	.	.	.	.	.	.	.	.	.	.	228
	Cod,	.	.	.	.	.	.	1	3	5	.	.	.	.	.	.	.	.	.	.	.	9
	Whitings,	.	.	.	8	22	106	.	10	.	1	.	.	.	.	.	.	.	.	.	.	147
	Gurnards,	.	14	.	12	3	.	.	.	6	.	.	2	.	.	.	.	.	.	.	.	37
	Anglers,	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Dragonet,	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						722
Sept. 11.	Plaice,	.	.	2	1	6	.	14	22	13	4	3	.	.	.	.	.	.	.	.	.	65
10 a.m. to	Lemon soles,	.	.	.	2	5	15	6	.	3	3	.	.	.	.	.	.	.	.	.	.	34
11.40 a.m.	Common dabs,	.	7	17	87	70	27	3	1	.	.	.	.	.	.	.	.	.	.	.	.	212
	Long rough dabs,	.	.	7	13	9	4	.	3	.	.	.	.	.	.	.	.	.	.	.	.	36
	Haddocks,	.	.	1	2	4	19	39	21	27	.	.	.	.	.	.	.	.	.	.	.	108
	Cod,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
	Whitings,	.	.	.	.	3	31	28	1	.	.	.	.	.	.	.	.	.	.	.	.	63
	Gurnards,	.	2	2	2	3	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	11
	Angler,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Dragonet,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						533
Dec. 6.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
11.15 a.m.	Plaice,	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	2
to	Lemon soles,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
12.55 p.m.	Common dabs,	.	.	1	1	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Long rough dabs,	.	.	6	25	7	1	4	.	1	.	.	.	.	.	.	.	.	.	.	.	44
	Haddocks,	.	.	.	.	.	1	.	1	.	5	.	.	.	.	.	.	.	.	.	.	7
	Cod,	.	1	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	4
	Whitings,	1	.	.	.	.	3	2	1	1	.	.	.	.	.	.	.	.	.	.	.	8
	Angler,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
																						74
Dec. 26.	Thornback ray,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
12 noon	Plaice,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Lemon soles,	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	2
1.55 p.m.	Common dabs	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Long rough dabs,	.	.	8	30	13	.	3	1	1	.	.	.	.	.	.	.	.	.	.	.	56
	Haddock,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Cod,	.	1	.	2	.	.	.	.	1	.	.	.	.	.	2	.	.	.	.	1	7
	Whitings,	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Anglers,	.	.	1	.	2	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	4
																						76

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station III. 1894.																						
Feb. 20.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
11.30 a.m.	Plaice,	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	3
to	Lemon soles,	.	.	3	.	.	2	2	4	.	2	.	.	.	.	.	.	.	.	.	.	13
2.35 p.m.	Common dabs,	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Flounder,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	6	4	.	13	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	30
	Haddocks,	.	.	4	.	.	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	12
	Cod,	.	4	20	.	40	.	30	36	.	.	.	.	15	16	.	.	.	17	.	19*	197
	Whitings,	.	3	.	19	9	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4†	4
	Herrings,	2	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	4
																						301
Mar. 20.	Thornback rays,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	1	.	3
11.15 a.m.	Plaice,	.	.	.	3	2	.	.	.	4	.	2	4	.	.	.	.	.	.	.	.	15
to	Lemon soles,	.	.	5	.	2	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	10
2.10 p.m.	Common dabs,	12	.	41	.	5	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	59
	Flounders,	.	.	.	.	1	2	.	.	1	.	1	.	.	.	.	.	.	.	.	.	5
	Long rough dabs,	.	11	4	.	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	21
	Cod,	.	2	.	3	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	1	13
	Whitings,	.	.	.	2	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Herring,	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Rockling,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						134
April 16.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
1.20 p.m.	Plaice,	.	.	.	.	.	.	5	10	.	7	.	.	.	.	.	.	.	.	.	.	22
to	Lemon soles,	.	6	7	.	.	3	.	.	.	2	.	.	1	.	.	.	.	.	.	.	19
4.10 p.m.	Common dabs,	.	4	8	.	16	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	65
	Flounders,	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Haddocks,	.	.	1	23	35	.	26	.	.	.	.	.	.	.	.	.	.	.	.	.	85
	Cod,	.	.	.	11	.	.	.	9	.	.	.	.	1	.	.	.	.	.	.	1‡	22
	Whitings,	.	1	.	6	27	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41
	Gurnards,	.	.	.	4	.	2	.	3	5	.	.	.	.	.	.	.	.	.	.	.	14
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Herring,	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						276
June 21.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
8.10 a.m.	Plaice,	.	.	.	.	.	7	4	11	5	8	2	1	.	.	.	.	.	.	.	.	38
to	Lemon soles,	.	.	7	12	3	4	5	7	2	1	.	.	.	.	.	.	.	.	.	.	41
10.45 a.m.	Common dabs,	.	3	14	11	14	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	44
	Long rough dabs,	.	3	8	4	3	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	20
	Haddocks,	.	.	.	.	3	22	6	1	.	.	.	.	.	.	.	.	.	.	.	.	32
	Cod,	.	.	.	.	2	6	4	3	4	2	.	.	.	.	.	.	.	.	.	.	21
	Whitings,	.	.	.	.	1	1	5	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Ling,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	Gurnards,	.	.	7	20	15	3	3	1	.	.	.	.	.	.	.	.	.	.	.	.	42
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	2
																						249
Aug. 24.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
10.25 a.m.	Plaice,	.	.	.	.	.	1	12	1	10	14	9	.	.	.	.	.	.	.	.	.	47
to	Lemon soles,	.	.	7	13	48	4	7	.	7	1	6*	.	.	.	.	.	.	.	.	.	93
12.50 p.m.	Common dabs,	4	.	36	32	26	12	11	1	.	.	.	.	.	.	.	.	.	.	.	.	122
	Long rough dabs,	.	1	14	39	30	16	5	.	.	.	.	.	.	.	.	.	.	.	.	.	105
	Haddocks,	.	.	.	.	.	72	45	32	10	.	.	.	.	.	.	.	.	.	.	.	169
	Cod,	.	.	.	.	1	7	1	9	17	.	6	.	1	.	3	1	4	.	1	1§	52
	Whitings,	1	.	.	3	15	62	63	30	1	.	.	.	.	.	.	.	.	.	.	.	105
	Ling,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	.	10	7	2	.	.	2	3	.	.	.	.	.	.	.	.	.	.	24
	Brassy,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Anglers,	.	.	.	.	.	.	1	.	.	.	.	.	.	1	2	.	1	.	.	.	5
	Dragonet,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						796

* Two over 26 inches. † One over 35 inches. ‡ 26 inches. § 28 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Sept. 19.	Grey skate,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
10.30 a.m.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	1	.	.	.	.	6
to	Plaice,	.	.	.	.	3	.	6	8	10	10	3	1	.	.	.	.	.	.	.	.	41
12.45 p.m.	Lemon soles,	.	.	.	12	7	4	.	2	10	5	.	.	.	.	.	.	.	.	.	.	40
	Common dabs,	.	1	17	30	10	17	1	.	.	.	.	.	.	.	.	.	.	.	.	.	76
	Long rough dabs,	.	.	4	32	8	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.	54
	Haddocks,	.	.	.	.	1	13	17	14	14	6	.	.	.	.	.	.	.	.	.	.	65
	Cod,	.	.	.	.	.	8	2	4	6	13	.	.	.	1	1	.	.	.	.	.	35
	Gurnards,	.	.	.	.	.	.	1	.	2	.	1	.	.	.	.	.	.	.	.	.	4
	Anglers,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	1*	3
	Picked dog-fish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	Pogge,	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						327
Dec. 10.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	.	.	5
11.55 a.m.	Plaice,	.	.	.	.	.	1	.	.	2	.	1	.	.	.	.	.	.	.	.	.	4
to	Lemon soles,	.	.	.	1	1	1	.	.	2	.	2	.	.	.	.	.	.	.	.	.	7
2.30 p.m.	Common dabs,	.	2	8	22	18	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	51
	Long rough dabs,	.	.	16	33	35	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	89
	Haddocks,	.	.	.	.	.	3	.	4	.	.	.	.	.	.	.	.	.	.	.	.	7
	Cod,	.	.	2	.	.	.	1	2	.	4	.	1	.	.	2	.	.	.	2	.	14
	Whitings,	.	4	.	.	1	18	13	5	.	.	.	.	.	.	.	.	.	.	.	.	41
	Ling,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
	Anglers,	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	2	7
																						226
Dec. 27.	Plaice,	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2
11.30 a.m.	Lemon soles,	.	.	1	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	4
to	Common dabs,	.	.	.	4	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
3.30 p.m.	Long rough dabs,	.	4	7	4	5	3	.	4	.	.	.	.	.	.	.	.	.	.	.	.	27
	Haddock,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Cod,	.	.	5	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	7
	Whitings,	.	.	.	2	.	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Anglers,	.	.	.	.	.	.	.	.	.	1	3	.	1	.	.	.	.	.	.	.	4
	Pogge,	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						63
Station IV.																						
1894. Jan. 17.	Plaice,	.	.	.	20	15	7	47	100	.	20	19	.	2	.	.	.	.	.	.	.	230
11.15 a.m.	Common dabs,	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
to	Flounders,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
2.15 p.m.	Long rough dabs,	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
																						236
Feb. 15.	Plaice,	.	.	4	.	.	168	.	98	104	.	18	.	.	.	.	.	.	.	.	.	392
7.40 a.m.	Common dabs,	3	.	9	.	9	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	30
to	Flounders,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
10.40 a.m.	Cod,	.	.	1	.	.	.	3	.	.	6	.	.	.	.	3	.	.	.	.	.	13
	Whitings,	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						438
Mar. 21.	Plaice,	10	.	.	47	.	71	.	.	82	.	3	3	.	.	.	.	.	.	.	.	216
2.40 p.m.	Common dabs,	.	2	.	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
to	Flounders,	.	.	3	.	2	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	8
5.40 p.m.	Lumpsuckers,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
																						232
Apr. 13.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
10.40 a.m.	Plaice,	.	.	.	.	37	.	.	86	.	17	.	.	.	.	1	.	.	.	.	.	141
to	Common dabs,	.	.	4	4	6	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	52
1.40 p.m.	Flounders,	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	.	.	3	3	6	.	2	.	.	.	.	.	.	.	.	.	.	.	.	14
	Whitings,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Father-lasher,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						213

* 38 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. June 21.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
11.35 a.m.	Plaice,	.	.	7	5	1	7	18	20	15	7	2	3	.	1	1	.	.	.	.	.	90
to	Lemon soles,	.	.	1	1	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	5
2.35 p.m.	Common dabs,	.	.	2	.	3	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Flounders,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Haddocks,	.	.	.	.	.	10	3	.	1	.	.	.	.	.	.	.	.	.	.	.	14
	Cod,	.	.	.	.	1	.	2	2	4	1	.	.	1	.	.	.	.	.	.	.	11
	Whitings,	.	.	.	2	10	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	21
	Gurnards,	.	.	.	2	11	2	4	1	5	.	.	.	.	.	.	.	.	.	.	.	25
	Sprats,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2*
																						183
Aug. 23.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	2	2	4	.	2	.	4	1	1	.	16
2.10 p.m.	Plaice,	.	7	.	.	27	.	96	49	73	1	9	1	.	.	.	.	.	.	.	.	263
to 5 p.m.	Lemon soles,	.	.	3	.	11	8	.	3	.	.	.	.	.	.	.	.	.	.	.	.	25
	Common dabs,	6	.	15	27	.	9	.	1	.	.	.	.	.	.	.	.	.	.	.	.	58
	Long rough dabs,	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Turbot,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	2
	Haddocks,	.	.	.	.	.	.	2	.	9	.	.	.	.	.	.	.	.	.	.	.	11
	Cod,	.	.	.	.	.	.	.	.	.	4	1	.	.	1	.	.	.	.	.	.	6
	Whitings,	.	.	.	4	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Gurnards,	.	.	.	.	3	.	.	.	9	.	.	.	4	.	.	.	.	.	.	.	16
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1†	1
																						407
Sept. 19.	Plaice,	.	5	17	13	25	26	10	31	26	12	6	1	.	.	.	.	.	.	.	.	173
1.25 p.m.	Lemon soles,	.	.	.	.	6	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	7
to	Common dabs,	.	8	10	59	11	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	96
3.55 p.m.	Flounder,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Cod,	.	.	.	.	.	.	.	1	15	.	19	.	.	3	.	2	.	.	.	.	40
	Whitings,	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Gurnards,	.	1	.	.	3	.	6	.	.	.	3	.	.	.	.	.	.	.	.	.	13
																						338
Nov. 23.	Gray skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
2.30 p.m.	Plaice,	.	.	.	2	.	3	34	23	24	21	7	10	3	.	.	.	.	1	.	.	128
to	Lemon soles,	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2
5.30 p.m.	Common dabs,	.	16	6	19	12	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	58
	Long rough dabs,	.	.	.	3	7	2	1	1	.	.	.	.	.	.	.	.	.	.	.	.	14
	Cod,	.	.	.	.	.	.	.	.	.	.	2	1	1	.	3	.	1	.	4	11‡	23
	Whitings,	.	.	1	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Anglers,	.	.	.	.	.	7	.	2	4	1	.	.	.	.	.	.	.	.	.	.	14
																						244
Station V.																						
1894. Feb. 22.	Plaice,	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	3
12.40 p.m.	Lemon soles,	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	3
to	Common dabs,	.	2	3	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
2.45 p.m.	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	2	.	.	.	.	4
	Long rough dabs,	10	.	9	32	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	56
	Haddocks,	.	.	16	.	349	98	16	.	.	.	1	.	.	.	.	.	.	.	.	.	480
	Cod,	.	.	14	.	.	.	10	.	.	3	1	2	.	5	.	.	.	1	2	1	39
	Whitings,	.	.	17	15	.	.	9	.	.	10	.	.	.	.	.	.	.	.	.	.	51
	Ling,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Herrings,	.	.	.	3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	4
																						648

* 3 inches long. † 29 inches. ‡ One at 26, four at 28, four at 30, and two at 35 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Mar. 30.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	1
9.30 a.m.	Plaice,	.	.	.	1	.	.	.	2	.	5	.	.	.	.	.	.	.	.	.	.	8
to	Lemon soles,	.	.	.	2	.	.	1	.	.	2	.	1	.	.	.	.	.	.	.	.	6
11.35 a.m.	Common dabs,	.	10	5	.	3	.	2	.	2	.	.	.	.	.	.	.	.	.	.	.	22
	Witch soles,	.	.	.	.	1	.	1	.	.	3	.	1	.	.	.	.	.	.	.	.	6
	Flounders,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	8	.	53	.	.	8	.	.	.	1	.	.	.	.	.	.	.	.	.	70
	Haddocks,	.	.	.	9	111	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170
	Cod,	.	.	.	9	.	.	.	1	.	2	.	.	.	.	2	.	3	.	.	5†	22
	Whitings,	.	.	.	2	.	.	4	.	2	.	.	.	.	.	.	.	.	.	.	.	8
	Brassie,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	3
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Catfish,	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	1	3
																						322
Apr. 19.	Plaice,	.	.	.	.	.	.	.	.	.	.	7	.	.	1	.	.	.	.	1	.	9
7.45 p.m.	Lemon soles,	.	.	1	.	.	4	.	6	.	.	2	.	.	.	.	.	.	.	.	.	13
to	Common dabs,	.	5	.	8	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	15
9.55 p.m.	Witch soles,	.	.	.	.	.	.	.	.	1	.	.	1	.	.	3	.	.	.	.	.	5
	Long rough dabs,	10	9	2	.	30	.	.	5	.	1	.	.	.	.	.	.	.	.	.	.	57
	Haddocks,	.	.	7	.	203	220	.	.	.	.	1	.	1	.	.	.	.	.	.	.	432
	Cod,	.	.	.	.	12	.	.	9	.	1	.	.	3	.	2	.	.	5	.	3	35
	Whitings,	.	.	.	.	22	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31
	Brassie,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	.	1	.	2	.	.	.	3	.	.	.	.	.	.	.	.	.	.	6
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2‡	2
	Herrings,	.	1	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
																						610
June 20.	Plaice,	.	.	.	1	.	.	1	.	3	11	2	1	1	.	.	.	.	.	.	.	20
11.20 a.m.	Lemon soles,	.	.	.	2	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	4
to	Common dabs,	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
1.25 p.m.	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
	Long rough dabs,	.	5	14	15	10	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50
	Haddocks,	.	.	.	3	44	290	146	17	.	.	.	.	.	.	.	.	.	.	.	.	500
	Cod,	.	.	.	.	1	3	5	.	4	2	.	1	2	2	2	.	.	1	1	3§	27
	Whitings,	.	.	2	7	.	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.	18
	Gurnards,	.	.	.	3	1	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Brassie,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						631
Aug. 30.	Grey skate,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
8.15 a.m.	Plaice,	.	.	.	.	.	.	.	2	.	9	2	5	4	.	.	1	.	.	.	.	23
to	Lemon soles,	.	.	.	11	.	.	.	1	.	5	.	.	.	.	.	.	.	.	.	.	17
10.20 a.m.	Common dabs,	.	.	10	3	8	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	22
	Witch soles,	.	.	.	.	.	.	.	.	.	5	3	.	1	1	.	.	.	.	.	.	10
	Long rough dabs,	.	31	10	39	18	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	102
	Haddocks,	.	.	.	5	4	129	374	104	13	.	.	.	.	.	.	.	.	.	.	.	629
	Cod,	.	.	.	.	1	1	2	5	1	2	1	.	.	.	.	1	1	1	.	2‖	18
	Whitings,	.	.	.	3	8	41	60	5	.	.	1	.	.	.	.	.	.	.	.	.	118
	Gurnards,	.	.	.	1	9	.	11	.	.	12	1	1	.	.	.	.	.	.	.	.	35
	Anglers,	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						977
Sept. 13.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
7.15 a.m.	Plaice,	.	.	.	.	.	.	.	6	.	9	10	10	3	1	.	.	.	.	.	.	39
to	Lemon soles,	.	.	.	.	.	.	2	1	3	5	.	.	.	.	.	.	.	.	.	.	11
9.15 a.m.	Common dabs,	.	.	.	25	.	16	2	.	.	.	.	.	.	.	.	.	.	.	.	.	43
	Witch soles,	.	.	.	.	.	.	.	.	1	4	1	.	.	1	1	2	.	.	.	.	10
	Long rough dabs,	.	1	43	.	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Haddocks,	.	.	.	.	9	39	281	116	25	.	.	.	.	.	.	.	.	.	.	.	470
	Cod,	.	.	.	.	.	.	.	2	1	1	.	.	.	1	2	.	.	.	2	2	11
	Whitings,	1	4	.	3	12	36	22	3	.	4	.	.	.	.	.	.	.	.	.	.	85
	Gurnards,	.	.	.	.	2	.	5	.	.	7	4	.	.	.	.	.	.	.	.	.	18
	Anglers,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	2
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
																						698

* Over 30 inches. † Two at 28 inches. ‡ 35 and 28 inches. § Two 28 inches. ‖ Over 28 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Nov. 30. 8.45 a.m. to 10.50 a.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	2	.	7	5	.	.	.	1	.	.	.	.	15
	Lemon soles,	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2
	Common dabs,	.	.	.	5	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
	Witch soles,	.	.	.	.	.	.	.	.	2	1	.	4	.	.	1	.	.	.	.	.	8
	Long rough dabs,	.	.	16	62	11	.	6	.	1	.	.	.	.	.	.	.	.	.	.	.	96
	Haddocks,	.	.	.	.	.	.	15	58	92	.	.	.	.	.	.	.	.	.	.	.	165
	Cod,	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	2	.	4	5*	14
	Whitings,	2	.	.	.	3	4	2	13	.	.	4	.	1	.	.	.	.	.	.	.	29
	Gurnard,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Anglers,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	2
																						344
Station VI.																						
1894. Feb. 22. 3.45 p.m. to 4.40 p.m.	Plaice,	.	.	.	.	.	.	5	.	.	20	.	10	6	.	2	.	.	.	1	1*	45
	Lemon soles,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	2	.	6	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	10
	Brill,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Cod,	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	1	.	3
																						60
Mar. 30. 1 p.m. to 2 p.m.	Plaice,	.	.	.	.	.	.	.	7	.	9	5	.	2	.	.	.	.	.	.	.	23
	Lemon soles,	.	.	.	.	1	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	5
	Common dabs,	.	.	.	2	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	4
	Gurnards,	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	2
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2
																						36
Apr. 19. 11.10 a.m. to 12.5 p.m.	Plaice,	.	.	.	.	.	.	.	.	.	2	3	.	.	.	.	.	.	1	.	.	6
	Lemon soles,	.	.	9	.	4	.	5	.	6	.	.	.	.	.	.	.	.	.	.	.	24
	Common dabs,	.	3	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Long rough dabs,	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Haddock,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	1	2	.	7
	Gurnards,	.	.	2	.	.	2	.	3	.	.	.	.	.	.	.	.	.	.	.	.	7
																						53
June 20. 2.35 p.m. to 3.40 p.m.	Plaice,	.	.	.	.	.	.	.	.	.	3	8	2	1	1	.	.	1	.	.	.	16
	Lemon soles,	.	.	1	1	2	2	2	5	6	2	1	.	.	.	.	.	.	.	.	.	22
	Common dabs,	.	1	20	8	4	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	35
	Long rough dabs,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Brill,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	2
	Haddocks,	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Cod,	.	.	.	.	.	.	1	.	.	1	1	.	1	1	.	.	.	.	.	.	5
	Whitings,	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Gurnard,	.	.	7	9	.	8	4	.	.	.	.	.	.	.	.	.	.	.	.	.	28
	Anglers,	.	.	.	1	2	1	1	.	.	.	1	.	.	.	1	.	.	.	2	.	9
																						123
Aug. 30. 11.5 a.m. to 11.50 a.m.	Plaice,	.	.	.	.	.	.	1	1	1	4	10	8	4	1	1	.	.	.	.	1	32
	Lemon soles,	.	.	5	11	1	3	6	5	3	1	.	.	.	.	.	.	.	.	.	.	35
	Common dabs,	9	11	22	13	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	57
	Long rough dabs,	.	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Brill,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Haddocks,	.	.	.	.	1	2	3	4	.	2	.	.	.	.	.	.	.	.	.	.	12
	Cod,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Whitings,	.	.	.	1	10	4	8	.	.	.	1	.	.	.	.	.	.	.	.	.	24
	Gurnards,	.	9	.	6	6	.	.	4	.	.	1	.	.	.	.	.	.	.	.	.	26
	Anglers,	.	.	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	2	1	.	6
	Dragonet,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						199

* Three 28 inches, one 33 inches, one 38 inches. † 28 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Sept. 13. 10.7 a.m. to 11 a.m.	Plaice,	.	.	.	.	.	.	.	.	6	8	11	1	1	1	1	.	1	.	2	.	32
	Lemon soles,	.	.	1	9	22	.	.	12	2	3	7	1	.	.	.	.	.	.	.	.	57
	Common dabs,	.	7	.	26	.	25	.	4	.	.	.	.	.	.	.	.	.	.	.	.	62
	Long rough dabs,	.	1	2	18	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35
	Brill,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Haddocks,	.	.	.	.	6	12	.	9	5	.	.	.	.	.	.	.	.	.	.	.	32
	Cod,	.	.	.	.	.	.	.	1	3	.	1	1	.	.	.	.	.	.	.	.	6
	Whitings,	.	.	.	.	2	5	.	6	1	.	.	.	.	.	.	.	.	.	.	.	14
	Gurnards,	.	4	3	2	5	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	15
	Anglers,	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2
																						256
Nov. 30. 11.25 a.m. to 12.25 p.m.	Sandy ray,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Starry ray,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	2	.	5	.	6	.	.	.	1	.	.	.	.	.	14
	Lemon soles,	.	.	.	.	.	.	2	.	1	1	.	.	.	.	.	.	.	.	.	.	4
	Common dabs,	.	.	.	.	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Long rough dabs,	.	.	.	8	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
	Haddocks,	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	3
	Cod,	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
	Whitings,	.	.	.	.	9	.	6	.	2	.	.	.	.	.	.	.	.	.	.	.	17
	Gurnards,	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	2
	Anglers,	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	3
																						70
Station VII.																						
1894. Jan. 18. 11.40 a.m. to 1.20 p.m.	Plaice,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
	Common dabs,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	2	2	7	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	20
	Turbot,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	1	17	.	28	.	.	.	.	.	.	.	.	.	.	.	.	.	46
	Cod,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	2
	Whitings,	.	.	.	.	5	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2
																						80
Feb. 23. 7.20 a.m. to 9.10 a.m.	Grey skate,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Thornback ray,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Starry ray,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	2
	Lemon soles,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Witch soles,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	7	.	1	.	.	.	9
	Flounder,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	2	.	.	5	.	6	1	.	.	.	.	.	.	.	.	.	.	.	.	.	14
	Haddocks,	.	.	.	181	.	72	25	.	.	1	.	.	.	.	.	.	.	.	.	.	279
	Cod,	.	.	.	.	5	.	.	.	9	.	.	.	4	.	.	.	.	.	1	.	19
	Whitings,	.	.	.	3	23	9	.	4	.	.	.	.	.	.	.	.	.	.	.	.	39
	Herring,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						371
Mar. 29.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Thornback rays,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	2
	Starry rays,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	1	.	.	.	5
	Lemon soles,	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2
	Common dabs,	20	25	20	.	10	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	76
	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	3
	Flounders,	.	.	.	.	2	3	.	3	.	.	2	.	.	.	.	.	.	.	.	.	10
	Long rough dabs,	.	22	.	.	14	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	38
	Haddocks,	.	.	.	4	23	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	38
	Whitings,	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Gurnards,	.	.	1	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	4
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	1
	Herring,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						184

* 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. Fish Caught—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Apr. 13.	Plaice,	.	.	.	.	.	.	.	.	5	.	1	.	1	.	.	.	.	.	.	.	7
3.30 p.m.	Lemon sole,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Common dabs,	2	.	8	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
5.10 p.m.	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	3
	Long rough dabs,	.	5	10	.	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	22
	Haddocks,	.	.	.	19	83	19	24	.	.	.	.	.	.	.	.	.	.	.	.	.	145
	Cod,	.	.	.	.	2	.	.	.	.	3	.	2	.	.	.	.	2	.	.	.	9
	Whitings,	.	.	.	.	12	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	13
	Gurnards,	.	.	.	.	.	4	.	1	.	.	.	4	.	.	.	.	.	.	.	.	9
	Herring,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						221
June 20.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
7.50 a.m.	Starry ray,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Plaice,	.	.	.	.	1	3	5	2	5	4	4	2	3	.	.	1	1	.	.	.	31
9.50 a.m.	Lemon soles,	.	.	2	4	1	2	3	3	1	.	.	.	.	.	.	.	.	.	.	.	16
	Common dabs,	5	40	29	16	5	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	109
	Witch soles,	.	.	.	.	.	.	.	1	.	.	1	.	.	.	2	2	.	.	.	.	6
	Long rough dabs,	.	2	7	8	.	7	.	1	.	.	.	.	.	.	.	.	.	.	.	.	25
	Haddocks,	.	.	.	.	7	57	23	.	1	.	.	.	.	.	.	.	.	.	.	.	88
	Cod,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Whitings,	.	.	.	4	13	12	4	.	.	.	.	.	.	.	.	.	.	.	.	.	33
	Gurnards,	.	.	29	15	4	3	1	.	.	.	1	.	.	.	.	.	.	.	.	.	53
	Dragonet,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						365
Aug. 23.	Grey skate,	.	.	.	.	2	.	.	.	1	.	1	.	.	1	.	.	.	1	.	.	6
11.10 a.m.	Thornback ray,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Plaice,	.	.	.	.	.	5	.	9	7	14	2	6	14	.	.	.	.	.	.	.	57
1.10 p.m.	Lemon soles,	.	.	3	10	15	.	4	.	3	.	.	.	.	.	.	.	.	.	.	.	35
	Common dabs,	9	22	183	240	47	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	503
	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	2	.	.	.	4
	Black soles,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Long rough dabs,	.	.	4	43	41	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	125
	Haddocks,	.	.	.	.	2	26	108	42	.	.	.	.	1	.	.	.	.	.	.	.	179
	Whitings,	.	.	1	.	7	16	15	6	.	.	.	.	.	.	.	.	.	.	.	.	45
	Gurnards,	.	9	.	7	6	.	1	.	3	.	4	.	.	.	.	.	.	.	.	.	30
	Anglers,	.	.	.	.	.	2	.	6	.	.	.	.	.	.	.	.	.	.	.	.	8
	Dragonet,	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Father-lasher,	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						998
Sept. 13.	Plaice,	.	.	.	.	.	4	6	8	.	9	.	6	.	.	.	.	.	.	.	.	33
12.15 p.m.	Lemon soles,	.	.	.	1	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	4
to	Common dabs,	.	5	41	94	70	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	210
2.17 p.m.	Witch soles,	.	.	.	.	.	.	.	1	.	.	.	3	1	.	3	.	.	1	.	.	9
	Long rough dabs,	1	.	3	21	35	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	63
	Black sole,	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	2
	Haddocks,	.	.	.	.	10	.	20	61	.	.	.	.	.	.	.	.	.	.	.	.	91
	Whiting,	.	.	.	.	.	1	4	6	.	1	.	.	.	.	.	.	.	.	.	.	12
	Gurnards,	.	6	.	2	.	.	1	2	.	4	.	.	.	.	.	.	.	.	.	.	15
	Anglers,	.	.	.	.	.	3	.	5	3	.	2	.	.	.	.	.	.	.	.	.	13
																						452
Nov. 30.	Grey skate,	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	2
1.30 p.m.	Thornback rays,	.	.	.	1	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	3
to	Plaice,	.	.	.	.	.	.	.	.	2	.	3	.	.	.	.	.	.	.	.	.	5
3.35 p.m.	Lemon sole,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Common dab.	.	1	.	7	.	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	14
	Long rough dabs,	.	.	.	19	30	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	52
	Witch sole,	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	2	.	.	.	.	6
	Haddocks,	.	.	1	.	1	.	5	.	5	.	.	.	.	.	.	.	.	.	.	.	12
	Cod,	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	3
	Whitings,	.	.	5	.	6	8	.	.	3	.	.	.	.	.	.	.	.	.	.	.	22
	Gurnards,	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	2
	Anglers,	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	1†	5
	Dragonet,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						148

* 29 inches. † 28 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches. 4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	Total.
Station VIII.																						
Jan. 18.	Lemon sole,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
1.45 p.m.	Common dabs,	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
o	Long rough dabs,	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
3.50 p.m.	Haddocks,	.	.	4	.	8	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27
	Cod,	.	.	.	1	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1*	5
	Brassie,	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
																						42
Feb. 21.	Grey skate,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2
1.10 p.m.	Thornback rays,	.	.	.	.	.	.	.	1	1	.	3	.	.	.	.	.	.	.	.	.	5
to	Plaice,	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	2
3.15 p.m.	Common dabs,	2	1	3	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Witch soles,	.	.	.	.	.	.	1	.	.	.	.	.	.	1	1	.	.	.	.	.	3
	Long rough dabs,	4	.	11	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
	Haddocks,	.	1	.	71	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	93
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	3
	Whitings,	.	.	.	.	3	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	4
	Herring,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						140
Mar. 14.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	2
12.35 p.m.	Plaice,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Lemon soles,	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
2.35 p.m.	Common dabs,	.	.	.	1	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	4
	Sail fluke,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	2
	Flounder,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dab,	.	.	.	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Haddock,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Cod,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1†	3
	Whiting,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnard,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	3
																						25
Apr. 18.	Plaice,	.	.	.	.	.	2	.	.	.	1	.	.	1	.	.	.	.	1	.	.	5
1.10 p.m.	Lemon soles,	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	3
to	Witch soles,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	2
3.15 p.m.	Common dabs,	.	3	.	29	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41
	Flounders,	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	12	14	12	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	40
	Turbot,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1‡	1
	Haddocks,	.	.	.	154	.	48	.	.	.	.	.	.	1	.	.	1	.	.	.	.	204
	Cod,	.	.	.	.	.	2	.	.	3	.	.	.	5	.	.	.	3	.	3	1§	17
	Whitings,	.	.	9	.	11	.	.	3	.	1	.	.	.	.	.	.	.	.	.	.	24
	Brassie,	.	.	4	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
	Four-bearded rockling,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						349
June 19.	Plaice,	.	.	.	.	.	2	1	.	.	1	2	2	.	.	.	.	.	.	.	.	8
1 p.m. to	Lemon soles,	.	.	1	1	1	3	4	1	3	4	1	1	.	.	.	.	.	.	.	.	20
3.5 p.m.	Common dabs,	.	4	9	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Witch soles,	.	.	.	.	.	1	1	.	.	.	1	1	1	.	.	.	.	.	.	.	5
	Long rough dabs,	2	6	6	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	18
	Haddocks,	.	.	.	1	10	21	2	2	.	.	.	.	.	.	.	.	.	.	.	.	36
	Cod,	.	.	.	.	1	1	3	1	2	1	2	1	1	.	.	.	.	.	.	.	13
	Whitings,	.	.	5	4	7	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	19
	Brassie,	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Gurnards,	.	.	2	10	7	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	22
	Catfish,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
																						161

* 30 inches. † 30 inches. ‡ 28 inches. § 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894.																						
Aug. 29.	Starry ray, . .	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
12.50 p.m.	Plaice, . .	.	.	.	.	.	.	.	4	2	.	1	.	.	.	.	.	.	.	.	.	7
to	Lemon soles, .	.	.	3	.	.	3	2	.	1	2	.	.	.	.	.	.	.	.	.	.	11
2.45 p.m.	Common dabs, .	1	.	.	13	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
	Witch soles, .	.	.	.	.	1	.	.	2	.	.	1	.	.	1	.	1	.	.	.	.	6
	Long rough dabs,	.	1	14	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41
	Haddocks, . .	.	.	.	.	.	65	153	51	.	.	.	.	.	.	.	.	.	.	.	.	269
	Cod, . . .	.	.	.	.	.	.	.	.	.	.	2	.	4	1	.	.	.	.	4	2*	13
	Ling, . . .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
	Whitings, . .	.	.	.	.	5	33	6	.	.	1	.	.	.	.	.	.	.	.	.	.	45
	Gurnards, . .	.	.	2	.	9	7	1	.	10	.	.	.	.	.	.	.	.	.	.	.	29
																						440
Sept. 12.	Starry ray, . .	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
11.50 a.m.	Plaice, . .	.	.	.	.	.	.	.	3	2	1	2	.	.	1	1	1	.	.	.	.	11
to	Lemon soles, .	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	2
1.50 p.m.	Common dabs, .	.	2	2	14	14	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	34
	Witch soles, .	.	.	.	.	1	.	.	.	4	.	2	3	1	1	1	.	.	.	.	.	13
	Long rough dabs,	.	4	39	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	77
	Haddocks, . .	.	.	.	4	62	47	104	.	.	.	.	.	.	.	.	.	.	.	.	.	217
	Cod, . . .	.	.	.	.	.	.	.	1	3	.	2	.	.	.	.	.	3	.	1	3†	13
	Whitings, . .	.	.	.	.	10	27	.	11	.	.	.	.	.	.	.	.	.	.	.	.	48
	Gurnards, . .	.	1	.	2	3	.	2	1	3	.	.	.	.	.	.	.	.	.	.	.	11
	Anglers, . .	.	.	.	.	.	1	.	.	.	1	.	1	.	.	.	.	.	.	.	.	3
	Catfish, . .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1‡	1
																						431
Nov. 29.	Grey skate, .	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	2
12.35 p.m.	Thornback rays,	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	3
to	Plaice, . .	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	1	.	.	4
2.35 p.m.	Lemon soles, .	.	.	.	.	1	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	4
	Common dabs, .	.	.	6	9	7	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.	31
	Witch soles, .	.	.	.	.	.	.	.	1	.	2	.	.	.	1	.	.	.	.	.	.	4
	Long rough dabs,	.	.	11	4	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	18
	Turbot, . .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	Haddocks, . .	.	.	.	.	1	.	8	22	.	.	.	.	.	.	.	.	.	.	.	.	31
	Cod, . . .	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Whitings, . .	.	.	.	1	.	1	3	1	.	.	.	.	.	.	.	.	.	.	.	.	6
	Gurnards, . .	.	.	.	.	1	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	4
	Anglers, . .	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	.	.	1§	4
																						113
Station IX.																						
1894.																						
Jan. 19.	Lemon soles, .	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
12.15 p.m.	Common dabs, .	.	.	1	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	4
to	Long rough dabs,	.	4	6	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
2.15 p.m.	Haddocks, . .	.	.	.	22	15	33	5	.	.	.	.	.	.	.	.	.	.	.	.	.	75
	Cod, . . .	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Whitings, . .	2	.	5	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23
	Brassie, . .	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						118
Feb. 21.	Lemon soles, .	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
3.55 p.m.	Common dabs, .	.	.	2	7	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
to	Witch soles, .	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
5.55 p.m.	Long rough dabs,	9	.	9	.	6	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28
	Haddocks, . .	.	.	49	242	.	81	.	.	.	.	.	.	.	.	.	.	.	.	.	.	372
	Cod, . . .	.	.	.	1	.	.	.	2	.	.	.	1	.	.	1	.	.	.	.	.	5
	Whitings, . .	.	.	4	.	21	.	6	.	.	.	3	.	.	.	.	.	.	.	.	.	34
	Ling, . . .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Herring, . .	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						455

* One at 30 inches. † 30 inches. ‡ 36 inches. § 29 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Mar. 14. 3.20 p.m to 5.20 p.m.	Lemon soles,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Common dabs,	.	.	.	3	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Flounders,	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Long rough dab,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Turbot,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	1
	Haddocks,	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	1	.	.	.	.	3
	Whiting,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
																						15
April 18. 4.5 p.m. to 6.10 p.m.	Starry rays,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	.	4	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	8
	Long rough dabs,	.	6	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Haddocks,	.	.	5	.	28	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	45
	Cod,	.	.	.	.	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	3
	Whitings,	.	4	.	21	5	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	32
	Gurnards,	.	.	.	.	1	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	4
	Dragonet,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						105
June 19. 3.55 p.m. to 6.5 p.m.	Plaice,	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	2
	Lemon soles,	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2
	Common dabs,	.	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Witch soles,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	1	14	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
	Haddocks,	.	.	.	.	7	124	9	2	.	.	.	.	.	.	.	.	.	.	.	.	142
	Cod,	.	.	.	.	2	.	.	.	.	.	2	1	.	.	.	.	.	1	.	.	6
	Whitings,	.	.	2	.	5	6	.	1	.	.	.	.	.	.	.	.	.	.	.	.	14
	Gurnards,	.	.	.	.	2	3	2	3	.	.	.	.	.	.	.	.	.	.	.	.	10
																						202
Aug. 29. 3.25 p.m. to 5.20 p.m.	Grey skate,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2
	Plaice,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	2
	Lemon soles,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Witch soles,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Long rough dabs,	.	.	12	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
	Haddocks,	.	.	.	1	.	24	81	63	.	.	.	.	.	.	.	.	.	.	.	.	169
	Cod,	.	.	.	.	.	.	1	4	.	.	.	.	.	1	.	.	.	.	1	1†	8
	Whitings,	.	.	.	12	.	.	19	6	.	7	.	.	.	.	.	.	.	.	.	.	44
	Gurnards,	.	.	.	.	1	.	4	.	4	.	.	.	2	.	.	.	.	.	.	.	11
																						258
Sept. 12. 2.30 p.m. to 4.30 p.m.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	2
	Plaice,	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	3
	Lemon soles,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Long rough dabs,	.	1	13	36	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	52
	Haddocks,	.	.	.	.	10	102	73	.	.	.	.	.	.	.	.	.	.	.	.	.	185
	Cod,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	2
	Whitings,	.	.	.	3	.	7	11	.	.	.	.	.	.	.	.	.	.	.	.	.	21
	Gurnards,	.	.	.	1	4	3	2	2	1	.	.	.	.	.	.	.	.	.	.	.	13
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Three - bearded rockling,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
																						284
Nov. 28. 3.15 p.m. to 5.20 p.m.	Starry ray,	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
	Common dab,	.	39	37	49	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	139
	Witch soles,	.	.	.	.	.	.	1	.	.	.	.	1	1	.	.	.	.	.	.	.	3
	Long rough dabs,	.	.	2	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
	Haddocks,	.	.	.	.	.	10	58	.	8	.	.	.	.	.	.	.	.	.	.	.	76
	Cod,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	3‡	5
	Whitings,	.	.	.	.	11	24	12	.	1	2	.	.	.	.	.	.	.	.	.	.	50
	Gurnards,	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	3
	Anglers,	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	2
	Hake,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
																						293

* 28 inches. † 30 inches. ‡ 29, 36, and 39 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—I. Firth of Forth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station. X. 1894. (Limekilns Station.)	Thornback ray,		1																			1
Jan. 25.	Lemon soles,		1						1													2
11.20 a.m.	Cod,		1			1	2		2	2					1					1		10
to	Whitings,	1		1	3																	5
12.20 p.m.	Herring,	1																				1
																						19
Feb. 17.	Grey skate,							1		1												2
10.35 a.m.	Thornback rays,								3									1				4
to	Plaice,					1																1
11.25 a.m.	Lemon soles,									1		1										2
	Common dabs,			1																		1
	Long rough dabs,				1		1															2
	Cod,					9		15		5		8	2									39
	Whitings,		1		5		6	4														16
	Herring,							1														1
	Sprat,	1																				1
																						69
Aug. 31.	Grey skate,				2	1				1												4
11.15 a.m,	Thornback rays,			1			1		1	1	1											6*
to	Lemon soles,				1																	1
11.45 a.m.	Flounders,					1																1
	Cod,								1	2	5											8
	Whitings,	1			1	4	8	1	3													18
	Father-lasher,			1	1																	2
																						40
Sept. 15.	Thornback rays,		2			4		2	1		4			2	1				1			17
10.20 a.m.	Plaice,					1		1														2
to 11 a.m.	Lemon soles,					2																2
	Cod,							1	2			2	6	1								12
	Whiting,				1		3		6													10
	Father-lasher,				1	1			2													4
																						47
Dec. 8.	Thornback rays,					1	1	2														4
11.30 a.m.	Lemon soles,				2																	2
to	Common dabs,																					1†
12.10 p.m.	Long rough dabs,					1																1
	Cod,									1		3	1	2			2	1				10
	Whitings,	1				3		1		1		1										7
	Pogge,		1																			1
																						26

II. St Andrews Bay.

Station, Date, and Time Trawl down.	Kind of Fish.	4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	Total.
Station I. 1894. Feb. 14.	Starry rays,				1					1												2
8.50 a.m.	Plaice,							1		1	1	†										3
to	Common dabs,					1	1															2
10.55 a.m.	Flounder,						1															1
	Long rough dabs,					1																1
	Herrings,	1	2																			3
	Pogge,	1																				1
																						13
April 6.	Plaice,					1		5		15		4										25
3.30 p.m.	Common dabs,		9		5		4		1													19
to	Flounders,				26		21															47
5.30 p.m.	Turbot,																1					1
	Haddocks,							5														5
	Gurnards,							4		3			21									28
																						125

* One at 3 inches. † 2 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Sept. 6.	Thornback rays,												1	2					1			4
2.20 p.m.	Plaice,				1	4	39	61	31	12	4			1								153
to	Common dabs,	1	11	112	125	34		6		1												290
4.20 p.m.	Long rough dabs,							2		1												3
	Haddocks,						3	10														13
	Whiting,						1															1
	Gurnards,			1	6			2	6			8										23
	Anglers,						1	2														3
	Dragonet,					1																1
																						491
Dec. 21.	Starry ray,			1																		1
11.35 a.m.	Plaice,										1				1							2
to	Common dab,							1	1													2
1.35 p.m.	Long rough dabs,				1			1														2
	Cod,																				1	1
																						8
Station II. 1894. Feb. 13.	Plaice,									1	2			1								4
11.10 a.m.	Common dabs,	1		1	1																	3
to 1 p.m.	Haddocks,				1																	1
	Whitings,		4		1	3			1													9
	Herrings,	2	2																			4
																						21
April 6.	Plaice,							5		8			2									15
12.35 p.m.	Lemon soles,					1																1
to	Common dabs,	36		25				4		1												66
2.30 p.m.	Flounders,							1														1
	Long rough dab,				1																	1
	Whiting,						1															1
	Gurnards,							1	1				3									5
																						90
Sept. 6.	Thornback ray,														1							1
11.55 a.m.	Starry ray,		1																			1
to	Plaice,				9	14	40	24	7													94
1.40 p.m.	Common dab,	31		41	103	24	33	2	2													236
	Long rough dab,		1			2	6	3		1												13
	Haddocks,						4	15														19
	Cod,							1														1
	Whitings,				1			2														3
	Gurnards,		1			1			1			2										5
	Anglers,				1		2		2	1												6
																						379
Dec. 19.	Starry ray,				1																	1
12.50 p.m.	Plaice,									1												1
to	Common dab,				1		1		1	1												4
2.50 p.m.	Cod,		1																			1
	Whitings,					1		1		1												3
	Gurnards,							1	2			1										4
	Dragonet,					1																1
																						15
Station III. 1894. Feb. 13.	Starry rays,					1				1												2
8.40 a.m.	Plaice,									1		1										2
to	Common dabs,		1	2																		3
9.30 a.m.	Flounder,											1										1
	Long rough dabs,		4	1																		5
	Cod,																		1	1	4*	6
	Whitings,	4			2	3	2															11
	Herring,		1																			1
	Pogge,	2																				2
																						33

* Three at 26 inches, and one at 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. April 6.	Plaice,	.	.	.	.	.	.	4	16	.	18	.	8	.	.	.	.	.	.	.	.	46
10.15 a.m.	Common dabs,	.	3	.	.	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
to noon.	Flounders,	.	.	.	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Long rough dabs,	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Whitings,	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Haddocks,	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
																						67
Sept. 6.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	2
9.35 a.m.	Plaice,	.	.	8	16	34	18	20	49	10	12	3	.	.	.	.	.	.	.	.	.	168
to	Lemon soles,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
11.25 a.m.	Common dabs,	.	20	47	110	46	14	5	2	.	.	.	.	.	.	.	.	.	.	.	.	244
	Long rough dabs,	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Black sole,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	.	4	4	2	.	.	.	.	.	.	.	.	.	.	.	.	10
	Whitings,	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2
	Gurnards,	.	3	.	3	9	8	.	9	3	3	1	.	.	.	.	.	.	.	.	.	39
	Anglers,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						470
Dec. 19.	Plaice,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
10.55 a.m.	Common dabs,	.	.	.	.	2	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	4
to	Long rough dabs,	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	3
12.25 p.m.	Gurnards,	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	2
																						10
Station IV.																						
1894. Feb. 13.	Plaice,	.	.	.	.	.	.	.	4	27	.	32	.	.	1	.	.	.	.	.	.	64
1.55 p.m.	Common dabs,	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
to	Whitings,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3*
4.10 p.m.	Father-lasher,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						70
April 6.	Starry rays,	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.	3
7.15 a.m.	Plaice,	.	.	.	.	.	8	26	.	57	.	29	.	.	.	.	.	.	.	.	.	120
to	Common dabs,	.	32	.	15	.	10	.	.	.	1	.	.	.	.	.	.	.	.	.	.	58
9.45 a.m.	Flounders,	.	.	.	7	9	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	17
	Whiting,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnard,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
																						201
Sept. 6.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	2
6.45 a.m.	Plaice,	2	.	11	87	68	94	88	18	8	.	3	.	1	.	.	.	.	.	.	.	380
to	Common dabs,	.	19	53	113	103	46	.	.	1	.	.	.	.	.	.	.	.	.	.	.	335
9.15 a.m.	Flounder,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Black sole,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	1	11	.	49	44	.	.	.	.	.	.	.	.	.	.	.	105
	Whitings,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	6	.	.	7	4	.	.	5	.	12	.	.	.	.	.	.	.	.	.	34
	Anglers,	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
																						863
Dec. 19.	Grey skate,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
8.20 a.m.	Starry ray,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Plaice,	.	.	.	.	.	.	.	1	.	3	.	.	1	.	.	.	.	.	.	.	5
10.40 a.m.	Common dabs,	.	1	.	1	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2†	2
	Angler,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
																						15

* Two at 3 inches. † 26 and 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches. 4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	Total.
Station V.																						
1894. Feb. 12. 2.40 p.m. to 4.40 p.m.	Common dabs,	3			2		1		1													7
	Long rough dabs,	1		2	1			1														5
	Haddocks,			1	6	18		13														38
	Cod,																	2				2
	Whitings,		1		6		4			1												12
	Gurnard,																					1*
	Pogge,	2																				2
																						67
April 5. 4.25 p.m. to 6.25 p.m.	Plaice,								3		3							1				7
	Common dabs,	7		6	6																	19
	Flounders,				6			6	2					2								16
	Long rough dabs,		2			1			1													4
	Haddocks,				15	65	79	52														211
	Cod,															1				1		2
	Whitings,			21			3		3			1										28
	Gurnards,					1		10			5	1										17
	Sprat,		1																			1
																						305
Sept. 7. 6 a.m. to 8 a.m.	Grey skate,											1										1
	Thornback ray,																			1		1
	Plaice,			1	2	7	9	20	1		4		1							1		46
	Lemon soles,			1																		1
	Common dabs,	3	22	79		8	9															121
	Sail fluke,																1					1
	Long rough dabs,				7		3															10
	Haddocks,		1				1	6														8
	Whitings,					3	4															7
	Gurnards,	1	1	1	8	3			2				2									18
																						214
Dec. 17. 1.55 p.m. to 3.55 p.m.	Starry ray,									1												1
	Plaice,							1	2			2		2								7
	Common dabs,		1	1		2		1			1											6
	Long rough dabs,	1		3	6					1												11
	Brill,									1												1
	Haddocks,			1		1		1	4													7
	Cod,																1	1				2
	Whitings,			1			1		2													4
	Gurnards,									2												2
																						41
Station VI.																						
1894. Feb. 14. 2.5 p.m. to 4.5 p.m.	Starry rays,							1		1												2
	Plaice,								1		2	2										5
	Common dabs,	1		1																		2
	Long rough dabs,	8		16		31		2														63†
	Haddocks,				30	95		10		1		3	1									140
	Cod,								1		1	3	1			2						8
	Whitings,			25			14			1		2										42
																						262
April 5. 1.35 p.m. to 3.35 p.m.	Lemon soles,					1					1											2
	Common dabs,	24	1	17		9			4													55
	Flounders,				7	8			5				1	3								24
	Long rough dabs,		9			11		1														21
	Turbot,											1										1
	Haddocks,		3		13	98	23		1													138
	Whitings,	1			27	1	8															37
	Brassie,				1																	1
	Gurnards,					6		22		20		4										52
	Angler,						1															1
	Dragonet,			1																		1
																						333

* 2 inches. † Six at 3 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—II. St Andrews Bay—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Sept. 7.	Plaice,	.	.	.	.	.	2	3	2	.	1	.	.	.	.	.	.	.	.	.	.	8
8.30 a.m.	Lemon soles,	.	.	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3
to	Common dabs,	.	2	22	21	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	51
10.20 a.m.	Long rough dabs,	.	.	.	2	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Haddocks,	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	3
	Whiting,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	2	4	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14
	Anglers,	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
																						86
Dec. 12.	Starry ray,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1.35 p.m.	Plaice,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
to	Common dab,	.	1	.	3	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
3.40 p.m.	Long rough dab,	.	5	21	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34
	Haddocks,	.	.	.	.	.	.	3	2	.	.	.	.	.	.	.	.	.	.	.	.	5
	Whitings,	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.	.	3
	Gurnards,	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2
	Anglers,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
																						57

III. Montrose Bay.

Station, Date, and Time Trawl down.	Kind of Fish.	4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	Total.
Station I.																						
1894. Sept. 21.	Thornback rays,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	2
10 a.m. to	Plaice,	.	.	.	.	.	16	12	11	28	2	17	.	.	.	.	.	1	.	.	.	87
11.30 a.m.	Lemon soles,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	6	.	35	58	37	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	147
	Long rough dabs,	.	.	.	3	.	4	.	3	1	.	.	.	.	.	.	.	.	.	.	.	11
	Haddocks,	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	4
	Whitings,	.	.	.	.	1	3	.	.	1	.	2	.	.	.	.	.	.	.	.	.	7
	Gurnards,	.	.	.	1	4	6	3	.	1	.	.	.	.	.	.	.	.	.	.	.	15
	Angler,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
																						275
Dec. 20.	Starry ray,	.	2	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	5
12 noon to	Plaice,	.	.	.	.	.	.	.	1	.	2	.	1	.	.	.	.	.	.	.	.	4
1.55 p.m.	Long rough dabs,	.	.	2	9	3	1	2	.	2	.	.	.	.	.	.	.	.	.	.	.	19
	Haddocks,	.	.	.	.	.	.	3	11	6	.	.	.	.	.	.	.	.	.	.	.	20
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	9*	12
	Angler,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
																						61
Station II.																						
1894. Sept. 21.	Thornback rays,	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
12.30 p.m.	Plaice,	.	.	.	3	9	37	8	6	18	4	7	4	2	1	.	1	.	.	.	.	100
to	Common dabs,	.	22	.	34	49	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	106
1.35 p.m.	Long rough dabs,	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Haddocks,	.	.	.	.	.	.	12	7	3	1	.	.	.	.	.	.	.	.	.	.	23
	Whitings,	.	.	.	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Gurnards,	.	.	12	.	28	.	1	.	.	3	.	.	.	.	.	.	.	.	.	.	44
	Anglers,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2
																						286
Dec. 20.	Starry ray,	.	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
9.20 a.m. to	Plaice,	.	.	.	.	.	.	.	2	.	3	.	.	1	1	.	.	.	.	.	.	7
10.25 a.m.	Long rough dabs,	.	.	.	2	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	5
	Haddocks,	.	.	.	.	.	.	1	2	2	.	2	.	.	.	.	.	.	.	.	.	7
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2†	4
																						27

* Five at 26 inches, four at 28 iches

† 27 and 29 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—IV. Aberdeen Bay.

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station I.																						
1894.																						
Sept. 25.	Starry ray,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
9.10 a.m.	Plaice,	.	.	.	.	6	.	4	9	5	1	1	15	1	1	1	.	.	.	.	.	44
to	Common dabs,	.	33	28	31	37	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	131
11.15 a.m.	Lemon soles,	.	.	.	2	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Long rough dabs,	.	.	10	12	34	.	4	.	2	3	.	.	.	.	.	.	.	.	.	.	65
	Brill,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
	Haddocks,	.	.	1	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3
	Whitings,	.	.	.	.	.	4	1	1	.	.	.	.	.	.	.	.	.	.	.	.	6
	Gurnards,	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Anglers,	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	2
Station II.																						260
1894.																						
Sept 25.	Plaice,	.	.	.	.	.	.	2	1	.	6	2	.	.	.	.	.	.	.	.	.	11
11.45 a.m.	Common dabs,	1	22	10	.	17	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	51
to	Long rough dabs,	.	.	.	1	.	5	.	.	1	1	.	.	.	.	.	.	.	.	.	.	8
1.15 p.m.	Sail fluke,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
	Gurnard,	.	1	.	2	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	7
Station III.																						78
1894.																						
Sept. 25.	Plaice,	.	.	.	.	.	11	.	4	13	20	5	.	2	.	.	.	.	.	.	.	55
1.55 p.m.	Common dabs,	.	10	.	28	60	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	101
to	Long rough dabs,	.	.	.	12	37	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	50
3.25 p.m.	Turbot	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	.	1	.	.	8	.	.	.	.	.	.	.	1	.	.	.	10
	Whitings,	.	.	.	.	1	2	.	2	2	.	1	.	.	.	.	.	.	.	.	.	8
	Gurnards,	.	.	.	4	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Station IV.																						230
1894.																						
Sept. 27.	Plaice,	.	.	.	.	6	.	12	.	12	.	15	15	9	.	.	.	.	.	1	.	70
12.40 p.m.	Lemon soles,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
to	Common dabs,	.	6	.	19	43	6	2	.	.	.	.	.	.	.	.	.	.	.	.	.	76
2.10 p.m.	Long rough dabs,	.	.	.	22	21	27	1	.	1	.	.	.	.	.	.	.	.	.	.	.	72
	Haddocks,	.	.	.	.	.	.	22	50	146	30	.	.	13	1	1	2	.	1	.	.	266
	Cod,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Whitings,	.	.	.	.	3	143	22	28	.	16	.	.	.	.	.	.	.	.	.	.	212
	Gurnards,	.	.	.	8	.	14	.	.	.	.	2	.	.	.	.	.	.	.	.	.	24
	Anglers,	.	.	.	.	.	.	.	.	.	3	.	1	.	.	.	.	.	.	.	.	5
Station V.																						727
1894.																						
Sept. 27.	Starry ray,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
10.40 a.m.	Plaice,	.	.	.	2	.	10	16	.	.	.	2	7	7	1	.	.	1	.	.	.	46
to	Common dabs,	.	3	.	43	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	48
12.15 p.m.	Long rough dabs,	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2
	Haddocks,	.	.	.	.	.	.	5	87	188	23	17	2	6	.	.	3	.	.	1	.	332
	Cod,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Whitings,	.	.	.	6	27	28	51	69	.	9	.	.	1	.	.	.	.	.	.	.	191
	Gurnards,	.	.	.	.	.	.	7	.	2	.	.	1	.	.	.	.	.	.	.	.	10
	Angler,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
Station VI.																						632
1894.																						
Sept. 27.	Plaice,	.	.	.	.	.	.	4	3	4	1	3	.	1	1	.	.	.	.	.	.	17
8.20 a.m.	Lemon soles,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
to	Common dabs,	4	.	11	11	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	36
9.50 a.m.	Long rough dabs,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Turbot,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
	Haddocks,	.	.	1	.	.	5	40	95	24	.	1	2	.	.	.	1	.	.	.	.	169
	Whitings,	.	.	.	.	3	69	207	100	11	.	.	1	.	.	.	.	.	.	.	.	391
	Gurnards,	.	.	5	.	.	3	.	.	.	1	.	1	.	.	.	.	.	.	.	.	10
	Horse-mackerel,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
																						627

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—IV. Aberdeen Bay—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station VII.																						
1894.																						
Sept. 26.	Plaice,	.	.	.	.	.	.	.	7	3	6	16	8	1	6	2	1	.	.	.	.	50
12.10 p.m.	Common dabs,	.	12	18	29	35	8	2	.	.	.	.	.	.	.	.	.	.	.	.	.	104
to	Turbot,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
1.50 p.m.	Haddocks,	.	.	.	.	.	.	11	.	10	2	.	.	.	.	.	.	.	.	.	.	23
	Whiting,	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Lythe,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	1
	Gurnards,	.	.	1	.	1	5	.	.	2	2	.	.	.	.	.	.	.	.	.	.	11
																						194

V. Moray Firth.

Station, Date, and Time Trawl down.	Kind of Fish.	4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	Total.
Station I.																						
1894.																						
July 3.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
1 hour.	Plaice,	.	.	.	.	.	.	.	.	1	1	1	.	2	.	1	.	.	1	1	.	8
	Lemon dab,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dab,	.	1	9	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
	Haddock,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
																						30
Oct. 5.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
8.5 a.m. to	Plaice,	.	.	.	.	.	.	1	2	2	5	8	1	3	3	3	4	2	2	4	1	41
10.5 a.m.	Common dabs,	.	3	20	.	82	52	9	2	.	.	.	.	.	.	.	.	.	.	.	.	148
	Brill,	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
	Haddock,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
	Gurnards,	.	.	1	.	1	6	5	4	2	.	.	.	.	.	.	.	.	.	.	.	19
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	2
																						213
Station II.																						
1894.																						
July 3.	Plaice,	.	.	4	5	1	10	.	11	.	1	.	1	.	.	1	.	.	.	.	.	34
2 hours.	Witch sole,	.	.	.	.	.	.	.	.	1	1	.	.	.	2	.	.	.	.	.	.	4
	Lemon sole,	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2
	Dab,	20	.	22	22	5	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	72
	Long rough dab,	.	8	5	.	27	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41
	Haddocks,	.	.	.	.	.	2	4	.	.	.	.	.	.	.	.	.	.	.	.	.	6
	Cod,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	3
	Gurnards,	.	.	.	5	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	8
	Anglers,	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	1	.	.	3
	Dragonet,	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2
																						175
Oct. 4.	Grey skate,	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	3
11.20 a.m.	Thornback rays,	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	1	.	3
to 1.25 p.m.	Plaice,	.	.	2	.	14	18	2	1	1	.	.	.	.	.	.	.	.	.	.	.	38
	Lemon soles,	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2
	Common dabs,	.	18	51	7	.	18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	94
	Witch soles,	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	.	3
	Haddocks,	.	.	.	.	.	1	.	5	1	.	.	.	.	.	.	.	.	.	.	.	7
	Cod,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2
	Gurnards,	.	.	1	.	1	.	2	.	.	.	.	.	.	1	.	.	.	.	.	.	5
	Angler,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	?	.	.	.	2	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
																						166

* 26 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station III.																						
1894. July 7. 1 hour.	Thornback rays,	.	.	.	.	.	.	.	.	.	.	.	.	3	.	1	.	1	2	.	2	9
	Plaice,	.	.	.	14	.	.	9	20	.	.	18	5	.	.	.	.	.	.	.	.	66
	Lemon sole,	.	.	.	1	.	6	.	2	2	.	1	.	.	.	.	.	.	.	.	.	12
	Common dab,	1	.	3	5	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Haddocks,	.	.	.	.	.	.	3	.	2	.	.	.	.	.	.	.	.	.	.	.	5
	Cod,	.	.	.	.	7	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	9
	Whiting,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	.	.	.	7	3	.	2	.	.	.	.	.	.	.	.	.	.	.	12
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1*	1
																						125
Oct. 6. 8.45 a.m. to 10.30 a.m.	Thornback rays,	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	1	.	.	.	5
	Plaice,	.	.	.	.	.	.	6	11	8	15	.	.	9	.	.	.	.	.	2	.	51
	Lemon soles,	.	.	.	.	3	.	.	9	2	.	1	.	.	.	.	.	.	.	.	.	15
	Common dabs,	.	.	3	5	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Cod,	.	.	.	.	.	2	.	.	2	.	.	4	.	.	.	.	.	.	.	1†	9
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	2
	Butter-fish,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						93
Station IV.																						
1894. July 4. 2 hours.	Plaice,	.	52	.	.	130	37	.	.	2	23	2	2	18	1	.	.	.	.	.	1	268
	Common dab,	.	55	90	.	12	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	163
	Flounders,	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Long rough dab,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	.	2	.	6	.	.	.	.	.	.	.	.	.	.	.	.	8
	Gurnard,	.	.	30	1	15	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.	62
																						504
Oct. 22. 9 a.m. to 11.15 a.m.	Thornback rays,	.	.	.	.	.	2	.	1	1	4	.	.	.	.	.	.	.	.	.	.	8
	Plaice,	.	.	3	18	61	36	48	33	13	10	23	19	5	.	.	.	.	1	4	2‡	276
	Common dabs,	.	27	10	73	15	3	5	3	1	2	.	.	.	.	.	.	.	.	.	.	139
	Brill,	.	.	.	.	.	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	5
	Haddocks,	.	.	.	.	.	.	.	6	3	.	.	.	.	.	.	.	.	.	.	.	9
	Cod,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
	Gurnard,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
	Anglers,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1	.	.	.	.	3
	Butter-fish,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						444
Station V.																						
1894. July 4. 2 hours.	Plaice,	.	.	2	.	7	4	1	1	.	.	1	.	.	.	1	.	.	.	1	.	18
	Lemon soles,	.	.	.	2	1	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	6
	Common dab,	38	.	44	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	87§
	Haddocks,	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Whiting,	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	1	21	12	1	.	2	.	.	1	.	1	.	.	.	.	.	.	.	.	39
																						154
Oct. 22. 11.25 a.m. to 1.5 p.m.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	60	36	12	.	.	5	3	2	.	.	.	.	2	1	.	.	121
	Lemon soles,	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	.	6	62	137	22	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	236
	Brill,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Haddocks,	.	.	.	.	.	.	15	11	.	.	.	.	.	.	.	.	.	.	.	.	26
	Cod,	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	2
																						388

* 28 inches. † 31 inches. ‡ 31 inches. § Three at 3 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station VI.																						
1894. July 5. 2 hours.	Plaice,	.	.	.	11	10	.	5	.	.	1	.	.	1	.	1	.	1	.	1	.	31
	Lemon soles,	.	.	2	8	.	3	.	1	12	.	2	2	1	.	.	.	.	.	.	.	31
	Common dabs,	8	57	84	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	150
	Haddocks,	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Whiting,	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	.	3	7	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	12
	Anglers,	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Pogge,	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						231
Oct. 22. 1.25 p.m. to 3.25 p.m.	Thornback rays,	.	.	.	.	.	.	.	.	1	.	1	.	.	.	2	.	1	.	.	.	5
	Plaice,	.	.	.	5	16	21	53	34	11	.	10	10	6	3	.	1	.	4	3	2*	179
	Lemon soles,	.	.	.	.	.	2	.	.	.	1	.	1	.	.	.	.	.	.	.	.	4
	Common dabs,	.	4	71	111	28	2	.	2	.	.	.	.	.	.	.	.	.	.	.	.	218
	Haddocks,	.	.	.	.	.	1	17	24	12	.	.	.	.	.	.	.	.	.	.	.	54
	Cod,	.	.	.	.	.	.	.	1	2	3	.	.	.	.	.	.	.	.	.	.	6
	Whiting,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnards,	.	.	2	.	.	3	.	.	.	1	.	.	.	.	.	.	.	.	.	.	6
	Anglers,	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2
																						475
Station VII.																						
1894. July 5. 2 hours.	Grey skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2†	2
	Lemon soles,	.	.	.	6	2	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	10
	Common dab,	.	17	38	8	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	66‡
	Long rough dabs,	1	10	30	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	51
	Haddocks,	.	.	.	3	2	8	.	1	.	.	.	.	.	.	.	.	.	.	.	.	14
	Whitings,	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
	Gurnards,	1	3	.	12	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	20
	Hake,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2§	2
																						168
Oct. 9. 11.20 a.m. to 1.20 p.m.	Grey skate,	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Lemon sole,	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Common dabs,	1	4	83	54	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	170
	Witch sole,	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
	Sail fluke,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
	Long rough dabs,	.	9	17	69	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	95
	Haddocks,	.	.	.	.	10	119	227	47	.	2	.	.	.	.	.	.	.	.	.	.	405
	Cod,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Whitings,	.	.	.	.	4	4	10	12	3	2	2	.	.	.	.	.	.	.	.	.	37
	Gurnards,	.	.	3	7	24	13	22	.	5	.	3	.	1	.	.	.	.	.	.	.	78
	Anglers,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2‖	2
	Hake,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
																						794
Station VIII.																						
1894. July 9. 2 hours.	Thornback ray,	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
	Plaice,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
	Lemon soles,	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Witch sole,	.	.	.	.	1	1	4	2	1	1	.	1	.	.	.	.	.	.	.	.	11
	Common dab,	.	8	56	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	73
	Sail-fluke,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Long rough dab,	.	34	102	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	138
	Haddocks,	.	.	.	.	7	231	80	.	.	1	.	.	.	.	.	.	.	.	.	.	319
	Whitings,	.	.	.	.	.	5	.	.	.	2	1	.	1	.	.	.	.	.	.	.	9
	Gurnards,	.	2	.	28	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	32
	Angler,	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
																						591

* 26 and 27 inches. † 32 and 33 inches. ‡ Two at 3 inches.
§ 30 and 36 inches. ‖ 34 and 37 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894. Oct. 23. 9.35 a.m. to 11.35 a.m.	Grey skate,					1																1
	Plaice,																		1		1*	2
	Lemon soles,			1	1				1				1									4
	Common dabs,			13	79	13	6															111
	Witch soles,						2		8	8		7	3				1					29
	Sail-fluke,									1			1									2
	Long rough dabs,			18	67	26																111
	Haddocks,						4	164	186			3			1							358
	Cod,											3									2†	5
	Whitings,							10			3		1									14
	Gurnards,			3			8	3					2									16
	Angler,									1												1
	Ling,																			1	2	3
	Hake,																	1				1
																						658
Station IX.																						
1894. July 9. 2 hours.	Lemon soles,			1					1													2
	Witch soles,						3	1	8		4	1	2									19
	Common dabs,			15	26		4															45
	Sail-fluke,								1										1			2
	Long rough dabs,		39	1	29																	69
	Haddocks,			1		59	160	38		1	1											260
	Whitings,			2			9			2	2											15
	Gurnards,				6			1	1				1	1								10
	Cod,																				1‡	1
																						423
Oct. 23. 12.25 p.m. to 2.30 p.m.	Starry ray,							1														1
	Plaice,										1	1										2
	Lemon soles,				4	2																6
	Common dabs,				97	73	24															194
	Witch soles,							2		1		2	2									7
	Long rough dabs,			5	35	44																84
	Haddocks,						34	243	61	14		4			1							357
	Cod,					1															1§	2
	Whitings,							25		16			1	1								43
	Gurnards,					14	26	5														45
	Angler,											1										1
																						742
Station X.																						
1894. July 13.	Sandy ray,									1			1									2
	Plaice,												1	2		1			2	2		8
	Lemon soles,						1															1
	Common dabs,			5																		5
	Haddocks,						1	11													1	13
	Cod,														1						1	2
	Whiting,							1														1
	Gurnard,						1															1
	Anglers,																			2		2
																						35
Oct. 5. 1.40 p.m. to 3.40 p.m.	Starry ray,							1														1
	Sandy rays,								1				2									3
	Plaice,										1	1	3	1	1							7
	Lemon soles,						8	4		1		2	1		1							17
	Common dabs,			27	29	21	11															88
	Sail-fluke,									1				1								2
	Long rough dabs,		8		27	5																40
	Haddocks,						24	91	129													244
	Cod,						1			1										1		3
	Whitings,						2	3	7			1										13
	Gurnards,			1	4	14	7	22		22		40										110
	Anglers,								2		1								1			4
																						532

* 27 inches. † 34 and 39 inches. ‡ 34½ inches. § 38 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station XI.																						
1894. (Smith Bank.) July 16. 2 hours.	Thornback rays,										1			2								3
	Plaice,												6		5		2					13
	Lemon soles,						1		1													2
	Common dabs,			10	6																	16
	Cod,														1					1		2
	Gurnards,		5		11		5		2													23
	Anglers,						1														1	2
																						61
	Shrimp Trawl.																					
July 16. ½ hour.	Lemon soles,									2												2
	Common dabs,		3	3																		11*
	Haddocks,								2					1								3
	Cod,		5			1																7†
	Ling,																				1	1
	Gurnards,				5		1	1														7
	Poor-cod,	1																				10‡
	Solenette,																					1§
	Angler,																			1		1
																						43
Oct. 11. 5.55 a.m. to 8 a.m.	Plaice,											1		2						1	1	5
	Lemon soles,			1																		1
	Common dabs,			4	3																	7
	Haddocks,							18	18													36
	Cod,								2				2									4
	Whiting,								1													1
	Gurnards,				2	3				11	6											22
	Anglers,												1						2		1‖	4
																						80
Station XII.																						
1894. (Smith Bank.) July 16. 2 hours.	Thornback ray,																	1				1
	Plaice,												1	2	5	3						11
	Lemon soles,													2								2
	Brill,																	1				1
	Common dabs,		4																			4
	Haddocks,							5		1												6
	Gurnards,					20			7													27
	Angler,																	1				1
																						53
Oct. 11. 10.15 a.m. to 11.45 a.m.	Plaice,											1	1	2	1	2		1	3			11
	Lemon sole,					1	1		1	1	1			2								7
	Common dabs,		1	4	5	9		1														20
	Brill,																		1			1
	Haddocks,						3	8	12													23
	Cod,								1						1		4		2		1¶	9
	Gurnards,					2	1	1	1		1											6
	Ling,														1							1
	Anglers,																			1	4**	5
																						83
Station XIII.																						
1894. (Smith Bank.) July 17. 2½ hrs.	Plaice,												3		2	1		2				8
	Lemon soles,					4		2	1		4		4	1								16
	Common dabs,			38	25																	63
	Haddocks,						5		3					2								10
	Cod,							1				1				1						3
	Gurnards,		1	17			2					3										23
	Dragonet,						2															2
	Wolf-fish,																				1††	1
																						126

* Five at 3 inches. † One at 3 inches ‡ Nine at 2 inches. § 3 inches. ‖ 31 inches.
¶ 28 inches. ** Two at 28 ; one at 33 inches. †† 30 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—V. Moray Firth—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
1894.	*Shrimp Trawl.*																					
July 17.	Haddocks,							3			1	1										5
½ hr.	Whiting,					1																1
	Gurnards,					3		2														5
																						11
Oct. 11.	Starry ray,									1												1
1.35 p.m.	Plaice,												2	3	4	3	2	1				15
to	Lemon soles,					4							1									5
3.35 p.m.	Common dabs,			48	31																	79
	Long rough dabs,				9																	9
	Haddocks,							56	56	41												153
	Cod,								1				1									2
	Whitings,						1		7													8
	Gurnards,					12			11	3												26
	Anglers,																		2		2	4
Station XIV.																						302
1894. (Smith Bank.) July 17. 2 hrs.	Thornback rays,	2																		1	1	4
	Plaice,										2	1	1	3								7
	Lemon soles,		1		9	1	2		1				3									17
	Brill,																			1		1
	Common dabs,	4	63		25																	92
	Sail-fluke,											1		1								2
	Long rough dabs,		19		12																	31
	Haddock,					1																1
	Gurnards,			18			19		5			2										44
	Angler,														1							1
																						200
Oct. 11.	Grey skate,										1											1
5 p.m. to	Thornback ray,	1																				1
7.5 p.m.	Starry rays,			1						1												2
	Lemon soles,			1	17	1		4			1	1		2								27
	Common dabs,			8	10		2															20
	Sail-fluke,			1																		1
	Long rough dabs,		5	13	6	1																25
	Haddocks,					3		108	377	12												500
	Whitings,						7	40	34													81
	Gurnards,			5	14	18	7			2												46
	Angler,													1								1
Station XV.																						705
1894. (Smith Bank.) July 17. 2 hrs.	Thornback ray,																				1	1
	Plaice,										1					1						2
	Lemon soles,				1	8					1		1	2								13
	Common dabs,		151	54																		205
	Long rough dabs,		9	11																		20
	Gurnards,	1			27			1				2										31
	Three-bearded rockling,	1																				1
	Anglers,				1								1							2		4
	Pogge,		1																			1
																						278
Oct. 12.	Thornback rays,													1							1*	2
10.25 a.m.	Plaice,											4		11								15
to	Lemon soles,				6		3	1														10
12.30 p.m.	Common dabs,			30	210	19																259
	Long rough dabs,				9	8																17
	Haddocks,						134			43		11										188
	Cod,								2	2		2										6
	Whitings,							15				1										16
	Gurnards,			7		58		8		12												85
	Anglers,														2					1		3
	Pogge,			1																		1
																						602

* 29 inches.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND DURING 1894.

A. FISH CAUGHT—V. MORAY FIRTH—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station XVI.																						
1894. July 17. 2 hrs.	Plaice,												1	1	1		1					4
	Lemon dab,				2	1	1							1								5
	Dab,		19		21																	40
	Long rough dab,			5	6																	11
	Haddock,					1		3														4
	Gurnard,		1	8		13	1															23
	Angler,								1													1
																						88
	Shrimp Trawl.																					
July 17. ½ hr.	Lemon dab,							1				1										3*
	Dab,																					1†
	Cod,				1																	1
	Gurnard,				1		1															2
	Brassie,	1		1	2																	4
	Angler,							1													1	2
																						13
Oct. 12. 7.15 a.m. to 9.15 a.m.	Grey skate,						1															1
	Starry ray,		1							3												4
	Plaice,											1										1
	Lemon soles,			4		6		2				1		2								15
	Common dab,			75	110		20															205
	Witch soles,								10	5		2										17
	Sail-fluke,										1			1								2
	Long rough dab,			45		15																60
	Haddock,						7	248		24		1	1									281
	Cod,							1													1‡	2
	Whitings,					14	15			7	2					1						39
	Angler fish,					1				3			2									6
	Hake,																1					1
																						634
	VI. ORKNEY ISLES.																					
Station I.																						
1894. July 21. 2 hrs.	Thornback skate,																1					1
	Plaice,							1	1	2	1	2								1		8
	Lemon dab,			3	17		5		1													26
	Sail-fluke,														1							1
	Dab,	7		16	11		3	1		1												39
	Haddock,						1	23		21												45
	Cod,					2		1			1											4
	Gurnard,						5	1	1			1										8
	Angler,																		4			1
																						133
Station II.																						
1894. July 21. ½ hr.	Plaice,														1							1
	Dab,		8										1									9
	Thornback skate,																		1	1		2
	Haddock,							3	1													4
	Gurnard,		1	2	3	3	1	2		1												13
																						29
Station III.																						
1894. July 27. 1½ hrs.	Plaice,		5		10		11	20	18	2	19	2	3									90
	Lemon dab,				1	2	1	1	5													10
	Thornback skate,	1												1				1				3
	Gurnard,	1		1				1														3
	Angler,								1					1						1		3
																						109

* One at 3 inches. † 3 inches. ‡ 34 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

A. FISH CAUGHT—VI. Orkney Isles—*continued.*

Station, Date, and Time Trawl down.	Kind of Fish.	Size in Inches.																				Total.
		4 +	5 +	6 +	7 +	8 +	9 +	10 +	11 +	12 +	13 +	14 +	15 +	16 +	17 +	18 +	19 +	20 +	21 +	23 +	25 +	
Station IV. 1894. July 24. 2 hrs.	Plaice,	.	.	.	.	.	.	1	1	3	1	.	.	1	.	.	.	.	.	.	.	7
	Lemon dab,	.	.	.	.	4	2	2	1	2	2	.	1	.	.	.	.	.	.	.	.	14
	Witch,	.	.	13	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	14
	Dab,	.	12	21	8	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	44
	Thornback skate,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
	Sandy ray,	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Gurnard,	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
	Haddock,	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Angler,	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1*	2
																						89

* 40 inches.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—I. Firth of Forth.

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station I.		
1894. 26th Jan. 2.5 p.m. to 4 p.m.	Surface	Too stormy to use surface net.
	Bottom	Euphausidæ, c.; *Calanus finmarchicus*, c.; *Caligus*, sp. f.; *Sagitta*, fr.
16th Feb. 2.25 p.m. to 4.20 p.m.	Surface	*Parathemisto oblivia*, r.; *Sagitta*, f.; small Medusæ, r.
	Bottom	Euphausidæ, f.; *Calanus finmarchicus*, f.; *Caligus*, r.; *Sagitta*, f.; small Medusæ, r.
16th April. 11 a.m. to 12.45 p.m.	Surface	*Parathemisto*, fr.; *Calanus finmarchicus*, ab.; fish eggs, fr.
	Bottom	*Parathemisto*, f.; *Calanus finmarchicus*, fr.; *Temora longicornis*, f.; *Caligus*, f.; *Sagitta*, f.; young *Balani*, ab.; young lumpsucker, one.
24th Aug. 1.30 p.m. to 3.30 p.m.	Surface	*Hyperoche*, sp. r.; *Acartia*, sp. f.; Ctenophora, fr.; young Crustacea, fr.
	Bottom	*Crangon allmanni*, f.; *Hetcromysis formosa*, r.; *Metopa alderi*, fr.; *Argissa hamatipes*, fr.; *Apherusa borealis*, fr.; *Centropagcs hamata*, fr.; *Cyclopicera nigripes*, r.; *Sagitta*, fr.; Ctenophora, fr.; young Crustacea, fr.
4th Dec. 12.30 p.m. to 2.10 p.m.	Surface	Euphausidæ, r.; *Parathemisto oblivia*, r.; *Hyperoche*, sp. r.; *Calanus finmarchicus*, f.; *Acartia*, sp. f.; *Sagitta*, r.; Ctenophora, f.
	Bottom	*Calanus finmarchicus*, f.; *Sagitta*, fr.; *Tomopteris*, c.; Ctenophora, c.
Station II.		
26th Jan. 11 a.m. to 12.40 p.m.	Surface	Euphausidæ, f.; *Parathemisto*, f.; *Calanus finmarchicus*, c.; *Sagitta*, r.
	Bottom	Euphausidæ, fr.; *Parathemisto*, f.; *Calanus finmarchicus*, ab.; *Caligus*, r.; *Sagitta*, fr.
16th Feb. 11.10 a.m. to 12.55 p.m.	Surface	*Parathemisto oblivia*, r.; *Sagitta*, f.; small Medusæ, r.
	Bottom	Euphausidæ, f.; *Calanus finmarchicus*, f.; *Caligus*, r.; *Sagitta*, f.; small Medusæ, r.
20th April. 12.55 p.m. to 2.20 p.m.	Surface	*Calanus finmarchicus*, ab.; *Temora longicornis*, f.; young Crustacea (*Balani*, &c.), fr.; fish eggs, f.
	Bottom	*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus*, r.; young *Balani*, f.
30th Aug. 1.10 p.m. to 2.45 p.m.	Surface	*Hyperoche*, sp. r.; *Acartia*, sp. r.; *Temora longicornis*, f.; *Sagitta*, f.; Ctenophora, f.; young Crustacea, f.
	Bottom	*Metopa rubrovitata*, f.; *Metopa aldcri*, f.; *Argissa hamatipcs*, r.; *Apherusa*, sp. fr.; *Acartia*, sp. fr.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Parapontella brevicornis*, r.; *Monstrilla*, sp. r.; *Sagitta*, c.; post-larval fishes, r.; young Crustacea, fr.
6th Dec. 11.15 a.m. to 12.55 p.m.	Surface	*Hyperoche*, sp. f.; *Calanus finmarchicus*, r.; *Sagitta*, f.; Ctenophora, f.
	Bottom	*Calanus finmarchicus*, f.; *Temora longicornis*, r.; *Caligus rapax*, fr.; *Sagitta*, r.; *Tomopteris*, c.; Ctenophora, f.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—I. Firth of Forth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
1894. 26th Dec. 12 noon to 1.55 p.m.	Surface	*Parathemisto*, sp. f. ; *Hyperoche*, sp. r. ; *Calanus finmarchicus*, f. ; *Acartia*, sp. f. ; *Sagitta*, f. ; *Ctenophora*, f. ; *Appendicularia*, f.
	Bottom	*Crangon nanus*, r. ; *Erythrops goesii*, r. ; *Diastylus* sp. r. ; *Hyperoche*, sp. f. ; *Ampelisca*, sp. r. ; *Apherusa*, sp. r. ; *Calanus finmarchicus*, f. ; *Pseudocalanus elongatus*, f. ; *Temora longicornis*, f. ; *Alteutha*, sp. r. ; *Caligus rapax*, f. ; *Cythere jonesii*, r. ; *Tomopteris*, f. ; *Sagitta*, f. ; Ctenophora, fr.
Station III.		
20th Feb. 11.30 a.m. to 2.35 p.m.	Surface	*Gammarus*, sp. r ; some rubbish, very little in net.
	Bottom	Euphausidæ, fr. ; *Erythrops*, f. ; *Gastrosaccus spinifer*, r. ; *Mysis flexuosus*, f. ; *Mysis ornatus*, fr. ; *Mysis spiritus*, f. ; *Mysidopsis gibbosa*, f. ; *Crangon nanus*, f. ; *Parathemisto*, f. ; *Calanus finmarchicus*, fr. ; *Sagitta*, fr. ; small Medusæ, f.
16th April. 1.20 p.m. to 4.10 p.m.	Surface	*Calanus finmarchicus*, fr. ; *Temora longicornis*, f. ; *Sagitta*, r. ; young *Balani*, fr. ; fish eggs, r.
	Bottom	*Parathemisto*, r. ; *Calanus finmarchicus* ; *Temora longicornis*, fr. ; *Caligus*, r. ; young *Balani*, ab. ; post-larval fishes, r. ; fish eggs, r.
21st June. 8.10 a.m. to 10.45 a.m.	Surface	Amphipoda, sp. f. ; *Calanus finmarchicus*, f. ; *Acartia*, sp. f. ; *Temora longicornis*, f. ; *Centropages*, sp. r. ; *Podon*, sp. r. ; a young Lumpsucker ; young Crustacea, f. ; young *Aurelia*, r.
	Bottom	*Hyperoche*, sp. r. ; Ctenophora, ab. ; young fish, r.
24th Aug. 10.15 a.m. to 12.50 p.m.	Surface	*Hyperoche*, sp. r. ; *Parathemisto*, sp. r. ; *Apherusa borealis*, r. ; *Calanus finmarchicus*, r. ; *Acartia*, sp. fr. ; *Caligus* ; Ctenophora, fr.
	Bottom	*Crangon allmanni*, r. ; *Mysis*, sp. f. ; *Hyperoche*, sp. r. ; *Parathemisto*, sp. r. ; *Calanus finmarchicus*, f. ; *Sagitta*, c. ; Ctenophora, fr. ; post-larval fish.
10th Dec. 11.55 a.m. to 2.30 p.m.	Surface	Euphausidæ, f. ; *Parathemisto*, f. ; *Calanus finmarchicus*, fr. ; *Sagitta*, f. ; Ctenophora, f.
	Bottom	*Apherusa*, r. ; *Calanus finmarchicus*, f. ; *Caligus*, f. ; *Sagitta*, fr. ; *Tomopteris*, c. ; Ctenophora, f.
27th Dec. 11.30 a.m. to 3.30 p.m.	Surface	*Thysanoessa*, sp. f. ; *Parathemisto*, sp. fr. ; *Hyperoche*, sp. r. ; *Calanus finmarchicus*, fr. ; *Sagitta*, fr. ; Ctenophora, f. ; larval Crustacea, fr. ; post-larval fish, r.
	Bottom	*Thysanoessa*, fr. ; *Parathemisto*, f. ; *Hyperoche*, f. ; *Calanus finmarchicus*, fr. ; *Temora longicornis*, f. ; *Caligus rapax*, r. ; *Sagitta*, fr. ; *Tomopteris*, r. ; Ctenophora, fr.
Station IV.		
17th Jan. 11.15 a.m. to 2.15 p.m.	Surface	*Nil.*
	Bottom	*Calanus finmarchicus*, f. ; *Caligus*, fr. ; *Sagitta*, r. ; very little in net.
15th Feb. 7.40 a.m. to 10.40 a.m.	Surface	Euphausidæ, c. ; *Parathemisto oblivia*, c. ; *Hyperoche*, r. ; *Bathyporeia*, r. ; *Calanus finmarchicus*, f. ; *Sagitta*, c.
	Bottom	Net got fouled, and contained nothing.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—I. Firth of Forth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
1894. 13th April. 10.40 a.m. to 1.40 p.m	Surface	*Idotea marina*, r. ; *Calanus finmarchicus*, f. ; young *Balani*, fr. ; fish eggs, r.
	Bottom	*Calanus finmarchicus*, f.; *Temora longicornis*, f. ; *Sagitta*, f. ; young *Balani*, ab.
21st June. 11.35 a.m. to 2.35 p.m.	Surface	Young Crustacea, f. ; Minute brownish-coloured algæ, ab.
	Bottom	*Nil.*
23rd Aug. 2.10 a.m. to 5 p.m.	Surface	*Acartia*, sp. r. ; *Sagitta*, r.
	Bottom	Ctenophora, f. ; young Decapod Crustacea, ab.
Station V.		
22nd Feb. 12.40 p.m. to 2.45 p.m.	Surface	*Parathemisto*, r. ; *Calanus finmarchicus*, f. ; *Sagitta*, fr. ; small Medusæ, f. ; fish eggs, r.
	Bottom	Euphausidæ, c. ; *Erythrops*, f. ; *Mysis*, sp. f. ; *Parathemisto*, f. ; *Atylus bispinosus*, fr. ; Cumacea, f. ; *Calanus finmarchicus*, f. ; *Sagitta*, ab. ; *Tomopteris*, f.
19th April. 7.45 p.m. to 9.55 p.m.	Surface	*Calanus finmarchicus*, f. ; young Crustacea, c. ; post-larval fishes, f. ; fish eggs, ab.
	Bottom	Euphausidæ, r. ; *Calanus finmarchicus*, f. ; *Sagitta*, f. ; young Crustacea, r.
20th June. 11.20 a.m. to 1.25 p.m.	Surface	*Gammarus* (Juv.), r. ; *Anomalocera patersoni*, r. ; *Sagitta*, r. ; young Aurelia, r.
	Bottom	*Hyperoche*, sp. r.; Ctenophora, c.
30th Aug. 8.15 a.m. to 10.20 a.m.	Surface	*Acartia*, sp. f.; *Temora longicornis*, f.; young Decapod Crustacea, r. ; Ctenophora, f.
	Bottom	*Hyperoche*, sp. r.; *Apherusa*, sp. fr.; *Argina hamatipes*, fr.; *Stenothoe marina*, r.; *Metopa alderi*, f.; *Campylaspis*, sp. r.; *Pseudocuma cercaria*, f.; *Calanus finmarchicus*, f.; *Erythrop*, sp. f.; *Sagitta*, ab.; young lamellibranch Mollusca, f.; young Ophiuridæ, f.
Station VI.		
22nd Feb. 3.45 p.m. to 4.40 p.m.	Surface	Euphausidæ, f.; *Caligus*, r.; *Sagitta*, f.; small Medusæ, f.; post-larval fishes (herring), r.
	Bottom	Euphausidæ, f.; *Calanus finmarchicus*, f.; *Caligus*, r.; *Sagitta*, fr.; a quantity of broken shells.
19th April. 11.10 a.m. to 12.5 p.m.	Surface	*Calanus*, fr.; *Sagitta*, r.; young *Crustacea*, f.; fish eggs, c.
	Bottom	*Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus*, r.; *Sagitta*, fr.; young *Balani*, c.
20th June. 2.35 p.m. to 3.40 p.m.	Surface	Ctenophora, ab.
	Bottom	Small *Eupagurus bernhardus*, one ; small *Ophiura*, sp. one ; Ctenophora, f.; young *Balani* (Ostracod stage), r.; very little in the net.
30th Aug. 11.5 a.m. to 11.50 a.m.	Surface	*Parathemisto*, sp. r.; *Acartia*, sp. fr.; *Centropages*, sp. r.; young Decapods Crustacea, f.; Ctenophora, f.
	Bottom	*Acartia*, sp. fr.; *Temora longicornis*, c.; *Centropages*, sp. f.; *Sagitta*, f.; young Decapod Crustacea, f.; young Ophiuridæ, c.; young Gastropod Mollusca, f.; post-larval fish, f.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—I. Firth of Forth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station VII.		
1894.		
18th Jan.	Surface	*Nil.*
11.40 a.m. to 1.20 p.m.	Bottom	Euphausidæ, r.; *Calanus finmarchicus*, fr.; *Caligus*, f.; *Sagitta*, f.; *Tomopteris*, r.
23rd Feb.	Surface	*Parathemisto*, fr.; *Calanus finmarchicus*, f.
7.20 a.m. to 9.10 a.m.	Bottom	Euphausidæ, fr.; *Erythrops*, f.; *Mysis spiritus*, r.; *Mysis*, sp. fr.; *Mysidopsis gibbosa*, f.; *Parathemisto*, f.; *Atylus bispinosus*, f.; *Iphimedia*, sp. r.; *Amathilla sabina*, r.; *Dulichia*, sp. r.; Cumacea, f.; *Calanus finmarchicus*, f.; *Caligus*, f.; *Sagitta*, fr.; small Medusæ, f.; *Polycera lessonii*, one.
13th April. 3.30 p.m. to	Surface	*Parathemisto*, f.; *Calanus finmarchicus*, f.; *Sagitta*, c.; young *Balani*, c.; fish eggs, f.
5.10 p.m.	Bottom	*Pseudocuma cercaria*, f.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Sagitta*, fr.; young *Balani*, fr.
20th June. 7.50 a.m. to 9.50 a.m.	Surface	Euphausidæ, r.; *Parathemisto*, sp. r.; *Centropages*, sp. r.; Glutinous algæ of a brownish colour filling up the interstices of the net.
	Bottom	Net fouled on the trawl-head.
23rd Aug.	Surface	*Acartia*, sp. r.; *Sagitta*, r.; scarcely anything in net.
11.10 a.m. to 1.10 p.m.	Bottom	Young Decapod Crustacea, very ab.
18th Jan.	Surface	*Nil.*
1.45 p.m. to 3.50 p.m.	Bottom	*Virbius fasciger*, f.; Euphausidæ, fr.; *Parathemisto*, sp. f.; *Calanus finmarchicus*, c.; *Caligus*, sp. f.; *Sagitta*, c.
21st Feb. 1.10 p.m. to	Surface	*Parathemisto*, r.; *Calanus finmarchicus*, f.; *Sagitta*, f.; fish eggs.
3.15 p.m.	Bottom	*Euphausidæ*, f.; Amphipoda, f.; *Calanus finmarchicus*, f.; *Caligus*, r.; *Sagitta*, c.; *Tomopteris*, f.; small Medusæ, f.
18th April. 1.10 p.m. to	Surface	*Parathemisto*, f.; *Calanus finmarchicus*, f.; young Crustacea, ab.; fish eggs, ab.
3.15 p.m.	Bottom	*Sagitta*, f.; Appendicularia, r.; young Crustacea, f.
19th June 1 p.m. to	Surface 21–28 fath.	*Anomalocera patersoni*, fr.; very little else, except a few Ctenophora.
3.5 p.m.	Bottom	Ctenophora, ab.; nothing else.
29th Aug. 12.50 p.m.	Surface	*Centropages*, sp. f.; *Evadne nordmanni*, f.; *Podon*, r.; young Decapods, fr.; *Aurelia aurita*, r.
to 2.45 p.m.	Bottom	*Calanus finmarchicus*, f.; *Acartia*, sp. f.; *Temora longicornis*, f.; *Tomopteris*, r.; post-larval fish, r.
21st Feb. 3.55 p.m. to	Surface	*Parathemisto*, f.; *Calanus finmarchicus*, fr.; *Sagitta*, f.; fish eggs, r.
5.55 p.m.	Bottom	*Crangon allmanni*, r.; Euphausidæ, r.; *Mysis*, sp. f.; *Diastylus*, sp. f.; *Pseudocuma*, sp. f.; *Metopa*, r.; *Hippomedon*, f.; *Atylus bispinosus*, fr.; *Calanus finmarchicus*, fr.; *Caligus*, r.; *Sagitta*, c.
18th April.	Surface	*Calanus finmarchicus*, fr.; young Crustacea, v. ab.; fish eggs, ab.
4.5 p.m. to 6.10 p.m.	Bottom	*Pseudocuma cercaria*, f.; Amphipods, sp.? sev.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; young star-fishes, f.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—I. Firth of Forth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
1894. 19th June. 3.55 p.m. to 6.5 p.m.	Surface	*Gammarus* (Juv.), r.; *Anomalocera patersoni*, c.; *Sagitta*, f.; Ctenophora, f.; young Crustacea, fr.
	30–34 fath. Bottom	Ctenophora, ab.
29th Aug. 3.25 p.m. to 5.20 p.m.	Surface	*Acartia*, sp., f.; *Temora longicornis*, f.; *Centropages*, sp. f.; *Anomalocera patersoni*, f.; young Crustacea, c.; *Aurelia aurita*, r.; post-larval fish, f.; fish ova, f.
	Bottom	*Acartia*, sp. f.; *Temora longicornis*, r.; *Centropages*, s. f.; *Sagitta*, f.
25th Jan. 11.20 a.m. to 12.20 p.m.	Surface	*Mysis*, sp. r.; *Macropsis slabberi*, fr.; *Calanus finmarchicus*, f.; *Sagitta*, f.; small Medusæ, r.
	Bottom	*Mysis flexuosus*, f.; *Mysis spiritus*, f.; *Mysis*, sp. f.; *Macropsis slabberi*, fr.; *Gastrosaccus spinifer*, r.; *Crangon*, sp. r.; *Parathemisto oblivia*, f.; *Calanus finmarchicus*, f.; *Perioculoides longimanus*, r.; small Medusæ, f.
17th Feb. 10.35 a.m. to 11.25 a.m.	Surface	*Parathemisto*, fr.; *Calanus finmarchicus*, f.; small Medusæ, f.
	Bottom	Euphausidæ, f.; *Mysis spiritus*, fr.; *Mysis flexuosus*, f.; *Macropsis slabberi*, c.; *Parathemisto*, f.; *Atylus*, sp. r.; *Calanus finmarchicus*, fr.; *Caligus*, f.; *Sagitta*, fr.
31st Aug. 11.15 a.m. to 11.45 a.m.	Surface	*Mysis ornata*, f.; *Macropsis slabberi*, fr.; *Idotea linearis*, r.; *Temora longicornis*, fr.
	Bottom	*Crangon vulgaris*, f.; *Pandalus annulicornis*, r.; *Mysis flexuosus*, f.; *Mysis ornatus*, f.; *Gastrosaccus spinifer*, f.; *Macropsis slabberi*, f.; *Diastylus*, sp. fr.; *Idotea linearis*, f. Caprellidæ, f.
12th Dec. 11.30 a.m. to 12.10 p.m.	Surface	*Nil.*
	Bottom	*Macropsis slabberi*, fr.; *Calanus finmarchicus*, fr.; *Temora longicornis*, r.; *Sagitta*, f.

II. St Andrews Bay.

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station I.		
14th Feb. 8.50 a.m. to 10.55 a.m.	Surface	Euphausidæ, f.; Infusoria, c.
	Bottom	Euphausidæ, f.; *Metopa*, sp. r.; *Atylus bispinosa*, r.; *Dulichia*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, r.; *Caligus*, fr.; *Sagitta*, fr.; *Tomopteris*, r.; small Medusæ, r.; larval Crustacea, f.; young Lamellibranchs, r.
21st Dec. 11.35 a.m. to 1.35 p.m.	Surface	*Parathemisto oblivia*, fr.; *Calanus finmarchicus*, f.; *Sagitta*, f.; Ctenophora, f.
	Bottom	The bottom tow-net damaged; contents gone.
Station II.		
13th Feb. 11.10 a.m. to 1 p.m.	Surface	*Parathemisto oblivia*, f.; *Calanus finmarchicus*, f.; Euphausidæ, r.; *Sagitta*, f.; larval Crustacea, r.
	Bottom	Euphausidæ (*Thysanoessa*), f.; *Macropsis slabberi*, r.; *Gastrosaccus spinifer*, f.; *Mysis*, sp. f.; *Pseudocuma*, f.; *Bathyporeia*, sp. r.; *Iphimedia*, sp. r.; *Calanus finmarchicus*, f.; *Temora longicornis*, f.; *Caligus*, f.; *Sagitta*, fr.; *Tomopteris*, r.; young Lamellibranchs, fr.; young Clupeoids, r.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—II. St Andrews Bay—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
1894. 19th Dec. 12.50 p.m. to 2.50 p.m.	Surface	*Parathemisto*, sp. f. ; *Hyperoche*, sp. r. ; *Calanus finmarchicus*, f. ; *Sagitta*, f. ; Ctenophora, f.
	Bottom	*Calanus finmarchicus*, f. ; *Caligus rapax*, f. ; Ctenophora, f. ; water obscured by mud held in suspension.
Station III.		
13th Feb. 8.40 a.m. to 9.30 a.m.	Surface	Some rubbish only.
	Bottom	Euphausidæ, f. ; *Mysis flexuosus*, r. ; *Mysis*, sp. f. ; *Gastrosaccus spinifer*, fr. ; *Pseudocuma*, fr. ; *Parathemisto*, sp. r. ; *Bathyporeia*, r. ; *Perioculoides*, r. ; *Atylus*, r. ; *Calanus finmarchicus*, f. ; *Temora longicornis*, r. ; *Monstrilla*, v. r. ; *Caligus*, v. r. ; *Sagitta*, fr. ; young Lamellibranchs, f.
19th Dec. 10.55 a.m. to 12.25 p.m.	Surface	*Parathemisto*, r. ; *Calanus finmarchicus*, f. ; *Sagitta*, fr. ; *Ctenophora*, f. ; very little in the net.
	Bottom	*Calanus finmarchicus*, f. ; *Caligus*, f. ; *Sagitta*, f. ; Ctenophora, f.
Station IV.		
13th Feb. 1.55 p.m. to 4.10 p.m.	Surface	*Parathemisto oblivia*, r. ; small quantity of rubbish.
	Bottom	Euphausidæ, f. ; *Parathemisto oblivia*, r. ; *Pseudocuma cercaria*, r. ; *Calanus finmarchicus*, f. ; *Sagitta*, fr. ; small Medusæ, r. ; young Pipefish, one ; young Herring, one.
19th Dec. 8.20 a.m. to 10.40 a.m.	Surface	*Parathemisto*, sp. f. ; *Hyperoche*, sp. f. ; *Calanus finmarchicus*, f. ; Ctenophora, ab.
	Bottom	*Calanus finmarchicus*, f. ; *Sagitta*, f. ; a quantity of mud in suspension in the water.
Station V.		
12th Feb. 2.40 p m. to 4.40 p.m.	Surface	*Gammarus*, sp. r. ; some floating rubbish.
	Bottom	A quantity of fine mud, but apparently no living thing, except Infusoria.
Station VI.		
14th Feb. 2.5 p.m. to 4.5 p.m.	Surface	*Parathemisto oblivia*, f. ; *Sagitta*, f. ; small Medusæ, f. ; fish eggs, f.
	Bottom	Euphausidæ, fr. ; *Mysis*, sp. f. ; *Atylus bispinosus*, c. ; *Calanus finmarchicus*, fr. ; *Caligus*, f. ; *Sagitta*, c. ; young Ophiuridæ, fr.
12th Dec. 1.35 p.m. to 3.40 p.m.	Surface	*Parathemisto*, f. ; *Hyperoche*, f. ; *Apherusa*, f. ; *Calanus finmarchicus*, c. ; *Sagitta*, c. ; Ctenophora, f. ; young Crustacea, r.
	Bottom	*Calanus finmarchicus*, f. ; *Sagitta*, fr. ; some fine mud.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—III. Montrose Bay.

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station I.		
1894. 20th Dec. 12 noon to 1.55 p.m.	Surface	*Parathemisto*, sp. f.; *Calanus finmarchicus*, r.; *Sagitta*, f.; Ctenophora, fr.
	Bottom	*Mysis*, sp. (juv), one specimen ; *Diastylus*, sp., one specimen ; *Metopa*, sp. f.; *Calanus finmarchicus*, r.; *Caligus rapax*, rare ; *Sagitta*, f.; *Tomopteris*, f.; Ctenophora, f.
Station II.		
20th Dec. 9.20 a.m. to 10.25 a.m.	Surface	*Apherusa*, sp. r. ; *Calanus finmarchicus*, f.; *Sagitta*, f.; Ctenophora, f.
	Bottom	*Metopa*, sp. r.; *Calanus finmarchicus*, f.; *Caligus rapax*, f.; *Sagitta*, f.; *Tomopteris*, f.; Ctenophora, f.

IV. Moray Firth.

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station I.		
3rd July. 1 hour.	Surface	Ova ; Pleurobrachiæ, large number ; Hydromedusæ (*Thaumantias*, &c.) ; Copepods ; larval fishes.
	Bottom	Young Hydromedusæ ; Copepods ; *pluteus* larva of Echinoid ; ova ; larval fishes.
Station II.		
3rd July. 2 hours.	Surface	Ova ; Hydromedusæ ; Pleurobrachiæ ; Copepods ; larval fish.
	Bottom	One egg ; one larval fish ; hermit crab.
Station III.		
7th July. 1 hour.	Surface	Pleurobrachiæ ; Sarsiæ ; *Caligus;* Copepods ; Appendiculariæ ; small Schizopod.
Station IV.		
4th July.	Surface	Hydromedusæ ; Copepods ; *Megalops* larvæ ; ova.
	Bottom	Hydromedusæ ; Copepods ; ova ; larval fishes.
Station V.		
4th July. 1½ hours.	Surface	Hydromedusæ ; Pleurobrachiæ ; Copepods ; *Megalops* larvæ ; ova.
	Bottom	Hydromedusæ ; *Megalops* larvæ ; young Molluscs (*Natica*).
Station VI.		
5th July. 2 hours.	Surface	Pleurobrachiæ ; Hydromedusæ ; Copepods ; ova.
	Bottom	Hydromedusæ ; *Cypris* stage of Cirripedes.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

B. PELAGIC FAUNA—IV. Moray Firth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station VII.		
1894. 5th July. 2 hours.	Surface	Young Hydromedusæ ; Pleurobrachiæ ; Copepods ; *Megalops* larvæ ; ova.
	Bottom	Hydromedusæ ; Copepoda.
Station VIII.		
9th July. 2 hours.	Surface	Net split.
	Bottom	Hydromedusæ ; *Sagittæ ;* Copepods ; Phyllopods ; *Cypris* stage of Cirripedes.
Station IX.		
9th July. 2 hours.	1st time. Surface	Pleurobrachiæ ; Hydromedusæ (*Thaumantias*, &c.); *Megalops* larvæ ; Copepods ; *Cypris* stage of Cirripedes.
	Bottom	Young Hydromedusæ ; larval Annelids.
	2nd time. Surface	Pleurobrachiæ ; small *Aurelia aurita ;* number of young Hydromedusæ ; *Zoëa* larvæ ; Branchiopoda ; larval fishes.
Station X.		
13th July. 2 hours.	Surface	Pleurobrachiæ ; young Hydromedusæ ; *Zoëa* and *Megalops* larvæ ; Copepods ; ova.
	Bottom	Young Hydromedusæ, Copepods ; *Cypris* stage of Cirripedes ; ova ; post-larval fishes.
Station XI.		
16th July. 2 hours.	Surface	Pleurobrachiæ ; *Zoëa* larvæ ; Copepods ; ova.
	Bottom	Schizopoda (a few) ; post-larval Ophiuroids ; Copepods ; *Cypris* stage of Cirripedes ; larval Annelids ; a few ova.
Station XII.		
16th July. 2 hours.	Surface	Pleurobrachiæ ; *Zoëa* and *Megalops* larvæ ; ova.
	Bottom	Post-larval Ophiuroids ; larval Annelid ; Copepods ; *Cypris* stage of Cirripedes ; young Molluscs ; one ovum.
Station XIII.		
17th July. 2 hours.	Surface	Pleurobrachiæ ; *Megalops* larvæ ; ova.
	Bottom	*Cypris* stage of Cirripedes ; *Zoëa* and *Megalops* larvæ ; Copepods ; Schizopods.
Station XIV.		
17th July.	Surface	Pleurobrachiæ ; Sarsiæ ; Copepods ; ova.
	Bottom	Hydromedusæ ; larval Annelids ; *Cypris* stage of Cirripedes ; *Zoëa* larvæ ; two ova.

TABLE C.—Record of Observations made on board the 'Garland' during 1894.

B. PELAGIC FAUNA—IV. Moray Firth—*continued.*

Station, Date, and Time Net down.	Net.	Organisms Captured.
Station XV.		
1894. 17th July. 2 hours.	Surface	Pleurobrachiæ; Hydromedusæ; young *Aurelia aurita;* Copepods.
	Bottom	Pleurobrachia; Hydromedusa; *Sagittæ;* post-larval Ophiuroids; larval Annelids; *Zoëa* larvæ; *Cypris* stage of Cirripedes; young Molluscs (*Fusus,* &c.); larval fishes.
Station XVI.		
17th July. 2 hours.	Surface	Pleurobrachiæ; Hydromedusæ; small Amphipod; post-larval fish.
	Bottom	Sarsiæ; post-larval Ophiuroids; larval Annelid; *Sagittæ; Cypris* stage of Cirripedes; *Caligus;* post-larval Molluscs (bi-valves); ova.
		V. Orkney Isles.
Station I.		
21st July. 2 hours.	Surface	Young Hydromedusæ (*Thaumantias,* &c.); Pleurobrachiæ; Copepods; *Zoëa* larvæ; Cladocera; ova.
	Bottom	Pleurobrachiæ; Hydromedusæ; Copepods; a few Amphipods; *Cypris* stage of Cirripedes; a few Schizopods; *Tomopteris;* larval Annelids; ova; larval fishes.
Station II.		
21st July. ½ hour.	Surface	Pleurobrachiæ; Hydromedusæ; *Caligus;* Isopod; ova.
	Bottom	Post-larval Ophiuroids; *Sagittæ;* Copepods; *Cypris* stage of Cirripedes.
Station III.		
27th July. 1½ hours.	Surface	*Zoëa* and *Megalops* larvæ; ova of fishes.
	Bottom	*Cypris* stage of Cirripedes; ova of fishes.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c., IN THE TRAWL NET—
I. Firth of Forth.

Station and Date.	Organisms Captured.
Station I.	
1894. 26th January.	*Pecten opercularis*, fr.; *Mytilus modiolus*, fr.; *Carcinus mænas*, r.; *Asteria rubens*, f.; *Echinus esculentus*, fr.
16th February.	*Pecten opercularis*, f.; *Asterias rubens*, f.; *Solaster endeca*, r.; *Echinus esculentus*, f.; *Alcyonium*, sp. f.
16th April.	*Pecten opercularis*, f.; *Mytilus modiolus*, f.; *Nephrops norvegicus*, r.; *Asterias*, sp. f.; *Ophiothrix*, f.; *Solaster papposa*, f.; *S. endeca*, f.; a small quantity of weed.
24th August.	*Pecten opercularis*, fr.; *Fusus antiquus*, f.; *Buccinum undatum*, f.; *Nephrops norvegicus*, f.; *Eupagurus*, sp. fr.; *Asterias rubens*, ab.; *Solaster papposa*, f.; *Echinus esculentus*, f.; *Alcyonium*, f.
11th September.	*Pecten opercularis*, fr.; *Mytilus modiolus*, f.; *Nephrops*, fr.; *Asterias rubens*, f.; *Echinus esculentus*, f.; *Alcyonium*, f.
4th December.	*Pecten opercularis*, c.; Ascidians, f.; *Eupagurus*, f.; *Nephrops norvegicus*, f.; *Pandalus annulicornis*, r.; *Stenorrhynchus*, r.; *Asterias rubens*, fr.; *Alcyonium*, f.; Sea Anemones, f.; Zoophytes, f.
Station II.	
26th January.	*Asterias rubens*, f.; *Solaster papposa*, fr.; *Alcyonium*, f.
16th February.	*Buccinum undatum*, r.; *Pecten opercularis*, f.; *Asterias rubens*, fr.; *Solaster papposa*, fr.; *Ophiothrix rosula*, f.; *Echinus esculentus*, f.; *Cerebratulus angulatus*, one; Actinoloba, fr.; fragments of sponge.
20th April.	*Fusus antiquus*, r.; *Asterias*, f.; *Solaster endeca*, f.; *S. papposa*, f.; *Ophiothrix*, fr.; *Ophiura albida*, f.; *Echinus esculentus*, r.; Spongidæ, f.; *Alcyonium*, fr.; Ascidians, f.; dead *Cyprina* and other shells, c.
30th August.	*Eupagurus bernhardus*, f.; *Asterias rubens*, fr.; *Solaster papposa*, f.; *Solaster endeca*, r.; *Echinus esculentus*, r.; *Alcyonium digitatum*, fr.; Anemones, f.; dead shells, fr.
11th September.	*Pecten opercularis*, f.; Ascidians, f.; Cephalopods, f.; *Portunus holsatus*, f.; *Nephrops*, f.; *Eupagurus*, f.; *Asterias rubens*, f.; *Alcyonium*, f.; some sea-weed.
6th December.	*Pecten opercularis*, r.; *Buccinum undatum*, r.; Ascidians, f.; *Eupagurus*, f.; *Nephrops norvegicus*, r.; *Pandalus annulicornis*, f.; *Asterias rubens*, f.; *Solaster papposa*, r.; *S. endeca*, r.; *Ophiothrix*, f.; *Echinus esculentus*, r.; *Actinoloba dianthus*, f.; *Alcyonium*, r.
26th December.	*Pecten opercularis*, f.; *Mytilus modiolus*, r.; *Fusus antiquus*, r.; *Cancer pagurus*, f.; *Eupagurus bernhardus*, f.; *Porcellana longicornis*, fr.; *Asterias rubens*, c.; *Astropecten irregularis*, r.; *Ophiothrix rosula*, fr.; *Solaster papposa*, fr.; *Solaster endeca*, f.; *Cribella occulata*, f.; *Alcyonium*, f.; *Actinoloba dianthus*, f.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1894.

C. INVERTEBRATE FAUNA, &c.—I. FIRTH OF FORTH—*continued.*

Station and Date.	ORGANISMS CAPTURED.
Station III.	
1894. 20th February.	*Pecten opercularis*, fr.; *Mytilus modiolus*, f.; *Carcinus mænas*, r.; *Nephrops norvegica*, f.; *Asterias*, f.; *Solaster papposa*, f.; *S. endeca*, f.; *Echinus esculentus*, f.; a lump of peat in which *Pholas crispata* had several burrows.
16th April.	*Pecten opercularis*, f.; *Asterias*, fr.; *Solaster papposa*, f.; *Actinoloba*, f.; *Alcyonium*, f.
21st June.	*Pecten opercularis*, c.; *Mytilus modiolus*, r.; *Nephrops norvegicus*, r.; *Ophiothrix*, f.; *Asterias rubens*, f.; *Solaster papposa*, f.; *Echinus esculentus*, r.
24th August.	*Pecten opercularis*, fr.; *Buccinum undatum*, r.; *Nephrops norvegicus*, fr.; *Portunus holsatus*, r.; *Eupagurus*, sp. r.; *Asterias rubens*, fr.; *Solaster papposa*, f.; *Echinus esculentus*, f.; *Aphrodita aculeata*, r.; *Actinoloba dianthus*, fr.; *Alcyonium*, f.; large Medusa, r.
10th December.	*Pecten opercularis*, c.; *Mytilus modiolus*, r.; *Triton hombergi*, r.; *Cancer pagurus*, r.; *Eupagurus*, r.; *Nephrops norvegicus*, r.; *Asterias rubens*, c.; *Ophiothrix rosula*, f.; *Actinoloba dianthus*, fr.; *Alcyonium*, f.
27th December.	*Pecten opercularis*, ab.; *Mytilis modiolus*, f.; *Doris johnstoni*, r.; *Cancer pagurus*, r.; *Portunus depurator*, f.; *Nephrops norvegicus*, f.; *Asterias rubens*, fr.; *Ophiothrix rosula*, f.; *Solaster papposa*, r.; *Echinus esculentus*, fr.; *Alcyonium*, f.; Spongida, f.
Station IV.	
17th January.	*Pecten opercularis*, f.; *Buccinum undatum*, s.; a considerable quantity of weed.
15th February.	*Pecten opercularis*, f.; *Fusus antiquus*, r.; *Buccinum undatum*, c.; *Hyas araneus*, f.; *Solaster papposa*, f.; *Chalina*, f.; a considerable quantity of weed.
13th April.	*Pecten opercularis*, fr.; *Portunus holsatus*, fr.; weed and zoophytes, f.
21st June.	*Pecten opercularis*, c.; *Hyas coarctatus*, r.; *Portunus holsatus*, sp f.; *Porcellana longicornis*, f.; *Nephrops norvegicus*, r.; brittle starfish (*Ophiothrix*), f.; sponges, f.; young cuttlefish, f.; sea-weed, fr.
23rd November.	*Pecten opercularis*, c.; *Mytilis modiolus*, f.; Ascidians, f.; *Tritonia*, r.; *Portunus holsatus* and *depurator*, fr.; some weed.
Station V.	
22nd February.	*Fusus antiquus*, r.; *Nephrops norvegicus*, fr.; *Actinoloba*, f.
19th April.	*Eupagurus bernhardus*, r.; *Nephrops norvegicus*, f.; *Aphrodite*, r.; *Asterias*, f.; *Actinoloba*, f.; *Alcyonium*, f.
20th June.	*Fusus antiquus*, r.; *Nephrops norvegicus*, r.; *Solaster endeca*, r.; *Actinoloba dianthus*, r.; large Medusæ, fr.
30th August.	*Fusus antiquus*, r.; *Nephrops norvegicus*, c.; *Asterias*, f.; *Solaster papposa*, f.; *Aphrodite*, sp. r.; *Alcyonium*, f.; *Aurelius auritus*, r.; *Cyanea*, r.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—I. Firth of Forth—*continued.*

Station and Date.	Organisms Captured.
1894. 13th September.	Ascidians, f.; *Cancer pagurus*, r.; *Hyas coarctatus*, f.; *Portunus*, sp. (chiefly *holsatus*), fr.; *Eupagurus bernhardus*, fr.; *Asterias rubens*, fr.; *Spatangus purpureus*, several; *Alcyonium*, fr.; *Nephrops norvegicus*, f.
30th November.	*Buccinium undatum*, f.; *Nephrops norvegicus*, fr.; *Alcyonium*, fr.; sea-weed, small quantity; *Triton hombergi*, f.
Station VI.	
22nd February.	*Nephrops norvegicus*, f.; *Asterias rubens*, f.; *Actinoloba*, f.
19th April.	*Asterias*, f.; *Astropecten*, r.; *Alcyonium*, r.
20th June.	*Asterias rubens*, f.; *Solaster endeca*, f.; *Echinus esculentus*, fr.; *Spatangus purpureus*, c.; *Alcyonium*, f.
30th August.	*Asterias rubens*, f.; *Solaster endeca*, f.; *Astropecten irregularis*, r.; *Spatangus purpureus*, fr.; *Alcyonium*, f.; large Medusæ, f.; *Loligo*, r.
13th September.	*Echinus esculentus*, r.; *Alcyonium digitatum*, f.; *Nephrops norvegicus*, f.; *Asterias rubens*, f.
30th November.	*Solen*, sp. r.; *Buccinum undatum*, r.; *Eupagurus*, f.; Ascidians, f.; *Echinus esculentus*, r.; *Actinoloba dianthus*, f.; some sea-weed.
Station VII.	
18th January.	*Asterias rubens*, f.
23rd February.	*Asterias*, f.; *Solaster endeca*, fr.; *Nephrops norvegicus*, f.; *Alcyonium*, f.; *Actinoloba*, f.
13th April.	*Pecten opercularis*, r.; *Alcyonium*, f.; weed, f.
20th June.	*Asterias rubens*, fr.; *Luidia sarsi*, r.; *Solaster endeca*, c.; *Alcyonium*, fr.
13th September.	Ascidians, f.; *Cancer pagurus*, r.; *Hyas araneus*, f.; *Portunus*, sp. (mostly *holsatus*), several; *Asterias rubens*, fr.; *Spatangus purpureus*, f.; *Alcyonium*, fr.
30th November.	*Cardium*, sp. r.; *Cancer pagurus*, sp. f.; *Nephrops norvegicus*, f.; *Asterias rubens*, f.; *Actinoloba dianthus*, f.; *Alcyonium*, f.; some weed.
Station VIII.	
18th January.	*Nephrops norvegicus*, r.; *Echinus esculentus*, fr.; *Alcyonium*, f.
21st February.	*Fusus antiquus*, one; *Solaster papposa*, f.; *S. endeca*, f.; *Asterias rubens*, f.; *Actinoloba*, r.
18th April.	*Fusus antiquus*, r.; *Nephrops norvegicus*, f.; *Solaster endeca*, f.; *Alcyonium*, f.
19th June.	*Nephrops norvegicus*, r.; *Echinus esculentus*, fr.; *Actinoloba dianthus*, fr.; *Alcyonium*, f.
29th August.	*Fusus antiquus*, r.; *Solaster endeca*, r.; *Astropecten irregularis*, r.; *Echinus esculentus*, c.; *Nephrops norvegicus*, f.; *Alcyonium*, f.; *Aurelia aurita*, f.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—I. Firth of Forth—*continued.*

Station and Date.	Organisms Captured.
1894. 12th September.	*Nephrops norvegicus*, f.; *Eupagurus bernhardus*, r.; *Asterias rubens*, f.; *Alcyonium digitatum*, f.
28th November.	*Pecten opercularis*, f.; *Mytilus modiolus*, r.; *Eupagurus*, f.; *Nephrops norvegicus*, fr.; *Asterias rubens*, fr.; *Echinus esculentus*, r.; *Actinoloba dianthus*, f.
Station IX.	
19th January.	*Nephrops norvegicus*, fr.
21st February.	*Cancer pagurus*, r.; *Nephrops norvegicus*, fr.; *Asterias*, f.
18th April.	*Fusus antiquus*, r.; *Lithodes maia*, r.; *Nephrops norvegicus*, fr.; *Asterias*, f.
19th June.	*Nephrops norvegicus*, f.; *Asterias rubens*, f.; *Actinoloba dianthus*, r.
29th August.	*Nephrops norvegicus*, c.; *Actinoloba*, r.; *Aurelia aurita*, f.; *Cyanea*, fr.
12th September.	*Buccinum undatum*, r.; *Nephrops norvegicus*, c.; Ascidians, f.; *Asterias rubens*, fr.; *Eupagurus bernhardus*, r.
28th November.	*Eupagurus bernhardus*, f.; *Nephrops norvegicus*, fr.; *Asterias rubens*, f.
Station X.	
25th January.	*Hyas araneus*, f.; *Eupagurus bernhardus*, f.; a large quantity of hardened mud consisting of lumps of agglutinated mud-tubes of annelids.
17th February.	*Hyas araneus*, fr.; *Carcinus mænas*, r.; *Eupagurus bernhardus*, r.; a large quantity of mud.
31st August.	*Cancer pagurus*, f.; *Hyas coarctatus*, f.; *Portunus holsatus*, f.; *Eupagurus bernhardus*, f.; *Asterias rubens*, f.; Sea Anemones, f.; a large quantity of mud.
15th September.	*Hyas araneus*; *Cancer pagurus*; *Portunus*; *Eupagurus bernhardus*; *Pandalus annulicornis*; *Asterias rubens*; Sea Anemone; a quantity of mud.
8th December.	*Hyas araneus*, f.; *Cancer pagurus*, r.; *Carcinus mænas*, r.; *Eupagurus bernhardus*, f.; *Portunus holsatus*, f.; *Crangon vulgaris*, f.; *Asterias rubens*, f.; *Echinus miliaris*, r.; Anemone, sp. r.; a quantity of mud.

II. St Andrews Bay.

Station and Date.	Organisms Captured.
Station I.	
14th February.	*Buccinum undatum*, r.; *Asterias*, r.; some 'rubbish.'
21st December.	*Buccinum undatum*, v. r.; *Hyas coarctatus*, v. r.; *Portunus holsatus*, f.; *Asterias rubens*, c.; *Solaster endeca*, v. r.; Zoophytes, f.; a small quantity of weed.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—II. St Andrews Bay—*continued.*

Station and Date.	Organisms Captured.
Station II.	
1894. 13th February.	*Cancer pagurus*, r.; *Asterias rubens*, f.
19th December.	Ascidians, f.; *Asterias rubens*, fr.; *Solaster endeca*, r.; some weed.
Station III.	
13th February.	*Mytilus modiolus*, r.; Ascidians, r.; *Cancer pagurus*, r.; *Asterias*, f.
19th December.	*Corystes cassivelaunes*, one specimen; *Asterias rubens*, f.; large Medusæ, f.; a small quantity of weed.
Station IV.	
13th February.	*Cancer pagurus*, one; *Asterias rubens*, f.
19th December.	*Asterias rubens*, f.; a quantity of weed; very little refuse in trawl-net.
Station V.	
12th February.	*Buccinum undatum*, r.; Ascidians, r.; *Alcyonium*, r.
17th December.	*Pecten opercularis*, r.; *Buccinum undatum*, r.; *Portunus depurator*, f.; *Eupagurus bernhardus*, r.; *Asterias rubens*, fr.; *Solaster endeca*, r.; *Luidia sarsii*, r.
Station VI.	
14th February.	*Buccinum undatum*, r.; *Fusus antiquus*, r.; *Eupagurus bernhardus*, r.; *Asterias* fr.; *Solaster papposa*, r.; *S. endeca*, r.; *Echinus esculentus*, r.; *Alcyonium*, f.
12th December.	*Pecten opercularis*, r.; *Buccinum undatum*, r.; *Eupagurus bernhardus*, f.; *Nephrops norvegicus*, r.; *Asterias rubens*, c.; *Solaster papposa*, fr.; *Alcyonium*, f.

III. Montrose Bay.

Station and Date.	Organisms Captured.
Station I.	
21st September.	*Portunus; Eupagurus;* Ascidians; *Asterias; Aphrodita; Alcyonium.*
20th December.	*Fusus antiquus*, one specimen; *Cancer pagurus*, r.; *Portunus holsatus*, f.; *Eupagurus bernhardus*, r.; *Asterias rubens*, f.; *Ophiura albida*, r.; *Alcyonium*, fr.; *Actinoloba dianthus*, f.
Station II.	
21st September.	*Portunus; Asterias; Alcyonium digitatum.*
20th December.	Ascidians, f.; *Portunus depurator*, f.; *Asterias rubens*, f.; *Ophiura albida*, f.; Zoophytes, r.; a small quantity of weed.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—IV. Aberdeen Bay.

Station and Date.	Organisms Captured.
Station I. 1894. 25th September.	*Portunus; Eupagurus; Asterias rubens; Alcyonium digitatum;* some sea-weed.
Station IV.	
27th September.	*Portunus; Eupagurus; Asterias rubens.*
Station VI.	
27th September.	*Portunus; Hyas; Asterias rubens; Echinus esculentus;* Sea Anemone; *Alcyonium digitatum.*
Station VII.	
26th September.	*Portunus; Hyas; Eupagurus; Asterias rubens; Echinus esculentus; Alcyonium digitatum;* a quantity of sea-weed.
	V. Moray Firth.
Station I.	
7th July.	*Asterias rubens; Flustra.*
5th October.	*Asterias rubens,* f.; sea-weed, f.
Station II.	
3rd July.	Actinidæ; *Alcyonium digitatum; Solaster; Asterias rubens; Astropecten;* Ophiuroids; Annelids (*Nereis*); *Echinus esculentus;* Hermit crabs; *Galathea* crabs; Nudibranch; *Pholas* (in a piece of wood); *Flustra;* Ascidians.
4th October.	*Asterias rubens; Aphrodita; Alcyonium;* sea-weed.
Station III.	
7th July.	*Chalina; Asterias rubens; Ophiocoma rosula; Echinus esculentus; Echinus strongilocentrotus; Cucumaria; Modiolus modiola;* young Cephalopods (Decapods); *Chiton cinereus;* Annelids; *Ascidia intestinalis.*
6th October.	Ascidians; Holothurians; sea-weeds; *Pecten opercularis; Eupagurus; Pandalus; Asterias; Echinus.*
Station IV.	
4th July.	*Halichondria; Asterias rubens; Astropecten; Solaster;* Ophiuroids; Annelids (*Nereis*); egg capsules of *Buccinum;* Ascidians.
22nd October.	*Asterias;* sea-weed.
Station V.	
4th July.	*Halichondria; Alcyonium digitatum; Asterias rubens; Solaster; Astropecten;* Ophiuroids; *Echinus esculentus;* skeleton of *Spatangus;* Hermit crabs; *Buccinum; Flustra; Membranipora* (on *Fucus*); Ascidians.
22nd October.	*Buccinum undatum; Eupagurus; Asterias rubens;* some sea-weed.

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—V. Moray Firth—*continued.*

Station and Date.	Organisms Captured.
Station VI. 1894. **5th July.**	*Halichondria ; Aurelia aurita ; Alcyonium digitatum ; Asterias rubens ; Solaster ;* Ophiuroids ; *Echinus esculentus ;* Hermit crabs ; *Balanus ;* egg capsules of *Buccinum ;* Ascidiæ.
22nd October.	Ascidians ; *Eupagurus ; Asterias rubens ;* sponge ; some weed.
Station VII.	
5th July.	*Aurelia aurita ;* Actinidæ ; *Alcyonium digitatum ; Asterias rubens ;* Ophiuroid ; *Echinus esculentus ;* Stone crab (small) ; *Galathea* crab ; Hermit crabs ; egg capsules of *Buccinum.*
9th October.	*Eupagurus ; Asterias rubens.*
Station VIII.	
9th July.	*Aurelia aurita ; Actiniæ ; Asterias rubens ; Alcyonium digitatum ; Cucumaria ;* skeleton of *Spatangus ; Nephrops norvegicus ;* Hermit crabs ; *Gathathea* crabs ; Annelids ; Amphipods ; Ascidians.
23rd October.	Ascidians ; *Nephrops norvegicus ; Eupagurus ; Asterias rubens ;* Sea Anemones ; Holothurians (*Alcyonium*).
Station IX.	
9th July.	*Aurelia aurita ; Actiniæ ; Alcyonium digitatum ; Asterias rubens ; Astropecten ; Goniaster ; Cucumaria ;* Annelids ; Tubes of *Sabellaria ; Nephrops norvegicus ; Galathea* crabs ; Hermit crabs ; *Pecten opercularis ;* egg capsules of *Baccinum.*
23rd October.	*Cardium ; Ascidians ; Asterias rubens ; Echinus ; Fillograna ;* Anemones ; *Alcyonium ;* dead shells ; sea-weed.
Station X.	
13th July.	*Aurelia aurita ; Cyanea ; Alcyonium digitatum ; Asterias rubens ; Uraster ; Astropecten ; Ophiura ;* small Stone crab ; *Cyprina ; Solen siliqua ; Flustra ; Alcyonidium.*
5th October.	*Pecten opercularis,* f. ; *Eupagurus ; Asterias rubens ; Alcyonium ;* some sea-weed.
Station XI.	
16th July.	*Aurelia aurita; Alcyonium digitatum; Asterias rubens ; Astropecten ; Sertularia ; Ophiocoma rosula ; Echinus esculentus ;* skeleton of *Spatangus purpureus ; Cucumaria ; Mytilus modiolus ; Buccinum undatum ; Fusus antiquus ;* shell of *Solen ensis ;* egg capsules of *Buccinum ; Galathea* crabs ; *Ascidia aspersa.*
Shrimp Trawl. ½ hour.	*Asterias rubens ; Galathea* crab ; Hermit crab ; *Aporrhais pes-pelicani ; Trochus ziziphinus ; Pecten opercularis ; Natica alderi.*
11th October.	*Pecten opercularis ; Buccinum ; Asterias rubens ; Echinus ;* Holothurians ; *Alcyonium.*
Station XII.	
16th July.	*Aurelia aurita ; Alcyonium digitatum ; Sertularia ; Asterias rubens ; Astropecten ; Ophiocoma rosula ; Echinus esculentus ;* skeleton of *Spatangus purpureus ; Cucumaria ; Mytilus modiolus ; Buccinum undatum ; Fusus antiquus ;* shell of *Solen ensis ;* egg capsules of *Buccinum ; Galathea* crabs ; *Ascidia aspersa.*
11th October.	*Eupagurus ; Asterias ; Spatangus ;* Holothurians ; *Echinus ; Alcyonium.*

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

C. INVERTEBRATE FAUNA, &c.—V. Moray Firth—*continued.*

Station and Date.	Organisms Captured.
Station XIII. 1894. 17th July.	*Tubularia indivisa; Alcyonium digitatum; Asterias rubens; Astropecten; Luidia savigni; Echinus esculentus; Spatangus purpureus; Cucumaria; Buccinum undatum;* egg capsules of *Buccinum; Mytilus modiolus; Solen ensis; Psammobia Ferroensis; Ascidia aspersa; Flustra; Alcyonidium.*
Shrimp Trawl. ½ hour.	*Aurelia aurita; Cucumaria;* Hermit crabs; *Astropecten; Pectunculus glycineris; Trochus zizyphinus.*
11th October.	*Eupagurus; Pecten opercularis;* Ascidians; *Hyas; Asterias;* Holothurians; some sea-weed.
Station XIV.	
17th July	*Thuiara; Halichondria; Aurelia aurita; Asterias rubens; Astropecten; Solaster papposa; Solaster endeca; Goniaster equestris; Uraster; Ophiura; Echinus esculentus; Spatangus purpureus;* Nemerteans; *Galathea* crabs; Hermit crabs; *Stenorrhynchus; Dentalium, Ascidia aspersa; Ascidia intestinalis; Flustra; Alcyonidium; Dentalium entalis; Mangelia turriculata; Cylichna cylindracea; Psammobia Ferroensis; Phyllophorus drummondi.*
11th October.	Ascidians; *Hyas; Eupagurus; Asterias rubens; Ophiura albida; Ophiothrix rosula;* sponge; large quantity of sea-weed.
Station XV.	
17th July.	*Alcyonium digitatum;* portion of a *Pennatula; Halichondria; Asterias rubens; Uraster; Goniaster equestris; Luidia sarsii; Ophiura; Echinus esculentus; Spatangus purpureus; Cucumaria;* Hermit crabs; *Mytilus modiolus; Pecten opercularis; Cyprina islandica;* egg capsules of *Buccinum; Ascidia intestinalis.*
12th October.	*Pecten opercularis;* Ascidians; *Eupagurus; Asterias; Echinus; Nephrops; Fillograna;* Sea Anemones; *Pennatula;* sea-weed.
Station XVI.	
17th July.	Holothuriæ; *Uraster; Asterias rubens; Echinus esculentus; Spatangus purpureus;* Hermit crabs; shell of *Cyprina islandica; Flustra.*
Shrimp Trawl. ½ hour.	*Halichondria; Thuiaria; Sertularia; Asterias rubens; Goniaster; Luidia sarsii; Echinus esculentus; Stennorhynchus.*
12th October.	*Pecten opercularis; Eupagurus; Nephrops norvegicus; Asterias; Fillograna implexa;* Ascidians; Sea Anemones, f.; sea-weed.

VI. Orkney Isles.

Station I.	
21st July.	*Asterias rubens; Solaster endeca; Uraster; Astropecten; Echinus esculentus; Cucumaria nigra;* Hermit crabs; small Stone crab; *Galathea* crabs; large number of *Pecten opercularis;* shells of *Turritella; Ascidia intestinalis.*
Station II.	
21st July.	*Sertularia; Obelia; Asterias rubens; Echinus esculentus; Spatangus purpureus; Pecten opercularis;* shells of *Turritella; Ascidia aspersa;* Laminaria, with *Membranipora* upon it.

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1894.

C. INVERTEBRATE FAUNA, &c.—VI. ORKNEY ISLES—*continued.*

Station and Date.	ORGANISMS CAPTURED.
Station III.	
1894. 27th July.	*Echinus esculentus; Luidia savigni; Asterias rubens; Solaster papposa;* small Sea-urchins; Swimming crabs; small Stone crab; *Cancer edulis;* Annelids; shell of *Solen ensis; Cyprina islandica;* young Decapod (*Rossia*); *Ascidia aspersa; Ascidia intestinalis;* compound Ascidians; *Flustra; Alcyonidium.*
Station IV.	
24th July. 2 hours. 1st haul 1 hour.	*Aurelia aurita; Asterias rubens; Luidia savigni; Ophiura; Echinus esculentus;* Stone crab; Swimming crabs; Swimming crab, with parasitic *Sacculina*; shells of *Buccinum;* compound Ascidians, *Flustra.*
2nd haul. 1 hour.	*Aurelia aurita; Asterias rubens; Alcyonium digitatum; Solaster papposa; Echinus esculentus; Cucumaria; Spirorbis;* Swimming crabs; Swimming crab, ♂, with a *Serpula* and *Sacculina* parasitic on it; young Decapods (*Rossia*).

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—I. Firth of Forth.

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency, Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
Station I.												
1894. Jan. 26.												
2.5 p.m.	E.	2·5	4·9	4·9	14	W.	6	Hazy.	Choppy.	2 h. fl.	29·44	2½
4 p.m.	W.	3·0	5·0	5·0	16	W. by S.	..	,,	Moderate.	4 ,,	29·45	1
Feb. 16.												
2.25 p.m.	W.	4·7	4·4	4·9	10	E.S.E.	1	Strong haze, rain.	Slight.	3½ h. ebb.	29·94	2
4.20 p.m.	E.	4·5	4·4	4·7	13½	E.S.E.	4	,,	S.E. swell.	5½ ,,	29·94	3
Mar. 20.												
2.40 p.m.	W.	7·9	5·0	4·8	12	W.	1	Hazy.	Smooth.	¾ ,,	30·20	2½
4.30 p.m.	E.	7·0	5·0	4·9	15¼	Calm.	..	,,	,,	2½ ,,	30·20	2
April 16.												
11 a.m.	E.	8·5	6·6	6·0	15	E.	5	,,	Moderate.	5 h. fl.	29·50	3¼
12.45 p.m.	W.	8·8	6·9	6·4	17	E.	5	Cloudy.	Choppy.	¾ h. ebb.	29·48	1¾
June 22.												
10.35 a.m.	E.	12·5	11·1	7·8	13½	S.S.W.	3	Slight haze.	Slight.	5¾ ,,	29·91	4
12.30 p.m.	W.	15·0	9·9	8·5	9½	S.W.	4	Cloudy.	,,	1¼ h. fl.	29·88	3½
Aug. 24.												
1.30 p.m.	E.	15·1	12·9	11·2	14	E.	1	Clear.	E. swell.	½ ,,	30·16	3
3.30 p.m.	W.	15·7	12·7	11·9	9½	E.	3	,,	Slight.	2½ ,,	30·17	2
Sept. 11.												
1.7 p.m.	W.	13·5	12·3	11·8	14½	W. by N.	6	Cloudy.	Moderate.	½ h. ebb.	30·11	2½
3.3 p.m.	E.	16·2	12·3	11·9	16	W. by N.	4	,,	,,	2¼ ,,	30·14	2
Dec. 4.												
12.30 p.m.	W.	5·0	7·8	8·0	14	Calm.	..	Fog.	Smooth.	5¼ ,,	29·82	2¼
2.10 p.m.	E.	5·8	8·4	8·7	20	N.E.	2	,,	Slight.	1 h. fl.	29·81	3
Station II.												
Jan. 26.												
11 a.m.	W.	1·7	4·6	4·7	12¾	W.S.W.	5	Hazy.	Moderate.	5 h. ebb.	29·45	1½
12.40 p.m.	E.	2·3	4·6	4·3	10	W. by S.	6	,,	Choppy.	¾ h. fl.	29·45	1¾
Feb. 16.												
11.10 a.m.	W.	4·3	3·9	4·8	14	E.S.E.	1	Strong haze, rain.	Slight.	¼ h. ebb.	29·94	2
12.55 p.m.	E.	4·3	4·6	4·7	10	E.S.E.	4	,,	,,	2 ,,	29·95	3½
Mar. 21.												
11.30 a.m.	E.	10·7	5·2	5·0	13	S.W.	1	Hazy.	Smooth.	3 h. fl.	30·20	3¼
1.10 p.m.	W.	11·8	5·1	4·7	6½	W.	2	,,	Slight.	4¾ ,,	..	2½
April 20.												
12.55 p.m.	E.	7·7	7·3	6·3	14¼	E.S.E.	4	,,	,,	4½ ,,	30·08	4½
2.20 p.m.	W.	11·9	7·4	6·2	14	E.S.E.	3	,,	,,	near h. w.	30·08	4
June 22.												
7.50 a.m.	W.	12·8	11·2	8·0	13½	Variable	Light	,,	Smooth.	3 h. ebb.	29·96	3
9.35 a.m.	E.	13·5	11·2	8·4	13	S.S.W.	2	,,	,,	4¾ ,,	29·92	not stated
Aug. 30.												
1.10 p.m.	E.	14·3	12·2	11·0	15	W.	5	Slight haze.	Moderate.	5 h. fl.	30·10	3
2.45 p.m.	W.	14·0	12·1	11·4	15	W.	5	,,	,,	¾ h. ebb.	30·10	3
Sept. 11.												
10 a.m.	W.	14·0	12·1	11·7	14	W.	6	Cloudy.	Choppy.	4 h. fl.	30·13	3
11.40 p.m.	E.	16·0	12·2	11·8	13	W.	7	,,	,,	5½ ,,	30·12	3

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—I. Firth of Forth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
1894. Dec. 6.												
11.15 a.m.	W.	6·0	7·8	8·0	14	W.	3	Fog.	Sl.E.swell.	2½ h. ebb.	29·85	3
12.55 p.m.	E.	6·8	7·8	8·3	15½	W.	3	Slight fog.	,,	4¼ ,,	29·85	3
Dec. 26.												
12 noon.	E.	8·2	7·8	7·7	13¼	N.W.	5	Cloudy.	Moderate.	4 h. fl.	30·32	3
1.55 p.m.	W.	7·9	7·6	7·5	14¾	N.W.	3	,,	Slight.	near h.w.	30·34	3
Station III.												
Feb. 20.												
11.30 a.m.	E.	5·4	4·0	4·1	8	W.by N.	3	Hazy.	,,	2¾ h. fl.	30·36	1½
2.35 p.m.	W.	5·0	4·5	4·5	9½	W.by N.	2	,, rain.	,,	5¾ ,,	30·33	1½
Mar. 20.												
11.15 a.m.	E.	7·7	5·3	4·9	8½	W.	1	,,	Smooth.	3¼ ,,	30·22	2½
2.10 p.m.	W.	7·5	4·5	4·7	14½	W.	1	,,	,,	near h.w.	30·21	2
April 16.												
1.20 p.m.	W.	8·0	8·0	6·5	13	E.	6	Cloudy.	Choppy.	1¼ h. ebb.	29·45	2¾
4.10 p.m.	E.	6·7	6·7	6·3	14½	E.	6	Haze.	E. swell.	4 ,,	29·44	2
June 21.												
8.10 a.m.	W.	11·4	10·4	9·0	6½	W.	1	Slightly hazy	Smooth.	4 h. ebb.	30·06	2
10.45 a.m.	E.	14·9	10·0	9·0	10	Calm.	..	Hazy.	,,	¼ h. fl.	30·08	2¾
Aug. 24.												
10.25 a.m.	W.	13·8	12·4	11·7	11	E.	Light	Slight haze.	,,	3½ h. ebb.	30·15	2½
12.50 p.m.	E.	15·4	12·8	11·1	12	E.	1	Clear above, cloudy round horizon.	E. swell.	about l. w.	30·16	2½
Sept. 19.												
10.30 a.m.	W.	12·4	12·3	12·1	6	E.	2	Cloudy.	Slight.	5¾ h. ebb.	30·20	1½
12.45 p.m.	E.	12·8	12·3	12·0	10¾	E.	2	Overcast.	,,	1¾ h. fl.	30·20	3
Dec. 10.												
11.55 a.m.	W.	11·2	8·0	8·4	8½	W.S.W.	1	Hazy.	Slight S.E. swell.	5¾ h. fl.	29·80	2
2.30 p.m.	E.	9·9	8·0	8·4	17	SWbyW.	5	,,	Choppy.	2¼ h. ebb.	29·79	3
Dec. 27.												
11.30 a.m.	E.	7·4	6·8	7·0	7½	NWbyN.	4	Cloudy.	Slight.	2¾ h. fl.	30·51	2
2.30 p.m.	W.	7·6	7·6	7·5	12	N.W.	4	,,	,,	5¾ ,,	30·55	3
Station IV.												
Jan. 17.												
11.15 a.m.	W.	6·7	4·4	4·4	6	S.W.	3	Hazy.	Slight.	1½ h. ebb.	29·27	1¾
2.15 p.m.	E.	6·7	4·5	3·4	5	S.W.	5	Overcast.	,,	4½ ,,	29·25	2
Feb. 15.												
7.40 a.m.	E.	1·7	3·4	4·8	6	Calm.	..	Haze.	Smooth.	4½ h. .	30·05	1½
10.40 a.m.	W.	1·0	3·6	4·5	5½	S.E.	Light	,, snow.	,,	1¼ h. ebb.	30·05	1
Mar. 21.												
2.40 p.m.	W.	12·5	5·5	5·1	6½	W.	3	,,	Slight.	h. w.	30·16	2½
5.40 p.m.	E.	7·8	4·5	5·0	6½	W.N.W.	1	,,	Smooth.	3 h. ebb.	30·18	2
April 13.												
10.40 a.m.	W.	6·6	7·0	6·8	4	S.E.byE.	5	Dull.	Moderate.	1¾ ,,	29·89	¾
1.40 p.m.	E.	7·7	6·7	4·7	5¼	S.E.byE.	..	,,	,,	5¾ ,,	29·86	1¼
June 21.												
11.35 a.m.	E.	15·7	11·2	9·7	8	W.N.W.	Light	Hazy.	Smooth.	1 h. fl.	30·07	2½
2.35 p.m.	W.	13·2	11·6	10·3	6	W.	1	Cloudy.	Slight.	4 ,,	30·04	2
Aug. 23.												
2.10 p.m.	E.	14·5	13·3	12·2	7½	E.	2	,,	,,	1¾ ,,	29·98	2
5 p.m.	W.	14·4	13·4	12·6	5¼	E.	4	,,	,,	4¾ ,,	29·98	2

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—I. Firth of Forth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
1894. Sept. 19.												
1.25 p.m.	E.	12·5	12·5	12·3	6½	E.S.E.	2	Overcast.	Slight.	2½ h.fl.	30·20	2
3.55 p.m.	W.	13·2	12·6	12·4	6	E.S.E.	2	,,	,,	5 ,,	30·18	2
Nov. 23.												
2.30 p.m.	E.	7·8	8·2	7·8	7½	Calm.	..	Hazy.	Smooth.	3¼ h. ebb.	30·22	1¾
5.30 p.m.	W.	7·6	7·3	7·6	5¼	Light airs.	..	,,	,,	5½ ,,	30·22	2
Station V.												
Feb. 22.												
12.40 p.m.	E.	9·4	5·0	4·8	23½	W.S.W.	1	Haze.	Smooth.	2¾ h. fl.	30·19	3½
2.45 p.m.	W.	7·9	5·0	4·8	28½	W.S.W.	1	,,	,,	4¾ ,,	30·12	2¼
Mar. 30.												
9.30 a.m.	W.	8·4	5·5	5·0	29	Calm.	..	,,	,,	1¼ h. ebb.	29·88	3½
11.35 a.m.	E.	12·3	6·1	4·9	25	Calm.	..	,,	,,	3¼ ,,	29·86	2½
April 19.												
7.45 p.m.	E.	7·0	6·2	5·5	23	W.	Light	,,	,,	near l. w.	30·11	3¾
9.55 p.m.	W.	9·9	6·7	5·5	28½	W. by S.	Light	Cloudy.	S.E. swell.	2 h. fl.	30·11	4½
June 20.												
11.20 a.m.	E.	14·3	11·3	7·5	22	W.	Light	Overcast, fine	Smooth.	1½ h. fl.	29·88	4
1.25 p.m.	W.	13·0	10·0	7·2	30½	W.	Light	Cloudy, fine	,,	3½ ,,	29·90	5½
Aug. 30.												
8.15 a.m.	E.	12·6	12·3	10·8	23	W.	5	Slight haze.	Choppy.	¼ ,,	30·12	5
10.20 a.m.	W.	13·5	12·2	11·1	31½	W.	5	,,	,,	2¼ ,,	30·12	5
Sept. 13.												
7.15 a.m.	E.	11·2	12·2	11·4	22	W.	1	Cloudy.	Slight.	l. w.	30·38	3½
9.15 a.m.	W.	11·6	12·2	11·0	27½	W.	2	,,	,,	1¾ h. fl.	30·38	4½
Nov. 30.												
8.45 a.m.	E.	7·4	8·9	9·4	21½	N.W.	5	Slight haze.	Moderate.	4¾ h. ebb.	30·42	6
10.50 a.m.	W.	8·9	8·9	9·2	27	W.	4	Hazy.	,,	1¾ h. fl.	30·42	3
Station VI.												
Feb. 22.												
3.45 p.m.	W.	6·8	4·5	4·9	15	W.S.W.	1	Haze.	Smooth.	5¾ ,,	30·10	3½
4.40 p.m.	E.	5·5	4·9	4·9	16½	W.S.W.	3	,,	Slight.	½ h. ebb.	30·08	3
Mar. 30.												
1.0 p.m.	W.	11·2	6·0	5·1	16¼	E.S.E.	1	,,	S.E. swell.	4¾ ,,	29·83	3
2.0 p.m.	E.	12·2	6·2	5·0	13¾	E.S.E.	1	,,	,,	5¾ ,,	29·80	2¼
April 19.												
11.10 a.m.	E.	9·8	6·7	5·8	18	W.	1	Cloudy.	Smooth.	3½ h. fl.	30·11	4½
12.5 p.m.	W.	11·9	6·8	5·9	14¾	S.E.	Light	,,	,,	4½ ,,	30·11	4
June 20.												
2.35 p.m.	E.	12·0	10·0	8·0	..	E.S.E.	1	Cloudy, fine.	Slight.	4½ h. fl.	29·92	5
3.40 p.m.	W.	13·5	10·0	8·6	..	E.S.E.	2	,,	,,	near h. w.	29·94	4¾
Aug. 30.												
11.5 a.m.	E.	13·0	12·2	11·7	13	W.	5	Slight haze.	Choppy.	3 h. fl.	30·12	4½
11.50 a.m.	W.	14·4	12·1	11·8	16	W.	5	,,	,,	3¾ ,,	30·11	4½
Sept. 13.												
10.7 a.m.	E.	11·9	12·1	11·1	..	W.	2	Cloudy.	Smooth.	2½ ,,	30·38	4
11 a.m.	W.	12·3	12·1	11·3	..	W.	2	,,	,,	3¼ ,,	30·38	4
Nov. 30.												
11.25 a.m.	E.	8·4	9·1	9·1	15	W.	4	Hazy.	Moderate.	1½ ,,	30·42	3¼
12.25 p.m.	W	9·3	9·0	9·2	18	W.	4	,,	,,	2½ ,,	30·42	3

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—I. Firth of Forth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
Station VII. 1894.												
Jan. 18.												
11·40 a.m.	W.	5·4	4·5	4·6	13	W.S.W.	2	Haze.	Slight.	3¼ h. ebb.	29·33	3
1.20 p.m.	E.	7.2	4·5	5·0	27	W.	3	,,	,,	2½ ,,	29·33	2½
Feb. 23.												
7.20 a.m.	W.	5·0	4·3	4·3	12½	W.S.W.	3	Cloudy.	,,	2¾ ,,	29·72	2¾
9.10 a.m.	E.	5·3	4·3	4·8	25	S.S.W.	..	,,	Moderate.	4½ ,,	29·70	2¼
Mar. 29.												
1.30 p.m.	E.	14·5	5·7	5·0	17	Calm.	..	Haze.	S.E.swell.	l. w.	30·06	2½
3.35 p.m.	W.	12·9	7·2	5·1	12½	W.S.W.	2	,,	Slight.	2 h. fl.	30·02	3
April 13.												
3.30 p.m.	E.	6·0	6·7	5·4	17	S.E.byE.	5	Cloudy.	S.E.swell.	1¼ ,,	29·84	2
5.10 p.m.	W.	8·5	5·6	5·7	12	S.E.byE.	5	,,	,,	3 ,,	29·84	1¼
June 20.												
7.50 a.m.	W	12·5	11·6	7·8	11½	W.	1	Cloudy with slight haze.	Slight.	4¼ h. ebb.	29·86	2
9.50 a.m.	E.	14·0	11·7	7·8	19	W.	1	Cloudy, fine.	,,	l.w.	29·88	3
Aug. 23.												
11.10 a.m.	E.	14·6	12·8	11·4	7	E.	1	Clear.	Sl.E.swell.	4¾ h. ebb.	29·96	3
1.10 p.m.	W.	16·8	12·8	11·8	10½	E.	1	Cloudy.	,,	¾ h. fl.	29·98	2
Sept. 13.												
12.15 p.m.	E.	14·2	12·3	12·0	..	W.by N.	2	,,	Slight.	4¼ ,,	30·38	3
2.17 p.m.	W.	12·2	12·5	11·9	..	Calm.	..	,,	Smooth.	h.w.	30·38	2
Nov. 30.												
1.30 p.m.	E.	7·9	8·3	8·8	18½	W.	4	Hazy.	Moderate.	3 h. fl.	30·42	3½
3.35 p.m.	W.	8.5	8·2	9·0	14	W.	3	,,	Slight N. E. swell.	5¾ ,,	30·40	2
Station VIII.												
Jan. 18.												
1.45 p.m.	S.W.	7·2	4·6	4·8	22	W.	3	,,	Slight.	2¾ h. ebb.	29·34	3
3.50 p.m.	N.E.	6·6	5·5	5·8	28½	W.	4	,,	,,	4¾ ,,	29·38	3¼
Feb. 21.												
1.10 p.m.	S.W.	8·4	4·5	4·6	22	W.by N.	2	,,	,,	3¾ h. fl.	30·16	2¼
3.15 p.m.	N.E.	6·0	5·0	5·0	28	W.	5	,,	Choppy.	5¾ ,,	30·14	4
Mar. 14.												
12.35 p.m.	S.W.	5·4	4·7	4·7	19½	W.by N.	5	Cloudy.	N.E. swell.	5¾ h. ebb.	29·36	2¼
2.35 p.m.	N.E.	7·3	4·8	4·8	28	W.	3	Haze.	,,	1¾ h. fl.	29·36	36
April 18.												
1.10 p.m.	S.W.	7·4	6·7	5·8	23	E.N.E.	1	Dull.	,,	5¾ ,,	29·79	4
3.15 p.m.	N.E.	10·7	6·7	5·5	28¾	Calm.	..	Haze.	,,	1¾ ,,	29·84	4½
June 19.												
1 p.m.	S.W.	15·0	11·6	8·0	21	W.	1	Cloudy, fine.	Slight.	3¾ ,,	29·92	3¼
3.5 p.m.	N.E.	14·2	10·8	7·4	28	E.S.E	1	,, with slight haze.	,,	5¾ ,,	29·90	4½
Aug. 29.												
12.50 p.m.	S.W.	15·9	12·9	11·4	22	W.by N.	1	Hazy.	,,	near h. w.	30·15	5¼
2.45 p.m.	N.E.	15·1	13·2	10·8	28½	W.by N.	3	,,	Moderate.	1¾ h. ebb.	30·14	6
Sept. 12.												
11.50 a.m.	S.W.	14·7	12·6	11·7	..	Calm.	..	Clear.	Slight.	5 h. fl.	30·36	2
1.50 p.m.	N.E.	16·8	13·1	10·4	..	S.E.	1	Cloudy.	,,	1 h. ebb.	30·38	6
Nov. 28.												
12.35 p.m.	S.W.	9·8	8·7	9·3	22	W.	5	Hazy.	Moderate.	3½ h. fl.	30·21	5
2.35 p.m.	N.E.	10·0	9·5	9·7	30	W.	5	,,	,,	5½ ,,	30·18	7

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—I. Firth of Forth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
Station IX.												
1894. Jan. 19.												
12.15 p.m.	N.W.	6·7	4·9	5·0	31	S.S.W.	6	Overcast.	Choppy.	¾ h. ebb.	29·55	3½
2.15 p.m.	S.E.	6·8	5·0	5·7	33½	S.S.W.	5	,,	,,	2¾ ,,	29·50	3½
Feb. 21.												
3·55 p.m.	S.E.	6·0	4·7	5·0	30½	W.	5	Haze.	,,	½ ,,	30·12	3½
5.55 p.m.	N.W.	5·8	4·7	5·0	34	W.	3	,,	Moderate.	2½ ,,	30·16	
Mar. 14.												
3.20 p.m.	N.W.	5·2	4·8	4·7	30	W.	4	Cloudy.	N.E. swell.	2½ h. fl.	29·34	4
5.20 p.m.	S.E.	5·5	4·6	4·8	34	W.	2	Haze.	,,	4½ ,,	29·36	5
April. 18.												
4.5 p.m.	N.W.	8·5	6·8	5·0	23	N.E.	Light	Slight haze.	Smooth.	2½ ebb.	29·85	5½
6.10 p.m.	S.E.	7·7	6·9	5·1	28½	E.N.E.	Light	,, ,,	N.E. swell.	4½ ,,	29·89	5
June 19.												
3.55 p.m.	N.W.	13·5	10·1	7·4	30	S.E.	1	Cloudy, fine.	Slight.	½ h. ,,	29·88	7
6.5 p.m.	S.E.	13·4	11·4	7·4	34	S. S.W.	3	Dull.	Moderate.	2¾ ,,	29·86	7
Aug. 29.												
3.25 p.m.	N.W.	15·9	13·3	10	30	W.by N.	5	Hazy.	Choppy.	2½ ,,	30·12	5½
5.20 p.m.	S.E.	14·8	12·9	9·3	34	W.by N.	5	,,	,,	4¼ ,,	30·12	7
Sept. 12.												
2.30 p.m.	N.W.	13·8	12·3	10·4	29	S.E.	2	Cloudy.	Slight.	1½ ,,	30·38	4
4.30 p.m.	S.E	12·8	12·3	11·9	33	S.E.	2	,,	,,	3½ ,,	30·38	5½
Nov. 28.												
3.15 p.m.	N.W.	10·0	29·1	9·5	33	W.	5	Hazy.	Moderate.	¼ ,,	30·18	7
5.20 p.m.	S.E.	10·0	29·8	9·6	35	W.	5	,,	,,	2¼ ,,	30·16	7
Station X.												
Jan. 25.												
11.20 a.m.	W.	3·6	4·1	4·2	6½	W.by N.	4	Showery.	Slight.	5½ ,,	29·53	¼
12.20 p.m.	E.	3·8	4·3	4·3	9	W. by S.	4	Overcast.	,,	½ h. fl.	29·50	1/5
Feb. 17.												
10.35 a.m.	E.	2·2	4·5	4·8	9	E.	1	Haze.	Smooth.	3¾ ,,	30·02	¾
11.25 a.m.	W.	2·4	4·2	4·4	8	E.	1	,,	,,	4½ ,,	30·03	¾
Aug. 31.												
11.15 a.m.	E.	15·0	13·3	12·8	8½	W.N.W.	1	Cloudy.	,,	2¼ ,,	30·04	½
11.45 a.m.	W.	15·4	12·9	12·8	8	W.N.W.	1	,,	,,	2¾ ,,	30·04	¼
Sept. 15.												
10.20 a.m.	E.	14·3	12·7	12·4	7	Calm.	..	,,	,,	1½ ,,	30·38	5/12
11 a.m.	W.	14·3	12·9	12·5	8	Calm.	..	,,	,,	2 ,,	30·38	1/6
Dec. 8.												
11.30 a.m.	W.	6·0	7·7	8·3	9	N.W.	3	Hazy.	,,	1 h. ebb.	29·92	½
12.10 p.m.	E.	6·6	7·3	7·8	10	N.W.	3	,,	,,	1¾ ,,	29·93	½
II. St Andrews Bay.												
Station I.												
Feb. 14.												
8.50 a.m.	W.	1·0	3·4	4·9	8¼	W.by N.	2	Clear.	N.E. swell.	¾ h. ebb.	30·07	2
10.55 a.m.	E.	6·8	4·1	4·9	14	W.N.W.	2	Haze.	,,	2¾ ,,	30·10	2
April 6.												
3.30 p.m.	W.	6·1	6·7	5·3	8½	S.E.	5	Cloudy.	S.E. swell.	6 ,,	30·15	2¾
5.30 p.m.	E.	5·8	5·7	5·2	13¼	S.E.	5	,,	,,	2½ ,,	30·15	2

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—II. St Andrews Bay—*continued.*

Station, Date, and Hour.	End of Station.	Temperature. Air.	Temperature. Water.			Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
1894. Sept. 6. 2.20 p.m.	W.	10·3	12·7	12·6	7½	N.E.	2	Cloudy.	Moderate.	7¾ h. fl.	30·14	3
4.20 p.m.	E.	10·1	13·1	12·0	13½	S.	1	,,	,,	3¾ ,,	30·11	3½
Dec. 21. 11.35 a.m.	W.	6·8	6·9	7·6	8	W.S.W.	2	Hazy.	Slight.	1¾ h. ebb.	29·80	3
1.35 p.m.	E.	7·3	6·9	7·8	11¾	W.S.W.	4	,,	,,	3¾ ,,	29·76	4
Station II.												
Feb. 13. 11.10 a.m.	W.	3·8	4·0	4·9	8½	W.N.W.	5	Haze.	Moderate.	4 ,,	29·85	2
1 p.m.	E.	4·8	4·4	4·9	14	W. by N.	5	,,	Slight.	near h. w.	29·85	2½
Apr. 6. 12.35 p.m.	E.	7·3	5·8	5·4	14	S.E.	4	Cloudy.	Choppy.	3½ h. fl.	30·20	2½
2.30 p.m.	W.	8·2	6·4	4·1	9¼	S.E.	4	,,	S.E. swell.	5½ ,,	30·19	3
Sept. 6. 11.55 a.m.	E.	10·3	12·8	12·7	12½	N.N.E.	3	Clear.	Moderate.	5½ h. fl.	30·15	3
1.40 p.m.	W.	10·4	12·8	12·8	8½	N.E.	2	Cloudy.	,,	1¼ h. ebb.	30·14	4
Dec. 19. 12.50 p.m.	E.	6·7	7·3	8·0	14	N. W. by W.	6	,,	Choppy.	5 ,,	29·36	6
2.50 p.m.	W.	7·5	7·6	7·8	9½	N.W.	5	,,	,,	1 ,,	29·46	5
Station III.												
Feb. 13. 8·40 a.m.	E.	2·8	4·6	5·0	13	W.N.W.	5	Haze.	Moderate.	1½ ,,	29·81	2½
9.30 a.m.	W.	3·5	4·1	4·9	9½	W.N.W.	5	,,	,,	3¼ ,,	29·82	2
Apr. 6. 10.15 a.m	W.	5·7	6·3	5·3	8½	S.S.E.	5	Cloudy.	Choppy.	1¼ h. fl.	30·22	3½
12 p.m.	E.	6·5	6·0	5·0	12¾	S.E.	4	,,	,,	3 ,,	30·20	2
Sept. 6. 7.35 a.m.	W.	10·2	13·4	12·6	9	N.W.	2	Clear.	Slight.	3 h. ebb.	30·16	4
11·25 a.m.	E.	10·2	12·8	12·7	12½	N.N.E.	3	,,	,,	5 ,,	30·16	3
Dec. 19 10·55 a.m.	W.	5·8	7·7	8·0	9¾	W.N.W.	4	Cloudy.	Moderate.	3 ,,	29·31	3
12·25 p.m.	E.	6·7	7·2	7·9	13¼	N.W. by N.	6	,,	Choppy.	4½ ,,	29·34	3
Station IV.												
Feb. 13. 1.55 p.m.	E.	3·0	4·1	5·0	7	W.N.W.	6	,,	,,	¾ h. fl.	29·85	1
4.10 p.m.	W.	1·9	4·6	5·0	6¼	N. by E.	5	,, snow.	Moderate.	3 ,,	29·88	1¾
Apr. 6. 7.15 a.m.	E.	5·1	6·2	5·2	7¼	E. by S.	5	,,	Choppy.	4½ h. ebb.	30·24	3
9.45 a.m.	W.	6·4	6·6	6·3	5½	S.S.E.	5	,,	,,	¾ h. fl.	30·22	2½
Sept. 6. 6.45 a.m.	N.E.	10·0	12·7	12·5	11½	N.	2	,,	,,	h. w.	30·16	2
9.15 a.m.	S.W.	10·3	12·7	12·5	7	N.W.	2	,,	,,	2½ h. ebb.	30·16	2
Dec. 19. 8.20 a.m.	N.E.	5·0	7·8	8·0	8½	W.	5	,,	Moderate.	½ ,,	29·29	2
10.40 a.m.	S.W.	5·8	7·6	8·0	9	W.N.W.	4	,,	,,	2¾ ,,	29·30	3¼
Station V.												
Feb. 12. 2.40 p.m.	S.	2·2	5·0	5·0	16½	N.W.	5	,,	N.E. swell.	2½ h. fl.	29·23	3
4.40 p.m.	N.	2·5	4·7	4·9	15	W.	5	,,	,,	4½ ,,	29·27	2

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—II. St Andrews Bay—*continued.*

Station, Date, and Hour.	End of Station.	Temperature. Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Water. Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
1894. Apr. 5.												
4.25 p.m.	S.	7·8	6·4	5·1	16½	S.E.	4	Haze.	Moderate.	2¼ h. ebb.	30·24	3½
6.25 p.m.	N.	6·0	6·1	5·0	13¼	S.E.	5	,,	Choppy.	4¼ ,,	30·26	2
Sept. 7.												
6 a.m.	N.	10·1	12·6	12·4	14	N.W.	5	Overcast.	,,	4 h. fl.	30·00	3
8 a.m.	S.	11·0	12·6	12·3	15	N.W.	6	,,	,,	h. w.	29·94	4½
Dec. 17.												
1.55 p.m.	S.	4·3	8·9	8·4	..	N.W.	3	Hazy.	S.E. swell.	1¼ h. fl.	29·69	3½
3.55 p.m.	N.	4·2	8·8	8·0	..	N.W.	2	,,	,,	3¼ ,,	29·67	3
Station VI.												
Feb. 14.												
2.5 p.m.	N.	5·2	4·6	5·0	21	N.W.	2	Clear.	N.E. swell.	near l. w.	30·10	4
4.5 p.m	S.	4·6	4·6	5·0	24¾	Calm.	–	Slight haze.	,,	1½ h. fl.	30·10	2½
Apr. 5.												
1·35 p.m.	S.	7·1	6·2	4·9	25	S.E.	3	Haze.	Slight.	5½ ,,	30·24	4
3.35 p.m.	N.	7·0	6·6	5·1	20¾	S.E.	4	,,	Moderate.	1½ h. ebb.	30·24	2½
Sept. 7.												
8.30 a.m.	S.W.	11·0	12·6	12·3	25	W.N.W.	6	Overcast.	Rough.	1 ,,	29·94	5
10.20 a.m.	N.E.	11·0	12·5	12·5	21½	N.N.E.	6	Cloudy.	,,	2¼ ,,	29·94	5
Dec. 12.												
1.35 p.m.	S.W.	8·6	8·9	8·8	26	S.W.	6	Slight haze.	Choppy.	near h. w.	29·82	3
3.40 p.m.	N.E.	9·9	8·9	8·7	21	S.W.	6	Cloudy.	,,	2 h. ebb.	29·82	5

III. Montrose Bay.

Station, Date, and Hour.	End of Station.	Air. Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station I.												
Sept. 21.												
10 a.m.	S.W.	12·8	12·3	12·9	7	N.E.	3	Cloudy.	Slight.	5 h. ebb.	30·07	2½
11.30 a.m.	N.E.	13·0	12·9	12·8	16	N.E.	4	,,	,,	½ h. fl.	30·06	4
Dec. 20.												
12 noon.	N.E.	5	7·9	8·0	17½	N.N.W.	4	,,	N.E. swell.	4 h. ebb.	30·02	3
1.55 p.m.	S.W.	6·3	7·8	7·8	7½	N.N.W.	2	,,	,,	near l.w.	30·06	2
Station II.												
Sept. 21.												
12.30 p.m.	N.W.	11·8	12·9	13·0	4½	N.E.	4	Showery.	Moderate.	1½ h. fl.	30·06	1½
1.35 p.m.	S.E.	13·4	13·1	12·6	15	N.E.	4	Cloudy.	,,	2½ h. fl.	30·06	3
Dec. 20.												
9.20 a.m.	N.W.	5·4	7·8	7·7	7½	W.N.W.	2	Cloudy.	N.E. swell.	1¼ h. ebb.	30·01	¾
10.25 a.m.	S.E.	5·8	7·9	7·8	14¾	N.N.W.	3	Showery.	,,	2½ ,,	30·02	2

IV. Aberdeen Bay.

Station, Date, and Hour.	End of Station.	Air. Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station I.												
Sept. 25.												
9.10 a.m.	S.W.	10·9	13·8	12·5	10	N.W.	Light.	Hazy.	Smooth.	5 h. fl.	29·88	3
11.15 a.m.	N.E.	15·7	12·8	12·4	15	N.E.	1	Cloudy.	,,	1¼ h. ebb.	29·87	4
Station II.												
Sept. 25.												
11.45 a.m.	W.	13·9	14·9	12·4	7	E.S.E.	1	Cloudy.	Smooth.	1¾ h. ebb.	29·86	3½
1.15 p.m.	E.	13·7	12·7	12·4	19	E.S.E.	1	,,	,,	3¼ ,,	29·86	5½

TABLE C.—RECORD OF OBSERVATIONS MADE ON BOARD THE 'GARLAND' DURING 1894.

D. PHYSICAL OBSERVATIONS—IV. ABERDEEN BAY—*continued.*

Station, Date, and Hour.	End of Station.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station III. 1894. Sept. 25.												
1.55 p.m.	W.	15·2	13·4	12·1	8½	E.	1	Cloudy.	Smooth.	4 h. ebb.	29·86	3½
3.25 p.m.	E.	12·4	12·8	12·1	15¼	E.	2	Showery.	Slight.	5½ ,,	29·84	4
Station IV.												
Sept. 27.												
12.40 p.m.	N.E.	11·7	12·3	12·1	15	N.N.W.	6	Cloudy.	Choppy.	¾ h. ebb.	30·16	2
2.10 p.m.	S.W.	11·6	12·3	12·2	10	N.N.W.	6	,,	,,	2¼ ,,	30·17	3
Station V.												
Sept. 27.												
10.40 a.m.	N.E.	9·8	12·3	12·0	10½	N.N.W.	5	Showery.	N.E. swell.	4¾ h. fl.	30.13	2
12·15 p.m.	S.W.	9·5	12·3	11·9	11	N.N.W.	5	,,	,,	¼ E. ebb.	30·16	2
Station VI.												
Sept. 27.												
8.20 a.m.	N.E.	10·9	12·3	12·1	13	N.N.W.	5	Cloudy.	N.E. swell.	3 h. fl.	30·09	2
9.50 a.m.	S.W.	10·5	12·3	12·1	18	N.N.W.	5	Showery.	,,	4¼ ,,	30·13	3½
Station VII.												
Sept. 26.												
12.10 p.m.	S.	11·2	12·3	12·4	20	N.N.W.	5	Showery.	Moderate.	1¼ h. ebb.	29·88	4½
1.50 p.m.	N.	11·5	12·3	12·3	23	N.N.W.	5	,,	,,	3 ,,	29·90	6

V. MORAY FIRTH.

Station, Date, and Hour.	End of Station.	Air. Dry Bulb.	Water. Surface.	Water. Bottom.	Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station I.												
July 3.												
1.15 p.m.	W.	16·2	15·0	10·1	..	N.N.E.	1	Cloudy.	Slight.	1 h. ebb.	29·98	8
2.20 p.m.	E.	16·4	14·9	12·7	..	N.W.	3	,,	,,	2¼ ,,	30	6
Oct. 5.												
8.5 a.m.	W.	10·5	11·7	12·0	7½	S.S.E.	Light.	Hazy.	E. swell.	4¼ ,,	30·21	6
10.5 a.m.	E.	11·6	11·8	11·9	7½	E.	1	,,	,,	¼ h. fl.	30·20	5½
Station II.												
July 3.												
10 a.m.	W.	15·75	13·9	9·8	..	W.	3	Cloudy.	Slight.	4 h. fl.	29·98	7
12.5 p.m.	E.	18	14·3	8·9	..	Variable	..	,,	,,	h w	29·98	6
Oct. 4.												
11.20 a.m.	E.	11·4	11·8	12·7	..	Calm.	0	Hazy.	Smooth.	2½ h. fl.	30·30	5
1.25 p.m.	W.	11·6	11·7	12·3	..	,,	..	,	,,	4½ ,,	30·28	5
Station III.												
July 7.												
8.10 a.m.	W.	18·1	15·1	14·4	..	S.W.	1	Cloudy.	Smooth.	5 h. ebb.	29·74	2
9.15 a.m.	E.	20	14·7	13·5	..	W.	1	,,	,,	l.w.	29·745	2½
Oct. 6.												
8.45 a.m.	W.	10·5	12·3	11·5	7½	E.S.E.	4	,,	Slight.	4¼ h. ebb.	30·12	3½
10.30 a.m.	E.	11·4	12·1	11·7	13	E.S.E.	4	,,	,,	Near l.w.	30·13	3½

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS.—V. Moray Firth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
Station IV.												
1894.												
July 4.												
5 p.m.	N.	15·4	14·9	9·4	..	E.S.E.	1	Cloudy.	Slight.	4½ h. ebb.	29·96	7½
7.10 p.m.	S.	14·75	14·9	9·5	..	E.S.E.	1	,,	,,	½ h. fl.	29·96	7
Oct. 22.												
9 a.m.	W.	6·2	9·7	8·6	10¼	W. by N.	4	Cloudy.	Moderate.	3¾ h. ebb.	29·77	5
11.15 a.m.	E.	8·7	10·0	11·0	11¼	W.N.W.	5	,,	,,	Near l.w.	29·79	4
Station V.												
July 4.												
2.45 p.m.	S.W.	18·25	14·0	9·4	..	W.	2	Cloudy.	Slight.	2 h. ebb.	29·96	7
4.20 p.m.	N.E.	16	14·2	8·9	..	S.E.	1	,,	,,	3½ ,,	29·96	7
Oct. 22.												
11.25 a.m.	E.	8·4	10·2	11·2	16	W.N.W.	5	Showery.	Moderate.	¼ h. fl.	29·79	5½
1.5 p.m.	W.	8·7	10·1	9·9	12	W.N.W.	5	Cloudy.	,,	1¾ ,,	29·78	6
Station VI.												
July 5.												
6.20 a.m.	W.	15·9	14·6	9·4	..	S.W.	1	Cloudy.	Slight.	5¼ h. ebb.	29·94	7
8.20 a.m.	E.	16·5	15·2	8·5	..	S.W.	1	,,	,,	1¼ h. fl.	29·96	7
Oct. 22.												
1.25 p.m.	W.	8·5	9·2	9·4	7¼	W.	5	Cloudy.	Moderate.	2¼ h. fl.	29·78	4¾
3.25 p.m.	E	8·4	10·5	9·5	7½	W.	5	,,	,,	4¼ ,,	28·81	6
Station VII.												
July 5.												
9.45 a.m.	E.	16	13·6	9.0	..	S.	2	Cloudy.	Slight.	2½ h. fl.	29·942	10
11.30 a.m.	W.	17·5	14·8	8·6	..	S.	Light.	,,	,,	4¼ ,,	29·945	10
Oct. 9.												
11.20 a.m.	W.	13·9	11·9	11·9	24	SW by S.	6	Hazy.	Choppy.	2½ h. ebb.	29·94	6
1.20 p.m.	E.	11·5	12·1	11·9	33	S.W.	6	Rain.	,,	4½ ,,	29·94	5
Station VIII.												
July 9.												
12.10 p.m.	N.	14·2	13·4	9·6	..	S.E.	Light.	Cloudy.	Slight.	2 h. fl.	29·73	11
2.10 p.m.	S.	15	13·9	9·4	..	S.W.	1	,,	,,	4 ,,	29·73	11
Oct. 23.												
9.35 p.m.	S.	8·9	11·2	11·1	30	S.E.	1	Clear.	E. swell.	2 h. ebb.	30·01	7½
11.35 a.m.	N.	9·4	11·3	11·9	31½	S.S.E.	3	,,	,,	4 ,,	30·01	7
Station IX.												
July 9.												
6 p.m.	S.	14·1	14·5	9·4	..	S.E.	1	Cloudy.	Slight.	1½ h. ebb.	29·695	10½
8.5 p.m.	N.	14·2	13·9	9·5	..	S.E.	2	,,	,,	3½ ,,	29·69	7
Oct. 23.												
12.25 p.m.	N.	9·5	11·3	12·0	30	S.S.E.	5	Clear.	E. swell.	4¾ h. ebb.	30·0	8
2.30 p.m.	S.	10·2	11·4	11·7	33	S.S.E.	5	,,	,,	¾ h. fl.	29·98	6½

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—V. Moray Firth—*continued.*

Station, Date, and Hour.	End of Station.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Temperature. Water. Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station X. 1894. July 13.												
11.10 a.m.	N.W.	14·3	13·0	9·0	..	W.	5	Cloudy.	Choppy.	2¾ h. fl.	29·3	9½
12.40 p.m.	S.E.	16	13·1	12·4	..	W.	5	,,	Moderate	4¼ h. ebb.	29·34	7
Oct. 5.												
1.40 p.m.	S.E.	11·8	12·1	12·8	18	E.S.E.	4	Hazy.	E. swell.	4 h. fl.	30·18	7½
3.40 p.m.	N.W.	11·8	12·1	11·8	35	E.S.E.	4	,,	,,	h.w.	30·18	7

Smith Bank (Moray Firth).

Station, Date, and Hour.	End of Station.	Temperature. Air. Dry Bulb.	Temperature. Water. Surface.	Temperature. Water. Bottom.	Temperature. Water. Depth in faths.	Wind. Direction.	Wind. Force.	Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
Station XI.												
July 16.												
12.20 p.m.	W.	12·2	12·8	10·1	..	S. by E.	5	Slight haze.	Choppy.	1½ h. ebb.	29·58	7
2.15 p.m.	E.	13·5	12·4	10·4	..	S.E.	5	Hazy.	,,	3½ ,,	29·54	6½
Oct. 11.												
5.55 a.m.	W.	10·8	11·8	11·8	23	W.	3	Cloudy.	E. swell.	2 h. fl.	30·14	7½
8.0 a.m.	E.	11·4	11·8	11·4	24	W.	4	,,	,,	4 ,,	30·14	10½
Station XII.												
July 16.												
3.40 p.m.	S.	12·9	12·7	10·1	..	S.S.E.	5	Rain.	Choppy.	5 h. ebb.	29·53	8
5.30 p.m.	N.	12·5	12·5	9·3	..	S.S.E.	5	Hazy with rain.	,,	¾ h. fl.	29·5	7
Oct. 11.												
10.15 a.m.	N.	12·5	11·9	11·8	23¾	W.	3	Cloudy.	E. swell.	h.w.	30·16	9
11.45 a.m.	S.	11·4	12·1	11·8	24	W.	2	Clear.	Moderate.	1½ h. ebb.	30·19	8
Station XIII.												
July 17.												
5.55 a.m.	S.	11·9	12·1	10·4	..	N.	4	Hazy with rain.	Moderate.	5½ h. ebb.	29·44	7
8.15 a.m.	N.	11·9	12·1	10·6	..	N.N.W.	4	Slight haze.	,,	abt 1½ h.fl.	29·46	7
Oct. 11.												
1.35 p.m.	S.	14·5	12·6	12·2	28	W.	2	Clear.	Moderate.	3½ h. ebb	30·18	10
3.35 p.m.	N.	11·9	12 1	12·4	24	W.	1	,,	,,	6½ ,,	30.18	11½
Station XIV.												
July 17.												
10·45 a.m.	N.	12·8	11·2	10·8	..	N.N.W.	4	Overcast.	Moderate.	4 h. fl.	29·46	7½
12·45 p.m.	S.	12·2	11·6	10·8	..	N.E.	4	Hazy with rain.	Slight.	n. h. w.	29·47	6
Oct. 11.												
5.0 p.m.	N.	11·8	11·8	12·0	29½	Calm.	0	Clear.	Sl. E. swell.	1 h. fl.	30·18	10
7.5 p.m.	S.	11·8	11·9	12·3	37	S. by E.	1	Hazy.	E. swell.	3 ,,	30·20	9
Station XV.												
July 17.												
2.0 p.m.	N.	12·4	12·1	10·7	..	N. by E.	4	Cloudy.	Slight.	1¼ h. ebb.	2947	6¾
4.0 p.m.	S.	15·8	13·0	10·5	..	N.N.E.	3	,,	,,	3¼ ,,	9··49	8
Oct. 12.												
10.25 a.m.	S.	12·4	11·9	12·0	26	S.S.W.	3	Hazy.	Slight.	near h. w.	30·08	9
12.30 p.m.	N.	12·8	11·9	12·4	28	S. by W.	2	,,	,,	2 h. ebb.	30·08	6½

TABLE C.—Record of Observations made on Board the 'Garland' during 1894.

D. PHYSICAL OBSERVATIONS—V. Smith Bank (Moray Firth)—*continued.*

Station, Date, and Hour.	End of Station.	Temperature.				Wind.		Weather.	Sea.	Tide.	Barometer.	Transparency. Fathoms.
		Air.	Water.									
		Dry Bulb.	Surface.	Bottom.	Depth in faths.	Direction.	Force.					
Station XVI. 1894. July 17.												
5 p.m.	N.	12·9	12·8	10·4	..	N.N.E.	3	Hazy.	Slight.	4¼ h. ebb.	29·48	7
7 p.m.	S.	12	12·5	10·5	..	N.	3	Hazy with rain.	,,	¼ h. fl.	29·49	7
Oct. 12.												
7.15 a.m.	N.	11·9	11 8	12·6	32	S. by W.	3	Hazy.	Moderate.	3 h. fl.	30·11	9½
9.15 a.m.	S.	12·4	12·0	12·9	46	S.W.	3	,,	Slight.	5 ,,	30·10	8½
						VI. Orkney.						
Station I.												
July 21.												
5 a.m.	W.	12	12·2	11·4	..	Calm.	0	Hazy.	Smooth	n. l. w.	29·75	5
7.5 a.m.	E.	12·5	12·3	11·4	..	W.N.W.	1	Cloudy.	,,	2 h. fl.	29·77	5
Station II.												
July 21.												
8.45 a.m.	S.W.	15·1	11·7	11·3	..	Calm.	0	Cloudy.	Smooth.	3¾ h. fl.	29·77	7
9.15 a.m.	N.E.	14·9	11·9	11·3	..	,,	0	,,	,,	4¼ ,,	29·77	7
Station III.												
July 27.												
,,	N.W.	13·5	12·4	12	..	S.E.	2	Hazy.	Sl. E. swell.	4½ h. ebb.	30·03	6
,,	S.E.	16	12·5	12·3	..	E	1	,,	,,	n. l. w.	30·035	6
Station IV.												
July 24.												
,,	WNW	14·2	12·6	11·5	..	N.N.W.	1	Cloudy.	Slight.	3 hrs. fl.	30 235	6½
,,	E.S.E.	17·4	12·2	11·3	..	Calm.	0	,,	,,	4½ h. ebb.	30·23	7

TABLE D.—ANSTRUTHER DISTRICT.—BUCKHAVEN HADDOCK AND COD LINE FISHING—YEARS 1893-94.

MONTHS.	1893.								1894.							
	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, . .	23	182	96	12	213	67·5	8·4	1·17	16	152	34	344	326	28·63	289·7	2·14
February, . .	15	82	34	16	159	53·1	25·0	1·94	18	171	15¼	390	193	11·4	291·9	1·12
March, . . .	22	127	44	29	224	44·4	29·2	1·76	21	401	17	1170	304	5·4	373·4	0·75
April, . . .	25	273	127	248	128	59·5	116·3	0·47	24	488	-	1495	136	-	392·1	0·28
May, . . .	27	328	52½	468	-	20·5	182·6	-	27	301	-	1109	105	-	471·6	0·34
June, . . .	24	202	176¾	46	-	112·0	29·1	-	26	284	-	1390	-	-	626·5	-
July, . . .	24	172	191¼	1164¾	-	142·3	866·8	-	24	289	-	1521	12	-	673·7	0·04
August, . .	26	200	69¾	691¼	-	44·6	442·4	-	27	336	14½	1654	-	5·5	630·1	-
September, . .	23	199	49	671	18	31·5	431·6	0·09	25	578	55½	475½	57	12·3	105·3	0·09
October, . .	24	481	69½	990	343	18·5	263·4	0·71	26	917	107¾	2249	293	15·04	313·9	0·32
November, . .	21	448	45¼	1231	839	12·9	351·8	1·87	25	675	322	1255	1570	61·06	238·0	2·32
December, . .	22	407	71	1437	1203	22·3	451·9	2·95	23	572	195¾	621	1588	43·8	139·0	2·77
Totals for Year,	276	3101	1026	7004	3127	42·7	289·4	1·008	282	5164	761¾	13,673½	4584	18·8	338·9	0·88

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 THE MONTHLY TAKES OF LINE AND NET BOATS FROM INSHORE GROUNDS IN THE LEITH, ANSTRUTHER, MONTROSE, AND STONEHAVEN DISTRICTS.

I. LEITH DISTRICT. NORTH BERWICK.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		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.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
1893. Jan. (22)	1235½	11·2	41	0·33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	122	21 to 23 ft.	...	...
Feb. (20)	721	8·9	26	0·32	9½	0·12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	81	20 to 23 ft.	...	...
Mar. (21)	...	...	35	0·67	29	0·56	...	...	...	...	...	...	15	0·29	...	...	...	...	...	...	52	...	...	...
Apr. (25)	...	...	61	0·28	126	0·57	12	0·054	...	...	...	...	14	0·063	...	...	...	...	...	...	222	18 to 23 ft.	...	...
May (26)	...	...	82	0·35	141	0·60	...	...	...	...	...	...	24	0·1	...	...	...	...	...	...	235	18 to 23 ft.	...	...
June (26)	...	...	109½	0·53	248	1·21	...	...	...	...	...	...	23	0·11	...	...	2	0·01	...	...	205	18 to 23 ft.	...	...
July (26)	...	...	91	0·4	384	1·67	1	0·005	...	...	...	...	16	0·07	...	...	2	0·01	...	...	229	18 to 23 ft.	...	...
Aug. (27)	84	0·36	46	0·2	418	1·8	...	...	...	...	...	...	23	0·1	...	...	...	...	...	...	233	18 to 23 ft.	...	...
Sept. (23)	...	...	50	0·31	263	1·65	...	...	...	...	...	...	33	0·21	...	...	...	...	...	...	159	18 to 23 ft.	...	...
Oct. (22)	...	...	33	0·32	200	1·93	...	...	...	...	...	...	7	0·07	...	...	...	...	...	...	103	18 to 23 ft.	...	...
Nov. (25)	...	...	72½	0·68	124	1·17	...	...	...	...	...	...	6	0·057	...	...	...	...	...	...	106	18 to 23 ft.	...	...
Dec. (19)	92	0·98	51	0·54	86	0·91	...	...	...	...	...	...	...	...	1	0·01	...	...	...	...	·94	18 to 23 ft.	...	...
Total for year	2132½	1·16	698	0·38	2028	1·101	13	0·007	...	...	...	...	161	0·087	1	.0006	4	0·0021	...	...	1841		...	

TABLE E.—I. LEITH DISTRICT—*continued*. COCKENZIE AND PORTSETON.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1893.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (25)	...	...	435	1·24	216	0·61	7	0·02	...	...	...	...	31½	0·09	...	...	...	...	...	...	351	...	...	...
Feb. (21)	...	...	550	1·51	350	0·96	10	0·03	...	...	...	...	37	0·1	...	...	...	...	...	...	363	26 to 36 ft.	...	...
Mar. (25)	...	...	521	1·27	321	0·78	...	...	...	...	...	...	24	0·06	...	...	...	...	...	...	410	25 to 30 ft.	...	...
Apr. (25)	...	...	110½	0·44	309	1·22	4½	0·017	...	...	...	...	16½	0·065	...	...	...	...	...	...	253	24 to 29 ft.	...	...
May (27)	...	...	72	0·33	335	1·52	18½	0·084	...	...	...	...	31	0·14	...	...	...	...	...	...	220	23 to 25 ft.	...	...
June (26)	...	...	19	0·11	359	2·03	26	0·15	...	...	...	...	83½	0·47	...	...	...	...	...	...	177	23 to 25 ft.	...	...
July (26)	...	...	130	0·77	230	1·36	24	0·14	...	...	...	...	88	0·52	...	...	...	...	...	...	169	23 to 25 ft.	...	...
Aug. (27)	...	...	8	0·044	274	1·52	33	0·18	...	...	...	...	121½	0·67	...	...	...	...	...	...	180	23 to 25 ft.	...	...
Sept. (25)	...	...	107	0·3	1181	3·24	101	0·28	...	...	...	...	233	0·64	...	...	...	...	...	...	364	23 to 30 ft.	...	...
Oct. (27)	...	...	1181	1·8	891	1·36	97	0·15	...	...	...	...	205	0·31	...	...	...	...	...	...	656	23 to 30 ft.	...	...
Nov. (26)	...	...	1049	1·53	806	1·32	50½	0·07	...	...	...	...	247	0·36	...	...	...	...	...	...	684	23 to 30 ft.	...	...
Dec. (23)	...	...	576	1·14	665	1·31	32	0·06	...	...	...	...	107	0·21	...	...	...	...	...	...	504	23 to 30 ft.	...	...
Total for year	...	...	4758·5	1·05	5937	1·37	403·5	0·09	...	...	...	...	1225	0·28	...	...	...	...	...	...	4331			

TABLE E.—I. LEITH DISTRICT—*continued.* FISHERROW.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (21)	430	5·18	495	5·96	176	2·0	10	0·12	...	...	...	...	25	0·3	...	...	11	0·13	23	0·28	83	22 to 33 ft.	14	50 to 58 ft.
Feb. (18)	127	1·11	350	3·07	242	2·12	25	0·22	...	...	...	...	164	1·44	...	...	11	0·09	21	0·19	114	25 to 55 ft.	4	55 to 59 ft.
Mar. (22)	26	0·18	355	2·41	198	1·35	21	0·142	...	...	...	...	186	1·27	...	...	23	0·16	36	0·24	147	23 to 35 ft.	27	40 to 58 ft.
Apr. (16)	...	...	55	0·69	70	0·875	10	0·125	...	...	...	...	47	0·59	...	...	...	...	16	0·2	80	... ...	25	...
May (16)	...	...	47	0·88	77	1·45	12	0·23	...	...	...	...	44	0·83	...	...	...	...	11	0·2	53	22 to 30 ft.	10	35 to 58 ft.
June (13)	...	...	17	0·58	41	1·41	...	...	...	...	...	...	19	0·65	..	...	...	...	4	0·14	29	22 to 28 ft.	6	42 to 60 ft.
July (13)	...	...	55	0·94	86	1·48	13	0·22	...	...	...	...	54	0·94	...	...	...	...	16	0·27	58	23 to 28 ft.	...	...
Aug. (12)	...	...	73	0·94	115	1·47	21	0·27	...	...	...	...	77	0·99	...	..	...	...	18	0·23	78	22 to 33 ft.	...	...
Sept. (11)	...	...	39	0·72	79	1·46	13	0·24	...	...	...	...	68	1·26	...	...	...	...	13	0·24	54	23 to 40 ft.	9	40 to 58 ft.
Oct. (19)	...	...	173	1·37	181	1·44	26	0·19	...	...	...	...	122	0·97	...	...	...	...	24	0·19	126	23 to 38 ft.	32	43 to 59 ft.
Nov. (19)	...	...	279	1·72	484	2·99	51	0·31	...	...	...	...	105	0·65	...	...	...	...	45	0·28	162	23 to 58 ft.	16	48 to 58 ft.
Dec. (21)	188	1·23	472	3·11	418	2·74	39	0·25	...	...	...	...	46	0·3	...	...	21	0·14	37	0·24	152	23 to 34 ft.	2	50 to 58 ft.
Total for year	771	0·68	2410	2·12	2167	1·91	241	0·21	...	...	...	...	957	0·84	...	...	66	0·058	264	0·23	1136		145	

TABLE E.—I. LEITH DISTRICT—*continued.* NEWHAVEN.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1893.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (21)	3360	29·21	776	6·75	...	...	...	...	...	...	...	...	10	0·09	...	...	27	0·23	72	0·63	115	16 to 50 ft.	45	48 to 60 ft.
Feb. (20)	140	1·11	411	3·27	...	...	...	...	...	...	...	...	40	0·31	...	...	6	0·05	29	0·23	126	16 to 50 ft.	49	48 to 50 ft.
Mar. (21)	...	...	494	2·55	...	...	...	...	...	...	...	...	42	0·22	...	...	6	0·031	46	0·24	194	16 to 26 ft.	38	48 to 50 ft.
Apr. (20)	...	...	150	1·35	13	0·12	...	...	...	...	...	...	55	0·5	...	...	10	0·9	15	0·135	111	16 to 26 ft.	66	48 to 50 ft.
May (22)	...	...	63	0·51	58	0·47	...	...	...	...	...	...	87	0·7	...	...	31	0·25	...	...	124	16 to 26 ft.	172	45 to 50 ft.
June (22)	...	...	55	0·32	119	0·7	...	...	...	...	...	...	74	0·43	...	...	24	0·14	...	...	171	16 to 26 ft.	106	45 to 60 ft.
July (21)	...	...	94	0·56	264	1·57	8	0·05	...	...	...	...	42	0·25	...	...	11	0·065	...	...	168	16 to 26 ft.	29	45 to 60 ft.
Aug. (22)	...	...	107	0·39	283	1·04	21	0·08	...	...	...	...	46	0·17	...	...	2	0·008	½	0·002	273	16 to 26 ft.	34	60 ft.
Sept. (21)	...	...	206	0·43	686	1·42	51	0·11	...	...	...	...	37	0·08	...	...	...	...	...	...	482	16 to 29 ft.	25	50 to 60 ft.
Oct. (21)	...	...	331	1·02	428	1·32	23	0·07	...	...	...	...	26	0·08	...	...	5	0·015	...	...	325	16 to 28 ft.	25	50 to 60 ft.
Nov. (22)	20	0·12	422	2·54	125	0·75	...	...	...	...	...	...	23	0·14	...	...	68	0·41	17	0·1	166	16 to 50 ft.	60	45 to 50 ft.
Dec. (18)	...	...	965	6·52	43	0·29	...	...	...	...	...	...	11	0·07	...	...	115	0·78	50	0·34	148	16 to 50 ft.	39	40 to 60 ft.
Total for year	3520	1·46	4074	1·69	2019	0·84	103	0·042	...	...	...	...	493	0·205	...	...	305	0·126	229½	0·095	2403		688	

TABLE E.—II. ANSTRUTHER DISTRICT. LARGO.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (17)	...	...	43	0·34	203	1·6	...	...	...	...	...	...	31	0·244	...	...	...	...	...	...	127	15 to 25 ft.	...	...
Feb. (21)	...	...	27	0·13	15	0·071	...	...	...	...	...	...	344	1·64	...	...	...	...	...	...	210	15 to 25 ft.	...	...
Mar. (23)	...	...	17	0·08	124	0·6	...	...	...	...	...	...	148	0·71	...	...	...	...	...	...	207	15 to 25 ft.	...	...
Apr. (24)	...	...	24	0·12	188	0·96	...	...	...	...	...	...	30	0·16	...	...	...	...	...	...	195	15 to 25 ft.	...	...
May (27)	...	...	30	0·18	197	1·22	...	...	...	...	...	...	16	0·1	..	...	...	...	...	...	161	15 to 24 ft.	...	...
June (26)	...	...	32	0·18	317	1·83	...	...	...	...	...	...	...	...	...	...	...	...	...	...	173	14 to 24 ft.	...	...
July (26)	...	...	...	...	154	1·81	...	...	...	...	...	...	...	...	...	...	...	...	..	...	85	16 to 18 ft.	...	...
Aug. (27)	...	...	...	...	172	1·3	...	...	...	...	...	...	16	0·121	11	0·083	...	...	...	...	132	14 to 18 ft.	...	...
Sept. (25)	...	...	...	...	502	1·67	...	...	...	...	...	...	70	0·23	32	0·011	...	...	...	...	300	15 to 24 ft.	...	...
Oct. (27)	...	...	18	0·57	581	1·84	...	...	...	...	...	...	52	0·17	...	...	...	...	...	...	315	15 to 25 ft.	...	...
Nov. (26)	...	...	91	0·33	344	1·28	13	0·05	...	...	...	...	298	1·14	...	...	...	...	...	...	270	15 to 25 ft.	...	...
Dec. (22)	1¾	0·009	95	0·52	206	1·14	18	0·1	...	...	...	...	...	...	...	...	...	...	...	...	181	14 to 25 ft.	...	...
Total for year	1·75	0·0007	377	0·16	3003	1·28	31	0·013	...	...	...	...	1005	0·42	43	0·018	...	...	...	...	2356			

TABLE E.—II. Anstruther District—*continued.* Elie and Earlsferry.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		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.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
1894. Jan. (17)	...	...	13¼	0·27	45	0·91	4	0·08	...	...	...	...	...	...	...	...	...	...	...	...	49	16 ft.	...	...
Feb. (11)	...	...	18½	0·56	50¼	1·52	4	0·12	...	...	...	...	15¼	0·46	...	...	...	...	...	...	33	16 ft.	...	...
Mar. (25)	...	...	30	0·36	63¾	0·81	11¼	0·13	...	...	...	...	17¼	0·21	...	...	...	...	...	...	84	16 to 29 ft.	...	...
Apr. (25)	...	...	26¾	0·267	79¼	0·792	20½	0·205	...	...	...	...	4	0·04	...	...	...	...	...	...	100	16 ft.	...	...
May (25)	...	...	3½	0·04	51½	0·56	28	0·3	...	...	...	...	...	...	...	...	..	...	36¾	0·4	92	16 ft.	...	...
June (26)	...	...	9½	0·12	76¾	0·99	29¾	0·38	...	...	...	...	...	...	...	...	...	...	24½	0·31	78	16 ft.	...	...
July (26)	...	...	29¼	0·28	88¾	0·85	54¼	0·52	..	...	...	...	...	...	...	...	...	...	...	...	104	16 ft.	...	...
Aug. (27)	...	...	23¼	0·21	97½	0·9	19	0·18	...	...	...	...	...	...	...	...	...	...	...	...	108	16 ft.	...	...
Sept. (25)	...	...	12½	0·125	105¾	1·57	16¾	0·167	...	...	...	...	...	...	...	...	...	...	...	...	100	16 ft.	...	...
Oct. (22)	...	...	4½	0·9	68¼	1·36	11½	0·23	...	...	...	...	3½	0·7	...	...	...	...	...	...	50	16 to 17 ft.	...	...
Nov. (21)	...	...	8½	0·21	63	1·53	9	0·22	...	...	...	...	...	...	...	...	...	...	...	...	41	16 ft.	...	...
Dec. (18)	...	...	60	0·9	55¼	0·82	10¼	0·15	...	...	...	...	...	...	...	...	¼	0·004	...	...	67	16 to 55 ft.	...	...
Total for year	...	...	239½	0·264	849½	0·94	218¼	0·024	...	...	...	...	40	0·044	...	...	¼	0·0003	61¼	0·68	906			

TABLE E.—II. ANSTRUTHER DISTRICT—*continued*. ST. MONANCE.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (23)	959	2·29	543	1·3	320	0·76	49	0·12	...	...	...	...	...	...	...	...	2	0·005	11	0·026	419	28 to 56 ft.	...	...
Feb. (22)	1253	3·23	476	1·22	305	0·78	68	0·17	...	...	...	...	...	...	...	...	4	0·01	20	0·05	388	28 to 56 ft.	...	...
Mar. (25)	486½	0·98	278	0·56	293	0·59	62	0·13	...	...	...	...	...	...	...	...	...	...	...	...	495	24 to 56 ft.	70	50 to 56 ft.
Apr. (24)	...	...	178	0·69	255	0·85	53	0·17	...	...	...	...	...	...	...	...	3	0·01	...	...	300	28 to 56 ft.	45	44 to 58 ft.
May (27)	...	...	82	0·3	207	0·76	87	0·32	...	...	...	...	..	...	...	...	...	...	...	...	270	28 to 30 ft.	43	44 to 56 ft.
June (23)	...	...	45	0·31	102	0·7	59	0·4	...	...	...	...	...	...	...	...	...	...	...	...	146	24 to 30 ft.	49	44 to 56 ft.
July (21)	...	...	49	0·59	113	1·35	41	0·49	...	...	...	...	...	...	...	...	...	...	...	...	84	24 to 28 ft.	...	...
Aug. (26)	87½	0·875	64	0·64	157	1·57	17	0·17	...	...	...	...	...	...	...	...	...	...	...	...	100	24 to 28 ft.	...	...
Sept. (24)	...	...	82	0·63	261	2·02	44	0·34	...	...	...	...	...	...	...	...	...	...	...	...	129	24 to 30 ft.	...	...
Oct. (25)	...	...	144	0·54	488	1·83	75	0·28	...	...	...	...	...	...	...	...	...	...	...	...	266	24 to 30 ft.	...	...
Nov. (26)	...	...	190	0·65	415	1·41	97	0·33	...	...	...	...	...	...	...	...	...	...	...	...	294	24 to 56 ft.	...	...
Dec. (24)	94½	0·26	260	0·73	268	0·75	55	0·15	...	...	...	...	...	...	...	...	...	...	12	0·03	357	24 to 58 ft.	...	...
Total for year	2880½	0·88	2391	0·73	3184	0·98	707	0·22	...	...	...	...	...	...	...	...	9	0·003	43	0·013	3248		207	

TABLE E.—II. ANSTRUTHER DISTRICT—*continued.* PITTENWEEM.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		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.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
1894. Jan. (14)	323¾	2·77	69	0·59	170	1·45	7	0·06	...	...	...	...	...	...	...	...	...	...	...	...	117	25 ft.	14	48 to 50 ft.
Feb. (17)	780½	4·61	86	0·51	212	1·25	6	0·035	...	...	...	...	12	0·07	...	...	...	...	...	...	169	25 ft.	20	48 to 50 ft.
Mar. 19)	62⅜	0·32	117	0·6	212	1·1	10	0·05	...	...	...	...	12	0·06	...	...	...	...	...	...	192	25 ft.	23	48 to 50 ft.
Apr. (21)	...	...	82	0·44	143	0·77	9	0·05	...	...	...	...	4	0·021	...	...	...	...	...	...	185	25 ft.	12	48 to 50 ft.
May (22)	...	...	55	0·33	121	0·73	8	0·05	...	...	...	...	5	0·03	...	...	...	...	...	...	165	25 ft.	17	48 to 50 ft.
June (21)	22½	0·16	43	0·31	126	0·91	11	0·08	...	...	...	...	3	0·021	...	...	...	...	...	...	138	25 ft.	7	48 to 50 ft.
July (22)	...	...	47	0·34	196	1·41	10	0·072	...	...	...	...	2½	0·018	...	...	...	...	...	...	139	25 ft.	...	...
Aug. (25)	18⅜	0·11	86	0·52	231	1·4	8	0·05	...	...	...	...	3	0·013	...	...	...	...	...	...	165	25 ft.	...	...
Sept. (19)	...	...	52	0·4	174	1·33	6	0·05	...	...	...	...	2	0·015	...	...	...	...	...	...	131	25 ft.	...	...
Oct. (21)	...	...	98	0·52	271	1·43	7	0·037	...	...	...	...	6	0·031	...	...	...	...	...	...	190	25 ft.	10	48 ft.
Nov. (18)	...	...	104	0·48	276	1·27	9	0·041	...	...	...	...	3	0·014	...	...	...	...	...	...	218	25 ft.	22	48 to 50 ft.
Dec. (17)	...	...	153	0·7	293	1·35	8	0·04	...	...	...	...	3	0·014	...	...	...	...	...	..	217	25 ft.	43	48 to 50 ft.
Total for year	1207½	0·59	992	0·49	2425	1·19	99	0·049	...	...	...	...	55½	0·027	...	...	...	...	...	...	2926		168	

TABLE E.—II. ANSTRUTHER DISTRICT—*continued*. ANSTRUTHER.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (24)	10846½	14·46	160½	0·21	24	0·032	...	...	...	...	...	...	...	...	...	...	...	...	32	0·043	750	24 to 57 ft.	99	55 to 88 ft.
Feb. (22)	21630	24·7	278	0·32	18½	0·02	...	...	...	...	...	...	20	0·023	...	...	...	...	...	...	876	18 to 58 ft.	231	50 to 88 ft.
Mar. (23)	1596	2·89	24½	0·44	9	0·16	...	...	...	...	...	...	30	3·054	...	...	...	...	...	...	551	18 to 58 ft.	104	50 to 88 ft.
Apr.	...	...	...	...	...	...	30 small boats crab fishing.						...	...	...	...	...	...	...	...	...	...	228	54 to 88 ft.
May	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	191	50 to 88 ft.
June	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	122	50 to 88 ft.
July (?)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	30 ft.	39	41 to 67 ft.
Aug. (16)	1319½	21·28	...	...	28	0·45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	62	24 to 52 ft.	56	41 to 56 ft.
Sept. (17)	...	...	5	0·14	73	2·03	...	...	...	...	...	...	...	...	...	...	...	...	...	...	36	18 to 20 ft.	...	...
Oct. (18)	...	...	9	0·2	72¼	1·64	...	...	...	...	...	...	...	...	...	...	...	...	...	...	44	18 to 24 ft.	...	...
Nov. (15)	7	0·233	5¾	0·19	50	1·66	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30	20 to 29 ft.	5	76 to 88 ft.
Dec. (17)	288¾	1·85	9	0·056	41¼	0·26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	158	24 to 58 ft.	66	50 to 88 ft.
Total for year	35687¾	14·22	491¾	0·19	316	0·124	...	...	...	...	...	...	50	0·02	...	...	...	...	32	0·0127	2509		1141	

TABLE E.—II. ANSTRUTHER DISTRICT—*continued.* CRAIL.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (14)	119	1·43	148	1·8	34½	0·41	...	...	...	...	...	...	...	...	3½	0·04	...	...	...	...	83	16 to 56 ft.	...	...
Feb. (20)	14	0·11	165	1·35	113	0·92	...	...	...	...	...	...	...	...	12¾	0·14	...	...	...	...	122	16 to 50 ft.	...	...
Mar. (25)	...	...	16½	0·09	12	0·07	...	...	...	...	...	...	...	...	6½	0·036	...	...	...	...	180	16 to 23 ft.	...	...
Apr. (24)	...	...	13½	0·03	14	0·03	Boats, generally crab-fishing.								7½	0·016	...	...	...	...	457	16 to 26 ft.	...	...
May (27)	...	...	...	...	...	...	Crab-fishing boats only.						...	...	...	...	...	...	...	...	[538]	17 to 26 ft.	...	...
June (25)	...	...	55	0·11	...	...	Crab-fishing boats.						...	...	27	0·06	...	...	...	...	480	16 to 26 ft.	...	...
July (26)	...	...	73	0·29	128	0·51	Crab and line fishing boats.								...	...	...	...	...	...	253	17 to 26 ft.	...	...
Aug. (27)	5	0·019	84	0·32	166	0·64	...	...	...	...	...	...	...	...	20	0·08	...	...	...	...	258	16 to 23 ft.	...	...
Sept. (21)	...	...	72	0·51	128	0·92	...	...	...	...	...	...	...	...	...	...	...	...	...	...	139	17 to 26 ft.	...	...
Oct. (20)	...	...	58	0·41	161	1·14	...	..	...	...	...	...	...	...	...	...	...	...	...	...	141	17 to 25 ft.	...	...
Nov. (23)	...	...	467	1·91	71	0·29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	244	16 to 26 ft.	...	...
Dec. (19)	...	...	415	2·28	33	1·8	..	...	...	...	...	...	...	...	...	...	...	...	...	...	182	17 to 25 ft.	...	...
Total for year	138	0·05	1567	0·62	1160½	0·46	...	...	...	...	...	...	...	...	77¼	0·03	...	...	...	...	2539		...	

TABLE E.—II. ANSTRUTHER DISTRICT—*continued*. ST. ANDREWS.

Months and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		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.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
1894. Jan. (20)	...	...	40	0·36	...	...	...	...	...	...	...	...	281	2·53	...	...	...	...	...	...	111	20 to 42 ft.	164	30 to 42 ft.
Feb. (22)	...	...	...	...	...	...	...	...	...	...	...	...	514	2·21	...	...	...	...	...	...	233	20 to 42 ft.	89	42 ft.
Mar. (26)	...	...	...	...	...	...	...	...	...	...	...	...	241	2·01	...	...	...	...	...	...	120	20 to 42 ft.	149	42 ft.
Apr. (5)	...	...	...	...	...	...	...	...	...	...	...	...	12½	1·78	2	0·28	...	...	...	...	7	25 ft.	85	30 to 42 ft.
May (22)	...	...	...	...	178	2·14	...	...	...	...	...	...	...	...	85	1·02	...	...	...	...	83	20 to 42 ft.	69	30 to 50 ft.
June (25)	...	...	...	...	1163	3·95	...	...	...	...	...	...	...	...	67	0·23	...	...	...	...	294	18 to 42 ft.	20	42 to 48 ft.
July (23)	...	...	...	...	671	3·3	...	...	...	...	...	...	...	...	84	0·41	...	...	...	...	203	18 to 42 ft.	12	42 ft.
Aug. (24)	38⅝	0·37	...	...	92	0·88	...	...	...	...	...	...	...	...	71½	0·69	...	...	...	...	104	18 to 30 ft.	60	30 to 42 ft.
Sept. (21)	...	...	...	...	232	1·8	...	...	...	...	...	...	...	...	87	0·67	...	...	...	...	129	18 to 30 ft.	92	30 to 42 ft.
Oct. (14)	...	...	...	...	245	3·1	...	...	...	...	...	...	14	0·18	32	0·4	...	...	...	...	79	20 to 42 ft.	92	30 to 42 ft.
Nov. (26)	...	...	53	0·23	743	3·24	16	0·07	...	...	...	...	241	1·05	...	...	...	...	...	...	229	20 to 42 ft.	103	30 to 42 ft.
Dec. (18)	...	...	53	0·49	175	1·62	8	0·074	...	...	...	...	97	0·9	...	...	...	...	...	...	108	20 to 42 ft.	114	30 to 42 ft.
Total for year	38⅝	0·022	146	0·09	3499	2·58	24	0·014	...	...	...	...	1400½	0·82	428½	0·25	...	...	...	...	1700		1049	

TABLE E.—III. MONTROSE DISTRICT. Broughty Ferry.

Months and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot. and Brill.		Plaice and Flounders.		Dabs.		Skate.		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.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
1894. Jan. (11)	...	...	9	0·142	3	0·047	¼	0·004	...	...	...	...	171½	2·72	1	0·016	...	...	1	0·016	63	18 to 26 ft.	126	30 to 50 ft.
Feb. (19)	...	...	2½	0·011	...	...	...	...	...	...	...	...	631	2·93	...	...	...	...	...	...	215	18 to 42 ft.	97	30 to 50 ft.
Mar. (21)	...	...	6¼	0·034	45½	0·25	6¾	0·037	...	...	...	...	294	1·63	26	0·144	...	...	18½	0·103	180	18 to 20 ft.	160	35 to 50 ft.
Apr. (11)	...	...	9	0·13	142	2·06	8¼	0·12	...	...	...	...	16½	0·24	16	0·23	...	...	11¼	0·16	69	18 to 30 ft.	96	30 to 50 ft.
May (18)	...	...	4¼	0·034	342½	2·72	12	0·095	...	...	...	...	38½	0·3	33	0·26	...	...	15	0·12	126	18 to 30 ft.	158	30 to 50 ft.
June (18)	...	...	...	...	41¼	0·98	...	...	...	...	...	...	16¾	0·39	...	...	...	...	...	...	42	14 to 20 ft.	217	45 to 50 ft.
July (23)	42	0·8	24½	0·47	75½	1·45	4	0·08	...	...	...	...	33¾	0·65	...	...	...	...	16½	0·31	52	18 to 26 ft.	21	26 ft.
Aug. (4)	...	...	...	...	4	1·0	...	...	...	...	...	...	2	0·5	...	...	...	...	...	...	4	16 ft.	16	50 ft.
Sept. (17)	...	...	...	...	31	0·75	4	0·098	...	...	...	...	28½	0·7	...	...	...	...	...	...	41	15 to 18 ft.	225	40 to 50 ft.
Oct. (17)	...	...	...	...	25½	0·62	4	0·098	...	...	...	...	15	0·37	...	...	...	...	...	...	41	15 to 20 ft.	250	45 to 50 ft.
Nov. (18)	...	...	24¼	0·14	83½	0·48	5¼	0·003	...	...	...	...	432	2·5	13	0·075	...	...	17	0·098	173	18 to 26 ft.	156	30 to 50 ft.
Dec. (14)	...	...	10½	0·1	175½	1·65	9	0·085	...	...	...	...	123½	1·16	...	...	...	...	13	0·12	106	18 to 30 ft.	112	30 to 50 ft.
Total for year	42	0·04	90¼	0·081	969¼	0·87	53½	0·048	...	...	...	...	1803	1·62	89	0·08	...	...	92¼	0·082	1112		1634	

TABLE E.—III. MONTROSE DISTRICT—*continued*. ARBROATH.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (9)	...	...	6½	0·093	46	0·66	...	...	...	...	...	...	...	...	...	...	...	...	86	1·23	70	18 to 30 ft.	334	30 to 45 ft.
Feb. (13)	...	...	1½	0·01	40½	0·28	...	...	...	...	...	...	3	0·02	2½	0·017	...	...	100	0·7	145	18 to 30 ft.	393	30 to 45 ft.
Mar. (20)	...	...	5	0·04	58	0·48	...	...	...	...	...	...	8	0·07	...	...	...	...	111	0·925	120	18 to 30 ft.	475	30 to 45 ft.
Apr. (21)	...	...	4½	0·036	89	0·72	...	...	...	...	...	...	...	...	...	...	...	...	57	0·46	124	18 to 50 ft.	336	30 to 50 ft.
May (2 1	...	...	...	...	86	0·8	...	...	...	...	...	...	...	...	...	...	...	...	60½	0·55	109	18 to 30 ft.	397	30 to 50 ft.
June (25)	...	...	30½	0·21	109	0·75	...	...	...	...	...	...	...	...	...	...	...	...	85	0·6	144	18 to 30 ft.	385	18 to 50 ft.
July (24)	...	...	2	0·01	492	2·51	...	...	...	...	...	...	...	...	5	0·026	...	...	67	0·34	196	18 to 30 ft.	177	18 to 50 ft.
Aug. (26)	...	...	...	...	244	11·09	...	...	...	...	...	...	...	...	...	...	...	...	46½	2·1	22	18 to 30 ft.	172	30 to 45 ft.
Sept. (24)	...	...	1½	0·01	249	1·93	8	0·06	...	...	...	...	...	...	11	0·09	...	...	...	...	129	18 to 30 ft.	480	30 to 45 ft.
Oct. (20)	...	...	...	...	236	2·59	17	0·17	...	...	...	...	...	...	7	0·07	...	...	40	0·44	91	18 to 30 ft.	521	30 to 45 ft.
Nov. (24)	...	...	22	0·2	216	2·3	8½	0·08	...	...	...	...	...	...	13½	0·12	...	...	65	0·61	107	18 to 30 ft.	659	30 to 45 ft.
Dec. (19)	...	...	167	1·48	124	1·09	9½	0·08	...	...	...	...	...	...	4½	0·04	...	...	...	...	113	18 to 30 ft.	457	30 to 45 ft.
Total for year	...	...	240½	0·18	2019½	1·47	43	0·031	...	...	...	...	11	0·007	43½	0·03	...	...	717½	0·52	1370		4786	

TABLE E.—III. MONTROSE DISTRICT—*continued*. AUCHMITHIE.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot. and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (4)	...	...	3¼	0·12	32	1·23	4½	0·17	...	...	...	...	1½	0·05	...	...	...	...	17	0·65	26	16 to 20 ft.	95	16 to 20 ft.
Feb. (9)	...	...	16¼	0·3	38	0·7	5¾	0·1	...	...	...	...	2¾	0·005	...	...	½	0·009	38	0·7	54	16 to 20 ft.	145	16 to 20 ft.
Mar. (9)	...	...	2¼	0·1	22½	1·02	1¼	0·05	...	...	...	...	½	0·02	...	...	...	...	18½	0·84	22	16 to 18 ft.	200	18 to 20 ft.
Apr. (6)	...	...	1¼	0·1	11	0·92	¾	0·06	...	...	...	...	½	0·04	...	...	...	...	4½	0·37	12	16 ft.	177	18 to 20 ft.
May (6)	...	...	6	0·54	10	0·91	¾	0·68	...	...	...	...	½	0·045	...	...	...	...	1	0·091	11	16 ft.	175	18 to 20 ft.
June (4)	...	...	5	0·29	23	1·29	2½	0·15	...	...	...	...	...	...	...	...	...	...	2	0·117	17	16 to 18 ft.	135	18 to 20 ft.
July (9)	...	...	7½	0·4	28½	1·5	2½	0·13	...	...	...	...	1½	0·08	...	...	½	0·026	10	0·52	19	16 ft.	74	16 to 20 ft.
Aug. (8)	...	...	10½	0·525	33	1·65	2½	0·125	...	...	...	...	1½	0·75	...	...	...	...	7½	0·75	20	16 to 18 ft.	49	18 to 20 ft.
Sept. (8)	...	...	7½	0·47	26	1·625	2	0·125	...	...	...	...	1	0·063	...	...	...	...	4	0·25	16	16 ft.	154	18 to 20 ft.
Oct. (4)	...	...	4½	0·34	28	2·15	1¼	0·1	...	...	...	...	½	0·04	...	...	...	...	1½	0·12	13	18 to 20 ft.	132	18 to 20 ft.
Nov. (8)	...	...	12½	0·39	51	1·6	8½	0·26	...	...	...	...	1	0·03	...	...	...	...	9	0·28	32	16 to 20 ft.	128	18 to 20 ft.
Dec. (5)	...	...	10½	0·42	42½	1·68	6½	0·26	...	...	...	...	4¼	0·17	...	...	...	...	6	0·24	25	18 to 22 ft.	155	18 to 22 ft.
Total for year	...	...	87	0·32	345½	1·29	38¾	0·15	...	...	...	...	15½	0·06	...	...	1	0·004	119	0·44	267		1619	

TABLE E.—III. MONTROSE DISTRICT—*continued*. MONTROSE.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (11)	...	...	8½	0·29	3¼	0·11	...	...	...	...	...	...	...	...	...	...	...	...	5¾	0·2	29	18 to 25 ft.	508	25 to 50 ft.
Feb. (17)	...	...	2¼	0·48	4½	0·95	...	...	...	...	...	...	14	0·29	...	...	...	...	2	0·04	47	18 to 25 ft.	738	30 to 50 ft.
Mar. (25)	...	...	...	...	1	0·013	...	...	...	...	...	...	30½	0·41	½	0·007	...	...	13¾	0·18	74	18 to 25 ft.	621	25 to 50 ft.
Apr. (8)	...	...	...	...	8¾	0·51	...	...	...	...	...	...	...	...	1	0·06	...	...	1¼	0·07	17	18 to 25 ft.	251	30 to 50 ft.
May (10)	...	...	...	...	11½	0·7	...	...	...	...	...		...	...	...	...	...	...	1¼	0·078	16	20 to 30 ft.	243	30 to 50 ft.
June (22)	...	...	11¼	0·3	40¼	1·08	6¾	0·18	..	...	...	...	6½	0·17	...	...	...	...	...	...	37	16 to 20 ft.	326	24 to 55 ft.
July (22)	...	...	...	...	33¼	0·9	3¼	0·086	...	...	...	...	1½	0·04	...	...	...	...	...	...	37	15 to 20 ft.	661	30 to 50 ft.
Aug. (8)	...	...	...	...	19	0·86	4½	0·02	...	...	...	...	2½	0·11	...	...	...	...	...	...	22	16 to 20 ft.	928	40 to 50 ft.
Sept. (16)	...	...	3½	0·13	34½	...	6½	0·24	...	...	...	...	3¼	0·12	...	...	...	...	...	...	27	16 to 20 ft.	414	30 to 50 ft.
Oct. (19)	...	...	8½	0·16	37½	0·73	10	0·2	...	...	...	...	6	0·11	...	...	...	...	...	...	51	16 to 20 ft.	447	30 to 50 ft.
Nov. (18)	...	...	12	0·03	28½	0·71	8½	0·21	...	...	...	...	2½	0·062	...	...	...	...	...	...	40	16 to 18 ft.	738	30 to 50 ft.
Dec. (10)	...	...	10	0·38	21	0·81	5	0·19	...	...	...	...	2	0·08	...	...	...	...	...	...	26	18 to 20 ft.	450	30 to 50 ft.
Total for year	...	...	54	0·127	243	0·57	44½	0·105	...	...	...	...	68¾	0·26	1½	0·003	...	...	24	0·056	423		6325	

TABLE E.—III. MONTROSE DISTRICT—*continued.* JOHNSHAVEN.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (10)	...	...	52	1·33	40	1·03	...	...	...	...	...	...	...	...	...	...	...	...	48	1·23	39	18 to 22 ft.	147	27 to 35 ft.
Feb. (16)	...	...	41	0·56	44	0·6	...	...	...	...	...	...	..	...	...	...	...	...	101	1·38	73	18 to 22 ft.	149	25 to 35 ft.
Mar. (20)	...	...	15	0·14	87	0·81	...	...	...	...	...	...	...	...	...	...	...	...	43	0·4	108	18 to 22 ft.	154	25 to 35 ft.
Apr. (14)	...	...	3	0·06	51	0·98	...	...	...	...	...	...	...	...	...	...	...	...	11	0·22	52	18 to 22 ft.	60	27 to 50 ft.
May (17)	...	...	...	...	48	0·8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	60	18 to 22 ft.	54	27 to 50 ft.
June (17)	...	...	...	...	63	0·92	...	...	...	...	...	...	...	...	...	...	...	...	...	...	68	18 to 22 ft.	45	27 to 50 ft.
July (16)	505½	11·75	...	...	56	1·3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	43	18 to 22 ft.	74	25 to 40 ft.
Aug. (25)	...	...	...	...	103	2·02	...	...	...	...	...	...	...	...	...	...	...	...	...	...	51	21 to 35 ft.	6	35 ft.
Sept. (22)	...	...	...	...	237	2·75	33	0·38	...	...	...	...	...	...	...	...	...	...	...	...	86	18 to 25 ft.	46	25 to 38 ft.
Oct. (21)	...	...	1	0·03	357	10·2	31½	0·9	...	...	...	...	...	...	...	...	...	...	...	...	35	18 to 25 ft.	148	25 to 35 ft.
Nov. (19)	...	...	43½	0·36	248	2·08	3½	0·03	...	...	...	...	...	...	...	...	...	...	...	...	119	22 to 25 ft.	136	25 to 35 ft.
Dec. (18)	...	...	249	2·22	121	1·8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	112	18 to 30 ft.	160	25 to 35 ft.
Total for year	505½	·597	404½	0·48	1455	1·72	68	0·08	...	...	...	...	...	...	...	...	...	...	203	0·24	846		1179	

TABLE E.—III. MONTROSE DISTRICT—*continued.* GOURDON.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (13)	40	0·571	53	0·83	108	1·54	3	0·043	...	...	...	...	...	...	...	...	7	0·1	41	0·585	70	23 to 33 ft.	428	30 to 45 ft.
Feb. (18)	...	...	31	0·23	173	1·3	1	0·008	...	...	...	...	...	...	...	...	...	...	114	0·85	133	23 to 32 ft.	694	23 to 41 ft.
Mar. (21)	...	...	50	0·32	186	1·2	38	0·24	...	...	...	...	...	...	...	...	...	...	117	0·75	155	19 to 34 ft.	626	30 to 40 ft.
Apr. (18)	...	...	25	0·255	138	1·41	20	0·204	...	...	...	...	...	...	...	...	...	...	75	0·765	98	19 to 28 ft.	469	30 to 40 ft.
May (23)	...	...	34	0·26	211	1·6	36	0·27	...	...	...	...	...	...	...	...	...	...	122	0·92	132	19 to 33 ft.	758	32 to 40 ft.
June (23)	...	...	53	0·28	119	0·64	28	0·15	...	...	...	...	...	...	...	...	...	...	85	0·46	186	17 to 30 ft.	356	30 to 42 ft.
July (21)	...	...	...	...	114	1·56	28	0·38	...	...	...	...	...	...	...	...	...	...	46	0·63	73	14 to 19 ft.	174	23 to 40 ft.
Aug. (18)	...	...	...	...	298	1·93	21	0·14	...	...	...	...	...	...	...	...	...	...	144	0·93	154	20 to 26 ft.	224	30 to 52 ft.
Sept. (19)	...	...	...	...	210	1·75	48	0·4	...	...	...	...	...	...	...	...	...	...	72	0·6	120	17 to 29 ft.	503	25 to 41 ft.
Oct. (16)	...	...	...	...	177	1·17	43	0·284	...	...	...	...	...	...	...	...	...	...	99	0·65	151	19 to 30 ft.	568	29 to 41 ft.
Nov. (20)	...	...	...	...	118	0·9	...	...	...	...	...	...	...	...	...	...	...	...	105	0·8	132	19 to 27 ft.	563	25 to 40 ft.
Dec. (20)	...	...	118	0·85	145	1·04	...	...	...	...	...	...	...	...	...	...	...	...	139	1·0	139	19 to 30 ft.	642	31 to 41 ft.
Total for year	40	0·026	369	0·24	1997	1·29	266	0·17	...	...	...	...	...	...	...	...	7	0·005	1159	0·75	1543		6005	

TABLE E.—IV. STONEHAVEN DISTRICT. SHIELDHILL TO SKATERAW.

Month and Number of Days Fishing.	Quantity of Net and Line Fish caught within the Territorial Waters.																				Number of Trips and Size of Boats Fishing.			
	Herring.		Cod.		Haddock.		Whiting.		Lemon Soles.		Turbot and Brill.		Plaice and Flounders.		Dabs.		Skate.		Other White Fish.		Within the Territorial Waters.		Beyond the Territorial Waters.	
1894.	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*Cwts.*	*Aver.*	*No.*	*Size.*	*No.*	*Size.*
Jan. (18)	34	0·05	409	0·65	1082	1·72	...	...	...	...	...	...	5	0·008	...	...	...	...	7	0·01	627	22 to 38 ft.	276	26 to 35 ft.
Feb. (23)	...	...	657	0·72	2210	2·43	...	...	...	...	...	...	4	0·004	...	...	...	...	4	0·004	909	18 to 38 ft.	379	30 to 38 ft.
Mar. (26)	...	...	421	0·69	684	1·13	3	0·005	1	0·0016	...	...	12	0·02	...	...	...	...	4	0·006	606	16 to 36 ft.	739	24 to 38 ft.
Apr. (25)	...	...	266	0·41	728	1·11	30	0·046	1	0·001	...	...	4	0·006	...	...	...	...	7	0·01	652	18 to 24 ft.	154	20 to 56 ft.
May (25)	...	...	187	0·33	1013	1·71	52	0·93	...	...	...	...	4	0·007	...	...	...	...	3	0·005	559	18 to 24 ft.	176	18 to 54 ft.
June (26)	...	...	64	0·09	1572	2·3	222	0·32	...	...	...	...	7	0·01	...	...	...	...	6	0·009	687	18 to 24 ft.	228	20 to 50 ft.
July (26)	...	...	28	0·05	959	1·8	157	0·29	...	...	...	...	10	0·019	...	...	...	...	4	0·007	536	18 to 24 ft.	496	21 to 56 ft.
Aug. (27)	...	...	7	0·01	836	1·42	197	0·03	...	...	...	...	9	0·02	...	...	...	...	28	0·05	588	18 to 24 ft.	748	38 to 58 ft.
Sept. (24)	...	...	21	0·07	470	1·5	136	0·44	...	...	...	...	13	0·04	...	...	...	...	4	0·01	312	18 to 38 ft.	445	20 to 38 ft.
Oct. (23)	...	...	137	0·4	651	2·01	125	0·37	...	...	...	...	35	0·1	...	...	...	...	5	0·01	341	18 to 32 ft.	1016	26 to 38 ft.
Nov. (25)	...	...	298	0·67	842	1·9	182	0·41	...	...	...	...	18	0·04	...	...	...	...	13	0·03	442	18 to 36 ft.	746	20 to 40 ft.
Dec. (23)	...	...	255	0·63	742	1·84	77	0·19	...	...	...	...	3	0·007	...	...	6	0·015	20	0·05	404	18 to 38 ft.	598	30 to 38 ft.
Total for year	14	0·005	2750	0·041	11789	1·77	1181	0·18	2	0·0003	...	...	124	0·019	...	...	6	0·001	105	0·016	6663		6001	

TABLE F.—Showing the Quantities of Fish (in Cwts.) captured by Line Fishermen in the Territorial Waters of certain districts, with the Average per 'shot' in 1892, 1893 and 1894.

Note.—The Decimal figures in the second columns give the average cwts. per 'shot.'

DISTRICT.	Cod.		Haddock.		Whiting.		Lemon Soles, Flounders and Dabs.		Skate and Turbot.		Other White Fish.		Total Fish.		Total Trips.
	1892.														
Leith,	9,485½	1·35	7,826½	1·12	716	0·10	1,965	0·28	485½	0·06	484	0·06	20,962½	3·001	6,983
Anstruther,	7,303¼	0·53	9,822½	0·71	776¼	0·05	2,077¾	0·15	36	0·002	171¼	0·01	20,187	1·47	13,713
Montrose,	660	0·12	3,897¼	0·71	235¼	0·04	1,553¾	0·28	25¾	0·004	2,072¾	0·38	8,444¾	1·55	5,416
Stonehaven,	4,524	0·70	7,689	1·19	1,012	0·15	137	0·02	38	0·005	426	0·06	13,826	2·10	6,431
Total,	21,972¾	0·67	29,235¼	0·89	2,739½	0·08	5,733½	0·17	585¼	0·01	3,154	0·09	63,420¼	1·94	32,543
	1893.														
Leith,	7,436	1·306	4,436½	0·779	371	0·065	1,982½	0·348	575½	0·101	316½	0·055	15,118	2·656	5,691
Anstruther,	5,423¼	0·338	10,097¾	0·629	724	0·045	2,408¼	0·15	27	0·0016	232¼	0·014	18,911	1·179	16,032
Montrose,	669¼	0·134	3,396	0·68	226	0·045	1,574½	0·315	4¼	0·0008	2,974⅞	0·596	8,844	1·771	4,992
Stonehaven,	3,910	0·493	11,038	1·394	883	0·112	229	0·029	15	0·002	1,001	0·126	17,076	2·157	7,916
Total,	17,438½	0·504	28,968¼	0·836	2,204	0·063	6,194¼	0·178	621¾	0·017	4,524⅝	0·131	59,949	1·703	34,631
	1894.														
Leith,	11,940½	1·229	12,151	1·251	760½	0·078	2,837	0·292	375	0·038	493½	0·051	28,557½	2·941	9,711
Anstruther,	6,204¼	0·406	14,437	0·994	1,079¼	0·071	3,099¾	0·203	9¼	0·0006	136¼	0·009	24,965¾	1·633	15,284
Montrose,	2,245¼	0·224	7,029¼	1·266	513¾	0·092	2,032¼	0·365	8	0·0014	2,314¾	0·416	13,143¼	2·363	5,561
Stonehaven,	2,750	0·413	11,789	1·769	1,181	0·177	126	0·019	6	0·0009	105	0·016	15,957	2·395	6,663
Total,	22,140	0·595	45,406¼	1·22	3,534½	0·095	8,095	0·217	398¼	0·011	3,049½	0·082	82,623½	2·219	37,219

TABLE G.—Showing the Quantities Monthly of Large and Small Fish Landed in Aberdeen District by Beam Trawlers and Line Fishermen in 1893.

Month.	District.	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.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
Jan.	I. Beam trawl, . . .	1403	863	11,886	100	267	...	...	...	...	3429	118	...	...
	II. Line, ...	1333	288	1110	5	856	...	...	...	...	...	...	...	...
Feb.	I. Beam trawl, . . .	2240	866	12,231	87	616	...	...	...	...	1186	32	...	...
	II. Line, ...	1940	470	2489	13	1431	...	...	...	...	...	4	...	...
Mar.	I. Beam trawl, . . .	3612	634	17,518	228	661	...	...	...	...	2197	130	...	...
	II. Line, ...	2403	635	1709	73	2726	...	...	...	...	41	103	...	...
April	I. Beam trawl, . . .	3911	1639	5469	635	520	...	...	...	...	4373	270	...	...
	II. Line, ...	8685	1276	2203	307	2862	...	...	...	...	...	8	...	...
May	I. Beam trawl, . . .	3289	795	10,782	59	1259	...	...	...		5209	201	...	...
	II. Line, ...	8638	297	2612	281	3386	...	...	...	...	...	19	...	...
June	I. Beam trawl, . . .	2454	1038	9693	88	1032	...	...	...	...	4236	157	...	...
	II. Line, ...	6869	233	2834	376	3719	...	...	...	...	...	19	...	...
July	I. Beam trawl, . . .	1818	1381	12,637	110	1748	...	...	...	...	4628	237	...	...
	II. Line, ...	2827	40	927	344	2532	...	...	...	...	...	18	...	...
Aug.	I. Beam trawl, . . .	3134	1981	14,287	210	3273	...	...	...	...	4709	401	...	...
	II. Line, ...	3196	78	406	343	1643	...	...	...	...	...	16	...	...

TABLE G.—Showing the Quantities Monthly of Large and Small Fish Landed in Aberdeen District by Beam Trawlers and Line Fishermen in 1893—*continued.*

Month.	District.	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).
		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
	ABERDEEN—*continued.*													
Sept.	I. Beam trawl, . . .	2441	1231	18,265	103	2270	...	...	...	...	4169	395	...	...
	II. Line, ...	1993	108	1753	498	2695	...	...	...	...	...	53	...	...
Oct.	I. Beam trawl, . . .	3187	1682	18,575	185	3031	...	...	...	...	5530	442	...	...
	II. Line, ...	2131	176	2034	620	3649	...	...	...	...	...	40	...	...
Nov.	I. Beam trawl, . . .	3558	1944	18,025	175	3963	...	...	...	...	5132	810	...	...
	II. Line, ...	2791	535	1919	325	3498	...	...	...	...	...	24	...	...
Dec.	I. Beam trawl, . . .	3376	2438	15,897	167	1444	...	...	...	...	4550	300	...	...
	II. Line, ...	3793	519	1717	98	2168	...	...	...	...	...	20	...	...
Tl. for Year.	. . { Beam trawl, .	34,423	16,492	165,265	2147	20,084	...	...	...	...	49,348	3493	...	...
	{ Line, . . .	46,599	4655	186,978	3283	31,165	...	...	...	...	41	324	...	...

TABLE H.—SHOWING THE QUANTITIES OF FISH CAUGHT BY LINE WITHIN THE MORAY FIRTH (INSIDE A LINE BETWEEN DUNCANSBY HEAD AND RATTRAY POINT), AND THE NUMBER OF SHOTS OF THE BOATS BY WHICH THE FISH WERE CAUGHT.

I. WICK DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.
January	.	1,009	655	0·65	56	0·055	.	.	447	0·44	70	0·069	.	.	.	.	7	0·0069	10	0·01	18	0·018	78	0·078	215	0·2	1,556	1·54
February	.	1,183	1,530	1·29	124	0·014	.	.	318	0·27	64	0·054	.	.	.	.	34	0·029	92	0·078	25	0·02	170	0·14	278	0·231	2,635	2·23
March	.	1,088	1,150	1·06	141	0·13	.	.	634	0·58	172	0·16	.	.	.	.	35	0·03	49	0·04	56	0·05	685	0·63	320	0·29	3,242	2·98
April	105	550	698	1·06	84	0·13	.	.	339	0·52	145	0·22	.	.	.	.	32	0·05	.	.	9	0·014	89	0·13	172	0·26	1,568	2·39
May	81	380	985	2·13	.	.	.	.	259	0·56	70	0·15	.	.	.	.	5	0·011	.	.	.	.	21	0·045	116	0·25	1,456	3·15
June	66	496	565	1·005	.	.	.	.	191	0·34	220	0·39	.	.	.	.	2	0·0035	2	0·0035	1	0·0017	2	0·0035	170	0·3	1,153	2·05
July	.	424	396	0·93	.	.	.	.	83	0·196	180	0·42	15	0·03	.	.	.	.	.	.	.	.	.	.	156	0·36	830	1·96
August	.	415	406	0·98	6	0·014	.	.	309	0·74	256	0·61	13	0·03	.	.	.	.	.	.	.	.	.	.	131	0·31	1,121	2·7
September	27	520	326	0·6	24	0·044	.	.	118	0·21	1,006	1·84	37	0·069	.	.	.	.	5	0·009	.	.	.	.	99	0·18	1,615	2·95
October	50	433	348	0·72	19	0·039	.	.	159	0·33	985	2·04	33	0·068	.	.	.	.	16	0·033	.	.	13	0·027	83	0·17	1,656	3·43
November	38	410	265	0·59	12	0·027	.	.	130	0·29	637	1·42	17	0·04	.	.	.	.	12	0·027	4	0·009	.	.	94	0·21	1,171	2·57
December	29	387	338	0·81	16	0·04	.	.	115	0·27	375	0·9	13	0·03	.	.	.	.	8	0·019	.	.	.	.	140	0·33	1,005	2·41
Totals,	396	7,925	7,662	0·99	482	0·063	.	.	3,102	0·403	4,180	0·54	128	0·017	.	.	115	0·015	194	0·025	113	0·014	1,058	0·14	1,974	0·25	19,008	2·47

TABLE H.—*continued.*—LYBSTER DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cw .	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age	Cwt.	Aver-age.
January	4	43	246	5·23	.	.	.	.	15	0·32	35	0·74	.	.	.	.	1	0·02	.	.	.	.	.	.	63	1·34	360	7·66
February	3	24	270	10·0	.	.	.	.	.	.	33	1·22	.	.	.	.	.	.	.	.	.	.	.	.	15	0·55	318	11·77
March	11	140	295	1·95	9	0·06	.	.	29	0·19	183	1·21	.	.	.	.	.	.	.	.	.	.	.	.	116	0·77	632	4·18
April	2	83	54	0·63	.	.	.	.	5	0·06	111	1·31	.	.	.	.	1	0·012	.	.	.	.	3	0·035	54	0·63	228	2·68
May	.	32	40	1·25	.	.	.	.	7	0·219	43	1·34	.	.	.	.	.	.	.	.	.	.	.	.	24	0·75	114	3·56
June	.	81	107	1·32	.	.	.	.	83	1·02	28	0·34	1	0·012	.	.	.	.	.	.	5	0·061	.	.	42	0·52	266	3·28
July	.	25	63	2·52	.	.	.	.	146	5·84	.	.	16	0·64	.	.	.	.	.	.	3	0·12	2	0·08	26	1·04	256	10·24
August	.	.	69	.	.	.	.	.	83	.	.	.	13	.	.	.	.	.	.	.	.	.	.	.	37	.	202	.
September	.	123	108	0·87	.	.	.	.	73	0·59	251	2·04	.	.	.	.	.	.	.	.	23	0·18	4	0·032	70	0·57	529	4·3
October	.	100	101	1·01	.	.	.	.	.	.	392	3·92	.	.	.	.	.	.	.	.	47	0·47	4	0·04	65	0·65	609	6·09
November	.	113	164	1·45	.	.	.	.	18	0·16	244	2·16	.	.	.	.	.	.	.	.	.	.	.	.	53	0·47	479	4·24
December	2	112	212	1·86	.	.	.	.	12	0·105	149	1·307	.	.	.	.	.	.	.	.	.	.	.	.	42	0·368	415	3·64
Totals,	22	876	1,729	1·92	9	.	.	.	471	0·52	1,469	1·63	30	0·034	.	.	2	0·002	.	.	78	0·09	13	0·015	607	0·67	4,408	4·91

TABLE H.—*continued.*—HELMSDALE DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.
January	66	340	587	1·44	5	0·012	.	.	7	0·017	339	0·835	20	0·049	.	.	1	0·002	77	0·19	27	0·066	14	0·034	16	0·039	1,093	2·69
February	71	373	714	1·61	4	0·009	.	.	6	0·013	80	0·18	.	.	.	.	½	0·001	257	0·57	5	0·011	4	0·009	4	0·009	1,074½	2·42
March	49	599	900	1·39	4	0·006	.	.	7	0·011	421	0 63	14	0·021	.	.	2	0·003	323	0·49	6	0·0092	5	0·0077	7	0·011	1,639	2·61
April	.	417	144	0·34	.	.	.	.	40	0·096	489	1·17	31	0·07	.	.	.	.	39	0·93	20	0·048	.	.	.	.	763	1·83
May	3	343	200	0·57	.	.	.	.	98	0·28	470	1·36	62	0·18	.	.	5	0·014	7	0·02	119	0·34	28	0·081	11	0·03	1,000	2·89
June	.	342	192	0·56	.	.	.	.	43	0·12	420	1·22	31½	0·09	.	.	22	0·06	17	0·05	361	1·05	40	0·012	8	0·024	1,134½	3·31
July	.	73	34½	0·47	.	.	.	.	38	0·52	198	2·71	7	0·09	.	.	4	0·055	.	.	24	0·33	4	0·055	.	.	309½	4·24
August	.	67	36	0·54	.	.	.	.	.	.	212	3·16	9	0·134	.	.	.	.	2	0·03	28	0·42	.	.	.	.	287	4·28
September	2	507	116	0·22	.	.	.	.	.	.	2,321	4·56	66	0·13	.	.	.	.	40	0·08	12	0·023	.	.	4	0·008	2,559	5·03
October	.	349	80	0·23	.	.	.	.	.	.	1,417	4·06	56	0·16	.	.	.	.	154	0·44	2	0·006	.	.	4	0·012	1,713	4·91
November	2	494	142	0·28	.	.	.	.	14	0·028	2,014	4·06	69	0·14	.	.	.	.	33	0·06	.	.	.	.	12	0·024	2,284	4·6
December	6	384	242	0·62	.	.	.	.	64	0·16	1,322	3·38	67	0·17	.	.	.	.	16	0·04	.	.	.	.	9	0·023	1,720	4·41
Totals,	199	4,288	3,387½	0·75	13	0·003	.	.	317	0·07	9,703	2·16	432½	0·096	.	.	34½	0·0076	965	0·21	804	0·18	95	0·021	75	0·016	15,826½	3·52

TABLE H.—*continued.*—CROMARTY DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.	Cwt.	Aver-age.
January	.	218	396	1·81	3	0·014	.		.	.	629	2·88	14	0·064	.	.	.	.	74	0·34	15	0·07	5	0·23	48	0·22	1,184	5·43
February	.	357	436	1·22	.	.	.	.	11	0·031	880	2·46	20	0·056	.	.	.	.	199	0·56	10	0·028		0·014	82	0·23	1,643	4·6
March	.	618	1,008	1·63	6	0·01	.	.	12	0·02	979	1·58	20	0·032	.	.	.	.	279	0·45	.	.	6	0·01	149	0·24	2,459	3·97
April	.	400	204	0·51	.	.	.	.	14	0·032	678	1·695	25	0·062	.	.	.	.	94	0·235	.	.	3	0·0075	49	0·122	1,067	2·67
May	.	685	374	0·54	.	.	.	.	8	0·012	769	1·12	22	0·032	.	.	.	.	95	0·14	.	.	3	0·004	34	0·05	1,305	1·91
June	83	905	665	0·67	.	.	.	.	2	0·002	1,510	1·52	12	0·012	.	.	.	.	85	0·087	.	.	4	0·004	33	0·033	2,311	2·34
July	.	337	99	0·29	.	.	.	.	41	0·12	711	2·11	36	0·11	.	.	.	.	14	0·041	.	.	2	0·006	42	0·124	945	2·8
August	.	352	53	0·15	.	.	.	.	36	0·1	1,000	2·84	.	.	.	.	.	.	.	.	.	.	.	.	15	0·042	1,104	3·13
September	.	837	122	0·14	.	.	.	.	.	.	2,491	2·97	15	0·018	.	.	.	.	66	0·078	.	.	.	.	16	0·018	2,710	3·28
October	.	818	97	0·12	.	.	.	.		.	1,852	2·26	.	.	.	.	.	.	232	0·28	.	.	.	.	10	0·012	2,191	2·67
November	.	735	235	0·32	.	.	.	.	.	.	2,091	2·84	.	.	.	.	.	.	25	0·034	.	.	.	.	26	0·035	2,377	3·23
December	.	609	448	0·73	.	.	.	.	.	.	1,573	2·58	.	.	.	.	.	.	.	.	.	.	.	.	39	0·064	2,060	3·38
Totals,	83	6,871	4,137	0·59	9	0·0012	.	.	124	0·018	15,163	2·18	164	0·023	.	.	.	.	1,163	0·16	25	0·003	28	0·004	543	0·078	21,356	3·07

TABLE H.—*continued*.—FINDHORN DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.
January	370	1,069	1,099	0·76	38	0·02	.	.	24	0·012	2,683	1·86	285	0·198	1	0·0007	2¼	0·0015	24	0·016	7	0·005	38	0·026	29	0·02	4,230¼	2·94
February	333	889	1,483	1·21	43	0·035	.	.	23	0·019	2,419	1·98	505	0·41	.	.	2	0·0016	414	0·34	13	0·011	93	0·076	35	0·028	5,030	4·12
March	484	994	1,463	0·99	230	0·15	.	.	72	0·05	4,946	3·35	859	0·58	¼	0·0002	7	0·005	889	0·6	9	0·006	290	0·2	43	0·03	8,808¼	5·95
April	137	646	274	0·35	95	0·12	.	.	.	.	2,076	2·65	151	0·19	.	.	.	.	726	0·93	.	.	80	0·1	26	0·033	3,428	4·38
May	104	637	327	0·44	79	0·11	.	.	73	0·09	1,576	2·12	19	0·025	.	.	.	.	354	0·47	.	.	53	0·07	20	0·027	2,501	3·37
June	31	561	183	0·31	10	0·017	.	.	11	0·018	1,329	2·24	85	0·14	.	.	.	.	100	0·17	.	.	11	0·018	23	0·038	1,752	2·96
July	.	689	289	0·42	15	0·022	.	.	15	0·022	1,984	2·88	36	0·05	3¼	0·005	.	.	61	0·088	.	.	22	0·03	10	0·014	2,435¼	3·53
August	5	710	109	0·15	10	0·014	.	.	4	0·0056	2,185	3·05	225	0·31	.	.	.	.	66	0·092	.	.	11	0·015	24	0·033	2,634	3·68
September	294	1,088	265	0·18	4	0·003	.	.	.	.	5,543	4·01	466	0·34	.	.	.	.	112	0·08	.	.	10	0·007	52	0·038	6,452	4·67
October	432	1,057	168	0·11	10	0·0066	.	.	4	0·0026	6,559	4·41	308	0·21	.	.	.	.	208	0·14	3	0·002	13	0·009	60	0·04	7,333	4·99
November	566	1,281	313	0·17	12	0·006	.	.	32	0·017	8,306	4·49	95	0·05	.	.	1	0·0005	84	0·045	.	.	15	0·008	36	0·019	8,894	4·81
December	376	923	634	0·48	54	0·042	.	.	35	0 027	5,667	4·36	81	0·062	.	.	.	.	50	0·04	.	.	20	0·016	36	0·028	6,577	5·06
Totals,	3,132	10,544	6,607	0·48	600	0·044	.	.	293	0·02	45,273	3·31	3,115	0·23	4½	0·0003	12¼	0·0009	3,088	0·22	32	0·002	656	0·05	394	0·03	60,074¾	4·4

TABLE H.—*continued.*—Buckie District.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddocks.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average
January	414	568	1,337	1·36	143	0·14	.	.	146	0·15	3,998	4·07	.	.	.	.	10	0·01	.	.	8	0·008	194	0·2	570	0·58	6,406	6·52
February	300	509	953	1·18	127	0·15	.	.	31	0·04	2,797	3·45	.	.	.	.	9½	0·011	.	.	1	0·001	90	0·11	175	0·21	4,183½	5·17
March	311	807	657	0·587	45	0·04	.	.	51	0·045	2,745	2·45	.	.	½	0·0004	49	0·044	8	0·007	13	0·011	387	0·34	602	0·53	4,557½	4·076
April	78	350	26	0·06	393	0·91	.	.	38	0·09	1,127	2·63	.	.	.	.	.	.	.	.	1	0·002	.	.	394	0·92	1,979	4·62
May	20	618	218	0·34	.	.	.	.	13	0·02	1,738	2·72	.	.	.	.	1	0·0015	.	.	.	.	.	.	.	.	1,970	3·09
June	.	631	373	0·59	.	.	.	.	20	0·03	1,062	1·68	.	.	.	.	2	0·003	.	.	.	.	.	.	.	.	1,457	2·31
July	.	262	167	0·63	.	.	. .	.	.	.	667	2·54	.	.	.	.	.	.	.	.	29	0·11	2	0·007	.	.	865	3·3
August	.	274	70	0·25	.	.	.	.	.	.	866	3·15	5	0·018	.	.	.	.	.	.	14	0·05	.	.	30	0·11	985	3·6
September	164	830	386	0·39	.	.	.	.	.	.	4,480	4·51	14	0·014	.	.	.	.	.	.	1½	0·0014	.	.	109	0·11	4,990½	5·02
October	291	1,579	455	0·24	.	.	.	.	14	0·008	6,137	3·28	20	0·09	.	.	.	.	2	0·0011	5	0·0027	.	.	1,253	0·67	7,886	4·21
November	484	1,748	1,154	0·51	12	0·005	.	.	74	0·033	7,202	3·22	20	0·011	.	.	.	.	.	.	52	0·023	53	0·024	80	0·036	8,647	3·87
December	360	928	604	0·46	.	.	.	.	53	0·041	3,704	2·87	.	.	.	.	.	.	.	.	6	0·0046	23	0·018	224	0·17	4,614	3·58
	2,422	9,104	6,400	0·55	720	0·062	.	.	440	0·038	36,523	3·178	59	0·0051	½	0·0004	71½	0·0062	10	0·0009	130½	0·011	749	0·065	3,437	0·298	48,540½	4·21

TABLE H.—*continued.*—BANFF DISTRICT.

Months.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.
January	.	1,411	.	.	.	.	.	.	.	.	101	0·071	.	.	.	.	.	.	.	.	.	.	.	.	.	.	101	0·071
February	.	1,323	29	0·021	2	0·0015	.	.	4	0·003	90	0·068	2	0·0015	.	.	.	.	.	.	.	.	14	0·011	.	.	141	0·105
March	.	1,575	61	0·038	120	0·07	25	0·0158	3	0·002	394	0·25	4	0·0025	.	.	14	0·009	.	.	.	.	125	0·079	.	.	746	0·47
April	147	1,081	358	0·29	28	0·023	.	.	254	0·21	3,219	2·62	76	0·06	.	.	2	0·0016	8	0·0065	3	0·0024	16	0·013	.	.	3,964	3·23
May	.	770	155	0·2	.	.	.	.	73	0·095	1,544	2·01	25	0·032	.	.	3	0·004	.	.	2	0·0026	3	0·004	.	.	1,805	2·35
June	.	537	167	0·31	.	.	.	.	806	1·5	1,031	1·92	141	0·26	.	.	.	.	2	0·004	.	.	.	.	69	0·13	2,216	4·12
July	.	402	58	0·14	.	.	.	.	87	0·21	987	2·45	44	0·11	.	.	.	.	.	.	.	.	.	.	16	0·04	1,192	2·96
August	.	439	78	0·17	.	.	.	.	137	0·31	1,280	2·9	73	0·16	.	.	.	.	3	0·0065	.	.	6	0·013	56	0·13	1,633	3·72
September	37	1,871	203	0·11	.	.	.	.	.	.	7,657	4·01	210	0·11	.	.	.	.	.	.	.	.	.	.	190	0·1	8,260	4·33
October	159	2,492	362	0·13	3	0·0011	.	.	.	.	10,204	3·81	492	0·18	.	.	.	.	10	0·003	6	0·0023	.	.	205	0·077	11,282	4·21
November	270	2,579	698	0·24	94	0·033	.	.	9	0·0031	10,393	3·65	596	0·21	.	.	.	.	15	0·005	26	0·009	123	0·04	279	0·09	12,233	4·29
December	215	1,408	480	0·29	89	0·054	.	.	.	.	4,318	2·66	252	0·155	.	.	.	.	19	0·011	25	0·015	395	0·24	141	0·08	5,719	3·52
Totals,	828	15,888	2,649	0·13	336	0·02	25	0·0015	1,373	0·08	41,218	2·47	1,915	0·11	.	.	19	0·0011	57	0·0033	62	0·0039	682	0·04	956	0·057	49,292	2·94

TABLE I.—TOTAL QUANTITIES OF FISH CAUGHT BY LINE WITHIN THE MORAY FIRTH (INSIDE A LINE BETWEEN DUNCANSBY HEAD AND RATTRAY POINT), AND THE NUMBER OF SHOTS OF THE BOATS BY WHICH THE FISH WERE CAUGHT.

District.	Number of Shots.		Cod.		Ling.		Torsk (Tusk).		Saithe (Coalfish).		Haddock.		Whiting.		Turbot.		Halibut.		Flounder, Plaice, Brill.		Conger-Eel.		Skate.		Other kinds of White Fish.		Total of Line-caught Fish.	
	Large Boats.	Small Boats.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.	Cwt.	Average.
Wick, . .	396	7,295	7,662	0·99	482	0·063	.	.	3,102	0·403	4,180	0·54	128	0·017	.	.	115	0·015	194	0·025	113	0·014	1,058	0·14	1,974	0·25	19,008	2·47
Lybster, .	22	876	1,729	1·92	9	0·01	.	.	471	0·52	1,469	1·63	30	0·34	.	.	2	0·002	.	.	78	0·09	13	0·015	607	0·67	4,408	4·91
Helmsdale,	199	4,288	3,387½	0·75	13	0·003	.	.	317	0·07	9,703	2·16	432½	0·096	.	.	34½	0·0076	965	0·21	804	0·18	95	0·021	75	0·016	15,826½	3·52
Cromarty,	83	6,871	4,137	0·59	9	0·0012	.	.	124	0·018	15,163	2·18	164	0·023	.	.	.	.	1,163	0·16	25	0·003	28	0·004	533	0·078	21,346	3·07
Findhorn,	3,132	10,544	6,607	0·48	600	0·044	.	.	293	0·02	45,273	3·31	3,115	0·23	4½	0·0003	12¼	0·0009	3,088	0·22	32	0·002	656	0·05	394	0·03	60,074¾	4·4
Buckie, .	2,422	9,104	6,400	0·55	720	0·062	.	.	440	0·038	36,523	3·178	59	0·005	½	0·00004	71½	0·0062	10	0·001	130½	0·011	749	0·065	3,437	0·298	48,540½	4·21
Banff, . .	828	15,888	2,649	0·13	336	0·02	25	0·0015	1,373	0·08	41,218	2·47	1,915	0·11	.	.	19	0·0011	57	0·0033	62	0·0039	682	0·04	956	0·057	49,292	2·94
Totals,	7,082	54,866	32,571½	0·52	2,169	0·035	25	0·0015	6,120	0·09	153,529	2·47	5,845½	0·094	5	0·00008	254¼	0·004	5,477	0·088	1,244½	0·02	3,281	0·053	7,976	0·128	218,495¾	3·5

II.—ON THE HATCHING OPERATIONS AT DUNBAR MARINE HATCHERY during the Spring Season, 1895. By Harald Dannevig.

In the Board's Twelfth Annual Report I gave a detailed account of the operations at Dunbar Hatchery during the spring season, 1894. From that paper it will be seen that plaice (*Pleuronectes platessa*) was dealt with on a large scale, and that over 26,000,000 of fry were placed in the waters of the Firth of Forth and St Andrews Bay.

The physical conditions of the water in 1894 were, on the whole, very favourable to the work; the constant winds off-shore in the early part of the season caused no heavy seas on the coast, which again resulted in very clear and transparent water. Late in April and occasionally in May the winds blew from the sea, but as they only continued a few days at a time no great difficulty was encountered. The temperature of the air as well as of the sea water was not in any way exceptional.

During the season this year the general physical conditions were somewhat different, the winds being nearly all the time off the sea, and they continued to be very severe, so that in fact the herring fishing, which is generally considerable in this locality during the winter months, was this year nearly a failure, owing to the bad weather. The exceptionally low temperature of the air in January and February also reduced the temperature of the sea water in the Forth very much.

In Dr Fulton's account of Dunbar Hatchery last year, as well as in the above-mentioned paper of mine, it is pointed out that an early collection of the spawners was desirable, and would be a great benefit to the operations as a whole. In consequence of this it was the intention this year to have as many spawners collected, as early as possible, as there is at present room for at Dunbar. Several attempts were made in the winter, but the continually stormy weather prevented this being begun before the second week in February, as is described below. At the beginning of the season a considerable number of unfertilised eggs were found in the spawning pond and also in the creek, as is explained below.

Before the work was begun, the filtering system was altered in order to secure a better result with less expenditure of labour. The original plan of filtration was to lead the inflowing water over horizontal frames, covered with cheese-cloth or flannel of various degrees of fineness.

But as the sea-water after storms sometimes contains a relatively large quantity of sand or mud, blanket-cloth was found to be an excellent material to purify the water thoroughly. The pores in these filters, however, soon became closed, in which case the water remained on the top of the frame, and subsequently passed over the edge of it without any filtration at all. In this way, anything that was in the water found its way into the hatching apparatus.

Considerable attendance was therefore required to keep the filters in order. To avoid the constant attendance, a new system of filtration has this year been introduced, the principal idea being to force the water up through fixed filters. This idea is due to Dr Fulton, and is referred to in his account of the hatchery in last year's report. The original filter-boxes were altered in the following way:—The supply pipe was carried into the side of the box near the bottom. A few inches above this level, fillets were fixed inside all around, indiarubber tubing being attached on the top of it.

On this tubing, the first frame (each of which is one inch thick) is placed, being covered with galvanised iron netting of half-inch mesh, which is fastened in a groove along the inner margin of the frame, and therefore below the surface of the latter. The frame itself is made half an inch smaller all around than the box inside, leaving an equal space between itself and the sides of the box. The first filter cloth, which ought to be of a comparatively open material, is cut to the size of the box, so that when put down it will cover the whole of the frame. Two brass rods, introduced into a fold at the edge of the cloth, keep the filters stretched in proper position, the rods passing outside the frame, and resting in the space between the latter and the box. The frames are placed with the netting below, and one above each cloth. When the water passes, the filtering cloth is pressed against the netting on the frame above it, to which the whole strain is transferred, and which keep the cloths apart from one another. When the desired number of filters are put in one over the other, the whole pile is tightly pressed down against the fillets; and all the joints being perfectly tight, the inflowing water below the filters forces its way through them all, the outflow being near the top of the box. As the water supply is taken either from the pump directly or from the pond, it has pressure enough to pass through all kind of filtering materials; several sheets of blanketing have occasionally been used, and after the filtration the water is perfectly pure, while its transparency before is perhaps a few feet only. The filters can easily be taken out and replaced with clean ones. It was found necessary to use only one box in this way during the season, and when all the hatching apparatus were working, the filters in this box only required to be cleaned every six or eight hours in the most stormy weather, and usually only once in twelve hours.

In this way all difficulties regarding the hatching apparatus have been overcome so far as the filtration of the water is concerned. When sufficient pressure is available, any quantity can be obtained in the most pure and satisfactory condition.

The hatching operations were started on the 23rd of March and continued successfully to the last week in May, when the latest hatched fry were put out. That the hatching work this year did not meet with special difficulties from the exceptional conditions of the weather mentioned above is chiefly due to the new method of filtration of the water.

During the season 44,085,000 eggs were collected and 38,615,000 fry of plaice were transferred to various localities in the Firth of Forth and St Andrews Bay.

Besides the plaice, which was the principal species dealt with, 2,700,000 fry of cod were hatched and put out, and some hundred thousands of haddock and whiting. The eggs of the two latter species were artificially fertilised by Mr Liston while out on a trawler for spawning plaice, as were also the eggs of the cod, except half a million, which I myself fertilised at Dunbar.

1. The Collection and Acclimatisation of the Spawners.

During almost the whole season in 1894 some difficulty occurred with the spawners in the pond. The majority of them had been caught during the season, and a number placed in the spawning pond in a more or less injured condition. A considerable number of those died, and the water in the pond being deep, the bodies could not always be removed in time, a circumstance which very much interfered with the regular spawning of the healthy fishes. The total number of fishes in the pond, however, was not very great and the supply of water was abundant, so that the spawning continued till the fishes were spent; but I saw that in dealing with larger numbers it would be necessary to take precautions to avoid such difficulties as far as possible.

This year, therefore, it was intended to collect the fishes early enough to have an opportunity to select the healthy and suitable fishes before the season began, as far as that could be done. Shortly after Christmas such attempts were made, but the severe and continual gales from the north and east made it impossible to procure any spawners till the second week of February, when the first plaice were landed. With a few interruptions, the collection went on to the 9th of March, at which time nearly 800 fishes had been received here. Of these about 500 were at once transferred to the spawning pond, the season being so far advanced that spawning was expected to take place soon, and there was no other place to put them. The rest of the fishes were confined in the tidal creek, together with turbots and soles which had been kept from the last summer season. The intention was to select the ripe and healthy individuals from the creek for the pond, and to take back specimens that appeared seriously injured from the trawling operations by which they were caught. As the state of the weather had delayed the collection of the fishes till the beginning of the season, this arrangement was the only one by which a healthy and good stock of spawners in the pond could be gradually obtained. It is not always possible to distinguish the fishes which have been injured immediately after they are caught, as the injuries are mostly internal and due to pressure on the distended ovaries, while the surface is often in apparently good order. During the following weeks this transference took place, the best fishes being taken from the creek to the spawning pond and the most injured placed in the creek. An irregular spawning or emission of the eggs gradually began both in the creek and in the pond, the females shedding their eggs, which, however, were not fertilised, though ripe males were present in considerable numbers. This I thought was somewhat strange, especially in regard to the creek, where a sandy bottom offered the fishes a considerable advantage. Although the creek is a tidal one, it is very small, and the comparatively great number of fishes made me doubt if the natural supply of water was sufficient to keep all the fishes in a thriving condition. I therefore arranged so that water could be pumped occasionally into it from the harbour. In this way the water in the creek was artificially refreshed for about a week, but it had no visible effect on the fishes. In the meantime the spawners in the pond went on shedding their eggs at odd times, and on careful examination of the eggs it was found that none were fertilised. All the water available was therefore again pumped into the pond, as I felt sure the irregular spawning was largely owing to want of water, the fishes being in good condition otherwise. Shortly afterwards I found the fishes began to feed in the pond, an effect of their gradual acclimatisation and the improved circumstances; and by working the pump continually a regular spawning commenced on the 23rd of March.

In the creek matters were different, as the majority of the plaice there had been more or less injured in the trawling, nearly all the injured fishes from the pond being now transferred to it. It was therefore determined on the 22nd that all these fishes should be removed at the first opportunity, but before this could be done they all succumbed.

2. The Fishes in the Pond.

It has been explained how the fishes on arrival were at once placed in the pond and the injured specimens later transferred to the creek, and that an irregular spawning at first took place. Regular spawning began on the 23rd of March, and from that date till late in May fertilised eggs were daily collected, the percentage of those not fertilised being various, though relatively high all the season through.

The condition of the fishes in the pond was satisfactory, the death-rate being very low, a consequence of the selection that took place at the beginning of the season. A low death-rate amongst the spawners while in the pond is of great importance, otherwise the healthy fishes may delay their regular spawning.

By careful examination of the bottom of the pond daily, any fishes that succumb may be removed; but a very important point, as has been said, is the careful selection of the fishes during the first few weeks after they have been caught. From the delay in the spawning this season, owing to the low temperature, this was accomplished to a large extent before spawning became general, and no difficulties of the kind mentioned occurred, though the number in it was considerable. The fishes were fed on lugworms (*Arenicola marina*), gathered on the sands in the neighbourhood, and an average of about nine pounds were used daily in feeding the fishes. Plaice are extremely fond of this kind of food, the lugworms being put in alive and all eaten; no parts are left to contaminate the water. The space above the pond was also this year kept in darkness, the effect of this being to subdue the light to approximate to the natural condition in the sea. By careful examination, I have discovered not only that the plaice spawns at night, as was the case in 1894, but that spawning takes place in the course of a few hours after darkness sets in, and is always completed before midnight. This I was able to determine, not only by examination of the surface water in the pond during the night, but from the fact that in the morning the eggs which were then in the spawn-collector were found to be all advanced in development, and at the same stage.

Further, while the transparency of the water is of importance in order that the bottom and the fishes may be visible and at any time inspected, it has been found that the spawning is always increased if the water becomes somewhat obscure and dull,—a circumstance also showing the advantage of a darkened spawning pond.

3. Irregular Spawning (Unfertilised Eggs), and measures against it.

It has already been mentioned that an irregular emission of eggs took place at the beginning of the season, a number of the females shedding eggs without getting them fertilised. This being a matter of great importance, it will be of interest to state the probable cause of it, and the measures that can best be taken to prevent loss of eggs in that way. Eggs that are found unfertilised have generally been kept back in the ovaries of the fish after they were ripe and ready for spawning, and they differ in various ways from eggs that are spawned at the proper time. The irregularity is apparently owing to a voluntary action on the part of the fish, and is, I believe, a consequence of timidity, injury, or insufficient food and water supply. It is of interest to notice that nearly all such individuals have been hurt during the trawling, and as the irregular spawning mainly took place at the beginning of the season—shortly after the ripe fishes had been caught—the bulk of the unfertilised eggs were no doubt from specimens that were in the most ripe condition when placed in confinement.

It was only when acclimatised to some extent and supplied with a constant and full current of water that the fishes began to spawn in the ordinary way; at first the percentage of fertilised eggs was small as well as the total, but it gradually increased both ways.

This leads to the conclusion that an irregular spawning, such as occurred this year, is first of all due to the late capture of the fishes, when they are already in a ripe condition. The trouble and fright to which they are exposed makes them try to save the eggs,—which, though ready for spawning, are retained in the ovaries till they are destroyed. The facts that have been stated above all strongly point to the importance of collecting the spawners early—at least some months before the season begins. But even then the same acclimatisation would be required yearly—early or late ; injured fishes would be landed amongst the healthy ones, and yearly cause the same harm and trouble.

This would be avoided, or at least brought down to a minimum, if the spawners were kept from one year to another.

Such an arrangement is the only one by which the work can be carried out on the largest scale and with the greatest security in regard to the results. Twelve years' experience at the hatchery in Norway has led to the same conclusion ; there it has always been found that spawners kept in confinement for years are by far the best for breeding purposes. In consequence of this, hundreds of fishes are there constantly retained, although the severe winters cause difficulties that would not be met with in Scotland. That fishes which have been kept in the same locality for years form a better breeding-stock than those that have newly been caught, is quite natural; when constantly remaining in confinement, they will first of all be accustomed to it, but the eggs are also developing under the same circumstances in which they finally are spawned.

4. On the Hatching Process.

After the regular spawning began late in March, eggs were daily collected from the pond and transferred to the hatchery. This process was carried out in the same way as last year :—the eggs were separated from any extraneous matter by the addition of fresh water, which causes the eggs to sink to the bottom, so that the water can be poured off. The accompanying table shows the daily progress of the operations.

The total number of plaice eggs collected from the spawning pond and transferred to the hatching apparatus was 44,085,000, and from these 38,085,000 fry were distributed in the waters of the Firth of Forth and St Andrews Bay. The unfertilised eggs at first obtained from the pond were separated as much as possible; but a number were also mixed up with the fertilised eggs when they were measured, and in this way included in the total of eggs collected. This accounts for the higher apparent deathrate in the boxes,—amounting to about fourteen per cent. Last year, when practically no unfertilised eggs were collected the deathrate was only 4·4 per cent. As will be seen from the table, the total number in the hatching apparatus was sometimes considerable. From April 21st to May 13th more than 20,000,000 eggs were undergoing development, and during 13 days above 25,000,000. On such occasions it was necessary to crowd the eggs in the boxes—sometimes to the extent of about 400,000 per cubic foot of water; in such cases, of course, more special attention is required, or the deathrate would be considerably increased. On the 20th, 22nd, and 23rd of April about 6,000,000 eggs were fertilised artificially. I have mentioned above that very clear water delays the spawning to some extent; this varies for different individuals, and it has the greater effect on the fishes that are least vigorous from one cause or another. About the middle of April the water was clearer than usual, and I then found several fishes ripe, but apparently not spawning. The eggs of these were for the most part artificially fertilised, and are entered separately in the table, above the ordinary figure for collected eggs, on the 20th, 22nd, and 23rd of April.

The *specific gravity* of the water has this season been equally high and constant, as it was last year—a matter of great benefit in hatching operations on buoyant fish eggs.

Table showing the daily Proceedings at the Hatchery, and Observations on Temperatures, Specific Gravity, and Transparency of the Sea Water.

Date.		Temperature of the Air in the Hatchery at noon.	Temperature of the Sea-water at noon.	Specific Gravity of the Sea-water at noon.	Transparency in the Harbour at noon.	Number of Eggs Collected.	Number of Eggs found dead in Boxes.	Number of Fry put out.	Total Number in the Hatching Apparatus.
		Centi	grade.		Feet.				
Mar.	23	7·8	4·4	1027·1	18	550,000	...	...	550,000
,,	24	7·6	4·7	1027·0	18	450,000	...	...	1,000,000
,,	25	7·5	5·0	1027·2	16	380,000	...	...	1,380,000
,,	26	7·3	4·8	1027·1	18	320,000	...	...	1,700,000
,,	27	7·4	4·6	1027·0	10	300,000	60,000	...	1,940,000
,,	28	5·9	4·5	1027·3	6	340,000	...	...	2,280,000
,,	29	6·7	4·6	1027·4	2	360,020	...	...	2,640,000
,,	30	6·9	4·3	1027·2	1	550,000	180,000	...	3,010,000
,,	31	10·9	4·4	1027·2	1	750,000	...	...	3,760,000
Apr.	1	6·3	4·7	1027·0	1	500,000	230,000	...	4,030,000
,,	2	9·1	4·8	1027·1	3	700,000	...	...	4,730,000
,,	3	4·9	4·5	1027 0	3	650,090	...	...	5,380,000
,,	4	4·6	4·6	1027·2	4	650,000	...	...	6,030,000
,,	5	5·4	4·5	1027·2	3	600,000	...	...	6,630,000
,,	6	5·9	4·4	1027·0	2	500,000	270,000	...	6,860,000
,,	7	6·1	4·6	1027·0	4	790,000	...	...	7,550,000
,,	8	6·0	5·0	1027·1	7	825,000	...	...	8,475,000
,,	9	6·8	5·4	1027·3	10	850,000	...	...	9,325,000
,,	10	6·4	6·0	1027·5	16	700,000	...	...	10,025,000
,,	11	6·7	5·6	1027·3	18	1,100,000	240,000	...	10,885,000
,,	12	6·0	5·5	1027·3	14	600,000	...	...	11,485,000
,,	13	6·3	5·6	1027·1	10	700,000	...	...	12,185,000
,,	14	6·7	5·4	1027·1	15	900,000	...	...	13,085,000
,,	15	6·9	5·6	1027·3	18	1,200,000	340,000	...	13,945,000
,,	16	6·3	6·0	1027·1	12	1,050,000	...	...	14,995,000
,,	17	7·0	6·3	1027·1	10	800,000	...	...	15,795,000
,,	18	7·5	6·1	1027·0	14	925,000	...	...	16,720,000
,,	19	10·0	6·0	1027·2	18	850,000	...	...	17,570,000
,,	20	8·6	6·2	1027·3	more than 18	1,200,000 900,000	450,000	...	19,220,000
,,	21	9·2	6·5	1027·1	,,	1,300,000	...	...	20,520,000
,,	22	7·5	6·9	1026·9	,,	3,150,000 950,000	...	...	23,820,000
,,	23	9·1	6·6	1026·8	,,	1,800,000 960,000	...	...	26,380,000
,,	24	8·4	6·8	1027·0	,,	1,100,000	460,000	...	27,020,000
,,	25	10·4	7·1	1927·1	,,	1,400,000	...	3,200,000	25,220,000
,,	26	12·1	7·0	1027·1	,,	800,000	...	...	26,020,000
,,	27	11·5	7·1	1027·4	18	900,000	560,000	...	26,360,000
,,	28	13·1	7·5	1027·3	16	1,290,000	...	...	27,560,000
,,	29	14·4	7·3	1027·0	18	950,000	340,000	4,400,000	23,750,000
,,	30	13·6	7·4	1027·1	18	750,000	...	...	24,520,000
May	1	12·7	7·3	1026·9	more than 18	600,000	...	...	25,120,000
,,	2	13·4	7·5	1026·8	,,	675,000	410,000	...	25,385,000
,,	3	13·9	7·4	1026·9	,,	600,000	...	...	25,985,000
,,	4	12·9	7·7	1027·0	,,	670,000	...	...	26,655,000
,,	5	12·7	7·6	1027·1	,,	500,000	470,000	...	26,685,000
,,	6	12·9	7·8	1027·0	,,	870,000	...	...	27,535,000
,,	7	13·4	7·7	1026·9	,,	540,000	120,000	...	27,975,000
,,	8	13·1	8·0	1027·1	,,	500,000	320,000	6,800,000	21,355,000
,,	9	13·3	8·2	1027·1	,,	400,000	...	...	21,755,000
,,	10	13·4	8·1	1027·0	16	550,000	...	...	22,305,000
,,	11	13·9	8 2	1026·9	14	420,000	...	...	22,725,000
,,	12	15·4	8·3	1027·1	18	380,000	460,000	...	22,645,000
,,	13	14·4	8·1	1026·9	10	350,000	...	...	22,995,000
,,	14	14·5	8·5	1026·7	7	350,000	...	9,100,000	14,245,000
,,	15	15·5	8·4	1026·8	10	200,000	250,000	...	14,195,000
,,	16	15·2	8·6	1026·5	10	230,000	...	...	14,425,000
,,	17	15·9	8·7	1026·7	10	210,000	...	...	14,635,000
,,	18	16·5	8·8	1027·0	6	170,000	...	...	14,805,000
,,	19	16·1	9·1	1026·9	4	160,000	...	...	14,965,000
,,	20	16·9	9·2	1026·7	6	140,000	120,000	5,600,000	9,385,000
,,	21	16·0	9·3	1026·8	5	160,000	...	...	9,545,000
,,	22	16·4	9·5	1027·0	6	100,000	...	...	9,645,000
,,	23	16·7	9·9	1027·2	12	60,000	90,000	...	9,615,000
,,	24	16·3	9·9	1026·9	16	...	...	8,200,000	1,415,000
,,	25	17·0	9·8	1027·0	18	...	...	...	1,415,000
,,	26	17·7	10·1	1026·8	16	...	...	...	1,415,000
,,	27	16·9	10·2	1026·9	18	...	...	...	1,415,000
,,	28	17·1	9·8	1026·7	18	...	100,000	1,315,000	...
						44,085,000	5,470,000	38,615,000	

Before the hatching season began in February the *temperature* of the sea-water was exceptionally low. At Dunbar it generally varied between 1·5° and 2·5° C. during that month, while in other places further up the Forth the thermometer sometimes was down to zero or very near it.

Low temperatures such as those above mentioned have no particularly bad effect on the eggs while in the apparatus—I mean after they are spawned. But it will probably affect their preceding development in the ovaries as well as the condition of the fishes themselves.

The *transparency* of the water varied very much according to the direction of the wind; but by the new system of filtration the ill effects of muddy water on the occasions referred to have been considerably reduced.

5. The Distribution of the Fry.

The young fry are kept in the apparatus till the yolk-sac is nearly absorbed, at which stage they are distributed from the hatchery, the arrangements at which are not at present adapted for rearing the larval fishes. The time that elapses from the spawning of the eggs until the fry are ready for distribution varies considerably according to the temperature of the water; and the plaice generally remain in the hatchery for from three to five weeks.

The fry have been put out in the waters of the Firth of Forth and St Andrews Bay in various localities, as will be seen from the accompanying table. The fry have been distributed in the Forth when the tide on the occasion has been full or near it, and further out towards the Isle of May when the tide was low.

The same principle has been followed in St Andrews Bay.

Table showing the Localities where the Fry were put into the Sea.

Date.	Locality.	Temperature at the Surface.	Specific Gravity at the Surface.	Temperature at the Bottom.	Specific Gravity at the Bottom.	Transparency.	Depth in Fathoms.	Number of Fry put out.
		c.		c.				
Apr. 25	Firth of Forth, at the middle of Station V., about 4 miles west of Isle of May,	7·2	1027·5 / (8·6)	4·9	1028·1 / (8·1)	3	28	3,200,000
,, 29	Firth of Forth, midway between Isle of May and Fife Ness,	6·4	1027·8 / (8·2)	5·7	1028·0 / (7·8)	3	19	4,400,000
May 8	Firth of Forth, Station I., east end, 5¾ miles from Fidra,	7·5	1027·2 / (11·7)	6·4	1027·2 / (12·5)	3½	16½	6,800,000
,, 14	St Andrews Bay, Station I., middle, one mile off shore,	10·0	1026·2 / (10·6)	7·7	1027·2 / (10·5)	5	10	4,500,000
,, 14	St Andrews Bay, Station II., west end, two miles off shore,	9·8	1026·2 / (10·8)	7·6	1027·1 / (9·7)	5	9½	4,600,000
,, 20	Firth of Forth, 4 miles N.N.W. from Fidra,	10·4	1027·2 / (11·1)	7·9	1027·8 / (10·6)	6	24	2,900,000
,, 20	Firth of Forth, Station I., middle, four miles off shore,	9·3	1027·2 / (9·9)	7·8	1027·6 / (9·1)	3½	13	2,700,000
,, 24	Firth of Forth, Station V., middle, 4 miles west of Isle of May,	7·6	1027·7 / (8·7)	6·9	1027·6 / (8·7)	6	20	8,200,000
,, 28	St Andrews Bay, Station V., four miles off shore,	9·5	1026·7 / (10·9)	7·7	1027·4 / (10·4)	3½	15	1,315,000
								38,615,000

While the plaice this season have been mainly dealt with on a large scale, the eggs of other species have also been fertilised and incubated, and the young fry distributed in the waters of the neighbourhood. A summary of the numbers of young fry put out from the hatchery during this spring season (February—May), is as follows :—

Plaice (*Pleronectes platessa*)		38,615,000
Long rough dab (*Hippoglossoides limandoides*) Common dab (*Pl. limanda*) . . Flounder (*Pl. flesus*) . . .	about	600,000
Cod (*Gadus morrhua*)		2,760,000
Haddock (*G. æglefinus*). . . Whiting (*G. merlangus*) . .	about	450,000
	Total of fry hatched	42,425,000

6. Experiments with the Sole.

In my report* on the operations last year, a detailed account is given of the work on the plaice during the spring season.

Later, experiments were begun with the sole, turbot, and lemon dab, and I may here give particulars of these experiments during the time I was engaged in charge of the operations at the hatchery. This, however, terminated on the 20th of July, and before the experiments had been brought to an end.

In the account of the hatchery given in the Board's Twelfth Annual Report, full particulars will be found as to how soles were transported by rail from the Lancashire coast to Dunbar ; while turbot were brought in the same manner from the west coast of Scotland (Girvan). In the same paper, Dr Fulton also describes what arrangements had been made here to allow experiments with different species at the same time.

The spawning pond had been divided into two compartments, each with a separate in-flow and out-flow, the one part being for turbot, and the other for soles; while the tidal creek had been preserved for the lemon dabs.

During the early part of June soles were collected in the tidal creek, from which, on the 14th of that month, they were transferred to one of the compartments of the spawning pond, since a few eggs of the sole had been observed in the surface water in the former place. These eggs, however, were not fertilised ; but an occurrence like this often takes place previous to the actual spawning, which, therefore, was expected to take place in the near future. After this transference, the fishes remained very quiet, and were only occasionally seen swimming about in the water ; some specimens were seen to remain on the same spot for a day or more at a time. It was not until the end of the month that they became more acclimatised, and were apparently in good progress, as they about that time began to take food. Lugworms (*Arenicola*) were mostly used. But though the soles were prospering well, no eggs were observed in the water ; during the first weeks of July, I therefore made some modifications of the arrangements in order to find out the most desirable circumstances under which the fishes were expected to spawn. But before this could be finished my engagement in charge of the operations was terminated.

The collection of turbot from Girvan was carried out in the middle o

* *Twelfth Annual Report,* Part III. p. 196.

June; some of the fishes were at first confined in the creek, from which they were transferred on the 15th to the vacant compartment of the spawning pond. The fishes that were brought after that date were at once placed in the pond. In this confinement the turbot remained very quiet; in fact, none were seen swimming about in the water, and it was only when stirred up by the landing net, that some of them made their appearance near the surface. When left by themselves they again settled on the bottom.

While the soles in the beginning of July began to feed, and, on the whole appeared to make good progress, the turbot remained in the same quiet condition for a longer time, and it was not until about the middle of July that specimens were seen to swim about in a more natural way As in the case of the soles, modifying experiments as to the best arrangements were not completed. A great variety of food was put in to the fishes, such as lugworms, young soft crabs, small fish of various kinds, shrimps, &c., but during my stay I was unable to actually see if anything was eaten by the turbot.

As was explained last year, the tidal creek had been converted to a spawning pond in which the eggs might be collected by a floating collector—the depth of the water in the creek varying according to the tide.

The lemon soles were supplied by the 'Garland,' during the middle of June, and were caught in the Firth of Forth. This species is comparatively hardy, and, on the whole, easy to deal with, so a satisfactory result as to their breeding was looked forward to. And about the end of June and the beginning of July, fertilised eggs were found in the water, so that it was certain that natural spawning had occurred: their number was, however, too small for hatching operations. This was apparently owing to the fishes caught by the 'Garland' being of a small size. Of fifty-one specimens, of which I have got the measurements, the average size was 11 inches, and only thirteen had a length of 13 inches or more. The fishes, therefore, were mostly immature, which accounts for the small number of eggs. The lemon soles were caught by the 'Garland' when trawling for other purposes, and the fishes, notwithstanding their small size, were landed, as there was no particular trouble or expense in connection with the transport, or the confinement in the tidal creek.

7. On the Experiments with the Breeding of Turbot during the Autumn 1894, and the month of June 1895.

As has been stated above the experiments with the turbot last year did not lead to any actual spawning, though the fishes were kept under observation in the pond a considerable time. When removed a number were found to have become abraded and ulcerated on the lower surface of the head, apparently owing to friction against the wooden flooring. It was surprising that the same conditions which suited the plaice well should not have suited the turbot, and it was impossible to foresee that this would happen.

But it must be kept in mind that the turbot are much larger fishes than the plaice, and that they were kept in the pond for more than four months after I left, and without being acclimatised beforehand,—circumstances, to which it should not be necessary to have the fishes exposed. The injuries, however, were gradually healed some months after the turbot had been transferred to the creek, which has got a sandy bottom. The number which succumbed was naturally greatest during the first weeks after confinement, but was gradually and constantly decreasing. The twenty-three specimens which were left in November, lived in the creek throughout the winter, but they were unfortunately present in the creek when the injured plaice succumbed, and were all lost in the beginning of April this year, as I have explained above.

Examination of the ovaries showed that they contained minute ova under development for this season; while the eggs from last year were mostly present in a more or less disintegrated condition.

As has been mentioned already, the turbot last year became ulcerated on the lower part during their stay in the pond; they had been confined to the one half of the latter—a space, perhaps, too small for the rather big fishes; in any case, I am inclined to think the injury would have been less if the fishes had had more freedom for their movements in a larger space.

This year, in order, if possible, to avoid difficulties from the kind of bottom, the turbot have all the time, since they were received, been kept on a sandy bottom in the creek; and the bottom of the pond has also been covered with a layer of sand. As was done last year, the turbot have again been transported from Girvan: twelve were got on the 14th and sixteen on the 20th.

Though only a fortnight has passed since the first turbot were got, and not much time given for acclimatisation, they are already in good progress; during the last few days they have taken some food—fresh herring—and, though an actual spawning cannot yet be expected, owing to the short time of confinement, unfertilised eggs are daily found in the water; as some of the fishes are ripe, eggs have been artificially fertilised, and about 3,800,000 young turbot delivered in the neighbouring waters.

So far the work on turbot has this year been successful, and though nothing can be said as yet with certainty, as to the future progress during the season, there is good prospects that satisfactory results will be obtained.

III.—THE CAPTURE AND DESTRUCTION OF IMMATURE FISH. PART IV. THE RELATION BETWEEN THE SIZE OF HOOKS AND THE FISH CAPTURED. By Dr T. Wemyss Fulton, F.R.S.E., Superintendent of Scientific Investigations.

In continuation of the inquiries into the capture and destruction of immature fish by various modes of fishing, a number of experiments have been made concerning the relation between different sizes of hooks used in line fishing and the sizes of the fishes captured by them. In last year's report* the results of corresponding observations on the influence of variation in the sizes of the mesh of trawl-nets on the fish captured are described. It has been shown in various previous reports that considerable numbers of immature fishes, and especially round fishes, are caught by hooks in line-fishing; and it has been frequently proposed that the capture of such forms, which are commercially of little or no value, might be to a large extent avoided by the use of a different hook. These experiments were accordingly devised to determine this point. They have been carried on by means of the 'Garland,' and principally in the Firth of Forth, during autumn and spring for two years. Six varieties of hooks were employed, technically known as numbers 7, 8, 10, 18, 19 and 20, and they were disposed in twelve alternate series of 200 hooks, or 2400 in all; the total length of the line being 1200 fathoms; and the hooks were baited with mussels in the ordinary way.

The number of shots made in the course of the experiments was twenty-one, and the total number of fish caught was 2480, comprising chiefly haddocks, whitings, cod and common dabs. A special form was prepared, in which the size of the various fishes caught on each series of hooks was entered by Mr T. Scott, and also particulars showing the manner in which the individual fishes were caught, *i.e.* whether the hook had been swallowed and become fixed in the throat or gullet, or had merely penetrated the lip or other superficial part. The details in regard to the precise manner of capture are of importance as indicating the proportion of line-caught immature fish that would survive on being returned to the sea. It was shown that those caught by the gullet are fatally injured in the ordinary process of taking them from the hook, while those caught by a superficial part would, as a rule, survive.

Of the six kinds of hooks which were employed in the experiments, numbers 18, 19 and 20 are commonly used in the inshore haddock fishing; the other numbers are larger in size. As might have been anticipated, the smaller hooks caught a greater number of fish than the larger ones did. Thus, of 2532 haddocks, whitings, cod and common dabs captured, 715 were taken by number 20, 540 by number 19, 500 by number 18, 474 by number 10, 191 by number 8, and 112 by number 7. One of the principal points to be determined was the relative proportions of mature and immature individuals of the various species caught by the different sizes of hooks; information similar to that already obtained respecting variation in the sizes of the mesh in trawl nets. For this purpose the fishes captured by each kind of hook have been divided into two groups, one comprising the mature forms and the other the immature forms. Haddocks which measured 10 inches or more in extreme length have been regarded as mature; whitings of 8 inches or more, cod of 20 inches or above it, and common dabs of 6 inches or more, have also been included as mature;

* *Twelfth Annual Report,* Part III. p. 302.

these sizes being founded upon the information previously ascertained concerning the lengths at which the species named become sexually ripe.* The total number of mature haddocks taken in all the experiments was 776, the immature numbering 1303; the number of mature whitings was 209, and the immature only 14; the number of mature cod was 10, and the immature 102; the number of mature dabs was 117, and the immature only 1.

The proportion of immature haddocks obtained is considerable, and the ratio of the number of immature to mature increases as the size of the hook diminishes. Of 90 taken with the largest hook (No. 7), 47, or just a little over half, were immature; with the smallest hook (No. 20), 588 were captured, of which 425, or over three-fourths, were immature. It is the same with the whitings and the cod. Nevertheless, as may be seen from the accompanying table, a considerable number of immature forms were captured by the larger hooks :—

Showing the Numbers of Mature and Immature Fishes caught with the different kinds of Hooks.

No. of Hook.	Haddocks.		Whitings		Cod.		Common Dabs.	
	Mature.	Immature.	Mature.	Immature.	Mature.	Immature.	Mature.	Immature.
7	43	47	8	1	2	9	2	–
8	86	86	10	–	2	6	1	–
10	170	227	43	2	–	17	15	–
18	172	248	33	2	4	25	15	1
19	142	270	60	4	1	24	39	–
20	163	425	55	5	1	21	45	–
Total.	776	1303	209	14	10	102	117	1

The proportion of immature round fishes captured by hook in line-fishing is, therefore, considerable; but for the reasons above explained, it is necessary also to consider the precise manner in which they were captured, or in other words, the nature of the injury inflicted upon them by the hook. An analysis of the records shows that, of the 1419 immature haddocks, whitings, and cod obtained, 686 had swallowed the hook, which was imbedded in the throat; 652 were caught by the hook penetrating the mouth or inner surface of the lips; 39 were caught through the outer surface of the lip; and 42 by the gill or the skin. The figures for each species are as follows :—

	Caught by Pharynx.	Caught by Mouth.	Caught by Outer Surface of Lip.	Caught by Gill, Skin, &c.
Haddock, .	630	597	37	39
Whiting, .	3	9	1	1
Cod, . .	53	46	1	2

On considering the proportions caught in these various ways by the different kinds of hooks, it is found that the great majority of the immature specimens which were caught by the pharynx were taken by the smaller hooks, and that those captured by the larger hooks were

* *Eighth Annual Report*, Part III. p. 161; *Tenth Annual Report*, Part III. p. 236.

for the most part caught by the mouth or the inner surface of the lips. The proportions for each kind of hook are as follows :—

	Size of Hook.					
	No. 7.	No. 8.	No. 10.	No. 18.	No. 19.	No. 20.
HADDOCK.						
Caught by pharynx, .	3	14	78	131	128	276
,, ,, mouth, .	41	59	133	96	128	140
,, ,, outside of lip, .	1	4	12	10	6	4
,, ,, skin or gills,	2	9	4	11	8	5
COD.						
Caught by pharynx, .	5	4	10	12	15	7
,, ,, mouth, .	3	2	7	11	9	14
,, ,, outside of lip, . .		.	.	1	.	.
,, ,, skin or gills,	1	.	.	1	.	.
WHITING.						
Caught by pharynx, .	.	.		2	1	.
,, ,, mouth, .	1	.	2	.	2	4
,, ,, outside of lip, .	.	.	.	.	.	1
,, ,, skin or gills,	.	.	.	.	1	.

Another point investigated was the minimum and maximum sizes of the various kinds of fish caught by the different hooks; and it was found that, although the greater proportion of the smaller fishes were taken by the hooks of least size, the largest hooks also captured very small fishes. Conversely, the smallest hooks sometimes caught relatively large fishes. There is not, therefore, anything like the uniformity between the apparatus of capture and the size of the fishes caught in line-fishing, as there is in trawl-net fishing, in which variation in the size of the mesh has a profound influence on the size of the fishes taken. The minimum and maximum sizes caught by the different kinds of hooks are given in the following table :—

Showing the Maximum and Minimum Sizes of Fishes captured by the different-sized Hooks.

No. of Hooks.	Haddocks.		Whiting.		Cod.		Common Dabs.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
7	20	4	11½	7	24	9	12	10
8	18½	8	13	8	46	13	9	8
10	21	7	14	6	18	8	11	7
18	15½	6½	12	5	42	7	12	5
19	17	7	12	7	28	9	10½	7
20	20	7	15	5	31½	8	13	6

The results of these experiments show that it would not be practicable to avoid the capture of immature round fishes by the use of a larger hook, as has been sometimes proposed. While a larger hook would, to some extent, decrease the quantity of immature round fishes caught, and especially, as the above tables indicate, those caught by the pharynx or gullet, and thus fatally injured; any advantage in this way would not be commensurate with the general decrease in the catch. In this respect line-fishing is quite different from trawl-net fishing, in which variation in the size of the mesh directly affects the size of the fish caught. Besides, it has to be borne in mind that the immature fishes caught by line are almost entirely round fishes, such as haddock and cod, whose numbers do not appear to be diminishing. Of the 118 flatfishes (dabs) captured in the course of these experiments, only one was below the size at which sexual maturity is reached, although that size is only six inches.

IV.—ON THE HISTORY OF MUSSEL CULTURE AT MONTROSE DURING THE PAST SIX YEARS. By J. H. FULLARTON, M.A., D.Sc., F.R.S.E.

In the Seventh Annual Report of the Fishery Board for Scotland, my colleague, Mr Thomas Scott, F.L.S., and I, described the system of mussel culture which has been followed at Montrose since 1853. In choosing the Montrose beds to illustrate the cultivation of mussels on the bed system, regard was had not only to the character of the beds themselves, but also to the thorough methods in operation which had converted an expanse of mud and sand under water during the greater part of the day into ground capable of rearing large quantities of mussels. The mussel-ground in Montrose Basin is not of the highest class, and the cultivators have difficulties to contend with and to overcome, which are not met with in more favoured localities. Looked at as a whole, the area under cultivation is fairly good ground, and the operations there will serve as a pattern to various districts, where good, although not the best, mussel-growing ground is to be found. The biological, geological, and physical conditions exhibited by Montrose Basin, and the methods pursued by the cultivators—the Ferryden and Usan Fishermen's Society and Messrs J. Johnston & Sons—were given in some detail in the previous Report on Montrose. While the system remains the same, much has happened within the past six years, and difficulties have arisen within this period greater than any encountered since cultivation was begun upwards of forty years ago. Consequently, many lessons can be learned which will be useful to intending mussel farmers, whether these be public bodies or private individuals.

The object aimed at is to augment the producing power of the mussel ground, or possible cultivable ground, so that an additional supply of bait may be available for the small-line fishermen. The history of the Montrose beds for the past six years shows most praiseworthy enterprise, and when one is familiar with the detailed working of the beds, the vigilance exercised by the Superintendents, Messrs West & Lonie, must be noted. In the beginning of 1889, owing to certain contingencies the aspect of affairs in Montrose Basin was very different from what it is in 1895. In the former year the stocks carried were less on the north side and greater on the south side than in 1895. Progress, however, has been attained, and I have been a witness of the slow, but, nevertheless, sure and steady advance towards increased productiveness. The present condition of the mussel area on the Dun Sands has been attained only after combating successfully the difficulties which will always in a greater or less degree be experienced at Montrose. The first, and an ever-recurring difficulty, is the question of seed for stocking the large area under cultivation. The scarcity of seed during the first three of the six years under review was chiefly caused by the constant dredging of the Montrose Harbour Trustees. A navigable channel must always be maintained, and even mussel culture is secondary to the interests of navigation. The prolonged operations of the Harbour Trust to ensure a certain depth of water in the harbour, prevented the seed settling on the river bottom, or if it did settle, it was rapidly covered up and buried by the great quantity of mud carried in suspension by the currents of water and deposited over the whole river bottom. The bottom of the bed of the tidal South Esk forms an admirable collecting-ground for seed, but as the portion where it settles is below the suspension bridge and is part of the harbour, it will always be liable to disturbance and destruction when steam-dredges are engaged in obtaining increased depth of water. The dredging destroys not only the river bed as a catchment area, but the foreshore of the lower reaches of the river, as was noticed in the 1889 Report, cannot afford a resting-place for the spat owing to the great quantity of silt thrown upon it. Fortunately, however, dredging is not permanent. During the spatting season there are years when the increase in the rainfall is not appreciable, and so the spat is not lost from this cause. In such years the spat can collect on the large stretch of foreshore, below Ferryden as well as on the Scalp, Rossie Island, and the Briggs of Binny. After dredging operations have been concluded the river bottom is hard and presents the best condition possible for a catchment area for spat. Gravel, shingle, and rocks are the natural resting-places of such young molluscs as the common mussel, and when the surfaces of these are clean, they form the best kind of collectors for the free-swimming embryos.

Whilst the two great drawbacks to a plentiful supply of mussel-spat are the silting of mud depriving them of a solid foundation on which to rest, and the increased volume of river-water brought about by great rainfalls carrying the free-swimming embryos to sea, there are other conditions which are favourable. Where the bed of a stream is uneven, and where the river banks are winding, eddy currents are formed which carry the young mussels into quiet spots where they obtain time to affix themselves. Oysters are helped in a similar manner, and by the arrangement of sluices and collectors eddy currents are promoted in order that as large a brood as possible may be captured. The chief places at Montrose, where such eddy currents exist, are on the north side, at the Briggs of Binny and Binny Bank, and on the south side in the neighbourhood of the Scalp. The tongue of land, which is seen at low water running from the north side eastward into the stream of the South Esk, causes an eddy to be formed at this part; hence these banks become natural collecting-ground for spat. The current of the South Esk impinges against the shore of Rossie Island at the Trout Shot, and sometimes a coating of seed is obtained at that point where the current is divided, part flowing down the Inch Burn, but the chief stream running to the north of Rossie Island and forming an eddy. The best and most constant eddy, however, is found where the bank known as the Scalp narrows the breadth of the channel of the river. Consequently, this is the best seeding area at Montrose. Along the shores of the lower reaches of the river there are always currents running in a direction opposite to the direction of the current in the channel. While these side-currents are generally too swift to allow much seed to settle on the foreshore, yet, in some years, a large quantity is obtained from the shingle and gravel of the Ferryden foreshore below the village and above Johnny Mearns' Harbour. In addition to the eddies there are other agencies contributing to a successful deposit and ingathering of mussel spat. The number of mussels present in Montrose Basin bears a direct relation to the quantity of spat obtainable in any year. If all the spat, extruded from say a dozen mussels, were to fix, settle, and grow, probably these might stock as large an area of foreshore as is seen in an average year below Ferryden. But as only a very minute proportion of the free-swimming embryos—possibly not a millionth of a millionth of a millionth —ever finds a resting-place and grows, the larger the stock of adult mussels in Montrose Basin, the better the crop of seed that may be looked for. When the stocks were low at Montrose the quantity of mussels obtainable was not so great as when the whole basin in the upper reaches was completely stocked. The French recognise the direct relation of the quantity of adults to the yield of spat and so maintain large *bancs reserves* of oysters in order to supply a sufficient number of young oysters for stocking the growing-beds in future years. In mussel culture similar methods are as necessary as in oyster culture. If stocks are unduly diminished, prolific as mussels are, there need not be surprise if there is a diminished yield of seed for stocking the growing and fattening beds for some years to come.

Comparing the present condition of the mussel beds in Montrose Basin, while the beds on the north side of the South Esk tenanted by Messrs Johnston & Sons are stocked to their fullest extent, those of the Ferryden and Usan Fishermen's Society are not nearly sufficiently stocked. The Ferryden or Rossie beds are more favourably situated for growth and fattening than the Dun beds on the north side, but, owing to a scarcity of seed, advantage is not taken at present of all the available mussel-growing ground. Mr James West, the fishermen's superintendent, informs me that his society spent nearly £300 in obtaining seed in 1893, but that, as it was lifted much too soon, a large proportion of it was lost in sowing it on the inshore bank. The seed was about half-an-inch in length when it was lifted. It cannot be too strongly urged that seed so small as this is too young for transference from its first resting-place. Seed mussels should be, at the very least, three-quarters of an inch long before they are lifted. The French have a minimum size which all oysters must attain before they can be legally transported. Something similar is necessary in the case of mussel seed. When there is a dearth of seed the tendency is to secure it too soon, and when the labourers, who are not fishermen, rake the river bottom for seed in order to earn wages, they are too often regardless of whether the seed supplied conforms in size to the sample shown to the mussel farmers. Stringent regulations are required in connection with seed mussels, and intelligent enforcement of regulations will be welcomed by the mussel cultivators. The yield of spat from the South Esk has been quite inadequate to the stocking of the growing beds; consequently, large quantities had to be imported from a distance. The Tay furnishes the nearest mussel ground where a supply of seed can be got, and the unlimited resources of the estuary from the Tay Bridge to the Pool mouth were drawn upon. For three years large quantities were systematically and continuously imported at great cost from Tayport and from Broughty Ferry. This importation of Tay seed has given employment to a large number of Tayport mussel dredgers who secure the seed and forward it per rail to Montrose. The same system which is employed in France and Holland in connection with the cultivation of the oyster has, by the foresight of the tenants of the Dun Sands, been carried out at Montrose, with the result that Montrose Basin is now capable of yielding a larger supply of mussels from the north side of the South Esk than could have been obtained when our previous report was made. If the Scottish mussel beds are to be resuscitated a corresponding expenditure will be necessary. Since the importation of mussel seed from a distance began at Montrose, the Inverness Town Council, on my advice, carried out a similar plan, but on a much smaller scale, and the results have satisfied expectations. Except in the case of the E'e, near Nairn—and this was only on the small scale adopted by individual fishermen in the West of Scotland—we never have had anything similar to the large importations of seed from a distance as was the case at Montrose and in less proportion at Inverness. If the Ferryden Society would follow this excellent example, which, however, can only be carried out by a large expenditure of capital, their beds would be more prolific than they are at present or are likely to be for a few years to come.

The deficiency of native seed was predicted in our Report (*Seventh Annual Report*, Part III., p. 332), and the result has been in accordance with the prediction. Since 1889 till the autumn of 1892, there was no 'fall of seed' on the seeding ground of the River Bed, the Briggs of

Binny, Rossie Island, the Scalp or Ferryden foreshore. While this lack of seed was equally felt by both tenants, the Ferryden Society, on whose ground the chief catchment areas are found, have suffered most. As the society depends entirely on native seed mussels obtainable from the lower reaches of the South Esk, the three bad spatting seasons of 1889, 1890, and 1891, along with the large sales of adult mussels, caused their beds to become impoverished. This accounts for the less favourable condition of the stock on their mussel ground.

Dealing with the beds in order, I will notice the changes that have taken place in the different beds within the past six years.

Ferryden and Usan Fishermen's Society.

(1). *The Scalp* is one of the best seeding areas of the society, but the average quantity of seed yielded by it in recent years has not been maintained. For two years after our Report, no seed was obtained from it, but in the autumn of 1892 seed appeared on it, and this crop yielded between 4th June and 15th July in the following year 2000 baskets, and the river-bed bordering it added 2000 to this quantity, so that a total of 4000 baskets of seed mussels were available, and were deposited on the Inshore Bank. The seeding area of the Scalp extended on the inside of the lower end to 150 yards by 50 yards, and that of the middle, outer, and lower part was 200 yards by 20 yards, and extended into the deep part of the river. The mussel-seed lifted from it in 1893 was only about half-an-inch in length, the consequence of too early transference from the Scalp being that half of the quantity lifted and deposited on the Inshore Bank was lost. In 1894, however, 6000 baskets were lifted and deposited on the Salthouse Bank, and on the lower and inner edge of the Big Bank. As this was the remaining portion of the large seed crop which settled in 1892 on the Scalp, the mussels had, before lifting, attained a sufficient size to live and thrive after transference.

(2). *Rossie Island.*—On the shore at the Trout Shot, which was distinguished as the north west bed, where the branch current from the South Esk is diverted into the Inch Burn, so little seed has settled since 1889 as not to be worth lifting, but on the north east bed, inside the lower end of the Scalp, the foreshore yielded in 1893 a fair quantity of seed, the area covered being of much the same extent as that noticed in the previous Report.

(3). *Ferryden Shore of River.*—The operations of the Montrose Harbour Trustees, undertaken for the purpose of deepening the harbour in 1889, 1890, and 1891, naturally prevented the free-swimming embryos of the mussels settling on the foreshore or river bank, while the dredging work was in progress, or if seed did settle, it was quickly covered by the mud and silt carried down and deposited by the ebb current. As soon, however, as these operations ceased, seed settled after the next spatting season. Indications of a crop appeared in 1892, and the first crop after an interval of three years was reaped in September 1893, to the extent of 2000 baskets. In 1894, 1040 baskets of seed were lifted, being really the remains of the crop of 1893, and were sown on the Salthouse and Big Banks. The seed sown in 1893 was shifted to the Inch Burn Bed. The area covered by seed in former times extended to about half-a-mile in 1893 ; only a narrow strip of foreshore, about 300 yards long by 7 yards broad, carried seed mussels. Altogether, in 1893, the society expended nearly £300 in seeding, and about 8000 baskets were got from the shore, and dredged from the river.

(4). *Inch Burn Bed.*—Since previous Report two crops of mussels have been taken from this ground. The stock which was on this bed at the time of my first visit in 1889 was removed from it within a year, and a new lot of seed was sown in 1890. These mussels took from three to four years to become large and fat enough for bait. As laid down in 1890, they amounted to 2000 baskets, and about 6000 baskets were obtained from this, most of them in the season 1893–94, and the remainder of them in the past season. It is now again covered with 1894 seed, which should be ready for lifting in the course of the next three years. The ground here is better than it has been for several years, which is accounted for by the fact that before the last crop of mussels it had lain fallow for three years.

(5). *Big Bank.*—The increase in breadth noticed in the former Report has not continued. The increase or diminution of a bank may be regulated to a moderate degree by diverting the stream by the aid of obstacles, so placed that the current is made to wear away portion of the bank when a diminution in size is desired, or to carve away material from a neighbouring bank and throw it towards the bank to be increased. The small weir-like obstruction in the channel of the South Esk, above the Broadwater Bank, serves to protect this latter bank at the expense of the Big Bank. No increase in breadth can be made to the Big Bank, at least on the side next the Broadwater Bank. Between 1889 and 1893, it was fully stocked with mussels, but in the last mentioned year two-thirds of its area was stripped, and the remaining mussels were lifted in 1894. At present, about one-fourth of its surface at the upper end is covered with mussels transferred from the scalp in 1894. The rest of it, viz. three-fourths, is lying fallow, but if seed were obtainable it would also be covered, as it is in good condition to grow and fatten mussels. The society, however, lacks a supply of seed at present.

(6). *Guano Bank.*—This bank maintains much the same size as in 1889, but the lower end of it may diminish in extent by the encroachment of the South Esk towards the south. It is in parts somewhat too high for mussel growth and two-thirds of its extent is fallow, the remaining third being covered with mussels. If there had been a dearth of storage ground for the crop of the Fishermen's Society, it might probably have been utilised for this purpose, but at present, as the stocks are low this is not necessary.

(7). *Middle Bank.*—This bank is empty at present, but should be sufficiently worn down so as to be fit to carry mussels in 1896. The fishermen of Ferryden and Usan were supplied from this bank during the winter of 1893–94, but it did not afford them along with the mussels obtainable from the other banks of the society, a quantity sufficient to meet their bait requirements.

(8). *Salthouse Bank.*—This is still the best growing bank of the society, and mussels mature on it three years after being laid down as seed. The mussels, which were on it in 1890, were removed from it for bait in 1893. At ordinary times the increase in height by the accumulation of mud by the mussels, compels the superintendent to let it remain fallow in ordinary course for two or three years. When I visited it at the end of 1893, it was being cleaned, but the north east gale immediately before my visit did it as much good by lessening its height, as Mr West considers would be done by allowing it to lie fallow for three years. This storm which worked much havoc by the heaping together of the mussels and by the burying of them, especially on the West Steinschell Bank, cast ashore one hundred cart loads of sea-weed on the Salthouse and neighbouring banks, and so did much good, though also much harm to the mussel farmers. In 1894, the upper end of it was again stocked with seed mussels from the Scalp, and though the lower end of it towards Rossie Island is now bare, yet there is a sufficient quantity of mussels on the upper end to cover its whole area when they are spread out.

Messrs. J. Johnston & Sons.

(1). *Briggs of Binny.*—This bank is a seeding area and nursery for young mussels, and received a coating of seed in 1893 and in 1894. In 1893, its whole area was covered with seed, but a succession of gales and spates carried away half of the crop. Those mussels which were carried off during the flood-tide were swept to the westward, and were partly deposited on the bank on the upper side, and to this extent the loss was mitigated. Part of it was again covered by seed last winter, but the coating was small as compared with that of the previous season. The seed noticed first in the winter of 1893 was partly removed in 1894 to the other banks on the west of the Steinschell Burn, and the remainder of the same deposit of seed was being removed early this year, 1895. The seed of the winter of 1894 will remain on the Briggs of Binny till next year. The bank was being cleaned so as to be ready for the summer deposit of seed of 1895. This bank experiences the effects of storms and spates and its value as a catchment basin for seed is proportionally lessened. Its surface consists of stones and gravel which serve for collectors.

(2). *Big Binny Bank* like the Briggs of Binny is also hard ground—sand and gravel. The gravel, which is found where the eddy currents are strongest felt, extends over an area of 300 yards long by 80 yards broad, and it affords good resting-places for the young of the mussels. In the winter of 1893–94, it was seen to be covered with seed, which had not been noticed on it some months earlier, and Mr Andrew Lonie, the superintendent, believes that the seed was deposited in the winter, designating it by the name of January seed. He came to this conclusion also from the impoverished and thin condition of the adult mussels in the neighbourhood. Probably the seed was deposited some considerable time before it was observed, as when the embryo mussel-shell is transparent and minute it is not readily seen. At any rate, the spat must have been late in the season. If the spat was shed as late as the end of September and fixed then, the stagnation in growth, which many marine animals exhibit during the colder months of the year, might account for the very small size of the seed when it was first noticed in January 1894. It is evident that the spat must have been a late one, but it is unnecessary to place the spatting period so late as the end of the year. The impoverished and thin condition of the adults might be due not to spatting alone but perhaps also to the mussels being supplied with too much fresh water from the increased rainfall in the river basin; in this the normal quantity of food would be greatly lessened. The seed which was first seen in January 1894, is still on Big Binny Bank, but is now ready to be lifted However, as all the available ground on the Dun side of Montrose Basin is filled with mussels at various stages of development, the superintendent considers that it is better where it is, as it will grow quicker in its present situation, being only uncovered at ebb tides for a short time.

(3). *Broadwater Bank.*—This bank is now almost completely stocked with mussels, and, with the exception of a high ridge along its centre which is too long out of the water at low tides, it is in good condition to permit of growth and fattening taking place. The small gaps here and there which are bare of mussels are being filled up, and by the end of May there will be a uniform covering of mussels over its extensive area. The mussels on three-fourths of its surface will be ready for using as bait by October next. The stones placed diagonally across the stream slightly above the bank, as well as the large crop of mussels, serve to maintain its extent. The currents, however, have impinged against the upper end and carried away the clay along the edge so that the bed does not shallow gradually to the bottom of the stream, but ends abruptly. Since September 1893, fully one-half of the stock that was on the bank was sold during that season, and the remainder was ready for sale last winter. This bank sometimes takes a considerable time to clean before mussels can be removed from the higher banks to stock it.

(4). *Sticks Burn Bank.*—As in 1889 this bank is still very high. The great depth of clay and mud on its surface makes it very soft and it is difficult to scour. Such storms as were experienced in the winters of 1893 and of 1894 from the north-east and north-north-west respectively, might do much to lessen its height, but when the bed is completely clothed with mussels, much more harm than good is done. The north-easterly gale of 1893 did much damage to the crop, as some parts of it were laid entirely bare, while at other places the mussels were piled on the top of each other to the depth of several inches, and had to be re-spread. Storms cause great loss, especially on banks of medium height, and on the leeward side of them, but on such beds as Messrs Johnston & Sons, the loss is much mitigated by the great number of men who are employed without delay to save the mussels that are buried. The mussels which are heaped up are soon spread out so that the surface of the bed again presents a fairly uniform coating of mussels. Still, many of the mussels are lost by being buried in the soft mud. The same area is covered with mussels as in 1889, but the crop is not quite so closely packed as it was two or three years ago. This is one of the slowly-growing beds which requires seven or eight years' growth to bring the mussels to the proper size and fatness; this long time, however, is considerably shortened by the removal of the crop to other and better beds.

(5). *West Steinschell Bank.* — The increase in breadth which was noticed in the Report of 1889 still continues, and a strip, at least 10 yards broad, has been added to the bank on the east side. Unless the East Steinschell Bank can be cut in two by the diversion of the Steinschell Burn down a natural hollow in it, which has become more pronounced within the past year, it is unlikely that the bank will go on increasing in size to any appreciable extent. The bank on the south side is still very high, and the whole of its vast area is covered with mussels that have been sown on it within the last six years. The gales of November 1893 and December 1894 did much damage to the mussels on this bank, the crop on the shoreward, or west side of the bank, being heaped up in patches, but re-spreading by means of rakes saved a large proportion of the mussels. Before the mussels of this bank can attain to a bait size within three or four years, they must be shifted to a bank like the Broadwater Bank or the bed of the Steinschell Burn.

(6). *East Steinschell Bank.*—The formation of a bank on the east side of the Steinschell Burn was begun as early as 1887, and within the first two years it promised well. Since 1889, the mussels upon it have grown, and the indications are that it will form a valuable addition to the ground on the north side of Montrose Basin. One crop was obtained from it in 1893, and it is again filled with mussels. The mussels on it are encroaching on the neighbouring bank of sand to the east, and there are indications of the probability of the Steinschell Burn being diverted down the hollow in its middle.

(7). *Scaud Man's Head Banks.*—These banks have been bared since 1889, and the mussels, known as 'Crocks,' which were in large proportion on it, were transferred to the quicker growing-ground of the Basin, Steinschell, and Broadwater Banks. The great height of this large area of ground prevents the mussels filling up and growing, so that it is *storage* rather than *growing*-ground. In a properly conducted mussel-farm, storage as well as growing-ground is necessary. It forms a splendid area for the reception of the excess of native seed in such districts as yield seed in quantity. At Montrose, however, it is seldom the case that seed is in excess, the complaint being rather of its scarcity. But storage-ground was found necessary for the large importations of seed from the Tay. Part of the area covered in 1889 with mussels is now bare, but the total acreage of the Scaud Man's Head has been increased by utilising ground to the north and west which had never carried a crop of mussels in the past. The old area, not now carrying mussels, is to the south and east of the most easterly branch of the Scaud Man's Head Burn. Instead, a new area to the west of this branch burn has been sown with mussels, which now extend from Dronner's Dyke for 400 yards to the north, and the shoreward boundary runs nearly parallel with Dronner's Dyke. This large area now under mussels is a considerable factor towards maintaining an increase in the production of mussels from Montrose Basin. The mussels are thinner than in the beginning of winter, many having been destroyed during the prolonged period of frosty weather.

(8). *Tayock and Gas Work Banks.*—The area under mussels along these burns has been considerably augmented. The new portion added to what was under mussels in 1889 consists of a strip alongside of the burns, 400 yards in length and averages in breadth 8 to 10 yards. The mussels that were on it six years ago are still there. The frost destroyed a large number of mussels on this bank.

(9). *The Basin Bank.*—This is the hardest ground in Montrose Basin. The mussels on it show a fair amount of growth. There is still little mud upon it, especially on the higher portion which is too long out of the water to be good growing-ground. On the lower ground the mussels were fit for sale in 1893, 1894, and 1895, but on the higher part the mussels on it in 1889 are still there. Two crops of mussels were obtained from the part towards the south within that period.

Conclusion.

The question that first arises in connection with mussel culture at Montrose within the past six years is whether there has been advance or not in the methods employed, whether, in fact, Montrose Basin has increased in productiveness and can supply a larger quantity of mussels of bait size for the line fishermen. Having watched the different changes that the beds have undergone year by year, I must conclude that mussel culture presents a decided advance within the last six years, and the development of the bed system, that has taken place, has been the result of judicious foresight and wide practical acquaintance with all the details necessary for the successful working of mussel beds on a large scale. While certain areas of a limited extent have been abandoned, as experience dictated, this has been more than counter-balanced by the increase in the acreage of new ground brought for the first time under cultivation. The additional ground now bearing mussels has chiefly been in storage-ground. It is situated at the Tayock and Gaswork Burns, and at the Scaud Man's Head on the north side, and on the Inshore Bank on the Ferryden Shore. The total mussel area is fairly constant, but if methods of lessening the heights of the banks by artificial and natural means combined were adopted, the period during which banks have to lie fallow would be shortened, and the capacities of the estuary of the South Esk as a mussel-producing area would be increased.

The chief facts which have to be noted in connection with the culture of the last six years are :—(1) The importation of seed mussels from a distance to meet the deficiency of the seed obtained locally, and (2) the unusual severity of the past two winters, and the consequent destruction to the stocks on the beds.

As to the first, in no other instance in Scotland has seed been imported from a distance, and in such quantities to stock the beds from which bait mussels were removed and sold in ordinary course. The lesson to be learned from this new movement will be of value when mussel culture in Scotland is undertaken on a scale sufficient to meet the bait requirements of the line fishermen. When beds are depleted or recklessly fished, the seed-difficulty is the first one felt. The beds at Montrose have regained their former condition only by a large expenditure for seeding. The dredging of Tay seed, its transport by rail to Montrose, and re-laying on the mussel ground there is a marked advance on previous Scottish methods, and the additional employment afforded to the fishing communities of Tayport and Montrose has been considerable. Labour and a judicious expenditure in capital for stocking and other operations are as necessary for mussel farming as for the farming of arable land. But the first requisite for mussel culture is a thorough practical acquaintance with foreshore farming of the mussel in all its branches. Cultivation cannot otherwise be placed on a sound economic basis, and much money may be wasted.

The destruction brought about by the storms and frost of the past two winters has been the greatest on record. The north-east gale of November 1893, and the north-north-west gale of 22nd December 1894, caused havoc to the mussels, the like of which has never been known within the experience of the two mussel superintendents. The frost, in the beginning of 1895, did much damage, especially to the young seed on the higher banks like the Inshore Bank, but where the banks were not long bare during each tide, and where the mussels were older, the stock was not injuriously affected. Fortunately, floating ice did little or no damage. The destruction by the two northerly gales was much mitigated by the large number of men who were at once put to work to re-spread the mussels which had been driven together and heaped up at various points.

The manner in which natural difficulties have been overcome and mussels have been successfully cultivated at Montrose—which is not the best mussel-growing ground in Scotland—should form an incentive to other localities which possess good mussel ground, or ground which may be made capable of yielding a payable mussel crop. Regulations as to the size of mussels, especially when seed mussels may be lifted for re-sowing, and power to enforce regulations wisely drawn up by an independent authority, are urgently desired by the mussel cultivators, and assistance from a competent adviser will be heartily welcomed.

V.—THE INFLUENCE OF TEMPERATURE ON THE DEVELOPMENT OF THE EGGS OF FISHES. By Harald Dannevig. (Plate I.)

During the last ten or twelve years the development of a large number of species of sea-fishes has been studied by several naturalists, as Prof. M'Intosh, at the Marine Laboratory of St Andrews, Mr J. T. Cunningham, at Plymouth, and others, and full and detailed accounts have been given in several papers. The embryology of our common sea-fishes is therefore now comparatively well-known.

In different papers, but especially in his and Professor Prince's 'Researches,' Prof. M'Intosh describes the development of the eggs of no less than forty species,* and Mr Cunningham has also published valuable papers on the development of several species. But in few papers are particular statements given regarding the duration of incubation, or how long the different kinds of fish-eggs take to develop, when exposed to various temperatures. It is, however, known that a high temperature increases the rate of development, and that a low temperature prolongs it. Prof. M'Intosh has shown that the eggs of the flounder may survive after being in water heated to 98° F.;† but the precise effect the difference of a certain number of degrees will have on the time of incubation, and whether this effect is the same in a high temperature as in a low, are questions still left to be determined, and the object of this paper is to give some information on this subject. But I must at once mention that this work, though of so great interest, has had to be put aside occasionally in order not to interfere with my main duties in connection with the hatchery. My statements, therefore, will not always be so full as might be desired.

The intention being to observe the rate of development when the eggs were exposed to a certain temperature, my first task was to make such arrangements that the temperature of the water could be kept constant and independent of the variations of the temperature of the air.

Glass jars, holding fully 2 litres (nearly half a gallon), were filled with water up to about three-fourths of their height, so that they would still float when immersed in a larger bulk of water, the surface inside the jar being some inches below the surface outside it.

The separate spaces in one of the wooden hatching boxes were filled with water, sufficiently deep to allow the jars to float when placed in them, one jar in each space. The temperature of the water in the spaces being kept at a certain point, the eggs in the jars were also constantly exposed to the same temperature.

The temperatures below zero were kept constant by freezing-mixtures; those above zero and up to the temperature of the air were controlled by ice alone, while the highest were maintained constant by the addition of hot water. Wood being a bad conductor, changes in the temperature in all the spaces would be owing to the influence of the air; but this of course only affected the surface of the water, and the latter also being a bad conductor, the contents of the jars, which were placed several inches below the surface, were kept uniformly at the same temperature.

When regularly attended to, I found this arrangement to be the most convenient without going to any particular expense, and as the temperatures were controlled and corrected, generally once an hour

* *Trans. Roy. Soc. Edin.*, XXV. iii., 1890.
† *Report of Trawling Commission*, p. 363, 1885.

during the night and even oftener during the day, I daresay the results, as far as depending on the constant temperature, are almost accurate.

On the 15th of March I received eggs of three species: cod (*G. morrhua*), haddock (*G. æglefinus*), and whiting (*G. merlangus*). They had all been artifically fertilised by Mr Liston, the mate of the 'Garland,' who was out on a trawler to collect spawning plaice for the hatchery, and they were brought to Dunbar by the 'Garland.' The eggs on their arrival were all in an early stage of development, the second segmentation being completed in the whiting eggs; the others were not quite so far advanced. The eggs were divided into jars holding water of the same temperature in which they arrived (3° C.), and the jars transferred to the different spaces in the hatching apparatus, where the temperatures had been already fixed as follows: – 2°, – 1°, 0°, + 1°, 2°, 3°, 4°, 5°, 6°, 8°, 10°, 12°, 14° C., the corresponding figures, according to the Fahrenheit scale, being:—28·4, 30·2, 32·0, 33·8, 35·6, 37·4, 39·2, 41·0, 42·8, 46·4, 50·0, 53·6, 57·2° F. In this way the water in which the eggs were placed was gradually cooled or heated till the temperature reached the proper level.

As I had three species, and thirteen specimens were taken of each, there were thirty-nine bottles with eggs under observation at the same time.

The water was refreshed daily, and in order not to expose the eggs to a change in temperature while this was being done, a large jar, with clean spare water, was constantly kept in each room, so that it at any time had the proper temperature. The old water in the bottles and any dead eggs were removed by means of a syphon.

The eggs were also occasionally removed from the jar, and the latter thoroughly cleansed. This is a matter of great importance, in order to secure a satisfactory result when hatching is carried out in water that is only occasionally refreshed.

As to the time of incubation at the different temperatures, the result will be seen in the following table, which also includes plaice and flounder, the eggs of which I fertilised artificially at Dunbar.

The hatching of all the eggs of one species does not take place at the same time, even if the eggs are from the same female and dealt with in the same way. This difference in time varies from a few hours to several (3 or 5) days.

In regard to the eggs of the plaice, I took particular account in some cases, as will be seen in the following table:—

Table I.—*Showing the Difference in the Time of Incubation of Eggs, taken from one Plaice, at a Temperature of* 8°, 10°, *and* 12° *C.*

	Hatching Period.*					
	1st day.	2nd day.	3rd day.	4th day.	5th day.	
8° C.	1	1	14	10	35	Number of eggs hatched on each day.
10°	9	29	10	2	.	
12°	2	4	7	17	4	

* The "hatching period" includes the time from the emergence of the first to the emergence of the last embryo, in a batch.

The diameter of plaice eggs is about 1·95 mm., in comparison with which the eggs of the flounder are very small, the diameter being 0·92 mm.

In water of 12° C. the latter all hatched in the course of a few hours. At 10° it took a few hours more, and only at 8° a difference was noticed of half a day. Judging from this it is evidently the larger eggs that show the greatest difference in time of incubation under the same circumstances.

In *Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel für die Jahre* 1874–76 (page 32), Dr C. Kupffer has given the following explanation of the cause of the delayed hatching of herring eggs:—

"The egg-shell, he says, is constantly getting thinner (verdünnt sich stetig) during development, and the moment of emergence depends upon the relation between the strength of the shell and the muscular action of the embryo."

This explanation may account for a difference in the time of hatching, under the same circumstances, in general, and so far Kupffer is right; but according to his theory the irregularity in hatching should be the same in different temperatures; but my experience is that the difference is larger in the lower temperatures than in the high. Another fact also requires to be taken into consideration; namely, the difference in size that has been found to exist amongst eggs even from the same individual. The small eggs of the flounder hatch in four and a half days, while the large eggs of the plaice take twelve days under the same temperature (10° C.), and in the same way I believe a smaller egg will hatch quicker than a large one of the same species.

Table II.—*Showing the Average Rate of Development of the Eggs of Four Species when exposed to Different Temperatures.*

Temperature in Centigrade.	−2°	−1°	0°	1°	2°	3°	4°	5°	6°	8°	10°	12°	14°	
G. morrhua,* . .	.	†42	.	.	.	23	20½	17½	15½	12¾	10½	9⅔	8½	Time of incubation in days (24 hours).
G. merlangus, . .	.	.	.	.	.	.	.	15⅓	13½	10¼	8	6½	‡5¾	
G. æglefinus,* . .	.	†42	.	.	.	23	20½	17¾	15½	13	10¾	9⅔	8¾	
Pl. platessa, . .	.	.	.	.	.	.	.	.	18¼	14⅛	12	10½	.	
Pl. flesus, . .	.	.	.	.	.	.	.	.	6½	5½	4½	3⅔	.	
Temperature in Fahrenheit, .	28·4°	30·2°	32°	33·8°	35·6°	37·4°	39·2	41°	42·8°	46·4°	50°	53·6°	57·2°	

The details in this table, where the average time of evolution is given, are based on observations made with eggs that were hatched in jars without a constant circulation of water. An experiment so arranged

* The eggs of cod and haddock took about the same time in incubation; though I sometimes noticed that eggs of the cod hatched a day or so sooner than the haddock, the average time generally became the same. Cunningham makes the same statement in his paper 'On the Relation of the Yolk to the Gastrula in Teleosteans and in 'other vertebrate Types,' *Microscopical Journal*, vol. xxvi., new series, page 4.

† The eggs were kept at the temperature of −1° C. for 35 days, after which they were transferred to water of +6° C., as it was necessary for me to terminate the experiment. In the latter temperature the eggs hatched with an average time of 2½ days. The whole time of incubation at that temperature being 15½ days; one-sixth, or 6 days, should be added to the 35 days in water of −1° to give the whole average time for that temperature.

‡ The eggs were accidentally lost when the first embryos had been hatched at the beginning of the fifth day. The time stated is consequently to some extent estimated, but on a good basis; and when compared with the statements for the other temperatures, any deviation will be very small.

might give results a little different from mine, especially at the lower temperatures, but I have no reason to think any such difference will be considerable. The emergence of the embryo at the hatching period seems to be quite irregular, and this will influence the calculation of the average time. But a confined quantity of water ought to have a little influence on the rate of development and delay it, if the portion of water is small or not frequently changed.

On one occasion I had an opportunity to see the result in this respect. The water in a jar with eggs of the cod, a few days before the hatching period, had not been changed, and when examining it I found a number of the eggs had succumbed and had sunk to the bottom; others, again, were tending to sink, being scattered at various levels throughout the water. Some of these I examined and found all alive; but the beats of the heart had been considerably diminished. The average of four observations was 29 beats of the heart per minute in the embryos in those sinking eggs, the specific gravity of which had increased to about 1027·0; other eggs had the usual specific gravity, and floated at the surface of the water. The number of heart-beats in the latter averaged 45 per minute. The hatching, however, of these surviving eggs took place about two days later than what is usually found in the same temperature. The eggs of cod, haddock and plaice seem to thrive as well at a temperature near zero as in warmer water; the eggs at the low temperatures, were not, however, brought to the hatching stage; with one exception (in – 1°) they all succumbed owing to difficulties in attending to them, but as they all were in a healthy condition for from twenty to twenty-five days when the formation of the embryos had begun, there is no reason to think they should not be able to resist the low temperature for the rest of their development. A slight movement of the heart was noticed in the embryos in some of the eggs that had been kept at – 1° for thirty-five days, and when transferred to water of 6° C., the embryos emerged after an average time of two and a half days. The freezing point of sea-water, with a specific gravity of about 1027·0, is near – 2° C., so it occasionally happened that the eggs kept in water of that low temperature became inclosed in lumps of ice that floated on the surface; when those again were melted while the bottle was left quiet, a layer of fresh water was found floating on the top of the salt water. All the eggs were then seen floating exactly at the same level—at the limit between the fresh and salt water. Eggs of plaice and haddock appeared to be most capable of resisting these changes, while the whiting eggs gradually succumbed. As a whole, the latter did not seem to do so well in a temperature at zero or below it, while the eggs of the haddock especially appeared very hardy. The eggs of the cod, as a rule, I found to be the least hardy amongst them all.

Plate I. gives a graphic representation of the time of incubation of the various species referred to in table II.

The vertical lines represent the number of days from the time of fertilisation of the eggs till the embryo emerged, while the horizontal lines give the temperatures to which the eggs were exposed.

The figures given in the table are represented by a cross at the corresponding places in the plate. A line drawn between the marks representing the same species (cod and haddock are taken together), will not be quite regular; but, no doubt, if observations were made with the greatest care and with a constant supply of water to the eggs, as in a hatching apparatus, the line that represents the time of incubation at various temperatures would be quite regular, and perhaps mathematically so. Such curves I have constructed as much in correspondence with the data as possible.

The study of these curves of incubation is rather interesting: as a rule it will be seen that the smallest eggs have the shortest hatching-time under the same circumstances, and that the curves follow one another from left to right, according to the size of the eggs. The eggs of the cod, however, have the same hatching time as eggs of the haddock, although the latter are a little larger than the former. I am unable at present to explain this apparent irregularity.*

The hatching time for cod and haddock, at the temperature of 14°, is $8\frac{1}{2}$ days; at 12°, $9\frac{1}{3}$ days,—a difference for $2° = 1\frac{1}{3}$ days, or 16 hours for 1°.

The hatching time, in water of 4°, is $20\frac{1}{2}$ days; in 3°, 23 days, a difference of $2\frac{1}{2}$ days, or 60 hours for 1°. The effect of 1° of difference, at a temperature of 3° to 4°, is consequently nearly four times as great as a change of 1° above 12°.

If, therefore, eggs are hatched in a jar or apparatus, while the temperature is occasionally varying, the average hatching time that is based on such observation will not be in exact correspondence with my curves; and the difference will be according to the amount of variation there has been in the temperature to which the eggs have been exposed.

In the graphic representation, I have included some observations on the hatching time, based on an average temperature.

Mr J. T. Cunningham, in his paper 'On the Relation of the Yolk to 'the Gastrula in Teleosteans, and in other vertebrate types,' states that whiting hatched on the eleventh day, at an average temperature of 7°·5 C. (Pl. I., 1), and that cod and haddock hatched on the twelfth day at an average temperature of 7°·5 C. (Pl. I., 2).

This is not in correspondance with my curve No. III., which shows a hatching time of about 13 days at the same temperature. But Cunningham only says that the eggs hatched on the twelfth day, and does not mention if the whole hatching period was confined to that day, or if it continued longer. If his statement is meant to give the day on which emergence began, his observations and mine will correspond.

In my paper on the operations at Dunbar Marine Hatchery, during the spring season 1894,† the hatching time for plaice is given as 21 days, at an average temperature of 5°·24 C. (Pl. I., 3), and 14 days at an average temperature of 8°·86 C. (Pl. I., 4).

In the same paper, the hatching time for cod is stated to be fourteen days at an average temperature of 6°·52 C. (Pl. I., 5); and that for the flounder, six days at an average temperature of 6°·12 C. (Pl. I., 6).

When compared with one another there will be found a difference in the formation of the curves of incubation.

No. 1 is nearly straight and No. 3 much curved; No. 2 and 4 seem to follow one another in the high temperatures, and though both sloping much to the right, No. 4 seems most inclined towards the horizontal direction.

The observations and experiments above detailed show:—1. That the time of incubation is various under the same circumstances for different species. 2. That this difference is in relation to the size of the eggs in this way, that the large eggs take a longer time than the smaller ones. 3. That the time of incubation for the same species varies according to the temperature.‡ 4. That this variation for each degree is comparatively

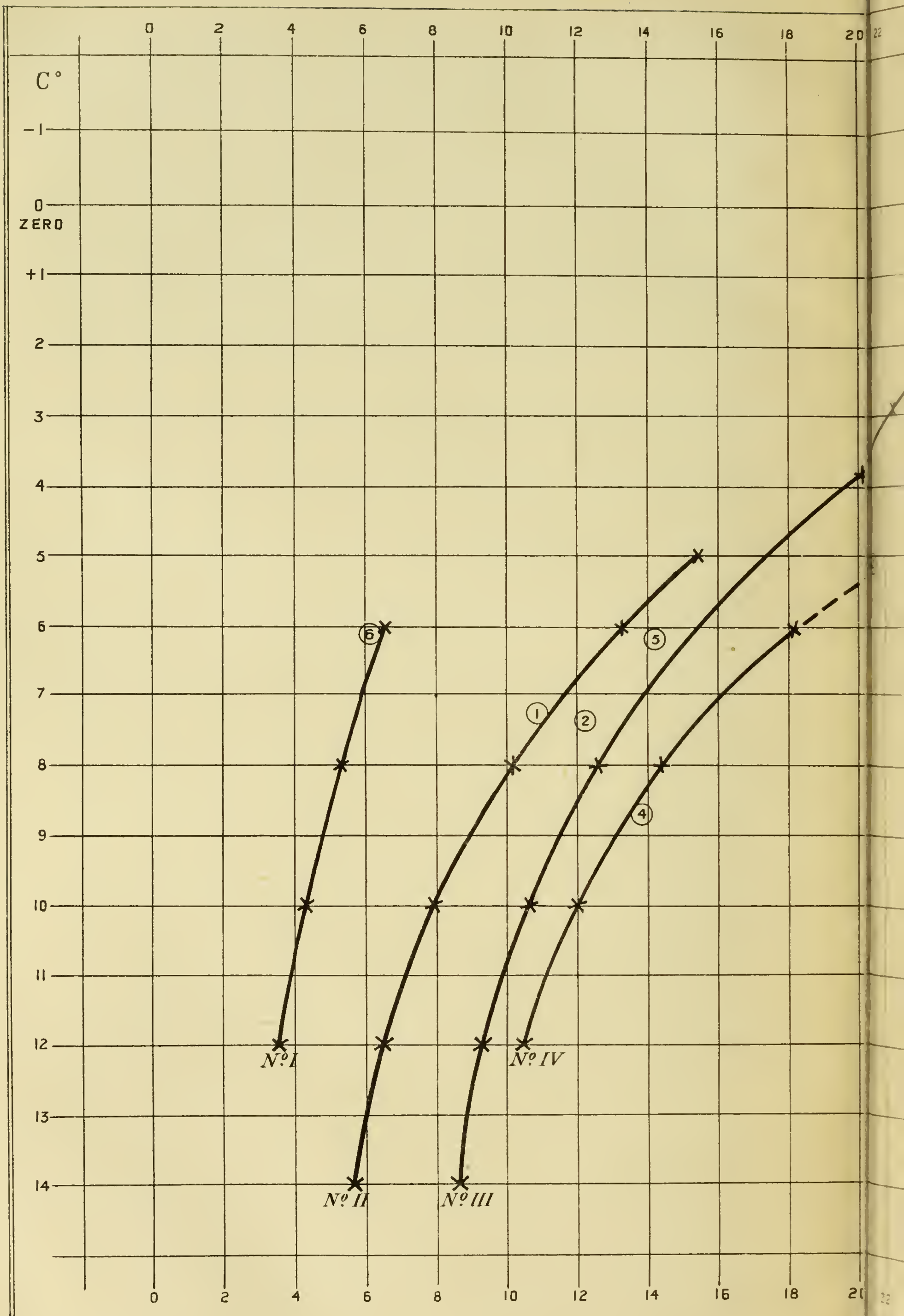
* The diameters of the eggs dealt with are—*Pl. flesus* = 0·92 mm.; *G. merlangus* = 1·25 mm.; *G. morrhua* = 1·39 mm.; *G. æglefinus* = 1·45 mm.; *Pl. platessa* = 1·95 mm.

† *Twelfth Annual Report, Fishery Board*, Pt. III. p. 212.

‡ In the Kiel Commission Reports for 1874–76, p. 32, Dr C. Kupffer expresses an opposite opinion regarding the herring in the western Baltic. He says that the development of the eggs of the herring takes place within seven days after impregnation, and independently of the temperature or specific gravity of the water.

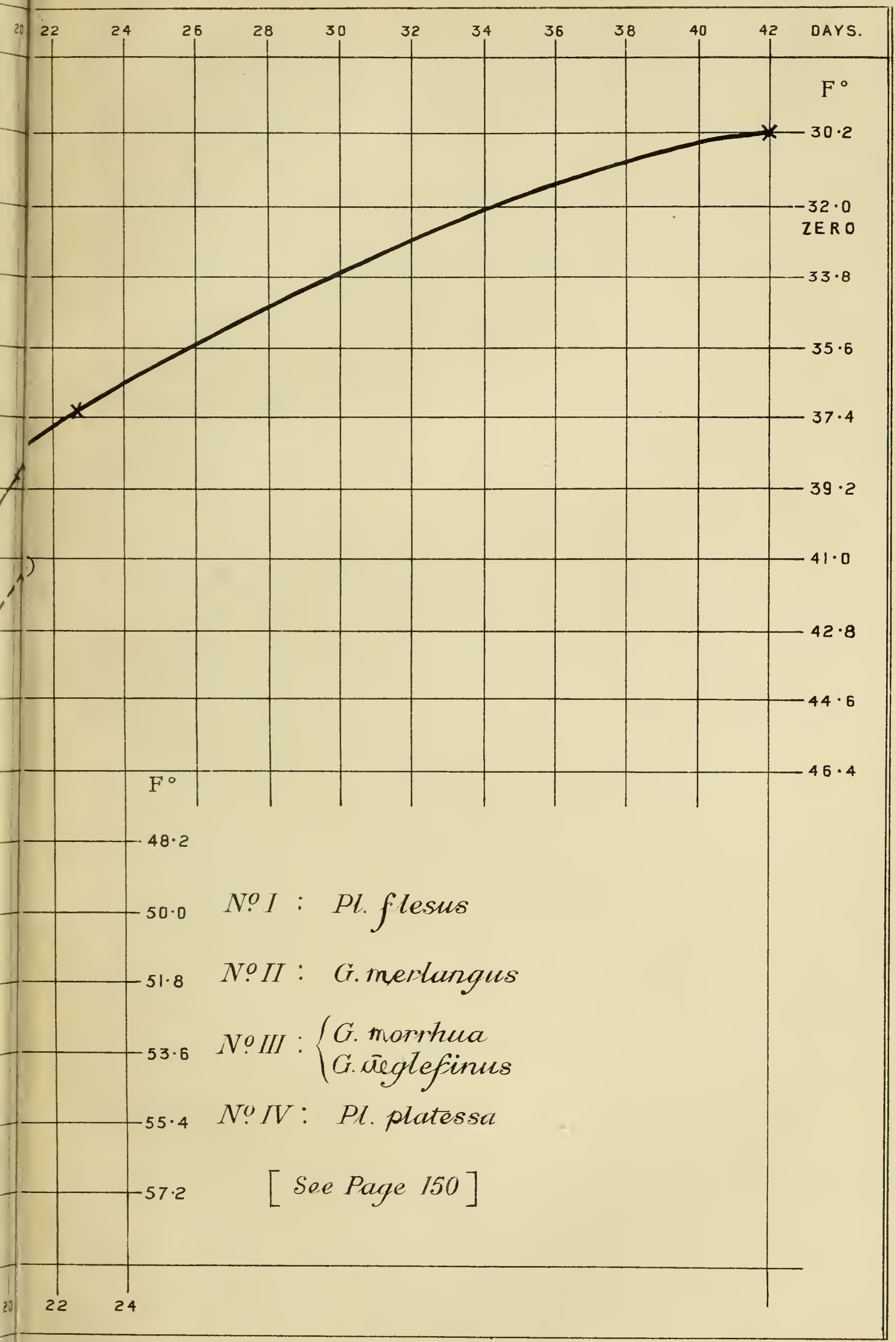
larger in a low temperature than in a high. 5. That development of fish-eggs takes place also at temperatures below zero, when the specific gravity of the water is sufficiently high to prevent it from freezing.

As regards the hatched embryos or larval fishes, they seem to thrive satisfactorily at all temperatures above zero. With respect to the temperatures below zero, I am unable to say anything from experience ; but the fry at the high temperatures, 12° and 14°C., were not so lively, which, I am sure, was at least to some extent owing to the confinement in a small portion of water. Fry of haddock, that had been hatched in water of 6° C., were exposed to a sudden change in temperature by being transferred to water of 0°—others were at once placed in water of 10°—and in no case was I able to discover any particular effect from the change. Immediately after their transference they appeared quiet and inactive but they soon again showed their usual activity and vigour.



C°
ZERO
Nº I
Nº II
Nº III
Nº IV

PLATE I.


20
22
24
26
28
30
32
34
36
38
40
42
DAYS.
F°
30·2
32·0
ZERO
33·8
35·6
37·4
39·2
41·0
42·8
44·6
46·4
F°
48·2
50·0
51·8
53·6
55·4
57·2
Nº I : Pl. flesus
Nº II : G. merlangus
Nº III : G. morrhua
G. æglefinus
Nº IV : Pl. platessa
[See Page 150]

VI.—THE RELATION OF MARINE CURRENTS TO OFF-SHORE SPAWNING AREAS AND INSHORE NURSERIES. By Dr T. Wemyss Fulton, F.R.S.E., Superintendent of Scientific Investigations. (Plate II.)

Of late years the physical conditions of the sea in relation to fishery problems have received a considerable amount of attention in various countries, more particularly with regard to the range and variations of temperature and density. On Continental coasts, as well as on our own, periodical observations have been made, both at fixed stations and by means of vessels, into the changes which take place in these two important physical factors; but practically nothing has been hitherto attempted to ascertain the influence of another factor which has an important bearing upon several fishery questions, namely, marine currents. It is now well known that the eggs of almost all edible sea-fishes float at or near the surface of the sea, and that they, as well as the newly-hatched larval fishes which emerge from them, are borne helplessly by the currents. It has also been shown that nearly all the food fishes with floating eggs spawn on the East Coast outside the three-mile limit, and that their spawning areas may extend for very considerable distances from shore; and, further, that certain grounds, such as Smith Bank, in the Moray Firth, are frequented at the spawning period by immense shoals of the food fishes, which in succession shed their eggs in myriads into the waters. Before the experiments described in this paper were begun no attempt had been made to determine the relation between such spawning areas and the inshore grounds along the coast. From the absence of spawning fish in the territorial waters and the presence there of their floating eggs and larvæ it was known that the latter were derived from the offshore areas, and had been borne shoreward by the currents; and it was generally assumed that the spawning areas from which they came were in the neighbourhood of the territorial waters in which the eggs and larvæ were found. The experiments which have been made show, however, that such is not the case. The floating eggs and the larval fishes derived from a particular spawning area may be carried considerable distances in a definite direction in a comparatively short space of time and may hence form the source of supply not to the adjacent parts of the coast but to parts situated at a considersble distance. The chief aim of the experiments was to determine this relationship—to show the course traversed by the currents bearing the floating spawn and larvæ and the portions of the coast on which they impinge. Knowledge of this kind is obviously of importance in relation to proposals to control fishing operations on the spawning grounds. For instance, the experiment, so far as they have gone, tend to show that the inshore waters of the Firth of Forth and St Andrews Bay derive their main supplies not from the waters lying contiguous to them to the eastward, but from northern areas. When these experiments are sufficiently complete it will be possible to assign the offshore spawning area which is in natural connection with any portion of the territorial waters, and which forms its chief source of supplies. The experiments also show the direction in which the pelagic fish-food is carried.

Similar experiments have been made previously for hydrographic purposes, and on several occasions in connection with oceanic circulation especially in the Atlantic; but I am not aware of any having been made in the North sea. The most extensive and elaborate were those carried on by the Prince of Monaco and Professor Pouchet in the North Atlantic, and which have been described in several publications.* In these experiments metallic spheres were for the most part employed, containing a slip of paper with directions, in eight languages, how to dispose of the sphere when found. The method adopted in the fishery experiments was simple and inexpensive. Small, coarse glass, one ounce bottles were employed, in which a slip of paper was placed having a number and printed directions to return the slip to the Fishery Board with the note of the place where, and the date on which it was found. The cork was dipped in melted paraffin to prevent the admission of water, and it acted admirably for the purpose. It was found that the buoyancy of the bottles was, as a rule, considerable, and that a portion projected above the surface of the water, which might have offered a surface for the action of the winds independent of the currents. In order to avoid this disturbing influence, each bottle before being put into the sea was placed in a pail of sea-water, and a piece of soft lead wire was wound round the neck, sufficient to submerge the whole bottle flush with the surface. In a few cases, owing to the original weight of the bottle, it was necessary to fix on the neck a small piece of cork for the same object. All the bottles were therefore kept flush with the surface, and could only be acted upon by the general movement of the water in which they were immersed—by the currents, and not by the winds. Some of the bottles were also furnished with rubber bands, in order to diminish the risk of breakage; but on consideration of the results t was deemed unnecessary to continue this mode.

The great majority of the 'drift-bottles,' as they may be termed, were put into the sea by the 'Garland,' either at the trawling stations or at other places; and a note was kept by Captain Campbell of the position where they were thrown into the sea, the date, the state of the tide, and the direction and force of the wind, as well as of the numbers on the labels. These particulars were recorded in a book, and it was thus a simple matter, on receiving the slips by post, with a note of the place where, and the date on which they were found, to discover the course and distance travelled. Some of the bottles were sent to H.M.S. 'Jackal,' and the late Commander, Lieutenant Wolfe-Murray caused them to be thrown into the sea at Smith Bank, and various parts of the Moray Firth. Others were, through the co-operation of some of the Fishery officers, given to fishermen who put them into the sea at selected places while going to or returning from the offshore fishing-grounds; and others, through the courtesy of Messrs. James Currie and Co., Leith, were taken charge of by the masters of some of their vessels, trading to the Baltic to be put away at fixed distances from the Scotch Coast. In these tables will be found particulars regarding the experiments, and full details concerning each of the bottles recovered. The experiments began in September last, and continued until May; and of 729 drift-bottles employed, 159, or as nearly as possible 22 per cent. have been up to the present recovered. Considering the fragile nature of the messenger this is a satisfactory result. In some cases the label alone was discovered on the shore; and there is evidence that bottles were sometimes found, but not returned by those who found them. The condition of the bottle also showed in certain cases that it had been for some time carried to and fro about the shore before being discovered, the edges having been worn by attrition; the time given in the table does not therefore necessarily indicate the minimum time occupied on the voyage. The messengers

* Prince Albert de Monaco 'Sur les resultats partiels des deux premières expériences pour determiner la direction des courants de l'Atlantique Nord,' *Comptes rendus*, 10th January 1887, and several other numbers; Pouchet 'Experiences sur les courants de l'Atlantique Nord faites sous les auspices du Conseil municipal de Paris.' Paris, 1889.

were put into the sea at distances varying from a mile or two up to 50 miles from the shore, and the majority of them in relation to the spawning grounds lying off the Firth of Forth and St Andrew's Bay, and in the Moray Firth. The time that elapsed between dropping them into the sea and their recovery varied from one to 239 days, and the distance travelled from two to 494 miles, measured in a straight line between the two points. Five were picked up on the coast of Norway and 33 on the English coast. Three of the former were put into the sea on November 5th, 8 miles south-east of Buchan Ness, Aberdeenshire, and were found on the Norwegian coast in 29, 43, and 52 days thereafter, having respectively travelled 270, 490, and 494 miles in the periods named. The fourth was put away 10 miles south-east of Girdleness on 6th November, and was found near Christiansund, Norway, 470 miles distant, 52 days afterwards; and the fifth was put in on 7th November 10 miles south-east of Bervie, and was found north of Bergen on 1st January. These bottles appear to have been drifted in a north-easterly direction, until they reached the currents passing from the Atlantic north of Scotland towards the coast of Norway, as shown in the Prince of Monaco's chart above referred to.

Excluding these examples, it will be found that the other cases fall into two groups, one in which the direction taken varied with the tidal streams and the winds within the Firth of Forth and the Moray Firth, close to the shores, and another group in which they moved, usually at some distance from the coast, steadily in a south-south-east direction, which brought them to the shore, often 100 or even over 200 miles south of the point where they were placed in the sea. If a chart showing the eastern boundary of the North sea—the coasts of Scotland and England—be examined, it will be seen that in the northern portion, the region of the Moray Firth, the coast (Caithness, Sutherland) tends westward and then passes abruptly eastwards (Elginshire, Banffshire and Aberdeenshire), the coastline facing north; thereafter it passes westwards to the Firth of Forth, and south of the Firth of Forth it bends gradually eastwards to the region of the Wash, which is as far as the area of the experiments goes. Setting aside in the meantime the results relating to the inshore movements, the experiments show that a general current passes down the east coast of Scotland and England from Duncansby Head to the Wash. The course of this current seems to be confined to the neighbourhood of the coast, and to be modified somewhat by the coastline, and also—so far at least as the surface waters are concerned—by the prevailing winds. It will be convenient to consider two portions of the east coast of Scotland separately, the Moray Firth and the region south of it. Nineteen drift-bottles were put away in March at from ten to twenty miles from the Shetlands, but no intimation of the recovery of any of these has yet been received; probably they have been carried by the Atlantic currents in a north-easterly direction towards the northern parts of Norway. In the region of the Moray Firth, 310 drift bottles were put into the sea in October, January, February and March, at distances varying from two miles to fifty-five miles from shore; and of these 64 have been recovered. They fall into two groups in regard to the direction taken, one group in the area to the west of a line between Lossiemouth and Wick and the other to the eastward of that line. All the latter moved in a definite southerly direction,* S.S.W., S. by W., S. and S.S E., and sometimes with considerable rapidity. For instance, all the bottles put in at Smith Bank and neighbourhood which were again recovered (nineteen in number) were found on the coast of Banffshire and Aberdeenshire, along a stretch of about thirty-five miles between Buckie and Fraserburgh, most of them

* The direction in all cases is given as *magnetic.*

being found in the vicinity of Cullen, Banffshire. One of five put away twelve miles east of Wick was similarly recovered on the shore at Portsoy, Banffshire. In none of the cases did they pass westwards or northwards. The distance between Smith Bank and the nearest part of the Banffshire coast where the bottles were found is twenty-nine miles, which was traversed in five days; the period which elapsed between the throwing in of the bottles and their being found on the shore varying from five to seventeen days. There is thus clear evidence that a current runs in a southerly direction to the eastward of a line between Buckie and Wick, which corresponds closely to the second degree of west longitude. This current, as will be shown below, distributes along the northern coasts of Aberdeenshire and Banff the larval fishes, which are derived in immense numbers from the great spawning areas of Smith Bank and neighbourhood, from fifteen or twenty to thirty or forty miles distant from those coasts.

The currents in the inner portions of the Firth, to the westward of the line above referred to, take a less regular course. The great southerly stream which comes round Noss Head and impinges on the coasts of Banff and Aberdeen, as already described, appears to be partly deflected westwards about the region of the Spey, forming as it were a great eddy, which passes up the coast of Cromarty and Sutherland. The course of the bottles was therefore in a direction west by south, west, and west by north. All those put into the waters of the Firth at distances of from eight to sixteen miles east by south of Tarbetness travelled westward or west by north towards the Dornoch Firth. It is evident from the circumstances stated that these currents will tend to distribute the larval fishes from the off-shore spawning-grounds throughout the inner reaches of the Moray Firth, and up the coasts of Cromarty and Caithness.

The experiments on the east coast south of the Moray Firth also fall into two groups,—those relating to the movements inshore in the Firth of Forth, and those relating to the movements further from land. In the latter case all the drift-bottles were found to the south of the places where they were put into the sea, and sometimes at considerable distances. Of twelve thrown into the sea a quarter of a mile from the Bell Rock Lighthouse four were found near North Berwick on the coast of Haddingtonshire, about twenty-six miles distant, three on the seventh and one on the eighth day after being put away. Twelve thrown in eleven miles off Scurdy Ness, Forfarshire, were carried to the same part of the coast, but a little further eastward to the vicinity of Dunbar, having travelled over forty miles in eight days; one was found at Holy Island, Northumberland, 72 miles distant, on the twenty-fourth day. Others put into the sea 18 and 22 miles east of the Isle of May, near the Bell Rock, and even within St Andrews Bay and the Firth of Forth, were also carried southwards to the English coast; none of them were found to the north. Thus one drift-bottle travelled from near Fife Ness to Donna Nook, Lincolnshire, a distance of 208 miles in forty-eight days; another from the same place to Scarborough, 161 miles away, in forty-seven days; several from the mouth of the Firth of Forth to the coast of Northumberland, distances of over sixty miles in fifteen and even thirteen days. Another bottle put into the sea 18 miles off Stonehaven in Kincardineshire was picked up on the shore near Cullercoats, Northumberland, fifty-one days after it had been put away. The apparent course taken by the drift-bottles is shown on the chart (Pl. II.) from which it is obvious that a strong stream passes southwards along the whole extent of the east coast of Scotland, and proceeds at least as far as the Wash. It is noteworthy that 33 of the 84 recovered on the east coast, or over one-third, should have been carried to the English coast, namely, 6 to Northumberland, 4 to Durham, 21 to Yorkshire, and 2 to Lincolnshire. Within the Firth of Forth the drift-bottles took varying directions, as they did in the Moray Firth, the course apparently depending upon the prevailing winds as well as upon the tides. On the north side, however, that is along the Fife Coast, the direction was eastward or outwards, some of the bottles passing northwards to St Andrews Bay or even to Arbroath, Forfarshire. Others joined the great outer current passing southwards towards the English Coast. This also occurred on the south coast of the Firth.

When the speed of the currents is considered in connection with the rate of development of the pelagic eggs, it is obvious that the latter, before the young fishes emerge, may be transported considerable distances. The period of incubation varies in different species, and according to the temperature, from three or four days to two or three weeks, and for some time after hatching the young fishes are helpless and unable to make their way against the current. It would therefore appear that the eggs thrown into the water on the offshore grounds on the East Coast of Scotland are carried southwards, and the larval fishes distributed far from where the eggs were spawned. The inshore waters on the coast of Haddingtonshire appear to receive their chief supplies of young fishes from the spawning areas in the neighbourhood of the Bell Rock, and even from those off the Forfarshire Coast. On the other hand, very large numbers of the floating eggs and larval fishes derived from the spawning areas of the Firth of Forth and St Andrews Bay must be carried to the northern parts of the east coast of England.

In July two bottles were found on the other side of the North Sea, and they furnish interesting evidence of the apparent course of the currents from the English coast. One of them belonged to a group of three put into the sea off Musselburgh, in the Firth of Forth, on 23rd November 1894, of which two have been recovered. One of the two was found near Redcar, Yorkshire, on 17th February 1895, and the other on 20th July, at Ording, Schleswig, Germany. In the other case, five bottles were put into the sea three miles off the Isle of May, on 28th November 1894, and two of this lot were also recovered; one on 17th February at West Hartlepool, Durham, and the other on 18th July on the island of Heligoland. These examples seem to show that the current after or before reaching the neighbourhood of the Wash, passes eastward to the coast of the Continent; none of the bottles have been found on the English coast south of Lincolnshire, and it is probable that others will be recovered in the course of the next few months on the German and Danish coasts. Should further observations prove the currents to move in the direction indicated, it would go far to explain the existence of the immense nurseries of immature flat-fish in the bight between Holland and Schleswig, which the English trawlers desire to have closed, and which are believed to form a great source of supply to the North Sea.

TABLE GIVING PARTICULARS CONCERNING THE DRIFT-BOTTLES RECOVERED.

Date and Position where set Adrift.					Date and Position where Recovered.		Distance travelled in Geog. Miles.	Time between setting away and Recovery, in Days.	Apparent Direction taken.
Date.	Number of Bottles.	Position.	Tide.	Wind.	Date.	Position.			
1894. 21 Sept.	12	$\frac{1}{4}$ mile E. by N. of Bell Rock	...	...	1894. 28 Sept.	Tyninghame, Haddingtonshire	$27\frac{1}{2}$	7	S.W. by S.
...	...	... ...	...	...	,, ,,	$\frac{1}{2}$ mile W. of North Berwick	25	7	S.W.
...	...	... ...	...	...	,, ,,	,, ,,	,,	7	,,
...	...	... ...	...	...	29 ,,	3 miles E. ,,	$24\frac{1}{2}$	8	,,
...	...	... ...	...	...	4 Oct.	Worminstone, Fifeness	11	13	S.W. by W.
...	12	11 miles off Scurdy Ness	...	...	29 Sept.	Dunbar	41	8	,, S.
...	...	... ...	...	...	,, ,,	Belhaven, Dunbar	$41\frac{1}{2}$	8	,, ,,
...	...	... ...	...	...	30 ,,	,, Sands, Dunbar	$41\frac{1}{2}$	9	,, ,,
...	...	... ...	...	...	9 Oct.	$1\frac{1}{2}$ miles E. of Dunbar	$41\frac{1}{2}$	18	,, ,,
...	...	... ...	...	...	15 ,,	Holy Island, Northumberland	72	24	S.
...	...	... ...	...	...	16 ,,	3 miles E. of Tantallon Castle	$40\frac{1}{2}$	25	S.W.
...	...	... ...	...	...	,, ,,	,, ,,	,,	25	,,
...	...	... ...	...	...	(?) 15 Nov.	3 miles W. of Dunbar	$41\frac{1}{2}$	55	,,
5 Nov.	20	8 miles S.E. of Buchan Ness	...	...	4 Dec.	Brandesund, near Bergen, Norway	270	29	E. by N.
...	...	... ...	...	...	18 ,,	Kjarvaagsund, near Trondhjemsfjord	490	43	N.E. by E.
...	...	... ...	...	...	27 ,,	15 miles N. of Trondhjem, Norway	494	52	,, ,,
6 Nov.	20	10 miles S.E. of Girdleness	...	...	28 ,,	Smolen, Christiansund, Norway	470	52	,, ,,
,, ,,	,,	,, ,, Bervie	...	...	1 Jan.	Kirm, N. of Bergen, Norway	340	56	,, ,,
20 ,,	3	Firth of Forth, 2 miles E. of Inchkeith	$2\frac{1}{4}$ h. ebb	S.W. 5	28 Nov.	Arbroath	41	8	E.N.E. & N.N.E.
28 ,,	,,	,, ,, 2 miles N. of Musselburgh	5 h. fl.	S. 1	17 Feb.	Near Redcar, Yorkshire	113	86	S. by E.
,, ,,	,,	,, ,, ,, ,, ,,	,,	,,	20 July	Near Ording, Schleswig, Germany	430	239	S.S.E. and E.
,, ,,	,,	,, ,, 1 mile W.N.W. of Gullane Ness	$3\frac{1}{4}$ h. ebb	Calm	...	... ...	...	...	...
28 ,,	5	Off ,, ,, 3 miles S.S.E. of May Isle	$5\frac{1}{2}$ h. fl.	W. 5	18 July	Heligoland, Germany	360	237	S.S.E. and E.
...	...	... ...	...	...	17 Feb.	Seaton Carew, West Hartlepool	106	81	S.S.E.
28 Nov.	10	Off Firth of Forth, 8 miles S.E. of May Isle	$1\frac{1}{4}$ h. ebb	W. 5	...	... ...	...	...	...
30 ,,	6	,, ,, 3 miles S. of Fifeness	4 ,,	N.W. 5	...	... ...	...	...	...
,, ,,	5	,, ,, 1 mile W. of Isle of May	$4\frac{3}{4}$,,	,, ,,	16 Feb.	$3\frac{1}{2}$ miles S.W. from Bridlington Pier, Yorks.	162	78	S. by E.
,, ,,	5	,, ,, 3 miles S. of Elie Ness	$1\frac{3}{4}$ h. fl.	W. 4	17 ,,	Near Redcar, Yorkshire	118	79	S. by E.

...	...	... ...	...	...	19 Feb.	Filey, Yorkshire	140	81	S. by E.
...	...	... ...	...	...	23 ,,	1¼ miles W. of Whitby, Yorkshire	122	85	S. by E.
30 Nov.	4	Firth of Forth, 1¼ miles S. of Pittenweem	1½ h. fl.	W. 4	1 Dec.	W. side Isle of May	5	1	S.E. by E.
...	...	... ...	...	...	5 Feb.	4 miles S. of Withernsea, Yorkshire	190	67	S.S.E.
30 Nov.	4	Firth of Forth, 1¼ miles S. of St Monance	2½ h. fl.	W. 4	1 Dec.	W. side Isle of May	5	1	S.E. by E.
,, ,,	3	,, ,, ½ mile N. of Bass Rock	3½ ,,	,, 5	15 Feb.	Atwick, near Hornsea, Yorkshire	178	77	S.S.E.
,, ,,	,,	,, ,, ,,	,, ,,	,, ,,	19 ,,	Seaton Carew, Durham	121	81	...
,, ,,	3	,, ,, ½ mile N. by E. of Fidra	5¾ h. fl.	W. 3	...	... ...	...	...	...
1 Dec.	5	,, ,, midway between Largo and Cockenzie	1½ ,,	W. 5	8 Dec.	Elie, Fife	7½	7	N.E. by E.
...	...	... ...	...	...	10 ,,	St Monance, Fife	9½	9	E.N.E.
1 Dec.	5	Firth of Forth, 1½ miles E. of Inchkeith	2¼ h. fl.	W. 5	,, ,,	Elie, Fife	12	9	,, ,,
6 ,,	3	,, ,, 2 miles S. by E. of West Wemyss	2½ h. ebb	W. 3	,, ,,	Wemyss Castle, Fife	2	4	N. by W.
...	...	... ...	...	...	,, ,,	West Wemyss Harbour, Fife	2	4	,, ,,
6 Dec.	3	Firth of Forth, 2 miles S. by E. of Leven	4¼ h. ebb	W. 3	14 ,,	Kincraig, Elie, Fife	3	8	,, E.
7 ,,	10	18 miles E. by S. from May Isle	5½ h. fl.	S. 5	5 Feb.	Withernsea, near Hull	178	60	S. by E.
...	...	... ...	...	...	24 ,,	Gristhorpe, Filey, Yorkshire	149	79	,, ,,
7 Dec.	10	22 miles E. by S. from May Isle	N.H.W.	S. 6	4 ,,	Withernsea, near Hull	180	59	,, ,,
...	...	... ...	...	...	15 ,,	Hornsea Sands, Yorkshire	163	70	,, ,,
10 Dec.	3	Firth of Forth, 1 mile N.E. of Gullane Ness	2¼ h. ebb	SW. by W. 5	...	... ...	...	...	...
12 ,,	10	3½ miles S.S.W. of Bell Rock Lighthouse	2 h. ebb	SW. 6	5 Feb.	Withernsea, near Hull	192	55	S. by E.
...	...	... ...	...	...	6 ,,	2 miles S. Donna Nook, Lincolnshire	207	56	,, ,,
17 Dec.	3	3 miles E. of Barbert Ness, Fife	1½ h. fl.	N.W. 3	2 ,,	Filey Beach, near Scarboro'	161	47	,, ,,
...	...	... ...	...	...	3 ,,	1 mile N. of Withernsea, near Hull	192	48	,, ,,
...	...	... ...	...	...	,, ,,	Donna Nook, Lincolnshire	208	48	,, ,,
17 Dec.	3	5½ miles S.E. by S. of Buddon Ness	3¼ h. fl.	N.W. 2	...	... ...	...	...	...
19 ,,	3	2 ,, S.S.E. of Buddon Ness	½ h. ebb	W. 5	...	... ...	...	...	...
20 ,,	6	8 miles S. E. Scurdy Ness	3¼ ,,	W. 4	20 Feb.	Coatham, Redcar, Yorkshire	143	62	S. by E.
...	...	... ...	...	...	22 ,,	Hinderwell, near Whitby, Yorkshire	154	64	,, ,,
1895.									
29 Jan.	2	Firth of Forth, 2 miles S. by E. of West Wemyss	½ h. fl.	N.E. 4	...	... ...	...	...	...
,, ,,	2	,, ,, 2 miles S. by E. of Leven	1 ,,	E.N.E. 4	4 Feb.	Salmon Stake Nets, Dalmeny Park	16½	6	W.S.W.
,, ,,	4	,, ,, midway between Largo and Cockenzie	1¾ ,,	,, 4	,, ,,	Barnbogle Castle, Dalmeny Park	16	4	,, ,,
...	...	... ...	...	...	2 Feb.	Barnbogle Castle,	6	4	W.S.W.
...	...	... ...	...	...	5 ,,	,, ,,	,,	7	,, ,,
...	...	... ...	...	...	15 ,,	East Wemyss, Fife	4	17	E. by S.
29 Jan.	4	Firth of Forth, 1½ miles E. of Inchkeith	4½ h. fl.	E.N.E. 4	3 ,,	Granton Harbour	5¾	5	W.S.W.

TABLE giving particulars concerning the Drift-bottles recovered—*Continued.*

Date and Position where set Adrift.					Date and Position where Recovered.		Distance travelled in Geog. Miles.	Time between setting away and Recovery, in Days.	Apparent Direction Taken.
Date.	Number of Bottles.	Position.	Tide.	Wind.	Date.	Position.			
1895.									
30 Jan.	3	Firth of Forth, 1 mile W.N.W. of Gullane Ness	1¼ h. fl.	E.S.E. 1	2 Feb.	Wardie Burn, Granton	5½	3	W.S.W.
,, ,,	3	,, ,, 2 miles N. of Musselburgh	5½ ,,	E. 2.	...	...	...	...	...
8 Feb.	3	,, ,, 1½ miles E. of Bass Rock	5½ ,,	N.N.W.	...	...	...	...	...
,, ,,	3	,, ,, 3 miles S.S.E. of May Isle	1¼ h. ebb	N.E 2	...	...	...	...	...
11 ,,	4	,, ,, ½ mile N. of Bass Rock	2½ h. fl.	W.W. by N 4.	...	...	...	...	...
,, ,,		,, ,, ½ mile N. by E. of Fidra	4½ ,,	W.N.W. 3	18 Feb.	St Monance, Fife	7½	7	N.N.E.
,, ,,	3	,, ,, 1¼ miles S. of St Monance	5¾ h. fl.	N. by W. 3.	16 Feb.	East Sands, St Andrews	17	5	E.N.E. & N.W.
...	...	...	...	...	24 ,,	Tentsmuir Sands	20	13	,, ,,
11 Feb.	3	,, ,, 1¼ ,, S. of Pittenweem	¾ h. ebb	N. W. by N. 2	18 ,,	Kingsbarns, Fife	10	7	,, ,,
12 ,,	6	10½ miles S.E. of May Isle	low water	N.W. 4	,, ,,	3 miles N.W. of Fifeness	16¼	6	N.W. by N.
...	...	...	...	...	22 ,,	Kingsbarns, Fife	16	10	,,
12 Feb.	6	5 miles S.E. of May Isle	2½ h. fl.	N.W. 5	23 ,,	¼ mile E. of Crail	9½	11	N.N.W.
18 Mar.	5	10 miles E. of Buchan Ness	...	S.S.W.	...	...	...	...	...
,, ,,	5	15 ,, ,, ,,	...	,,	...	...	...	...	...
7 ,,	5	18 ,, E.N.E. of Fife Ness	...	Calm	24 June	Scarborough, Yorkshire	140	109	S.S.E.
14 ,,	5	8 ,, E.S.E. of Stonehaven	...	W.S.W.	...	...	...	...	...
13 ,,	5	3 ,, E. of Barbert Ness, Fife	5½ h. fl.	S. 1	...	...	...	...	...
,, ,,	5	5½ ,, S.E. by S. of Buddon Ness	1½ h. ebb	S. 2	...	...	...	...	...
14 ,,	5	7 miles E. of St Andrews	1¼ h. fl.	W.S.W. 2.	...	...	...	...	...
,, ,,	5	6 ,, ,, ,,	1¾ ,,	,,	...	...	...	...	...
15 ,,	10	17 ,, E., ½ S. of Dunbar	2 ,,	S. 1	...	...	...	...	...
18 ,,	5	10 ,, E. of Buchan Ness	...	S.S.W.	...	...	...	...	...
,, ,,	5	15 ,, ,, ,, ,,	...	,,	...	...	...	...	...
,, ,,	5	35 ,, N.E. of Fraserburgh	...	S.W.	...	...	...	...	...

18 Mar.	5	55 miles N.E. of Fraserburgh	...	S.W.	...	... ...	...	...	...
20 ,,	5	Firth of Forth, ½ mile N. of Bass Rock	nr. h. w.	N.E. 1	...	... ...	...	...	...
,, ,,	5	,, ,, 3 miles S. of Elie Ness	¾ h. ebb	E.N.E. 2	20 May	Near Spurn Point, Yorkshire	202	61	,,
,, ,,	5	,, ,, 1 mile W. of Isle of May	2¾ ,,	S.E. 2	4 Apr.	1 mile N.E. of Warkworth, Northumberld.	64	15	,,
,, ,,	4	,, ,, 1¼ miles S. of St Monance	3½ ,,	,,	2 ,,	Amble Pier, Acklington, ,,	...	13	,,
...	...	... ...	...	...	2 ,,	Warkworth Harbour, ,,	67	13	,,
...	...	... ...	...	...	4 Apr.	3 miles S. of Blyth, ,,	82	15	S.S.E.
20 Mar.	4	Firth of Forth, 1¼ miles S. of Pittenweem	4½ h. ebb	S.E. 2	...	... ...	...	...	...
29 ,,	5	32 miles N.E. by E. of Fraserburgh	...	S.E.	7 Apr.	½ mile W. of Rosehearty, Aberdeenshire	34½	9	S.W. by W.
,, ,,	5	55 ,, ,, ,, ,,	...	,,	...	... ...	...	...	...
	10	3½ ,, S.S.W. of Bell Rock	2½ h. ebb	S.S.E. 1	18 May	½ mile E. of Dunbar	22½	40	S.S.W.
...	...	... ...	...	...	22 ,,	Largo, Fife	24½	44	S.W. by W.
...	...	... ...	...	...	5 June	East Hartlepool, Durham	121	...	S.S.E.
...	...	... ...	...	...	12 ,,	Whitby, Yorkshire	139	65	,,
17 Apr.	5	Firth of Forth, 2 miles E. of Inchkeith	2 h. ebb	E. 3	25 Apr.	1 mile E. of Largo, Fife	13½	8	N.E.
...	...	... ...	...	...	3 May	Earlsferry, Fife	12	16	N.E. by E.
17 Apr.	5	Firth of Forth, midway between Largo and Cockenzie	¾ h. fl.	E. 3	25 Apr.	Elie, Fife	7½	8	,,
...	...	... ...	...	...	26 ,,	Cove, Haddingtonshire	23	9	S.E. by E.
...	...	... ...	...	...	28 ,,	Step Rock, St Andrews	26½	11	E.N.E. & N.W.
22 Apr.	5	3 miles S.S.E. of May Isle	2 h. ebb	S.E. 3	26 ,,	Kingsbarns, Fife	12	4	N. by W.
...	...	... ...	...	...	28 ,,	Boarhill, Fife	13¼	6	,, ,,
...	...	... ...	...	...	5 May	Ruddon Point, Largo Bay, Fife	13½	13	N.W. by W.
22 Apr.	5	5 miles S.E. of May Isle	2⅔ h. ebb	S.E. 3	7 May	Belhaven, Dunbar	10	15	S.W. by W.
...	...	... ...	...	...	9 ,,	5 miles W. of Dunbar	9½	17	W.S.W.
22 Apr.	6	10 miles S.E. of May	4 h. ebb	S.E. 3	14 ,,	3 ,, ,,	12¼	22	W. by S.
...	...	... ...	...	...	29 Apr.	Belhaven, Dunbar	11½	7	,, ,,
...	...	... ...	...	...	1 May	Thorntonloch, Haddingtonshire	10	9	S.W
...	...	... ...	...	...	22 ,,	Blackhall Rocks, Hartlepool	100	30	S.S.E.
16 Apr.	5	18 miles E.S.E. of Stonehaven	...	N.E.	6 June	St Mary's Isle, 3 miles N. of Cullercoats	129	51	S.S.W.
,, ,,	5	35 ,, ,, ,,	...	,,	...	... ...	...	...	...
22 ,,	5	67 ,, E. ½ S. of May Isle	...	S.W.	...	... ...	...	...	...
27 ,,	5	25 ,, E. by N. ,,	...	N.E.	13 July	5 miles N. of Scarborough	142	77	S.S.E.
1 May	5	10 ,, ,, Buchan Ness	...	N.W.	...	... ...	...	...	...
,, ,,	5	20 ,, ,, ,,	...	,,	...	... ...	...	...	...
20 ,,	5	Firth of Forth, 4½ miles N.N.W. from Fidra	3 h. ebb	E. 2	26 May	Burntisland, Fife	13	6	W.
...	...	... ...	...	...	29 May	Point Garry, North Berwick	7½	9	S.E. by S.
20 May	5	Firth of Forth, 4½ miles E. by N. of Inchkeith	...	...	30 ,,	1½ miles W. of Craig Royston, Granton	9½	10	W. by S.
24 ,,	7	,, ,, 4 miles W. of May Isle	3 h. ebb	E. 3	5 June	Pathhead, Kirkcaldy, Fife	15¾	12	,, N.

TABLE giving particulars concerning the Drift-bottles recovered—*Continued.*

Date and Position where set Adrift.					Date and Position where Recovered.		Distance travelled in Geog. Miles.	Time between setting away and Recovery, in Days.	Apparent Direction taken.
Date.	Number of Bottles.	Position.	Tide.	Wind.	Date.	Position.			
1894.									
4 Oct.	10	5 miles N.E. by E. of Nairn	...	...	7 Oct.	Cromarty	8	3	N.W. by W.
...	...	...	...	...	14 Mar.	Old Bar, Nairn	5	(?) 161	S.W. by W.
5 Oct.	10	2¾ miles N.E. of Findhorn	...	...	29 Oct.	Lothbeg, 5 miles N. of Brora	22	24	N.
" "	10	4 miles N.E. of Lossiemouth	...	...	15 "	Covesea Lighthouse, near Lossiemouth	4¾	10	W. by S.
...	...	...	...	...	" "	" " "	"	10	" "
...	...	...	...	...	16 "	" " "	"	11	S. by W.
...	...	...	...	...	18 "	" " "	"	13	" "
...	...	...	...	...	" "	" " "	"	13	" "
...	...	...	...	...	26 "	" " "	"	21	" "
...	...	...	...	...	27 "	3 miles E. of Lossiemouth	5	22	" "
...	...	...	...	...	27 "	4 " "	5¾	22	S.
...	...	...	...	...	1 Nov.	2 " "	4½	27	S.S.W.
6 Oct.	10	1½ miles W.S.W. of Cromarty	...	...	11 Oct.	N. side Cromarty Ferry	2½	5	E.
...	...	...	...	...	16 "	Nairn	10	10	S.S.E.
...	...	...	...	...	21 "	Nigg Sands	3	15	N.E.
...	...	...	...	...	28 "	N. side Nigg Bay	3½	22	"
9 Oct.	10	7 miles E. by S. of Tarbet Ness	...	...	15 "	E. Bay, Hopeman	11½	6	S.
...	...	...	...	...	" "	Hopeman Harbour	"	6	"
...	...	...	...	...	3 Jan.	½ mile E. of Burghead	"	86	S. by W.
11 Oct.	20	Smith Bank (middle)	...	...	16 Oct.	¼ " " Portknockie, Banffshire	29	5	S.S.W.
...	...	...	...	...	21 "	Eastside of Cullen, Banffshire	29¼	10	S. by W.
...	...	...	...	...	24 "	2 miles E. of Cullen, Banffshire	29¾	13	" "
11 Oct.	20	Smith Bank (middle)	...	...	16 "	Findochty, Banffshire	29	5	S.S.W.
...	...	...	...	...	17 "	W. of Portknockie, Banffshire	29¼	6	"
...	...	...	...	...	19 "	¼ mile E. of Cullen, "	29½	8	"
...	...	...	...	...	23 "	" " "	29½	12	"
11 Oct.	10	25 miles E. by S. of Ord of Caithness	...	...	17 "	Macduff, Banffshire	34	6	S. by W.
...	...	...	...	...	" "	Banff, Banffshire	34	6	" "

11 Oct.	10	16 miles E. by S. of Ord of Caithness	...	...	17 Oct.	Janstown, Buckie, Banffshire	33	6	S.S.W.
...	...	...	...	...	,, ,,	Findochty, Banffshire	32	6	S. by E.
12 Oct.	10	16 miles N.N.E. of Cullen	...	...	29 ,,	1½ mile E. of Cullen, Banffshire	16	17	S.S.W.
,, ,,	10	15 ,, S.E. of Ord of Caithness	...	...	...	...	...	...	...
22 ,,	10	2¼ ,, E.S.E. of Embo	...	...	25 Oct.	Embo, Sutherlandshire	2¼	3	W.N.W.
...	...	...	...	...	26 ,,	,, ,,	,,	4	,,
...	...	...	...	...	,, ,,	,, ,,	,,	4	,,
...	...	...	...	...	,, ,,	,, ,,	,,	4	,,
...	...	...	...	...	,, ,,	,, ,,	,,	4	,,
...	...	...	...	...	,, ,,	,, ,,	,,	4	,,
22 Oct.	10	2¾ miles S. of Brora	...	...	...	...	...	...	...
,, ,,	10	3 miles N.N.E. of Tarbet Ness	...	...	21 Nov.	Golspie, Sutherlandshire	7	30	N.W.
23 ,,	10	9¼ miles N. by E. of Lossiemouth	...	...	28 Oct.	3 miles E. of Tain	20	5	W.N.W.
...	...	...	...	...	29 ,,	3½ miles W. of Tarbet Lighthouse	16	6	,,
...	...	...	...	...	12 Nov.	Tain	23	20	W. by N.
...	...	...	...	...	28 ,,	Embo, Sutherlandshire	21	36	N.W. by W.
...	...	...	...	...	15 Jan.	½ mile W. of Tarbet Ness	14½	84	W.N.W.
...	...	...	...	...	21 ,,	2 miles E. of Tain	21	90	,,
23 Oct.	10	16 miles E. by S. of Tarbet Ness	...	...	29 ,,	Rockfield, near Tarbet Ness	19	98	W.
...	...	...	...	...	1 Nov.	Near Ballone Castle, Tarbet Ness	17	9	,,
...	...	...	...	...	3 ,,	,, ,, ,,	17	11	,,
...	...	...	...	...	14 ,,	,, ,, ,,	,,	22	,,
...	...	...	...	...	28 Jan.	Tarbet Ness Point	16	97	W. by N.
1895.									
11 Jan.	5	10 P.M. Kinnaird Head	3 h. fl.	S.E. 3	...	...	...	...	...
,, ,,	5	9.40 P.M.	2¼ ,,	,,	25 Feb.	Knockinnon, near Dunbeath	...	45	...
,, ,,	5	6.50 ,,	L.W.	,,	27 ,,	Burghead Harbour	...	47	...
,, ,,	5	6.15 ,,	5¼ h. ebb	,,	...	...	...	...	...
9 Feb.	5	Ord of Caithness, N. 60 W. 11 min.	H. W.	W. 2–3	...	...	...	...	...
10 ,,	5	Noss Head, N. 37 W. 11 min.	2 h. ebb	Calm	...	...	...	...	...
,, ,,	10	,, ,, 10 min.	3 h. fl.	W. 2–3	27 Feb.	Aberdour, near Fraserburgh	...	17	...
23 ,,	5	Kinnaird Head, S. 24 min. E. 28 min.	H. W.	N.W. 1–2	...	...	...	...	...
24 ,,	10	Smith Bank	2 h. ebb	E.S.E. 4	12 Mar.	Philorth River, Fraserburgh	45	18	S.S.E.
...	...	...	...	...	7 ,,	,, ,,	,,	13	,,
1 Mar.	45	Smith Bank	5 h. ebb	W.N.W. 4	4 ,,	New Aberdour ,,	40	3	,,
...	...	...	...	...	4 Mar.	New Aberdour, Fraserburgh	...	3	S.S.E.
...	...	...	...	...	4 ,,	Dindarg Castle, near Rosehearty	40	3	,,

TABLE giving particulars concerning the Drift-bottles recovered—*Continued.*

Date and Position where set Adrift.					Date and Position where Recovered.		Distance travelled in Geog. Miles.	Time between setting away and Recovery, in Days.	Apparent Direction taken.
Date.	Number of Bottles.	Position.	Tide.	Wind.	Date.	Position.			
1894.									
...	...	... ...	...	...	5 Mar.	Pennan Harbour, Aberdeenshire	38½	4	S.S.E.
...	...	... ...	...	...	5 ,,	,, ,,	38½	4	,,
12 Mar.	5	12 miles S.E. of Wick	...	W.N.W.	...	... ...	...	...	...
13 ,,	5	25 ,, E. ,,	...	S.W.	...	... ...	...	...	...
15 ,,	5	12 ,, ,, ,,	...	S light.	16 June	Portsoy, Banffshire	52	93	S.S.W.
,, ,,	5	24 ,, E.N.E. of Wick	...	S.E. ,,	23 Apr.	So. Pharay, by Longhope, Orkney	25	39	N.W.
19 ,,	5	10 ,, S.E. of Lerwick	...	light	...	... ...	...	...	...
15 ,,	5	20 ,, ,, Unst	...	S.E. ,,	...	... ...	...	...	...
,, ,,	4	10 ,, ,, Flugga Lighthouse	...	,, ,,	...	... ...	...	...	...
30 ,,	5	20 ,, ,, Lerwick	...	S.W. ,,	...	... ...	...	...	...

See page 153

SHETLAND ISLANDS
ORKNEY ISLANDS
Pentland Firth
Duncansby Hd
CAITHNESS
Wick
Tarbat Ness
South Bank
FIRTH OF MORAY
Kinnaird Hd
Banff
BANFF
Buchan Ness
ABERDEEN
Aberdeen
Girdle Ness
SCOTLAND
KINCARDINE
Stonehaven
Montrose
FORFAR
Arbroath
St Andrews
FIFE
FIRTH OF FORTH
EDINBURGH
Dunbar
HADDINGTON
Berwick
BERWICK
Holy I.
NORTHUMBERLAND
Warkworth
Newcastle
DURHAM
Hartlepool
Whitby
Scarborough
YORK
Filey
Flamborough Head
Hornsea
Withernsea
Gt Grimsby
R. Humber
Donna Nook
LINCOLN
ENGLAND
Boston
Kings Lynn
Cromer
NORFOLK
Yarmouth
Lowestoft
SUFFOLK
NORTH SEA
LONG FORTIES
DOGGER BANK
Var. 19° 35' W
Magnetic

SECTION B.—BIOLOGICAL INVESTIGATIONS.

I.—ADDITIONS TO THE FAUNA OF THE FIRTH OF FORTH. —PART VII. By Thomas Scott, F.L.S. (Plates III., IV.)

Owing to continued efforts being made to work up what remains of dredged and other material collected in various parts of the Firth of Forth during recent years, and also to still further extend our investigations of the fauna of the Forth estuary, a considerable number of organisms have, as the result of these efforts, been added to those described in the Annual Reports of previous years. The additions this year comprise one species of Pisces, twenty-eight species of Copepoda, and one species of Trematoda.

Descriptions of most of these have been already published,* descriptions of others are in course of publication,† while several others are described here for the first time.

I am again indebted to my son, Mr Andrew Scott, Fisheries Assistant, University College, Liverpool, for the drawings that illustrate this memoir. My friend, Mr William Eagle Clark, identified for me the fish that is here recorded; Dr R. Blanchard, the eminent French naturalist, kindly favoured me with the name of the Trematode fish parasite referred to above, while Dr. T. Wemyss Fulton, F.R.S.E., Superintendent of Scientific Investigations, by his uniform and kindly interest in our work, has done much to make our work successful. I have also to acknowledge my indebtedness to Captain Robert Campbell of the Fishery Cruiser 'Garland, for the assistance he is always, whenever possible, so ready and willing to give.

Pisces.

Triglops Murrayi, Gunther (1885).

Triglops Murrayi, Gunther, Proc. Roy. Soc. Edin., vol. xv. p. 209, Pl. IV. fig. A (1885).

Triglops Murrayi, W. Eagle Clark, Ann. Scot. Nat. Hist., No. 13, p. 23 (Jan. 1895).

Habitat.—A few miles west of May Island (28th Nov. 1890).

Though *Triglops Murrayi* was obtained in 1890, the species was unknown to us at that time; the specimen was therefore put aside till an opportunity should occur for a study being made of its peculiar features. It was thus allowed to stand over till last year, when it was sent to Mr Eagle Clark of the Museum of Science and Art, Edinburgh, who identified it as *Triglops Murrayi*, Gunther. In the *Annals of Scottish Natural History* for January 1895, Mr Eagle Clark gives a summary of all the known records of the occurrence of this fish since its discovery on the west coast of Scotland by Dr Murray in 1885. It does not appear to have been observed in the Firth of Forth previous to 1890.

* In *Ann. and Mag. Nat. Hist.* for January 1895, and in *Ann. Scot. Nat. Hist.* for the same month.

† In the *Trans. of the Linnean Society of London.*

CRUSTACEA.

Copepoda.

Genus *Bradya*, Boeck (1872).

A revision of the British Copepoda belonging to the genera *Bradya* and *Ectinosoma*, by myself and my son, Mr A. Scott, is in course of publication by the Linnean Society of London. The following species belonging to these two genera are from the Firth of Forth, and are additions to previous records :—

Bradya typica, Boeck.

1872. *Bradya typica*, Boeck, Nye Slægter og Arter, Saltsvands copepoda, p. 15.

Habitat.—West of May Island.

Bradya elegans, T. and A. Scott.

Habitat.—Largo Bay.

Bradya hirsuta, T. and A. Scott.

Habitat.—Largo Bay.

Bradya fusca, T. and A. Scott.

Habitat.—Largo Bay.

Bradya minor, T. and A. Scott.

Habitat.—Off St. Monans.

Genus *Ectinosoma*, Boeck (1864).

Ectinosoma propinquum, T. and A. Scott.

Habitat.—Off Musselburgh, Firth of Forth.

Ectinosoma gracile, T. and A. Scott.

Habitat.— Off St Monans, Firth of Forth.

Ectinosoma curticorne, Boeck.

1885. *Ectinosoma curticorne*, Boeck, Abhandl.'d. Natur u. Vereins zu Bremen, IX. Band, p. 194, t. vi. figs. 1–12.

Habitat.—Off Burntisland, Firth of Forth.

Ectinosoma Herdmani, T. and A. Scott.

Habitat.—Off St. Monans, Firth of Forth.

Ectinosoma pygmæum, T. and A. Scott.

Habitat.—Firth of Forth.

Ectinosoma armiferum, T. and A. Scott.

Habitat.—West of May Island, Firth of Forth.

Ectinosoma Normani, T. and A. Scott.

Habitat.—Off Burntisland, Firth of Forth.

Ectinosoma tenuipes, T. and A. Scott.

Habitat.—Off St. Monans, Firth of Forth.

Ectinosoma longicorne, T. and A. Scott.

Habitat.— Off St. Monans, Firth of Forth.

Ectinosoma tenuicorne, T. and A. Scott.

Habitat.—Off St. Monans, Firth of Forth.

Genus *Stenhelia*, Boeck (1864).

Stenhelia reflexa, n. sp. (Pl. III. figs. 1–9).

Description of the species.—Female, length 1·2 mm. ($\frac{1}{21}$ of an inch). Body slender, somewhat similar to *Stenhelia ima*, Brady, but considerably more elongate. Antennules short, eight-jointed, the first two joints dilated, second joint longer than any of the others, the fifth, sixth and seventh short, terminal joint about half the length of the second. The proportional lengths of all the joints are shown in the formula—

Proportional lengths of the joints,	21 · 26 · 16 · 21 · 8 · 9 · 6 · 13
Numbers of the joints,	1 · 2 · 3 · 4 · 5 · 6 · 7 · 8

Antennæ stout, secondary branch of moderate length, three-jointed (fig. 3). Basal joints of the mandible-palp dilated, both branches two-jointed, but the end joints are small (fig. 4). Posterior foot-jaws somewhat like those of *Stenhelia ima*,—a plumose seta springs from the inner distal angle of the first joint, a longitudinal and slightly curved row of small hairs extends along the side—interiorly—of the second joint, while the inner margin of the same joint bears two slender setæ on the distal half; two small supplementary setæ also spring from the base of the terminal claw (fig. 5). First pair of swimming feet elongate, the last joint of the inner branches is about twice the length of the second, while the entire length of the second and third joints is only about two-thirds the length of the first joint. The outer branches are rather more elongate than the first joint of the inner branches (fig. 6). The other four pairs somewhat similar to those of *Stenhelia ima*, but the secondary joint of the fifth pair is proportionately less elongate, so that the inner portion of the basal joint extends to about two-thirds the length of the secondary joint (fig. 8). Caudal stylets very short, the principal seta of each is interiorly gibbous at the articulation near the base (fig. 9).

Habitat.—Shore near Dunbar, Firth of Forth. Rather rare.

Remarks.—This species may be distinguished from *Stenhelia ima*, Brady, which appears to be its nearest ally, not only by its greater length, but also by the length and structure of the antennules, and by the proportionally longer inner branches of the first pair of swimming feet.

Genus *Mesochra*, Boeck (1864).

Mesochra spinicaudata, T. and A. Scott.

1895. *Mesochra spinicaudata*, T. and A. Scott, Ann. and Mag. Nat. Hist., ser. 6, vol. xv. p. 52, Pl. V. figs. 12–25.

Habitat.—In pools near low-water on the shore at Musselburgh, Firth of Forth. Frequent.

Remarks.—The posterior foot-jaws, with their extremely long terminal claws, form a prominent character in this species, and one by which it was readily distinguished from the other Copepoda among which it occurred in the shore gathering from Musselburgh.

Mesochra MacIntoshi, T. and A. Scott (Pl. IV. fig. 22).

1895. *Mesochra MacIntoshi*, T. and A. Scott, Ann. and Mag. Nat. Hist., ser. 6, vol. xv. p. 53, Pl. VI. figs. 1–7.

Habitat.—In pools near low-water mark on the shore at Musselburgh, Firth of Forth. Not uncommon.

Remarks.—Though this species is more slender than the typical *Mesochra*, it is nevertheless in the structure of its various appendages, a true member of that genus. The first pair of swimming feet closely resemble those of *Mesochra Lilljeborgii*, differing only in the proportionally greater length of the end joint of the inner branches.

Genus *Laophonte*, Philippi.

Laophonte intermedia, n. sp. (Pl. III. figs. 10–20).

Description of the species.—Female, length ·7 mm. ($\frac{1}{36}$ of an inch). Body robust and slightly arcuate, rostrum short and broadly rounded. Antennules short, stout and five-jointed; the fourth joint very short, the others subequal in length. The proportional lengths of the joints are nearly as follow :—

Proportional lengths of the joints,	18	20	20	6	18
Numbers of the joints,	1	2	3	4	5

The first joint of the antennæ is somewhat dilated, but the second joint is narrow,—both are of nearly equal length; secondary branch very small, one-jointed (fig. 13).

Mandible-palp narrow, elongate and hirsute, and furnished with three terminal setæ (fig. 14). Posterior foot-jaw stout, armed with a powerful terminal claw strongly hooked at the end (fig. 15). The first joint of the inner branch of the first pair of swimming feet is of great length, being about six times longer than broad; second joint short, and armed with a strongly hooked claw, scarcely twice the length of the joint from which it springs. Outer branch moderately stout, two-jointed; a stout short spine springs from the upper half of the outer margin of the second basal joint; a considerable portion of the integument of this joint and of the outer branches is densely hirsute on the outer aspect, as shown in the drawing (fig. 16). Inner branches of the fourth pair short, two-jointed, joints subequal (fig. 17). Fifth pair foliaceous, somewhat resembling those of *Laophonte hispida*; the produced portion of the basal joint is furnished with four moderately long and stout setæ on the inner distal margin and apex; the setæ on the secondary branch are shorter—at the apex there is one stout, plumose and very long slender seta; other three setæ spring at irregular intervals along the outer edge (fig. 18). Caudal stylets as long as the last abdominal segment, robust, sub-conical, strongly notched near the middle of the outer margin, and provided each with a stout conical, terminal spine; the integument of the abdominal segments and caudal stylets is more or less covered with minute setæ, as shown in the drawing (fig. 20). *Male.*—The male closely resembles the female except in the structure of the antennules, the fourth joint of which is considerably dilated, while the next three are narrow, and together form a hooked claw (fig. 12). The fifth pair of thoracic feet in the male are very small (fig. 19).

Habitat.—In shore pools at Musselburgh, Firth of Forth, and at Port Erin, Isle of Man.

Remarks.—This species appears to be intermediate between *Laophonte lamellata* and *Laophonte hispida*, but is quite distinct from both; it could easily be distinguished by the peculiar form of the caudal stylets alone, though mixed up with numbers of other Copepoda.

Genus *Cletodes*, Brady (1892).

Cletodes similis, n. sp. (Pl. III. figs. 22–26; Pl. IV. figs. 1–3).

1892. *Cletodes lata*, T. Scott, variety (?), Tenth Annual Report of the Fishery Board for Scotland, Part III. p. 257, Pl. X. fig. 18.

Description of the species.—Female, length ·65 mm. ($\frac{1}{38}$ of an inch). Resembling *Cletodes lata*, T. Scott, in general appearance. Antennules six-jointed, sparingly setiferous; the fourth joint is considerably shorter and the end joint longer, than the others, as shown by the formula—

Proportional lengths of the joints,	18 · 10 · 18 · 5 · 9 · 22
Number of the joints,	1 · 2 · 3 · 4 · 5 · 6

Antennæ somewhat similar to those of *Cletodes lata* (Pl. V. fig. 1). Posterior foot-jaw short, stout, and armed with a stout curved terminal claw; the claw is fringed with hairs on the distal half of the inner margin; a setiferous spine springs from the upper distal angle of the first joint; the second joint, which is somewhat dilated and gibbous below, is fringed with small hairs on both margins (Pl. III. fig. 24). The first joint of the outer branches of the first pair is nearly equal to the combined length of the second and third joints; the outer branches are also armed with long slender marginal spines and small spiniform setæ,—the end joint bears two marginal and one long slender terminal spine; the same joint is also furnished interiorly with two very long and plumose subterminal setæ, and a moderately long setæ, also plumose, springs from the lower distal half of the inner margin of the second joint; the inner branches, which are two-jointed, and reach to about the end of the second joint of the outer branches, have the first joint short but moderately stout, while the second joint is slender and more elongate, the first joint bears four short plumose setæ on the inner distal angle, and the second joint is furnished at the extremity with one short and one very long plumose setæ and a slender spine; a stout setiferous spine, which reaches to about the middle of the end joint of the inner branch, springs from the inner distal angle of the second basal joint, and a similar but rather more slender spine springs from the outer angle of the same joint (Pl. IV. fig. 2). The fourth pair are somewhat similar to the same pair in *Cletodes lata*, but the marginal spines of the outer branches are much shorter and stouter (Pl. IV. fig. 3). In the fifth pair the inner portion of the basal joint is produced into a subconical lobe bearing at its apex a long stout and coarsely plumose seta, while a smaller seta springs from the outer margin and close to the apical seta; secondary joint elongate, narrow and armed with one long terminal and three rather shorter marginal setæ; the setæ are all more or less curved, and the uppermost of the three marginal setæ is spiniform and setiferous (Pl. IV. fig. 25). Caudal stylets as in *Cletodes lata.*

Male.—The male differs little from the female, except in the structure of the antennules and fifth pair of thoracic feet. The antennules are apparently nine-jointed and rather more slender than those of the female, and are modified to form powerful grasping organs (Pl. III. fig. 23). The fifth pair in the male are scarcely half the size of those of the female, but somewhat similar in form; the two plumose setæ on the inner portion of the basal joint are much shorter; the secondary joint bears only two small marginal setæ, while the apical seta is of considerable length and plumose (Pl. III. fig. 26).

Habitat.—In shore pools, as well as in deep water, Firth of Forth, and Port Erin, Isle of Man.

Remarks.—This species has been known to us since 1891, and in the Tenth Annual Report of the Fishery Board for Scotland, Part III. p. 257, it is referred to as a doubtful variety of *Cletodes lata.* During recent months the same two forms, *Cletodes lata* and the species now described, have again been the subject of careful study, with the result that we are now satisfied that they are quite distinct. They differ in the structure of the antennules, and very markedly in the form of the posterior foot-jaws; they also differ in the proportional lengths, and in the armature of the outer and inner branches of the first pair of swimming feet. The difference in the form of the fifth pair is also very marked.

Genus *Thalestris*, Claus (1863).

Thalestris mysis, Claus.

1863. *Thalestris mysis*, Claus. Die frei lebenden Copepoden, p. 130, Pl. XVII. figs. 12–16.

Remarks.—This very distinct species was observed for the first time in the Firth of Forth during the last summer.

Pseudothalestris, Brady (1883).

Pseudothalestris pygmæa (T. and A. Scott).

1895. *Pseudowestwoodia pygmæa*, T. and A. Scott, Ann. and Mag. Nat. Hist., ser. 6, vol. xv. p. 55, Pl. VI. figs. 8–16 (Jan. 1895).

Habitat.—Near Dunbar, at the mouth of the Firth of Forth. In the Annals and Magazine of Natural History for May 1895 we have shown that the genus *Pseudothalestris*, Brady, which was described in the Report on the 'Challenger' Copepoda (p. 100), from a single specimen—a male—obtained in a gathering collected at Betsy Cove, Kerguelen Island, in lat. 49° 16′ S., long. 70° 12′ E., is apparently identical with *Pseudowestwoodia*, T. Scott, described in the Twelfth Annual Report of the Fishery Board for Scotland. This is another instance of the remarkable similarity that exists among some of the lowly organisms that inhabit opposite sides of the globe.

Pseudothalestris major (T. and A. Scott).

1895. *Pseudowestwoodia major*, T. and A. Scott, *op. cit.* p. 56, Pl. VI. figs. 17–20.

Habitat.—Vicinity of Granton, and of Dunbar, Firth of Forth. Rare.

Genus *Harpacticus*, Milne-Edwards (1838).

Harpacticus obscurus, n. sp. (Pl. IV. figs. 4–12).

Description of the species.—Female, length ·8 mm. ($\frac{1}{31}$ of an inch). Antennules somewhat slender, nine-jointed; the first four joints are of nearly equal length, the sixth, which is about half the length of the third, is nearly twice as long as the last joint. The proportional lengths of the joints are as shown by the formula—

Proportional lengths of the joints,	13 · 13 · 14 · 13 · 5 · 7 · 3 · 2 · 4
Number of the joints,	1 · 2 · 3 · 4 · 5 · 6 · 7 · 8 · 9

Antennæ very robust; secondary branch equal to about three-fourths the length of the end joint of the primary branch, very slender and composed of two nearly equal joints (fig. 6). Mandible stout, basal joint of mandible-palp dilated at the end (fig. 7). End joint of the posterior foot-jaw broadly ovate; a row of small setæ extends obliquely across part of the inner aspect of the joint, while a few small setæ arranged in a transverse row spring from the vicinity of the outer margin, as shown by the drawing (fig. 8). Terminal claw stout and strongly curved, a slender supplementary seta springs from the inner aspect of the claw near the base; a small seta also springs from the inner distal angle of the first joint. Outer branches of the first pair of swimming feet elongate, moderately stout; first and second joints of nearly equal length, and fringed with minute hairs on the outer edge; third joint almost obsolete; the first joint bears two small setæ on the outer distal angle, and one small seta springs from the distal half of the outer edge of the second joint; the outer branch is also armed with three stout and two very small spines, there is also a small subterminal and spiniform seta on the inner aspect; first joint of the inner branches nearly as long as the first joint of the outer branches, both margins fringed with short hairs, while a short plumose seta springs from near the distal end of the inner margin; other joints very short (fig. 9). The fifth pair has the basal joint broadly foliaceous and shortly produced interiorly, and furnished with four plumose setæ on the broadly rounded apex, the second seta from the outside being much longer than the others, while the innermost is the shortest; secondary joint subcylindrical, about twice as long as broad, and provided with five apical setæ, the two inner setæ being rather longer than the others and plumose; both margins of the secondary joint are ciliated (fig. 11). Caudal stylets very short (fig. 12).

Habitat.—Old quarry near Granton, into which the sea ebbs and flows.

Remarks.—This somewhat critical species may be distinguished from other species of *Harpacticus* by the structure of the antennules, by the form and armature of the posterior foot-jaws, the length of the first and second joints of the outer branches of the first pair of swimming feet, and by the form of the fifth pair. In all these characters it appears to be intermediate between *Harpacticus fulvus* and *Harpacticus flexus.*

Genus *Idya*, Philippi (1843).

Idya gracilis, n. sp. (Pl. IV. figs. 13–21).

Description of the species.—Female, length 1·4 mm. ($\frac{1}{18}$ of an inch). Body, seen from above, narrow and tapering gently towards the posterior end, length about three and a half times the breadth at the widest part, rostrum small (fig. 13). Antennules scarcely reaching to the end of the first cephalo-thoracic segment, eight-jointed; the second joint is rather more elongate than any of the others; the length of the fourth and the last is nearly equal, while the fifth, sixth and seventh are small, as shown by the formula—

Proportional lengths of the joints,	15	26	22	18	5	7	4	16
Numbers of the joints,	1	2	3	4	5	6	7	8

Antennæ slender, moderately elongate; secondary branches short, four jointed, furnished with several short plumose setæ; second and third joints subequal and smaller than the others, first and fourth also subequal (fig. 15). Mandible rather slender, and the one-jointed branches of the palp are so arranged that there is a considerable distance between them (fig. 16). The basal joint of the anterior foot-jaw is dilated; the end joint is long and very slender, and furnished near the middle of the posterior margin with two setæ—the one plain and slender, the other spiniform and plumose (fig. 17). Posterior foot-jaw large; two small setæ spring from the inner distal angle of the first joint; the terminal claw is stout and elongate, and has a moderately long plumose setæ alongside of it interiorly; both the first and second joints are also provided with a few small marginal hairs, as shown by the drawing (fig. 18). The inner branches of the first pair of swimming feet are of considerable length and very slender; the second joint, which is nearly one and a half times longer than the first, is equal in length to about seven times the width at the broadest part; a plumose seta, extending to slightly beyond the end of the branch, springs from the lower half of the inner margin of the first joint; and a small seta, also plumose, springs from the upper middle portion of the inner margin of the second joint; a fringe of minute hairs extends along the whole of the outer margin of both joints, and the inner margin is also partially fringed with small hairs; the first joint is nearly two-thirds the length of the second, a spiniform and coarsely plumose seta, rather longer than the joint, springs from its outer distal angle; a short, slender, setiferous spine springs from the lower half of the outer margin, and a short plumose seta from the inner margin of the second joint; the end joint is less than half the length of the second, and its armature is somewhat similar to that of the same joint in *Idya furcata* (fig. 19). The second, third and fourth pairs of swimming feet are somewhat similar to those of that species. The fifth pair are also somewhat similar to those of *Idya furcata*, but the secondary joint is narrower and more elongate, its extremity is subconical and the setæ are less crowded together at the apex (fig. 21). Caudal stylets rather longer than broad.

Habitat.—An old quarry near Granton, into which the sea ebbs and flows.

Remarks.—The elongate form of the animal, together with the difference in the proportional lengths of the antennules, the long and slender inner branches of the first pair of swimming feet, and the less powerful armature of the outer branches, are characters quite sufficient to distinguish this from *Idya furcata*, Baird, and *Idya longicornis*, T. and A. Scott.

Trematoda.

Octobothrium merlangi (Kuhn), (Pl. IV. figs. 23, 24).

This curious parasite was obtained on the gills of a specimen of the Whiting (*Gadus merlangus*) from the Firth of Forth, in March 1891. Several specimens were obtained. It was first described by Kuhn (*Memoires du Museum*) in 1830, and afterwards by P. J. van Beneden (*Bulletin de l'Académie de Belgique* (1) xxiii.) in 1856. The same author also refers to it in his *Animal Parasites* (vol. xx. of the International Scientific series), p. 261 (1876).

This parasite does not seem to be very common in the Firth of Forth—at anyrate I have only once observed it.

I am indebted to my kind correspondent, Dr R. Blanchard of Paris, for most of the above information concerning this interesting parasite.

DESCRIPTION OF THE PLATES.

Plate III.

Stenhelia reflexa, n. sp.

Fig.	1. Female—lateral view,	× 52	diameters.
Fig.	2. Antennule—female,	× 380	,,
Fig.	3. Antenna,	× 380	,,
Fig.	4. Mandible and palp,	× 380	,,
Fig.	5. Posterior foot-jaw,	× 380	,,
Fig.	6. Foot of first pair of swimming feet,	× 253	,,
Fig.	7. Foot of fourth pair,	× 127	,,
Fig.	8. Foot of fifth pair,	× 253	,,
Fig.	9. Last two abdominal segments and caudal stylets,	× 190	,,

PLATE III.

...ott, del.

FIG. 1-9.—*Stenhelia reflexa*, n. sp. FIGS. 10-20.—*Laophonte intermedia*, n. sp. FIGS. 21-26.—*Cletodes similis*, n. sp.

A. Scott, del.

FIGS. 1-3.—*Cletodes similis*, n. sp. FIGS. 4-12—*Harpacti[c]us obs[cu]rus*, n. sp. FIGS. 13-21.—*Idya gracilis*, n. sp.
FIG. 22.—*Mesochra MacIntoshi*, T. and A. Scott. FIGS. 23, 24.—*Octobothrium merlangi* (Kuhn).

Laophonte intermedia, n. sp.

Fig. 10.	Female—lateral view,	× 53 diameters.
Fig. 11.	Antennule—female,	× 380 ,,
Fig. 12.	Antennule—male,	× 380 ,,
Fig. 13.	Antenna,	× 380 ,,
Fig. 14.	Mandible and palp,	× 380 ,,
Fig. 15.	Posterior foot-jaw,	× 380 ,,
Fig. 16.	Foot of first pair of swimming feet,	× 380 ,,
Fig. 17.	Foot of fourth pair,	× 253 ,,
Fig. 18.	Foot of fifth pair—female,	× 380 ,,
Fig. 19.	Foot of fifth pair—male,	× 380 ,,
Fig. 19A.	One of the appendages to first abdominal segment—male,	× 380 ,
Fig. 20.	Last two abdominal segments and caudal stylets,	× 380 ,,

Cletodes similis, n. sp.

Fig. 21.	Female—dorsal view,	× 80 diameters.
Fig. 22.	Antennule—female,	× 380 ,,
Fig. 23.	Antennule—male,	× 380 ,,
Fig. 24.	Posterior foot-jaw,	× 380 ,,
Fig. 25.	Foot of fifth pair—female,	× 380 ,,
Fig. 26.	Foot of fifth pair—male,	× 380 ,,

PLATE IV.

Cletodes similis, n. sp.

Fig. 1.	Antenna—female,	× 380 diameters.
Fig. 2.	Foot of first pair of swimming feet,	× 380 ,,
Fig. 3.	Foot of fourth pair,	× 380 ,,

Harpacticus obscurus, n. sp.

Fig. 4.	Female—lateral view,	× 53 diameters.
Fig. 5.	Antennule—female,	× 253 ,,
Fig. 6.	Antenna,	× 380 ,,
Fig. 7.	Mandible and palp,	× 380 ,,
Fig. 8.	Posterior foot-jaw,	× 380 ,,
Fig. 9.	Foot of first pair of swimming feet,	× 253 ,,
Fig. 10.	Foot of fourth pair,	× 253 ,,
Fig. 11.	Foot of fifth pair,	× 380 ,,
Fig. 12.	Last two abdominal segments and caudal stylets,	× 126 ,,

Idya gracilis, n. sp.

Fig. 13.	Female—dorsal view,	× 40 diameters.
Fig. 14.	Antennule—female,	× 190 ,,
Fig. 15.	Antenna,	× 190 ,,
Fig. 16.	Mandible and palp,	× 253 ,,
Fig. 17.	Anterior foot-jaw,	× 380 ,,
Fig. 18.	Posterior foot-jaw,	× 380 ,,
Fig. 19.	Foot of first pair of swimming feet,	× 190 ,,
Fig. 20.	Foot of fourth pair,	× 126 ,,
Fig. 21.	Foot of fifth pair,	,,

Mesochra MacIntoshi. T. and A. Scott.

Fig. 22.	Female—lateral view,	× 106 diameters.

Octobothrium merlangi (Kuhn).

Fig. 23.	Specimen seen from below,	× 11 diameters.
Fig. 24.	The same seen from above,	× 11 ,,

II.—THE INLAND WATERS OF THE SHETLAND ISLANDS.

By Thomas Scott, F.L.S., and Robert Duthie, Fishery Officer.
(Plate V.)

No systematic attempt has hitherto been made to investigate the microfauna of the lochs of Shetland. Much has, no doubt, been written on various matters of interest, including the natural history and antiquities relating to these islands, but the references to their natural history have usually been confined to the *Vertebrata* among the animals and to the *Phanerogamia* and higher *Cryptogamia* among plants; while the investigation of the microfauna of the lochs of Shetland, as well as of their microflora, has very seldom, if ever, been taken up as a systematic study. This attempt to make a more or less thorough examination of the lochs of Shetland may therefore be of interest.

There is another thing we desire to draw attention to in these preliminary remarks. It is well known that many of the Shetland lochs, though comparatively of small size, are good lochs for trout, but it may not be so well known that one of the greatest enemies to the trout inhabiting these lochs is the cormorant. But it is the case that, in the more shallow lochs, where there is little aquatic vegetation, such as the pond weeds, rushes, sedges, etc., where trout can find at the same time shelter and food, the poor fish are sorely persecuted by these feathered pirates. It is a fact, as will be shown in the sequel, that the absence of trout in some of the smaller lochs of Shetland is almost entirely due to the incessant persecution by these marauding birds, and not to unfavourable natural conditions.

In the following notes we will show that in most of the lochs that have already been examined, there is an ample food supply for trout, and that what is wanted is protection for the fish by encouraging the cultivation of aquatic plants of the kinds already mentioned, under shelter of which the fish may find safety from their persecutors.

We have divided our paper into two sections. In Section I., Mr Duthie gives a general description of the lochs that have been examined, and which form the subject of the present memoir. In Section II., Mr Scott records the names of the various kinds of organisms that have been obtained and identified in the gatherings collected from the different lochs, together with notes on some of the more interesting species.

There is also a table appended giving a general view of the distribution of the species that have been identified.

We propose to describe the lochs in the following order:—

First.—The Lochs on the Island of Unst.

Loch of Cliff.	Loch of Belmont.
Loch of Whatley.	Small Loch of Uyasound.
Loch of Stourhoull.	Large Loch of Uyasound.
Loch of Snarravoe.	Small Waters of Unst.

Second.—Lochs on the Island of Whalsay.

Loch of Sandwick.	Loch of Livister.
Loch of Huxter.	Bu Water.

Third.—Lochs on the Mainland.

Loch of Brindister.	North Loch (off Clikimin).
Loch of Quarff.	Loch of Clikimin.

SECTION I.

This section contains a general description of the lochs recently examined.

First.—Lochs on the Island of Unst.

The island of Unst is intersected by a deep valley which runs from south to north, with high land on either side, and a chain of fresh water lochs connected by streams running through the centre of the valley. None of the lochs examined in Unst are far above the sea-level.

Loch of Cliff.

The most northerly, and by far the largest, is the Loch of Cliff, which was examined on the 12th of July. It is about three miles long by one-third of a mile broad. In the middle of the loch the average depth is said to be about thirty feet: nearer the shore the depth is four or five feet. This is one of the best trout lochs in Shetland. Sea-trout are often caught in it, and yellow trout are always abundant. There are differences in the quality of the fish in this loch. Towards the north end, near the sea, upon sandy bottom, the fish are beautifully marked and of an excellent flavour. Those found towards the southern extremity, where the burn enters from the Loch of Whatley, are of a similar character. But about the middle of the loch, and especially towards the western shore, the fish are of a dull, dark colour and of an inferior flavour. Upon two small islands near the centre of the loch there are the remains of buildings,—thought by some to be ancient lake-dwellings. (Old chapel ruins are numerous in Unst, also the remains of at least one old fort or Pictish *Brough.*)

A boat was obtained, and two drags with a surface tow-net made near the southern end of the loch. The hand-net was also used along the adjacent shores.

Loch of Whatley.

Loch of Whatley is about three miles southwards from Loch of Cliff, and connected with it by the burn of Mailand. It is a mile long and nearly half a mile broad, and is surrounded by moss, which gives a black appearance to the water. Specimens were collected by means of the hand-net, chiefly along the south-eastern shore: a thorough examination by means of the tow-net was impossible, as no boat was available.

Yellow trout, generally of a small size and rather insipid flavour, are very plentiful here, but no sea-trout have been observed, though the burn connecting it with the Loch of Cliff is always large enough to allow fish to pass up and down freely.

Loch of Stourhoull.

This loch lies about one and a half miles S.W. of the Loch of Whatley. It is about half a mile long and less than a quarter of a mile broad. When visited on 21st Sept., there was not sufficient daylight to admit of a thorough examination, and only the north end of the loch was searched. There was very little vegetation near the margin, the shore being gravelly with rough boulders; and no great quantity of animalculæ was visible. There was, however, a large quantity of dark gelatinous pellets, said to be Confervoid growths, of which specimens were secured.

Loch of Snarravoe.

Proceeding for about half a mile S.W. from the Loch of Stourhoull, along a connecting burn, we come to the Loch of Snarravoe. It is about three-quarters of a mile long and a quarter of a mile broad, and has a small burn falling into the sea (or Blue Mull Sound). It is said to be a splendid loch for trout fishing, the trout being the largest found in Unst. When visited in July the hand-net was freely used along the eastern shore of the loch. There is a boat on the loch, but it was not available at the time (12th July).

Loch of Belmont.

The Loch of Belmont lies below the Manor-house and farm of Belmont, and quite near the sea, with which it is connected by a small burn. No trout are found here. The last proprietor (the late Major Cameron of Garth) made a better connection with the sea by deepening the burn, and tried to stock it with trout, but without success. The experiment has been repeated by several others, but the fish always disappeared. As this is the only loch of any size in Unst where trout do not thrive, it would be interesting to know the reason. So far as remembered, there is no burn leading inland from the loch. The shores are gravelly, with little or no vegetation growing in the water, and it is possible that the fish put in had fallen a prey to cormorants. The loch is nearly one-third of a mile long, and comparatively narrow. Specimens of the fauna were collected in the hand-net at different places round the shore on 12th July.

Small Loch of Uyasound.

This is a small loch close to the Post Office, near the sea, but seldom flooded by salt water. It is therefore to all intents and purposes a fresh-water loch, and contains a considerable growth of rushes and other vegetation. A burn of considerable size runs through it to the sea, and also connects it with some smaller lochs—the 'Small Waters'—further inland. As might be expected, trout are plentiful here in summer and autumn. This loch was examined on 22nd Sept., the hand-net being used.

Large Loch of Uyasound.

The Large Loch of Uyasound is a pretty large sheet of water, quite close to the sea, and practically a tidal lagoon, as the spring-tides always flow into it. It was carefully searched by means of the hand-net in July, but the fauna that was abundant in the other lochs, examined at the same date, was here conspicuous by its absence. Several varieties of sea-weeds were found growing round the shores, even on the landward side, where a small burn falls into the loch. Trout, often of a large size, are very plentiful here.

Small Waters of Unst.

This term is applied to a group of small lochs lying to the north of Uyasound, in the direction of the Loch of Whatley. Several of these were searched on 22nd Sept., but no great variety of life was visible.

In some cases the shores were gravelly and destitute of vegetation; in others there was an abundance of green, slimy weed, which it was almost impossible to avoid with the hand-net. In the 'Clay Loch,' which is destitute of vegetation and shallow, masses of Diatoms were found near the shore, specimens of which were collected.

Pond of Gardiesfauld.

The Messrs Sandison, merchants, Uyasound, stocked a small pond near their houses and business premises. The trout throve and multiplied, and for a time afforded good sport to their owners; but they were at last discovered by cormorants, and as the pond was shallow and shelterless, the fish fell a ready prey to them. Some of these birds, on being disturbed during their fishing operations, have here disgorged in their alarm trout weighing over 1 lb. Copepods were very abundant in this pond.

Second.—Lochs on the Island of Whalsay.

Loch of Sandwick.

This loch lies near the S.W. end of Whalsay, not far above the sea-level. It is of moderate size and depth, and contains a rank vegetation. It was dark when this loch was visited (21st August), but the hand-net brought ashore a large number of animalculæ in a short time.

Loch of Huxter.

This is the largest loch in Whalsay, being from one-half to two-thirds of a mile long and one-third of a mile broad. It lies about 100 feet above the sea-level, and is said to be 6 or 8 fathoms deep in the centre. Rough boulders line the shores, and vegetation is scanty. A boat was obtained, and the hand-net used freely among some aquatic plants growing near the south western end of the loch, as well as round the western shore. There did not seem to be great abundance of organisms in the loch, and no trout are found in it. A small island near the east end of the loch contains the ruins of a Pictish 'Brough'. There is a belief that trout are never found in Shetland in lochs that have such ruins. It may be true, but one would be inclined to look for the cause elsewhere than among the ruins.

Loch of Livister.

The Loch of Livister lies a little to the north of the Loch of Huxter, and at a higher elevation. It is a small loch—scarcely a quarter of a mile in length. When visited on 7th Sept., it was not under favourable conditions: it was almost dark, with a strong, cold wind blowing, and this, no doubt, interfered with the search.

Bu Water.

Bu Water was visited on 8th Sept., and is a small loch above Symbister House. Lying at an altitude of upwards of 200 feet, it is almost entirely dependent upon the rain for its supplies, and by the appearance of the beach must be subject to evaporation or overflow, according to the condition of the weather. When visited, after protracted drought, the water was low, and the weather cold and windy. All round the margin is a beach of rough stones, and there is an absence of vegetation, except a small patch near the southern extremity of the loch, and too far from the shore to be reached by the hand-net. Fauna seemed scarce.

Third.—Lochs on The Mainland.

Loch of Brindister.

This loch, which lies some 5 miles south from Lerwick, has an elevation of over 200 feet above the sea-level. It is of a circular form, and about one-third of a mile in diameter. When examined by means of the hand-net, on 20th August, there was not much appearance of life in it; but a small loch not far from it, at a bend of the road near Quarff, contained a plentiful growth of vegetation, and the fauna was abundant.

Loch of Clickimin, near Lerwick.

This loch is chiefly interesting on account of the remains of a Pictish Brough on its southern shore. Free-swimming animalculæ seemed scarce, but specimens were found adhering to stones along the margin. Vegetation was not plentiful, but it was late in the season (20th October) when the loch was examined.

Trout were not formerly found in this loch; but recently, since the outlet to the sea was improved, one or two have been found along its shores in a dead or dying condition, and very much swollen. It would be interesting to know the cause of this.

North Loch (of Clickimin).

The North Loch is quite near the Loch of Clickimin, and a small burn connects them. When examined on 26th September, it was found to contain numerous animalculæ, mostly copepods. The sandy shores were generally covered with a deposit of black, mossy sediment and a growth of green, slimy matter, which were very difficult to avoid with the hand-net.

SECTION II.

In this section we propose to give the results of the examination of the gatherings from the various lochs described in Section I. including a record of the various organisms observed in each of the lochs. The lochs will be referred to in the same order as in Section I.

First.—Lochs on the Island of Unst.

Loch of Cliff.

The gatherings from this loch contained a fair abundance of Crustacea, but very few Mollusca. Among the more interesting species of Crustacea were, *Diaptomus serricornis* and *Canthocamptus hirticornis*,—the one a comparatively rare British fresh-water Calanid, the other, which is described at page 251, is an addition to the British fauna.

MOLLUSCA.

Pisidium nitidum, Jenyns.
Limnæa peregra (Müller).

CRUSTACEA.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops serrulatus, Fischer.
Cyclops strenuus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa (G. O. Sars).

Ostracoda.

Cypria serena (Koch).
Cypria lævis (O. F. Müller).
Cypridopsis vidua (Müller).
Cypridopsis villosa, Jurine.
Limnicythere inopinata (Baird).

Cladocera.

Bosmina longirostris (Müller).
Daphnia longispina, Müller.
Eurycercus lamellatus (Müller).
Chydorus globosus, Baird.
Alonopsis elongata, G. O. Sars.
Chydorus barbatus (O. S. Brady).
Alona quadrangularis (Müller).
Polyphemus pediculus (De Geer).

Besides the things now recorded, there were also Insect larvæ, Coleoptera, Rotifera, Diatoms and other fresh-water Algæ.

Loch of Whatley.

In the Loch of Whatley animal life, though moderately common, was not so varied as in Loch of Cliff, but among the organisms obtained there were one or two rather rare things, as for example :—*Ophiocamptus sarsi*, Mrazek ; *Attheyella pygmæa* (G. O. Sars.) ; and *Chydorus globosus*, Baird. Mollusca were apparently very scarce. Diatoms in great variety and abundance were observed in the gathering from this loch.

MOLLUSCA.

Planorbis nautileus (Linné).

CRUSTACEA.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops, sp.
Cyclops serrulatus, Fischer.
Cyclops fimbriatus, Fischer.
Attheyella pygmæa (G. O. Sars).
Ophiocamptus sarsi, Mrazek.

Ostracoda.

Cypria lævis (Müller).

Cladocera.

Eurycercus lamellatus (Müller).
Alona quadrangularis (Müller).
Chydorus globosus, Braid.
Polyphemus pediculus (De Geer).

Loch of Stourhoull.

Some interesting things were obtained in the gathering from this loch. Among the Ostracoda obtained here were *Ilyocypris gibba* and *Cytheridea lacustris*; while the Cladocera included the curious *Drepanothrix dentata* and *Harporhynchus falcatus.* The small roundish gelatinous bodies so frequent in some parts of this loch appeared to be colonies of Diatoms, held together by a confervoid growth of gelatinous consistency. Mollusca appeared to be rather rare.

MOLLUSCA.

Pisidium pusillum (Gmelin).
Planorbis nautileus (Linné).
Limnæa peregra (Muller).

Loch of Snarravoe.

The gathering from this loch is of interest from the number of *Neomysis vulgaris* contained in it. The occurrence of this schizopod confirms still further what has already been pointed out,* that *Neomysis vulgaris* can live in perfectly fresh water, and be apparently 'at home' in it. The *Gammarus* obtained here resembles more closely *Gammarus duabeni* than *Gammarus pulex. Diaptomus serricornis* and the fine *Chydorus globosus* were quite frequent in this loch; so also was *Canthocamptus hirticornis.* No Mollusca were observed, but *Notonectes* and *Hydrachnidæ* were frequent.

CRUSTACEA.

Schizopoda.

Neomysis vulgaris (J. V. Thompson).

Amphipoda

Gammarus (?) *duabeni*, Lillj.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops serrulatus, Fischer.
Canthocamptus hirticornis, T. Scott.

* *Ninth Annual Report of the Fishery Board for Scotland*, Part III. p. 285.

Ostracoda.

Cypria serena (Koch). *Cypria lævis* (Müller).
Candona candida (Müller).

Cladocera.

Eurycercus lamellatus (Müller). *Alona quadrangularis* (Muller).
Chydorus globosus, Baird.

Loch of Belmont.

Comparatively few species were obtained in the gathering from Loch of Belmont, but *Neomysis vulgaris* was common. No Mollusca were obtained.

CRUSTACEA.

Schizopoda.

Neomysis vulgaris (J. V. Thompson).

Amphipoda.

Gammarus (?) *duabeni*, Lillj.

Copepoda.

Diaptomus serricornis, Lillj. *Cyclops serrulatus*, Fischer.
Cyclops signatus, Koch. *Attheyella crassa* (G. O. Sars).

Ostracoda.

Candona candida (Müller).

Cladocera.

Chydorus barbatus (G. S. Brady). *Alona quadrangularis* (Müller).

Small Loch of Uyasound.

Neomysis vulgaris was obtained in this loch also, and associated with the schizopod were numerous typical fresh-water organisms. As a matter of fact the gathering from this small loch was a much richer gathering than from some of the larger lochs on the same island ; and not only were Crustacea numerous and varied, but other groups of organisms were also well represented, such as Insect larvæ, Tardigrada, Rotifera, Rhizopoda, Diatoms, &c. but no Mollusca were obtained in the gathering.

CRUSTACEA.

Schizopoda.

Neomysis vulgaris (J. V. Thompson).

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops strenuus, Fischer.
Cyclops, sp.
Cyclops serrulatus, Fischer.
Cyclops fimbriatus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa G. O. Sars.
Ophiocamptus sarsi, Mrazek.

Ostracoda.

Cypria serena (Koch).
Erpetocypris reptans (Baird).
Cypridopsis villosa (Jurine).
Candona candida (Müller).
Limnicythere inopinata (Baird).

Cladocera.

Ilyocryptus sordidus (Lievin).
Eurycercus lamellatus (Müller).
Acroperus harpæ, Baird.
Alona quadrangularis, Müller.
Chydorus globosus, Baird.

Large Loch of Uyasound.

The hand-net gathering from this loch was rather disappointing; so little of interest did it apparently contain that it was not preserved for examination as the other gatherings were.

The Small Waters of Unst.

As explained in the first portion of this Report, "The Small Waters" comprise several small lochs to the North of Uyasound. The list of organisms given here is made up of specimens from one or two of these little lochs, instead of being all from one loch.

MOLLUSCA.

Limnæa peregra (Müller).

CRUSTACEA.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops serrulatus, Fischer.

Ostracoda.

Cypria serena (Koch).
Loxoconcha viridis (Müller).

Cladocera.

Bosmina longirostris (Müller).
Daphnia longispina, Müller.
Eurycercus lamellatus (Müller).
Acroperus harpæ, Baird.
Alonopsis elongata, G. O. Sars.
Alona guttata, G. O. Sars.
Alona quadrangularis (Müller).
Alonella exigua, Lillj.
Harporhynchus falcatus, G. O. Sars.
Chydorus sphæricus, Müller.

Second.—Lochs on the Island of Whalsay.

Loch of Sandwick.

The gathering from the Loch of Sandwick contained a few rather rare entomostraca. I mention particularly the more noteworthy forms,—*Attheyella zschokkei*, Schmeil; *Latona setifera* (Müller); *Graptoleberis testudinarius*, Fischer, and *Alonella nana* (Baird). Mollusca were very scarce. *Notonectes*, Insect larvæ, Diatoms, and other organisms were also observed.

MOLLUSCA.

Pisidium pusillum, Gmelin.
Limnæa peregra (Müller).

CRUSTACEA.

Copepoda.

Cyclops signatus, Koch.
Cyclops strenuus, Fischer.
Cyclops serrulatus, Fischer.
Attheyella zschokkei, Schmeil.

Cladocera.

Latona setifera (Müller)
Ceriodaphnia quadrangula (Müller).
Eurycercus lamellatus (Müller).
Alonopsis elongatus, G. O. Sars.
Graptoleberis testudinarius, Fischer.
Alona quadrangularis (Müller).
Alonella exigua, Lillj.
Alonella nana (Baird).

Loch of Huxter.

Among the Crustacea obtained in this loch were the following rather rare and interesting species:—*Diaptomus serricornis*, *Attheyella zschokkei*, *Canthocamptus hirticornis*, and *Chydorus globosus*. Mollusca appeared to be rather rare. Fragments of the common pond-weed, *Potamogeton perfoliatum*, were obtained in the gathering from Loch of Huxter, as were also Rotifera, Rhizopoda, Diatoms, &c.

MOLLUSCA.

Planorbis nautileus (Linné).

CRUSTACEA.

Amphipoda.

Gammarus (?) *duabeni*, Lillj.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops signatus, Koch.
Cyclops serrulatus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa (G. O. Sars).
Attheyella zschokkei, Schmeil.

Ostracoda.

Cypria serena (Koch).
Candona candida (Müller).

Cladocera.

Bosmina longirostris (Müller).
Cereodaphnia quadrangula (Müller).
Acroperus harpæ, (Baird).
Alonopsis elongatus (G. O. Sars).
Chydorus barbatus, G. S. Brady.
Alona guttata, G. O. Sars.
Alona quadrangularis (Müller)
Alonella exigua, G. O. Sars.
Chydorus globosus, Baird.

Loch of Livister.

Though Loch of Livister is a much smaller loch than Loch of Huxter, the gathering collected here was richer in the number and variety of both animal and vegetable organisms:—Insect larvæ, Notonectidae, Coleoptera Rotifera, Infusoria (Ceratium), Diatoms and Desmids; a few of the species belonging to the two latter groups being large and beautiful. The only mollusc observed in the gathering from Loch of Livister was *Limnæa peregra.* Ostracoda were also comparatively rare.

MOLLUSCA.

Limnæa peregra (Müller).

CRUSTACEA.

Amphipoda.

Gammarus (?) *duabeni*, Lillj.

Copepoda.

Cyclops virides, Jurine.
Cyclops signatus, Koch.
Cyclops strenuus, Fischer.
Cyclops serrulatus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa (G. O. Sars).

Ostracoda.

Cypria serena (Koch).
Cytheridea lacustris (G. O. Sars).

Cladocera.

Latona setifera (Müller).
Bosmina longirostris (Müller).
Drepanothrix dentata (Euren).
Ilyocryptus sordidus (Lievin).
Acroperus harpæ, Baird.
Graptoleberis testudinarius (Fischer).
Chydorus barbatus (G. S. Brady).
Alona costata, G. O. Sars.
Alona neglecta, T. Scott.
Alona quadrangularis (Müller).
Harporhynchus falcatus, G. O. Sars.
Alona rustica, T. Scott.
Alona intermedia, G. O. Sars.

Bu Water.

The gathering from Bu Water is of interest because of the elevation of the loch, which is upwards of 200 feet above the sea, and because it seems to be altogether dependant on the rain for its supply of water. It might have been expected that under these conditions the micro-fauna of the Bu Water would have exhibited on the whole some variation from that of lochs nearer sea level. Such can hardly be said to be the case, however, as, with perhaps one or two exceptions, all the species identified are similar to those from other lochs. No Mollusca were observed in this loch.

CRUSTACEA.

Copepoda.

Cyclops strenuus, Fischer.
Cyclops serrulatus, Fischer.
Cyclops fimbriatus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa (G. O. Sars).
Ophiocamptus sarsii, Mrazek.

Cladocera.

Latona setifera (Müller).
Bosmina longirostris (Müller).
Drepanothrix dentata (Euren).
Ilyocryptus sordidus (Lievin).
Ceriodaphnia quadrangula (Müller).
Eurycercus lamellatus (Müller).
Acroperus harpæ, Baird.
Alonopsis elongatus, G. O. Sars.
Alona neglecta, T. Scott.
Alona rustica, T. Scott.
Alona quadrangularis (Müller).
Chydorus sphæricus (Müller).
Chydorus (?) *ovalis*, Kurz.

No Ostracoda were observed in the gathering from Bu Water, but Insect-larvæ, Notonectidae, Coleoptera, Rotifera and other micro-organisms were more or less common.

Third.—Lochs on the Mainland.

Loch of Brindister.

Very few Mollusca or Crustacea were obtained in the gathering from this loch, but the larvæ of the *Oxyethicra* * with their curious cases, Rotifera, Tardigrada, and other organisms were fairly common. The common water milfoil—an aquatic plant—was also obtained in the gathering.

* George Swainson, F.L.S., has published in the *British Naturalist* for 1894 a very interesting paper on several curious insect larvæ and their 'cases.'

MOLLUSCA.

Limnæa peregra (Müller).

CRUSTACEA.

Amphipoda.

Gammarus (?) *duabeni*, Lillj.

Copepoda.

Cyclops signatus, Koch.
Cyclops serrulatus, Fischer.
Canthocamptus hirticornis, T. Scott.
Attheyella crassa (G. O. Sars).

Cladocera.

Alonopsis elongatus, G. O. Sars.
Chydorus barbatus (G. S. Brady).
Alona quadrangularis (Müller).

Loch of Quarff.

Entomostraca were fairly numerous in the gathering from this loch, besides several other things. The common three-spined stickleback frequented this little loch, some of them being infested with the Entoparasite *Bothriocephalus*, which seemed in some cases to entirely fill up the abdominal cavity. Notonectidae, Coleoptera, Hydræ, Diatomacea, and Desmidæ were also common, but though Entomostraca were moderately common, there was not a great variety of them, as only about ten species altogether were obtained, the names of which are as follow :—

CRUSTACEA.

Copepoda.

Cyclops signatus, Koch.
Cyclops strenuus, Fischer.
Cyclops serrulatus, Fischer.
Attheyella pygmæa (G. O. Sars).

Cladocera.

Bosmina longirostris (Müller).
Chydorus barbatus (G. S. Brady).
Alona rustica, T. Scott.
Alona quadrangularis (Müller).
Alonella nana (Braid).
Chydorus sphæricus (Müller).

No Mollusca nor Ostracoda were observed in the gathering from Loch of Quarff.

Loch of Clickimin (near Lerwick).

Comparatively few organisms were obtained in the gathering from this loch. Probably the lateness of the season when the gathering was collected may partly account for the scarcity of animal life. Be that as it may, it is nevertheless interesting to find that, though the sea apparently has access to Loch of Clickimin, yet *Diaptomus serricornis*, *Daphnia longispina*, and other more or less typical fresh-water Crustacea were obtained in the gathering from this loch.

CRUSTACEA.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops serrulatus, Fischer.
Attheyella crassa (G. O. Sars).

Cladocera.

Bosmina longirostris (Muller).
Daphnia longispina, Muller.
Acroperus harpæ, Baird.
Alona quadrangularis (Müller).
Chydorus sphæricus.

North Loch (near Loch of Clickimin).

The North Loch, though but a short distance from that just described, contained a more numerous and varied fauna, the number of Crustacea obtained amounted to at least thirteen species. No Mollusca were observed.

CRUSTACEA.

Copepoda.

Diaptomus serricornis, Lillj.
Cyclops viridis (Jurine).
Cyclops strenuus, Fischer.
Cyclops serrulatus, Fischer.

Ostracoda.

Cypria ophthalmica (Jurine).

Cladocera.

Bosmina longirostris (Müller).
Ceriodaphnia quadrangula (Müller).
Daphnia longispina Müller.
Eurycercus lamellatus (Müller).
Alonopsis elongatus, G. O. Sars.
Alona quadrangularis (Müller).
Chydorus sphæricus (Müller).
Chydorus (?) *ovalis*, Kurz.

The following Table gives a general view of the distribution of all the species from the various lochs:—

TABLE containing the names of all the species identified in the Lochs of Shetland, described in the preceding pages, and shewing the Lochs in which each species was found. An × is used to indicate the Loch or Lochs in which the species was obtained.

Names of the Species.	Lochs of Unst.							Lochs of Whalsay.				Lochs on the Mainland.			
	Loch of Cliff.	Loch of Whatley.	Loch of Stourhoull.	Loch of Snarravoe.	Loch of Belmont.	Small Loch of Uyasound.	Small Waters.	Loch of Sandwick.	Loch of Huxter.	Loch of Livister.	Bu Water.	Loch of Brindister.	Loch of Quarff.	North Loch.	Loch of Clickimin.
MOLLUSCA.															
Pisidium pusillum (Gmelin), . .			×					×							
,, *nitidum*, Jenyns, . .	×														
Planorbis nautileus (Linné), . .		×	×						×						
Limnæa peregra (Müller), . .	×		×				×	×		×		×			
CRUSTACEA—SCHIZOPODA.															
Neomysis vulgaris (Thompson), .				×	×	×									
AMPHIPODA.															
Gammarus (?) *duabeni*, Lilljeborg,				×	×				×	×		×			
COPEPODA.															
Diaptomus serricornis, Lilljeborg, .	×	×	×	×	×	×	×		×	×				×	×
Cyclops viridis, Jurine, . . .										×				×	
* ,, sp., ...		×				×									
,, *signatus*, Koch, . . .	×	×	×	×	×	×	×	×	×	×		×	×		
,, *strenuus*, Fischer, . .	×		×			×		×		×	×		×	×	
,, *bicuspidatus*, Claus, . .	×	×				×									
,, *serrulatus*, Fischer, . .	×	×		×	×	×	×	×	×	×	×	×	×	×	×
,, *fimbriatus*, Fischer, . .		×				×					×				
Canthocamptus hirticornis, T. Scott, .	×			×		×			×	×	×	×			
Attheyella crassa (G. O. Sars), . .	×		×		×	×			×	×	×	×			×
,, *pygmæa* (G. O. Sars), .		×											×		
,, *Zchokkei* (Schmeil,) . .								×	×						
Ophiocamptus sarsi, Mrazek, . .		×				×					×				
OSTRACODA.															
Cypria ophthalmica (Jurine), . .														×	
,, *serena* (Koch), ...	×			×		×	×		×	×					
,, *lævis* (Müller), ...	×	×		×											
Erpetocypris reptans (Baird), . .						×									
Cypridopsis vidua (Müller), . .	×														
,, *villosa*, Jurine, . .	×					×									
Ilyocypris gibba (Ramdohr), . .			×												
Candona candida (Müller), . .			×	×	×	×			×						
Limnicythere inopinata (Baird), .	×		×			×									
Cytheridea lacustris (G. O. Sars), .			×							×					
Loxoconcha viridis (Müller), . .							×								
CLADOCERA.															
Latona setifera (Müller), ...								×		×	×				
Bosmina longirostris (Müller), . .	×						×		×	×	×		×	×	×
Drepanothrix dentata (Euren), . .			×							×	×				
Ilyocryptus sordidus (Lievin), . .						×				×	×				
Ceriodaphnia quadrangula (Müller),								×	×		×			×	×
Daphnia longispina, Müller, . .	×						×							×	
Eurycercus lamellatus (Müller), .	×	×	×	×		×	×	×			×			×	
Acroperus harpæ, Baird, . . .			×			×	×		×	×	×				×
Alonopsis elongatus, G. O. Sars, .	×						×	×	×		×	×		×	
Graptoleberis testudinarius (Fischer),								×		×					
Alona costata, G. O. Sars, . .			×							×					
,, *neglecta*, T. Scott, . . .										× ?	×				
,, *rustica*, T. Scott, . . .										×	×		×		
,, *guttata*, G. O. Sars, . .							×		×	×					
,, *intermedia*, G. O. Sars, . .										×					
,, *quadrangularis* (Müller), .	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Alonella exigua (Lilljeborg), . .							×	×	×						
,, *nana* (Baird), . . .								×					×		
Harporhynchus falcatus, G. O. Sars,			×				×			×					
Chydorus globosus, Baird, . .	×	×		×		×			×						
,, *sphæricus* (Müller), . .							×	×			×		×	×	×
,, (?) *ovalis*, Kurz, . . .											×			×	
,, *barbatus* (G. S. Brady), .	×				×				×	×		×	×		
Polyphemus pediculus (D. Geer), .	×	×			×										

* This species requires to be further studied, and will be described and figured later on.

NOTES ON THE SPECIES REPRESENTED BY THE DRAWINGS ON PLATE V. By Thomas Scott, F.L.S.

Daphnia longispina, Müller, Plate V. fig. 1.

This was the only species of *Daphnia* observed in the lochs of Shetland recently examined. It is distinguished from its close ally, *Daphnia pulex*, by the elongate posterior spine and by the absence of teeth on the post-abdominal claw.

Alona costata, G. O. Sars, Plate V. figs. 2 and 12.

Alona costata is a small species. The size of the specimen figured is ·65 m.m. ($\frac{1}{38}$ of an inch). It somewhat resembles a small form of *Alona quadrangularis*, especially in the form of the post-abdomen; but on carefully comparing the two together they are seen to differ in several respects,—the post-abdomen in *A. costata* is broader in proportion to its length than that of *A. quadrangularis*, and the terminal claw has no supplementary setæ at the base as in that species. Drawings of *Alona quadrangularis* and of its post-abdomen are given to show some of these differences (see figs. 2 and 13). Fig. 11 represents the male of *A. quadrangularis*; fig. 15 shows the male post-abdomen, and fig. 25 one of the first feet with its hook-like appendage.

Alona neglecta, n. sp., Plate V. figs. 4 and 18.

This Lynceid somewhat resembles *Alona quadrangularis* in general appearance, but is more decidedly truncate at the posterior end. The extremity of the post-abdomen is broadly truncate, and the supero-posteal angle boldly rounded; immediately anterior to this the width of the post-abdomen decreases, the superior margin curving slightly inwards and then extending in a nearly straight line to the superior marginal angle. The terminal claw is moderately slender, and the secondary claw is about one-third the length of the primary one. Length ·47 mm. ($\frac{1}{53}$ of an inch). I have been unable to identify this *Alona* with any described species.

Alona rustica, n. sp., Plate V. figs. 5 and 17.

Seen from the side, subquadrangular in outline, superior margin gently curved, posterior margin nearly straight and slightly sinuate, posterior end subtruncate. The width is equal to fully two-thirds of the length. Post-abdomen robust, the supero-posteal angle is produced prominently backward and is narrowily rounded; from thence the superior margin extends anteriorly and outwardly in a nearly straight line to a distance from the posteal angle equal to rather more than the length of the terminal claw; the margin then bends inwards and forms a shallow concavity, bounded anteriorly by a small papilliform process, as shown in the drawing (fig. 17); at this point the width of the post-abdomen is almost twice what it is at the posterior end. The terminal claw is short comparatively, and very stout, its secondary appendage is very small.

The hinder part of the superior margin of the post-abdomen is armed with strong conical teeth, and a fringe of small setæ borders the shallow concavity (fig. 17). Length ·41 mm. ($\frac{1}{60}$ of an inch). The carapace of *Alona rustica*, is sometimes ornamented with coarse pit-like markings (*guttæ*) somewhat like those of *Alona gutatta*, but coarser. I have also been unable to identify this with any described species.

Alona guttata, G. O. Sars, Plate V. figs. 8 and 21.

This is a very small species. The length of the specimen represented by the figure is ·35 mm. ($\frac{1}{70}$ of an inch). The form of the post-abdomen (fig. 21) is quite sufficient to distinguish this from any of the other British Lynceidæ.

Chydorus barbatus (G. S. Brady), Plate V. figs. 7 and 19; and figs. 8 and 21.

Figs. 7 and 19, and figs. 8 and 21, represent what appear to be two forms of the same species. Seen laterally the carapace is nearly quadrangular and thickly covered with little pits (*guttæ*). The post-abdomen is comparatively short. The supero-posteal angle is rounded and provided with a number of small setæ. The length of the specimen represented by fig. 7 is ·38 mm. ($\frac{1}{66}$ of an inch), while that represented by fig. 8 is ·43 mm. ($\frac{1}{58}$ of an inch).

Chydorus (?) *ovalis*, Kurz, Plate V. figs. 10 and 23.

This Lynceid appears to be the *Chydorus ovalis* of Kurz. Seen laterally the outline is quite different from that of *Chydorus sphæricus*, of which figures are also given for comparison (see figs. 9 and 22). The size of *Chydorus ovalis* represented by the figure is ·36 mm. ($\frac{1}{70}$ of an inch), while the specimen of *Chydorus sphæricus* is ·4 mm. ($\frac{1}{62}$ of an inch).

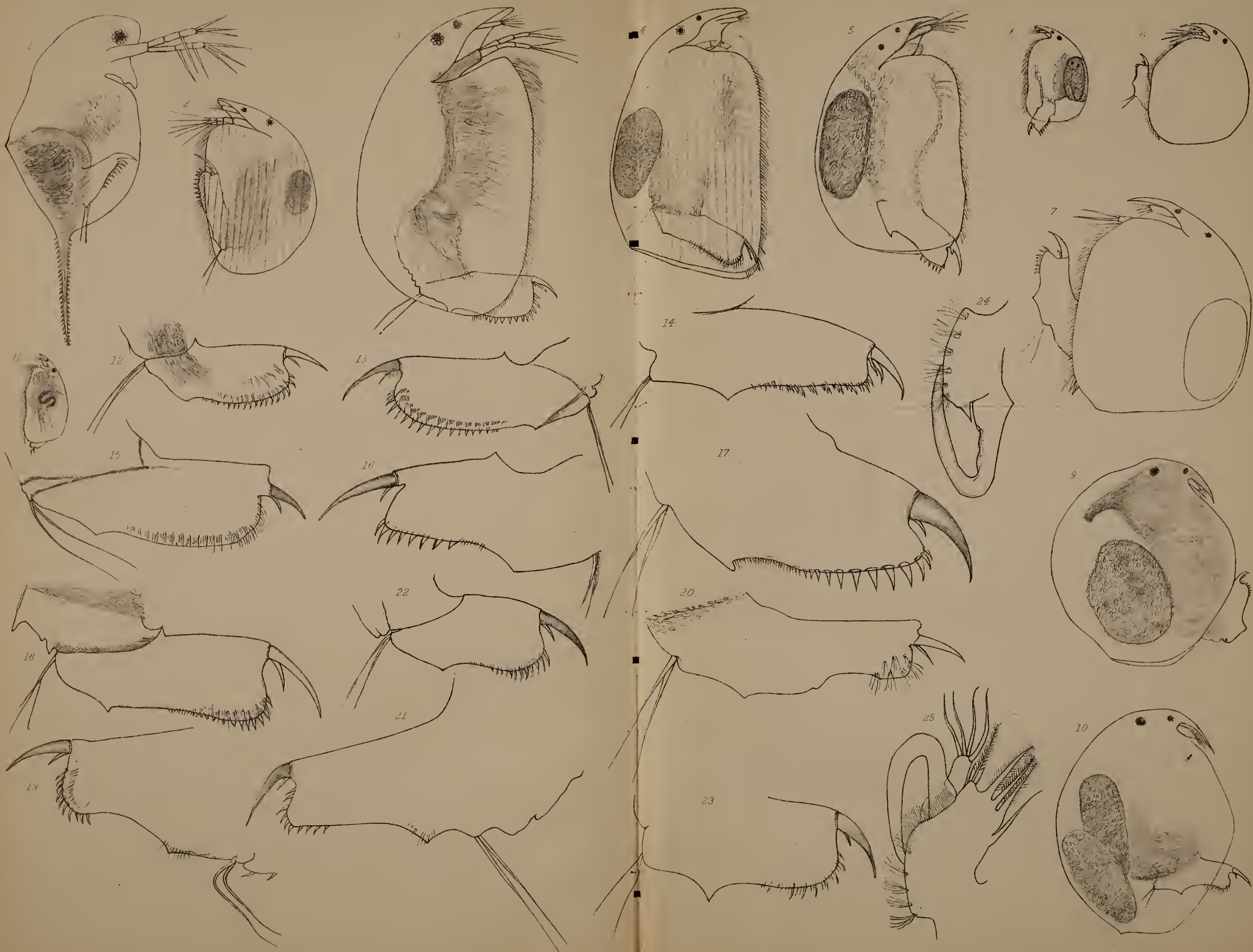
Alonella exigua, G. O. Sars, Plate V. fig. 14.

Alonella exigua was somewhat scarce in the Shetland lochs, but being a small species it is easily overlooked. Fig. 14 shows the post-abdomen of a specimen from Loch of Huxter.

Alonopsis elongatus, G. O. Sars, Plate V. figs. 20 and 24.

The drawings referred to represent the post-abdomen of a male specimen (fig. 20) and (fig. 24) the hook-like appendage of one of the first feet in the male.

I have much pleasure in acknowledging my indebtedness to Prof. G. F. Brady, and Mr A. J. Scourfield of London for assistance in the identification of some of the more obscure species of Cladocera.



C. Scott, del.

CLADOCERA.

DESCRIPTION OF PLATE V.

Fig. 1.	*Daphnia longispina*, O. F. Müller, lateral view,	× 29
Fig. 2.	*Alona costata*, G. O. Sars, lateral view,	× 63
Fig. 3.	*Alona quadrangularis* (Müller), lateral view,	× 63
Fig. 4.	*Alona neglecta*, n. sp., lateral view,	× 126
Fig. 5.	*Alona rustica*, n. sp., lateral view,	× 126
Fig. 6.	*Alona guttata*, G. O. Sars, lateral view,	× 63
Fig. 7.	*Chydorus barbatus* (G. S. Brady), lateral view,	× 126
Fig. 8.	*Chydorus barbatus* (another form), lateral view,	× 63
Fig. 9.	*Chydorus sphæricus* (Müller), lateral view,	× 126
Fig. 10.	*Chydorus* (?) *ovalis*, Kurz, lateral view,	× 133
Fig. 11.	*Alona quadrangularis* (Müller), lateral view, male,	× 31
Fig. 12.	*Alona costata*, G. O. Sars, post-abdomen,	× 100
Fig. 13.	*Alona quadrangularis* (Müller), post-abdomen, female,	× 100
Fig. 14.	*Alonella exigua*, G. O. Sars, post-abdomen,	× 400
Fig. 15.	*Alona quadrangularis* (Müller), post-abdomen, male,	× 200
Fig. 16.	*Alona guttata*, G. O. Sars, post-abdomen,	× 400
Fig. 17.	*Alona rustica*, n. sp., post-abdomen,	× 400
Fig. 18.	*Alona neglecta*, n. sp., post-abdomen,	× 100
Fig. 19.	*Chydorus barbatus* (G. S. Brady), post-abdomen (see fig. 8),	× 100
Fig. 20.	*Alonopsis elongatus*, G. O. Sars, post-abdomen,	× 200
Fig. 21.	*Chydorus barbatus* (G. S. Brady), post-abdomen (see fig. 7),	× 100
Fig. 22.	*Chydorus sphæricus* (Müller), post-abdomen,	× 100
Fig. 23.	*Chydorus* (?) *ovalis*, Kurz, post-abdomen,	× 400
Fig. 24.	*Alonopsis elongatus*, G. O. Sars, foot of first pair—male,	× 266
Fig. 25.	*Alona quadrangularis* (Müller), foot of first pair—male,	× 266

III.—ON THE REPRODUCTION OF THE EEL. By H. Charles Williamson, M.A., B.Sc., Marine Laboratory, St Andrews.

It is intended in this paper to briefly review the work which has been done within the past few years, in connection with the life-history of the eel.

The eel is, in most countries, considered an important food-fish, and in many places large revenues are derived from the eel-fisheries. In Scotland the eel is not regarded with favour as an article of diet. Large consignments of eels are, however, sent from Scotland to English markets. Various methods are used for the capture of this fish, the principal apparatus being the eel-trap. Eel-fishing is usually most prolific in the autumn, when the eels migrate to the sea. In certain places they are, at this time, captured by means of nets.

A very complete history of the eel question was published by Jacoby in 1880. He traces the different stages of the opinion of scientific men regarding the unsolved problem of the reproduction of the eel. The fact that the sexes were separate was not demonstrated until 1874, when Syrski described the organ which is now known by his name, and which is most probably the testis of the eel. The fresh impetus given by the discovery of the lobe-organ by Syrski, has resulted in a very extensive increase in the knowledge of the habits of this form. In this country and on the Continent the species of eel which has been under observation is *Anguilla vulgaris*; in the United States *Anguilla bostoniensis* has been studied. According to Günther these two species differ in the following points. In *Anguilla vulgaris* the length of the head is nearly equal to the distance between the commencements of the dorsal and anal fins, and is less than one-half of its distance from the vent, while in *Anguilla bostoniensis* the length of the head is conspicuously more than the distance between the commencement of the dorsal and anal fins, and is contained twice and one-half in its distance from the vent. Of the many varieties of the common eel, Günther considers *Anguilla latirostris* alone worthy of specific rank.

The following account of several points connected with the life-history of the eel is almost wholly drawn from the many articles in the subject. Observations made at this Laboratory, are, however, also included. It is proposed to deal first with the reproductive organs of both sexes, and subsequently with the autumn and spring migrations, &c.

The Female Reproductive Organs.

The ovary of the eel was first described by Mondini in 1777, and independently, three years later by O. F. Müller. In 1850 the first mature eel which had come under observation was examined by Rathke. The ovaries of the eel consist of two frill-like bands extending the whole length of the abdominal cavity, from the liver to beyond the anus. Each ovary is attached by its dorsal or adherent edge to the peritoneal covering of the swim-bladder and the upper part of the abdominal wall; its ventral border is free. The colour of the ovary varies according to the stage of development of the eel. In young eels 28·7 cm. (11·5 inches) long, the ovary is glassy in appearance, with a very slight whitish tinge; in larger eels the ovaries, crowded as they are with eggs and fat spaces, are opaque and white in colour.

The following is a description of the ovaries of an eel 90 cm. (36 inches) in length :—The right ovary commenced at a point, 3·2 cm. behind the diaphragm, and 5·5 cm. posterior to the insertion of the pectoral fin. The abdominal portion of the ovary, that is, from its anterior end to the level of the anus, was 32 cm. in length ; the caudal portion (Ro. fig. 4, Pl. VII.) ended at a distance of 4·4 cm. behind the anus. On the inner side of the caudal portion was an accessory ovary (*pars recurrens ovarii*) (Rpr.). The *pars recurrens* was not separate from the caudal portion in all its extent, but was united with it at its posterior extremity (x.), for a distance of 14 mm. It had a length, inclusive of the fused portion, of 29 mm.

The right ovary was 4 mm. wide at its anterior extremity ; it rapidly increased in breadth till at a distance of 3·5 cm. from the anterior end it measured 25 mm. in width. The same width was retained for a distance of 11·5 cm. The ovary then gradually diminished in width, until at the level of the anus it was 13 mm. wide. The caudal portion narrowed from the anus backwards, and at its posterior extremity had a width of 6 mm. The *pars recurrens*, at the point of union with the caudal portion, was 6 mm. wide, and at its anterior extremity 4 mm. wide.

The left ovary began at a point 6·2 cm. from the diaphragm, that is, 3 cm. behind the right ovary, and 8·2 cm. from the insertion of the pectorial fin. The length of the abdominal portion was 19·5 cm. The caudal portion (Lo.) extended to a distance of 8 cm. behind the anus. As in the case of the right ovary, there is an accessory ovary (Lpr.) on the inner side of the caudal portion. The *pars recurrens* was united to the posterior extremity of the caudal portion for a distance of 18 mm. The *pars recurrens* had a length, inclusive of the fused portion, of 8·2 cm., and extended forward to the level of the anus.

At its anterior extremity the left ovary measured 10 mm. in width. Its breadth increased very rapidly, and at a distance of 14 mm. from the anterior extremity of the ovary, was 27 mm. ; at a point 6 cm. further back the width was 30 mm. The ovary then diminished in breadth, until at the level of the anus its width was reduced to 18 mm. The caudal portion, at its posterior extremity, was 5 mm. wide. The *pars recurrens*, at the point of fusion with the caudal portion of the ovary, had a width of 9 mm., and at its anterior extremity a width of 5 mm.

'The portions of the right and left ovaries, which extend into the caudal 'region, do not unite, as some have asserted, but both are, towards the end, 'enclosed in a peritoneal membrane, and are separated from each other by the 'union of the membranes ; they have each on their inner face an accessory 'ovary (*pars recurrens ovarii*). In rare cases is such an accessory ovary want-'ing either on the right or on the left side.' * The eggs are borne on the outer surface of the ovary. 'The inner surface, that which is next the alimentary 'canal, is smooth; it is covered in with an endothelium and presents no trace 'of germinative epithelium. This surface has received the name of the 'vascular surface. The external surface is covered with lamellæ, which 'have on their surface sexual epithelium, and enclose ovules in their thick-'ness. This is the germinative surface. Brock is of the opinion that the 'ovary of the eel is a primitive type.' † In the accessory ovary, the eggs are, on the contrary, borne on the inner surface, its outer surface being in contact with the inner surface of the caudal portion of the ovary. The

* 'Lecture on the Organs of Reproduction, and the Fecundation of Fishes, and especially of Eels,' by Dr Syrski.—*Report U.S. Fish. Comm.*, 1873–4, 1874–5, Wash. 1876.

† Jules Macleod, 'Appareil Reproducteur femelle des Teleosteéns,' *Archives de Biologie, Van Beneden*, &c., vol. ii., 1881.

ovary has no oviduct. The genital pore opens externally into the urinary aperture: internally it communicates with the *fissura recto-vesicalis* (frv.), a slit between the rectum (Rt.) and the urinary bladder (bl.) This fissure joins the right and left portions of the abdominal cavity. Syrski says: 'It is generally admitted that the eggs when loosened from the 'ovaries fall indiscriminately into the abdominal cavity, but it is not said 'which way they take in order to go out through the genital orifice. As 'I have invariably found that the fully developed ovaries lean with their 'outer surface against the side of the abdominal cavity, and approach 'with their free edges the lower portion of the side, forming so to speak 'a furrow, I must conclude that the loosened eggs descend between the 'abdominal partition and the folds and leaflets of the ovary in the above-'mentioned furrow, and from it pass to the genital aperture without 'scattering in the abdominal cavity. It is another of Rathke's erroneous 'assertions, likewise maintained by others, that the genital opening through 'which the eggs pass out from the abdominal cavity is formed by two 'holes, a right one and a left. I have invariably found in all specimens 'examined a simple aperture, which communicated with the right and left 'halves of the abdominal cavity by means of a transverse fissure (*fissura* '*recto-vesicalis*) between the straight intestine and the urinary bladder and 'opens into the urethra.' In the eels examined at St Andrews, one genital aperture only was found. Internal to the ovary, and lying along each side of the alimentary canal, there is usually a band of fat. '* In the 'ovary, which contains a great deal of fat, numberless eggs are imbedded. 'By tearing a little piece of the ovary with a pin, and carefully wiping off 'the small drops of fat, one can recognise the eggs with the naked eye 'as very small white dots. The microscope will, however, distinctly 'reveal their form and inner construction. They are generally round, 'surrounded by a skin, which forms a clear transparent ring—the '*zona pellucida*. Inside of this skin there is a large mass of small 'grains, the yolk of the egg. In the larger eggs nothing but these 'grains is seen, especially when the eggs have lain in water for some time, 'because then the small grains composing the yolk have congealed and 'become opaque. But if one takes from the same ovarium the smaller 'and less developed eggs, one may very distinctly recognise the small and 'entirely colourless bladder, called the Purkinjean vesicle.' '† At any period 'of the year, the ovary shows its ovules more or less developed, but like 'those of all other osseous fishes, and its loose cellular tissue, which may 'be reduced to a minimum towards the period of oviposition, or may, on 'the contrary, subsequently become in part cellulo-adipose. The ovary 'also always shows the narrow projections or thickenings of its surfaces 'arranged parallel to each other. The folds run from the adherent to the 'free margin, passing the latter in the form of small blunt denticulations. 'Several authors, for example Valenciennes, say that in fresh water eels 'are never seen with full milts, or full ovaries. This is only true for the 'milt, or the contents of the testicle: but the ovaries are on the contrary 'full of spherical ovules of a diameter of from ·1 to ·2 mm. during the 'whole year. It is useless to insist here on the degrees of visibility of the 'germinative vesicle, of the more or less granular nature of the contents of 'the egg, or of the volume of the egg according to the season. During 'summer the greater part of the eggs preserve the volume which they have 'in winter, but they are less numerous than formerly, and the ground 'tissue of the ovary includes adipose cells in greater or less numbers than 'is seen at the time of the descent of the eels to the sea. In addition,

* Jacoby, 'The Eel Question,' *Report U.S. Fish. Comm.*, 1879.

† Robin, 'Les Anguilles mâles comparées aux femelles,' *Journal de l'Anatomie et de la Physiologie*, 1881, p. 437.

'during the summer, the ovules, in place of having a spherical germinative 'vesicle more or less finely granulated, show the vesicle segmented into 4, '8, or a very great number of semi-solid grayish globules, ovoid in shape, 'when they are from 2 to 8 in number, and spherical and naturally much 'smaller when more numerous.' In an eel 70·7 cm. long, kindly sent from Kilconquhar Loch by Mr Jamieson, Elie, on February 11th, 1895, the ova were found to measure ·18–·22 mm. while some measured ·27 mm. The ovum in the fresh condition showed a large mass of oil globules occupying almost the whole of the space within the zona. This collection of oil globules did not take up the place of the nucleus, but simply hid it. When a portion of the ovary was sectioned, the nucleus was seen in the centre of the ovum, surrounded by a large number of empty spaces, which had been occupied by the oil globules. The nucleus contained one large, and several small nucleoli. The mass of oil globules therefore appeared to be a hollow sphere.

'* The free edge of the ovary of the eel is straight. The organ is all 'of a piece like a ribbon, and not formed like the testicle of a succession of 'thin lobes, held or bound together at their base alone by the deferent 'canal and the sub-peritoneal cellular tissue. The ovary is supplied by 'vessels from the artery which, with the accompanying vein, runs along 'the adherent edge of the ovary. The arterioles proceed parallel to each 'other at right angles to the adherent edge, until near the free border of 'the ovary. There they anastomose in an arch. The blood is returned by 'veins similarly arranged. The external surface of the ovary is surmounted 'by straight transverse lamellæ, drawn close together, and directed 'parallel to the preceding vessels. They are shorter as the ovary is 'narrow. They terminate at some tenths of a millimetre from the free 'edge of the ovary without reaching it quite. The anastomosing loops 'surround the external or inferior extremities of the projecting lamellæ. 'The latter develop more or less in height on the surface of the ovary at 'the time of the maturation of the eggs, and limit, between their surfaces 'of contact, straight furrows. At the bottom of these grooves, in the 'laminæ or body even of the ovary are found the vessels indicated above, 'corresponding in some measure to so many intra-ovarian partitions. The 'ovules fill up all the interval between the vessels, and it is because the 'ovules are of greater depth than the ground-tissue, which runs over the 'vessels, that they form the projections on the external surface of the ovary. 'At the time of ovulation these laminæ increase in size, and rise much. 'When they hang down they pass beyond the free border of the ovary in 'denticulations. The internal surface, on the contrary, is white and 'shining without little projecting bands, or folds correctly speaking. One 'must not confound these particulars with those which give to the ovary 'the appearance of being plaited like a ruffle. The last tendency results 'from this, that the free edge of the ovary is longer than its adherent edge. 'The vessels also, which run from the latter to the free edge, deviate a 'little in approaching the latter. There results then from this the for-'mation of embossments and cup-shaped depressions, or waving collar-'like folds over the whole of the ovarian laminæ. These particulars are 'seen especially well in ovaries floating in water in a dissecting tray.'

All the eggs of the eel which have so far been examined have been very small. In the ripe eel described by Rathke, the largest eggs even measured only ·1 mm. in diameter. This eel is one of two ripe eels which have been recorded, and it is remarkable that the eggs in this case were much smaller than those subsequently found in unripe ovaries. The largest eggs described by observers have been ·27 mm. in diameter.

* Robin, 'Les Anguilles mâles comparées aux femelles,' *Journal de l'Anatomie et de la Physiologie*, 1881, p. 437.

Syrski noticed that a more advanced state of development of the egg was found in those eels, in which the *fissura recto-vesicalis* and the genital aperture were open, than in those eels in which they were closed. He found 'that from the end of November till the beginning of March, in 'many adult eels of 53 cm. and more, the ovaries were of the breadth of '15–25 mm., and of a yellowish and sometimes reddish-white colour, pro-'duced by the development of adipose tissues and of blood vessels, and not 'by the eggs filled with little globules of fat; the genital aperture, and the '*fissura recto-vesicalis* were open. In other eels of a length of 60 cm. and 'more, in which the genital aperture and *fissura recto-vesicalis* were closed, 'the ovaries were less broad with but little fat, and of a mucous and almost 'glassy appearance, so that the so-called vesicle [nucleus] and germinative 'dots [nucleoli] were visible. The ovaries of young eels of the length of 'about 50 cm. contained invariably but little fat, and the eggs were with-'out globules. The gradual growth and enlargement of the ovaries goes 'on simultaneously with the opening of the genital orifice. According to 'the quantity of fat contained in the ovaries, they have a mucous and 'glassy, or more or less opaque or white appearance, or have small shining 'dots.' From the end of March till October, he found in the majority of eels which he examined, measuring from 60–70 cm. in length, that the ovaries were scarcely white, and that the genital aperture was closed. The larger eggs measured by him had a diameter of ·25–·2 mm. The number of eggs contained in both developed ovaries reaches, according to his calculation, five millions. Robin found that the ovaries are full of spherical ovules of a diameter of ·1–·2 mm. during the whole year. 'It would seem probable,' says Benecke,* 'that the increase in the size of the 'eggs in the wandering eels begins to be very rapid after August and Sep-'tember, while in the earlier months of the year, in all eels of moderate 'size, the eggs were at the utmost 0·09 mm. in diameter. In September of 'the same year it was found (on an average of numerous measurements) 'that the eggs had a diameter of 0·10 mm., in October 0·16 mm., and in 'November 0·18–0·23 mm., while the eggs showed other characters con-'nected with approaching maturity, which earlier in the season are not to 'be seen. All the eels which were captured later, in December and in 'January, part of which came from rivers and harbours, part from the har-'bour of Putzig, had eggs measuring 0·09 mm., while very exceptionally 'some of the eggs measured 0·16 mm., although among the fish examined 'were some which measured 3 feet (about 91 cm.) in length.' The ovaries of eighty specimens of the American eel (*Anguilla bostoniensis*), which differs very slightly from *Anguilla vulgaris*, examined by Putnam,† were in various stages of development. 'In two the ovaries were very small, 'and the eggs in them exceedingly minute. From these the series showed 'a gradual increase in the size of the ovaries and of their contained eggs to 'the specimen exhibited, in which the eggs were still so small, as only to 'be seen by a lens of considerable magnifying power, and not ready to be 'excluded, though the ovaries themselves were large and full. The fact of 'the great rarity of the eels with eggs, and the occurrence in these speci-'mens of ovaries in various stages of development, seem to show that in 'contrast with the more usual slow development of the eggs in fishes 'generally, the eels rapidly attain their seasonal development, the ovaries 'immediately after the eggs are laid being reduced to a minute size.' In an article on the 'Breeding Habits of the Eel,' Packard ‡ says,—'As 'far as we are aware, the eggs of the American eel were first discovered by

* Brown Goode, 'Life History of Eel,' *Bull. U. S. Fish. Comm.*, vol. i., 1881.

† *Proceedings Boston Society*, xix., 1876-8.

‡ Packard, 'Breeding Habits of the Eel,' *American Naturalist*, vol. xiii., 1879.

'Mr J. Mooney of Providence, R. I., in October 1877. The eggs were 'examined by Prof. John Pierce, who found that they measured $\frac{1}{100}$ inch '(·25 mm.) in diameter.' Mobius * states that in eels from 48–55 cm. in length, procured from Holstein and Oland at the end of September 1884, the greatest eggs in the ovaries, which were well developed, measured ·215 mm. In one female, which died in June 1885, an egg measuring ·277 mm. was found. Jourdain,† who studied the eggs of the eel in all stages of development, found that the largest does not exceed ·25–·2 mm. in diameter. Fulton ‡ examined certain eels from Howietoun in May 1890. The ovaries contained eggs which measured ·25 mm. A ripe female which was captured in a trawl in the English Channel, 20 miles from land, is described by Calderwood.§ 'The ovaries were pure white in colour, 'and when touched crumbled away most easily. The ova were apparently 'quite ready to drop from the outer surface of the ovary. Sections showed, 'however, that in each ripening ovary the nuclear membrane was still dis-'tinctly visible. The nucleoli were arranged round the periphery, smaller 'bodies being found amongst the granular protoplasm of the nucleus. 'The substance of the ovum itself was richly stored with oil globules 'giving the characteristic appearance known in the conger's egg.'

In the eels which were examined at St Andrews during February, March, April, and May, the ova were found to vary in diameter from ·045 –·27 mm. The different lengths of these eels, with the sizes of their respective ova, are given in the following table :—

Date.	Length.	Locality whence procured.	Sizes of ova in mm.
1895.			
Feb. 7	25⅛ in. (628 mm.)	Found dead on the sands below Laboratory (probably came from the harbour).	·09, ·135, and ·144.
,, ,,	21⅞ in. (547 mm.)	,, ,,	·135.
,, 11	20¾ in. (518 mm.)	,, ,,	·099–·135.
,, ,,	28 5/16 in. (707 mm.)	,, ,,	·18–·225, ·27 (a few).
,, ,,	31⅞ in. (796 mm.)	,, ,,	Average ·18.
,, 25	12½ in. (312 mm.)	From Estuary of Eden, salt water.	About ·045.
,, ,,	11½ in. (287 mm.)	,, ,,	,,
Mar. 5	36½ in. (912 mm.)	From Loch Leven.	·18, and ·225.
,, ,,	35 13/16 in. (895 mm.)	,, ,,	,,
Apr. 14	10⅛ in. (253 mm.)	From the brackish water at a spring in the East Cliffs.	·0675.
May 20	19½ in. (487 mm.)	Found dead near harbour.	·135.
,, 21	36 in. (900 mm.)	From Loch Leven.	·135 (a few), ·225–·261.

The smallest ova, ·045 and ·067 mm. in diameter, were found in three eels, which measured less than 13 inches (325 mm.) in length. These eggs were clear and transparent, having few oil globules scattered through the yolk. In the remaining eels, of a length of from 19½–36½ inches, the ova, except in a few cases, were ·135 mm. and more in diameter. All the eggs in the same ovary do not have the same size. While the great

* *Fünft Ber. Komm. Wiss. Untersuch. deutsch. Meere*, 1887.

† Jourdain, Note 'Sur l'Anguille,' presentée par M. Blanchard, *Comptes Rendus Acad. Sc. Paris*, t. 109, 1889.

‡ Fulton, 'Migrations and Reproduction of Common Eel,' *Eighth Ann. Report Scottish Fishery Board*, for year 1889.

§ Calderwood, 'Freshwater Eel in Ripe Condition,' *Annals & Mag. Nat. Hist.* (6), vol. xii., 1893.

mass of the ova are of uniform diameter, there are usually a few smaller eggs present. In the case of the eels $25\frac{1}{8}$ and $20\frac{3}{4}$ inches long, the greater number of the ova had a diameter of ·135 mm., but some eggs were as small as ·09 mm. in diameter; and so with other specimens recorded in the table above. The larger eggs, from ·18–·27 mm. in diameter, show a large spherical mass of oil globules, which occupies almost all the space within the zona. When the egg is examined in the fresh condition the nucleus is not seen, owing to its being obscured by this collection of oil globules.

The Male Reproductive Organs.

What is undoubtedly the testis of the eel was first described by Syrski in 1874, under the name of 'lobe-organ.' No observer * has, so far, found ripe spermatozoa in the lobe-organ of Syrski, but the histological examination of the lobes made by several zoologists have shown that this organ exhibits a minute structure, similar to that found in the immature testis of other fishes. The discovery of spermatozoa, also, in the homologous organ of the Conger, by Dr Hermes,† affords conclusive proof of the testicular nature of the lobe-organ. The testis occupies in the body of the male a position corresponding exactly to that of the ovary in the female. It is formed of a large number of separate flattened lobes, convex on their internal surface, and on their external surface plane or slightly concave. Each lobe is attached by its base to the vas deferens; its free border is rounded at the corners. The testis begins in the anterior part of the abdominal cavity, and ends at some distance behind the anus, in a prolongation of the abdominal cavity. It is attached in its whole extent by the vas deferens to the peritoneal lining of the superior part of the abdominal wall, and occupies a position alongside the swim bladder. The vasa deferentia, from the abdominal and caudal portions of the testis on each side, open into a triangular-shaped cavity, which occupies a position between the rectum and urinary bladder. This cavity opens, by the genital orifice, into the ureter, and by the latter to the cloaca. The left testis begins a short distance behind the right testis, and extends a little further into the caudal region than the right. The lobes receive their blood supply from the testicular artery which runs parallel with and close to the vas deferens; the blood is returned to the testicular vein, which occupies a position alongside the testicular artery.

In a male eel, $12\frac{1}{16}\frac{5}{}$ inches (320 mm.) in length, examined at St Andrews, it was found that the right testis commenced at a point 12 mm. behind the diaphragm, and 16·5 mm. from the insertion of the pectoral fin. The portion of the testis within the abdominal cavity, that is, as far back as the anus, was 7·9 cm. in length, and consisted of 41 lobes. The caudal portion was 16 mm. long, giving a total length to the right testis of 9·5 cm. On the inner surface of the caudal portion there was an accessory testis (*pars recurrens testis*). The pars recurrens testis was described by Syrski. Robin, however, states that he failed to find a pars recurrens to either testis. The pars recurrens of the right testis began at a point 4·5 mm. from the posterior extremity of the testis, and extended forward for a distance of 7·5 mm.

The lobes of the anterior portion of the right testis had a breadth of 1·5 mm. The lobes decreased in width as they approached the anus, at

* Kingsley, however, was of the opinion that, on tearing a portion of a testis, he saw spermatozoa with independent motion. *American Naturalist*, vol. xiii., 1879.

† Hermes, 'On the Mature Male Organs of the Conger,' *Bulletin U.S. Fish. Comm.*, 1881.

which point a width of ·75 mm. was found. It was noticed that the length of the lobe varied from 1·5 to 4 mm. Behind the anus, the lobes became still narrower, and at its posterior extremity the testis was reduced to a filamentous termination. The caudal portions and partes recurrentes of both testis were lobed, but the separation between the lobes was not so distinctly marked as in the abdominal portions. The lobes were irregular in length, and in greatest breadth did not exceed ·75 mm. The pars recurrens on the right side ended in a filamentous prolongation at a point 4 mm. behind the anus.

The left testis began 24·5 mm. behind the diaphragm, and 28·5 mm. from the insertion of the pectoral fin. The abdominal portion was 7 cm. long and consisted of 25 lobes. The testis ended in a filamentous tip at a distance of 27 mm. behind the anus. The pars recurrens was 14 mm. long.

The breadth of the lobes at the anterior part of the left testis was 1 mm. At a distance of 4 cm. from the anterior end the width began to diminish, and at the anus it was reduced to ·7 mm. The length of the lobes varied from 1·25–4·5 mm. Behind the anus the width of the lobes was still further diminished, the caudal portion and pars recurrens ending in filamentous tips. The separation of the lobes of the latter was not deeply marked.

The testicular lobes are smooth, without leaflets, and have a shining glassy appearance. They are of much firmer consistence than the ovary, and show no trace of ovules nor of adipose cells. The greatest breadth of the lobe is given by Syrski as 3 mm.; Robin described a testis, of which the lobes were 2 mm. in breadth, usually a little longer than wide, measuring in greatest thickness 1 mm. out of the time of reproduction. The lobes of the testis examined by Cattie * were 0·5 mm. in depth of 0·75 mm. in length. Histological examinations of the testis have been made by several zoologists, at evidently different stages of development. The fibrous tissue of the lobe is composed of vascular compartments with thicker partitions, inclosing, according to the development of the organ, granular globules (Syrski). Kingsley † found that the male organs of the American eel (*Anguilla bostoniensis*) agreed almost exactly with the description given by Syrski. Cattie gives the following description :— 'The histological structure of the lobe organ was investigated by Freud. 'He found an areolar structure with connective tissue corpuscles, similar to 'the histological structure of the immature testis of fishes. My prepara- 'tions had a similar appearance as long as the smaller examples were the 'subjects of investigation. In the largest specimens of eels with lobulated 'organs investigated by me (445 mm. [17½ inches] long), I found cylin- 'driform strings, which passed from the bases to the tips of the lobes, and 'were filled with cells. After repeated trials with the most different 'reagents, I did not succeed in clearly distinguishing a nucleus in these 'cells. According to Jacoby (Der Fischfang in der Lagune von Coma- 'cchio), Von Siebold saw similar strings of cells in an eel in which the lobes 'were very strongly developed. These strings of cells presented to the eye 'the most undoubted similarity to the testicular mother-cells of spermatozoa.' Ryder also was of the opinion that the microscopic examination of the lobe demonstrated its testicular nature. '‡ Syrski states that these lobu-

* Cattie, 'Ueber die Genitalien der männlichen Aale, &c.,' *Phil. Nat. Cand. Docent. an der Realschule Zu Arnheim* (Holland). Trans. in *Proc. U.S. Nat. Mus.*, vol. iii., 1880, p. 280.

† Packard and Kingsley, 'The Discovery of Male Eels,' in *American Naturalist*, vol. xiii., 1879.

‡ Ryder, 'Note on the Male Organs of the Eel,' in *Bulletin U.S. Fish. Comm.*, vol. v., 1885.

'lated organs are filled with grains which are confined to compartments 'separated by fibrous membrane. I may say that this description is in 'general terms correct, but would point out that these compartments are 'more or less convoluted, long, and tubular, and therefore present the 'character of true spermatic tubuli. I find that the granules alluded to by 'Syrski are really the heads of what in future will become spermatozoa, for 'they are globular and nearly uniform in size. Another important fact I 'would point out, viz., that the Syrskian lobules of the testicle of the male 'eel correspond almost exactly with the muscular and skeletal segments of 'the animal, a trait which is not discoverable in the female organs, and one 'which illustrates a singular fact in morphology, viz., that metamerism 'may show itself in the glandular part of the reproductive organ of one sex, 'and not manifest itself in the structure of the generative apparatus of the 'other.'

Robin gives in *La Journal de l'Anatomie*, etc., 1881, a detailed and very clear description of the minute structure of the testis of the eel:—'The lobulated testis is traversed throughout its length by seminiferous, 'or testicular tubes, or cylinders—which are flexuous, twisted, and termi'nated cæcally at both ends, at least out of the breeding season: that is to 'say, falling into the type of *canaliculate* testis, such as that of the carp. 'Out of the period of reproduction, the seminiferous tubes are 0·08–0·09 'mm. in thickness, cylindrical, twisted in various directions, and ramifying 'once or twice. Some of them anastomose with their nearest neighbours. 'Their extremities are rounded and closed, with or without a slight 'dilatation. One of the extremities is usually situated close to the surface 'of the lobe, which is covered with a delicate peritoneal tunic. None of 'the tubes is particularly directed towards the deferent canal, and none 'opens into the latter. The flexuosities of the tubes, their volume, and 'their structure give to the tissues of the organ the characteristic arrange'ment and appearance usually observed in the testicular tissue of the 'higher vertebrata. It is only by an enormous dilatation at the breeding-'season that we can imagine these canaliculi at the state of seminal 'capsules. These tubes are imbedded in a dense web of cellular tissue 'without adipose vesicles, and of a thickness, between the tubes, of about 'half that of the latter. The ramifications of the blood-vessels coming 'from the bases of the lobes run along with the tubes, and form around 'each of their rounded extremities, at the surface of the organ, a circular 'mesh 0·08 mm. in breadth; these meshes together form an abundant net'work. One might be led, by the examination of the entire lobe before 'making sections, to suppose that these meshes enclose so many closed 'vesicles, or seminal capsules, whereas we really have in each mesh simply 'the extremity of a seminiparous canaliculus. This description might be 'taken as giving the general type of the structural disposition of the 'testicle of osseous fishes, apart from the period of ripeness. It is, indeed, 'in this case, a reduced disposition to a single and small lobe, in place of 'the long continuity existing in the unilobed testicles of the greater 'number of species, but it is none the less characteristic. The same 'remark applies to the following facts concerning the special structure of 'the individual tube. In a series of preparations of M. Herrman, I have 'been able to show that these tubes are composed of a peculiar thin wall, 'which is hyaline and homogeneous, plaiting or folding easily, and adher'ing strongly to the tissue surrounding it. The inner surface of the tube 'is uniformly lined with a single row of regular prismatic epithelial cells 'with polygonal bases, which separate easily from the thin wall of the tube. 'These cells are attenuated at their inner extremities. The straight canal, 'of which these cells form the boundary, is often closed through the con'tiguity of the inner extremities of the latter. The contents of the cells 'are finely granular, enclosing a relatively large hyaline nucleus without 'granules. In the nucleus there is a bright yellow nucleolus. These cells 'break off by dissociation, and give to the liquid of the preparation an 'opaline or milky appearance.

'A deferent canal, about 1 mm. in diameter, adhering to the internal 'or dorsal thin wall of each lobe, runs along the whole extent of each 'testicle. The wall of this sperm duct is about $\frac{1}{3}$ mm. in thickness. It is 'composed of two layers, an internal layer of longitudinal fibres, and an 'external layer of circular fibres. The bundles of fibres of both layers 'freely intermingle with those of the envelope of the male organ at the 'base of the lobe, and a little also on its external surface. These layers 'are composed of cellular tissue, mixed with smooth muscular fibres. 'A single row of small polyhedric epithelial cells lines the internal surface 'of the deferent canal. Adhering to the internal edge of the thin testicular 'lobes, the vas deferens is thus lodged in the peritoneal fold connecting 'the testicle to the swim bladder, and to the superior parts of the abdominal 'wall.

'It is important to institute a comparison with the male organs of 'other fishes. A thin hyaline wall constitutes essentially the seminiferous 'tubes of other fishes in general. An epithelium of small polyhedric cells 'distinct from the male ovules, at least in approaching the time of milting, 'lines the tubes. The male ovules at this period attain a diameter of 0·06 'mm. or more, and fill up and distend the tubes; they become regularly 'polyhedric by mutual pressure, and are full first of spermatoblasts and 'then of spermatozoids. The tubes, now whitish in colour, are perceptible 'to the naked eye. The epithelium of the tubes always remains distinct 'from the male ovules in the different stages of spermatogenesis. The 'testicular tissue in the ripe condition is friable, and allows the direction 'of the tubes, which are accompanied by capillaries, to be seen by the eye 'or lens at the surface of the torn tissue. The cæcal termination of these 'tubes, which may or may not end in slight swellings, with or without 'capillary meshes round them as in the eel, give to the surface of the 'testis a dotted whitish appearance. These testicular tubes are reticulated, 'that is to say, they ramify and anastomose, as in other vertebrates in 'general, having interposed between them a delicate and fragile woof of 'cellular tissue without adipose vesicles, but accompanied by numerous 'capillaries, as indicated above. At their opposite or internal extremities, 'the tubes become narrower, and open either into a central common 'cavity connected with the deferent canal, or directly into the deferent 'canal. In a certain number of species their internal extremities are 'closed, and open either into the sperm duct, or into the peritoneal cavity, 'at the time of milting only.'

Certain stages in the development of the testis are described by Syrski, who says:—'As regards the development of the spermatic organ, I have 'observed that the lobes of these organs in young eels measuring not more 'than 200–300 mm. (8–12 inches), are not yet very distinct, forming two 'thin ribbons, differing but little from the ovaries of the female in their 'average size. In eels measuring about 400 mm. (16 inches), the testicles 'can easily be distinguished from the ovaries. The former, much straighter 'and with tissue much more solid, are provided with a more developed net- 'work of vessels; their lobes are very distinct and the deferent canals are 'usually open, while the ovaries present the appearance of two continuous 'ribbons, have a more delicate tissue and an almost glassy appearance, 'and contain eggs with the germinative vesicles. The deferent canal and 'the genital orifice are closed in young eels of the male sex, and open 'simultaneously with the development of the lobes. In the male eels 'examined by me from March to October, I have found individuals of

'400 mm. (16 inches) and more, whose genital orifice and deferent canal 'were invariably open, while in some of the smaller ones they were closed, 'and in others open.' Ryder examined a series of male eels obtained from Wood's Holl, Mass., in November 1881, which showed the Syrskian organ slightly larger than that found in certain Fire Island specimens, captured near the shore in September. 'This fact indicates possibly that 'functional maturity of the male organ is not attained till midwinter. 'The eels in both instances showed the male reproductive organ so far 'advanced that there can be but little doubt, if the animal had been taken 'a few weeks later, ripe spermatozoa would have been found in the vasa 'deferentia of the testis.'

The Male Eel.

The male eel has not been known to exceed 480 mm. ($19\frac{1}{5}$ inches) in length. A male eel of this size was found by Jacoby at Comacchio. The smallest male recorded measured 240 mm. ($9\frac{3}{5}$ inches), and was procured by Jacoby in the same locality.

The question as to whether or not the male eel enters fresh water has given rise to much difference of opinion. It was generally believed that the male eel never left the brackish or salt water near the coast, except at the period of reproduction, when it joined the females which had migrated from the fresh water streams. This view has now been modified. The observations of Hermes, Pauly and Feddersen have proved that males do go up the rivers into the fresh water. In 1880 male eels were procured by Dr Hermes at Cumlosen on the Elbe, 120 miles from the German Ocean. The following account of the observations of Dr Pauly is taken from the article on "The Life-history of the Eel," &c., by Brown Goode, in the *Bull. U. S. Fish. Commission*, vol. i., 1881 :—A theory had been propounded by some one, that eels are at first of undifferentiated sex, and have the tendency under the influence of fresh water to become females, under that of salt water to develop male characters. It has however been shown by Pauly that among the very young eels (montée) taken near the mouths of rivers, there is a considerable percentage of males which, when transplanted to fresh water, will there retain their masculine characters and develop into perfect adult males. Pauly received from Kuffer a lot of eels weighing from 20–90 gms. ($\frac{2}{3}$–3 oz.) each, taken in fresh water. A large majority, 19 out of 27 of these small eels, were found to be males. Kuffer had received them two years previously from a French river, the *Sèvre niortaise*, where they were caught as young fry (montée) at a distance of 10 or 12 miles from its mouth, and furthermore, were at the time of their examination four years old. The females in this lot of eels exceeded the males in length and weight, and also exhibited the external characteristics described by Jacoby as indicating sex. The locality of the *Sèvre niortaise*, where the fish were taken, may easily, especially at flood tide, have been within the limits of brackish water. Pauly claims that his investigations and those of Jacoby prove that the young female eels do not necessarily break away from their parents and their birthplaces at sea, and alone proceed on their migration, while the males scatter through the sea, but that their brothers seem to accompany them part of the way upon their journey. He maintains that male eels undoubtedly ascend the rivers, but the numerical percentage of males to females appears to diminish as one proceeds up the stream.

Finally, Feddersen * arrives at the conclusion—

* Feddersen, *Dansk Fiskeri-forenings Medlemsblad*, No. 35, Aug. 1893.

(1) That the present view, that the montée (or eels coming up into the fresh waters) includes only females, cannot be upheld : both males and females are included.

(2) The male at its full growth, like the female, is not only in the lower reaches of the rivers and in the fjords and coast waters, but likewise in inland seas and other waters.

As to the numerical proportion of males to females, different results have been found in different localities. Of 258 eels from Chroggia and Comacchio, examined by Syrski in 1874, the males and females were in about equal proportions ; the greatest length of the former was about 430 mm., while the latter were of all sizes up to 1050 mm. Jacoby found in 1887 that among 1200 eels from the brackish waters of the lagoons of Comacchio, 5 per cent. were males, while among those less than 15 inches (375 mm.) 20 per cent. were males. In 1880 Dr Hermes discovered 8 males in a lot of 36 eels from Wismar, Denmark. At Rügers on the Baltic, in the same year, Dr Hermes found that in one lot of 137 eels, 44½ per cent. were males. Among 250 eels, from 11–15 inches in length, procured by Hermes at Cumlosen on the Elbe, 5 per cent. were males. Brunn * was able to ascertain that about 80 per cent. of the small eels that are caught in the lower Elbe belong to the male sex. In a collection of 60 eels, varying in size from 11¾–21¾ inches, procured from the estuary of the Eden in October 1894, there were 23 males and 38 females. The males measured from 12–16 inches, and the females 11¾–21¾ inches in length.

External Differences between Male and Female Eels.

Much attention has been given to the attempts to find external sexual differences in eels. Difference of colour, when taken together with certain anatomical differences, was considered to be of value in the separation of the sexes. The male was very often, invariably by Jacoby, found to have a metallic sheen on the sides of the body. The females were as a rule of lighter coloration on the back than the males. A very great difference in the maximum size of the eels of different sexes has been noticed. No male eel has been found whose length exceeded 20 inches (500 mm.) ; females are commonly got over 3 feet (900 mm). Jacoby † summarises the external sexual differences as follows :—The most important differences between live eels having an ovarium and those having a lobe-organ are :—

(1) *That of the length and size.* Syrski says that the largest eels with lobe-organs discovered by him measured 430 mm. (17⅕ in.). I have however, both at Trieste and Comacchio, found eels with this organ measuring 450, 460, 470, 480 mm. (18–19½ inches). All eels larger than this have, so far at least, been invariably found to be females. The outward differences are—

(2) *The broader snout* of the female, in contradistinction to the *narrow extended* or *short pointed* snout of the eel with the lobe-organ.

(3) *The lighter colour* of the female, green on the back, and yellow or yellowish on the lower side, the back of the male being generally a dark green, often almost black, with its sides having invariably a metallic glitter. I have found eels having a bronze colour, which were always eels with a Syrski organ, and their lower side white.

(4) A very striking difference is the *height of the dorsal fin.* All

* From 'De strijd over de mannetjes-alen,' *Mededeelingen over Visscherij,* Dr P. P. C. Hoek, Helder, 1894, p. 132.

† Jacoby, 'The Eel Question,' *Report U.S. Fish. Comm.*, 1879. Washington, 1882.

females have a higher and broader dorsal fin than eels with the lobe-organ of equal size ; and finally,—

(5) The generally—for it is not always the case—*larger diameter of the eye* in eels with lobe-organs. Eels with particularly small eyes are nearly always females, whilst eels with a Syrski organ have generally large eyes, although many female eels have also large eyes.

Jacoby, whilst examining female eels, found certain individuals whose reproductive organs were very undeveloped, and which showed distinct outward differences from the ordinary female. These he regards as sterile females. The following description is taken from his article on the 'Eel Question':—'In Comacchio, and doubtless wherever large masses of eels 'live in brackish waters, near the sea coast, a certain variety of eel exists, 'which I found were barren females of the common species. They are 'female eels whose ovaries show an entirely anomalous condition. On 'opening such an eel, one finds, instead of the well known yellowish white 'and very fatty frill-like organ, a frothy thin band without any fat and 'and having few folds, often as transparent as glass, otherwise of the same 'length and breadth as the frill organ, varying of course according to the 'size of the eel. If this band is examined under the microscope, the eggs 'appear transparent, containing but very few grains of yolk, or none at all. 'The band therefore appears an anomalously developed ovarium. The 'outward distinguishing marks of the barren females, which I found of 'all lengths up to 70 cm. (28 inches), are very striking. They show all 'the above-mentioned distinguishing marks of the female intensified. 'Their snout is broader, often especially the point of the lower jaw. 'Extraordinarily broad, the dorsal fin generally higher, the eyes decidedly 'smaller, in larger specimens astonishingly small, and the colour is 'generally a light almost yellowish-green ; the back of a lighter colour, and 'the belly of a brighter yellow than is the common female eels. In 'Comacchio, this eel is called 'pascuite.' By the term 'pascuite,' however, 'the fishermen understand immature normally developed eels, as well as 'the sterile females. The sterile females grow as large as ordinary females, 'but never leave the brackish waters.' According to Comisa,* the barren female may probably, under certain conditions, develop into a normal female.

Robin † states that, looking to the strongly marked characters of the male eel, one might be led to say that there are few species of fishes in which the external characters are so distinctive of the male in comparison with the female as in the eel. He found that, with very few exceptions, all the eels described under the varietal name of '*pimpeneau*,' or '*pimperneau*,' from the maritime pools and marshes (*glut-eel* of English authors), with large prominent eyes, a slender cylindriform body, with the back black, and the pectoral fins a little longer than in the river eels, not exceeding 38 or 40 cm., &c., are males. The largest male eel which he observed measured 45 cm. It is not rare to see in pimpeneaux, alongside females of the same size, the pectoral fins almost twice as long and distinctly wider, the eye almost double in size, the iris a little more blackish, the head a little more swollen in front of the opercular and branchial orifice, and the muzzle less elongated in front of the eyes. A. Pouchet, however, has remarked that the difference of tinge from the pale yellow or pale grayish to the intense green colour of some eels, is in agreement with the slimy, sandy, or other nature of the bottom of the water which they inhabit (*Zoologie classique*, Paris, 1841).

* Comisa, 'On the Sex of Eels and on the Sterile Females,' in *Zeitschr. f. Fischerei*, von Dr Weigelt, 1893, No. 4.

† Robin, 'Les Anguilles mâles comparée aux femelles,' *Journal de l'Anatomie*, etc., 1881.

The uncertainty of difference of colour as a sexual distinction has been shown by Cattie.* He found it impossible to discover distinctive difference of coloration. All the males and females investigated by him were of a white colour ventrally, green above, with a metallic lustre on the sides. His experiments, on the same lines as those of Jacoby, consisted of a comparison between male and female eels of equal size, as regards width of snout between the nasal tubes, length of mouth from middle of eye to tip of snout, diameter of eye, length of head to the gill opening measured along the lower jaw, and height of dorsal fin. He found, as Jacoby did, that the females have the dorsal fin higher and the snout broader than males of the same length. The large-eyed character of eels with lobulated organs appeared to him to be too uncertain a feature, so much so, that according to his observations the same feature might be assumed as characteristic of the females. 'The snout of the female is not 'only much broader, with more prominent eyes, but is also more *depressed*, 'a characteristic to which I would call special attention, and one which I 'do not find in the male. In contrast, the snout of the male eel is more '*convex*. By paying attention to the two most important characters, viz. 'the relative proportions of the dorsal fin and snout, by their help picking 'out those specimens which appeared to be males, I actually found 80–90 'per cent. of those individuals so selected to be males with the Syrskian 'organ.'

Sennebogen † observed that when eels are left dry, the female specimens give off far greater quantities of slime than the males, and that if the severed skin is examined through a microscope, the scales of the females are far smaller than those of the males.

Petersen found that very distinct anatomical differences existed between the yellow and silver varieties of eels. '‡ The sides of the yellow eel are 'of a canary yellow colour, the back dark gray or brownish black. The 'belly is sometimes yellow, oftener white, the colours on the whole varying. 'Sometimes they have a slight metallic sheen, but as a rule this is absent. 'In fresh water the yellow colour is not so often met with as in salt. If 'the yellow eel is lean, the head appears abnormally large, and the eel has 'a strange and repugnant appearance. Both males and females are found 'among yellow eels.

'The silver eels are distinguished by a very striking metallic sheen on 'the sides and belly. A bronze appearance is often seen in the neighbour-'hood of the lateral line in females as well as in males. The belly is usually 'pure silvery white. The eyes of the silver eel are much larger than those 'of the yellow eels of the same length, and rise up sideways so far that the 'lips, which are very narrow, are for the most part not to be seen outside 'the eyes if the head is looked at from above. The silver eel, according 'to the fishermen, are always somewhat sharp-headed, are fat and in much 'favour; the thick-headed specimens, which are only found among yellow 'eels, are in poor condition. The sexual organs of the silver eel are more 'developed, and heavier than those of the yellow eels of the same size.'

He found yellow eels of all sizes from 6 cm. upwards, but he discovered no silver eels smaller than about 29–33 cm. in males, and 42–44 cm. in females. He is led to the belief that the silver eel is the yellow eel in its 'marriage dress' (Parungskleid). This explains why there are no silver females whose total length is less than 42–44 cm., and no silver males

* Cattie, 'On the Genitalia of Male Eels and their Sexual Characters.' Trans. in *Proc. U.S. Nat. Museum*, vol. iii., 1880.

† From 'De strijd over de mannetjes-alen,' *Mededeelingen over Visscherij*, Dr P. P. C. Hoek, Helder, 1894, p. 116.

‡ Petersen, 'Das Parungskleid des Aales,' *Mittheil. des Deutschen Seefischereiver-eins*, February, 1895.

whose total length is less than 29–33 cm., for with those two lengths the two sexes become capable of reproduction. The change from the yellow to the silver colouration takes place rapidly—in a few weeks.

The Migration of the Eel.

During autumn the great majority of the adult eels leave the streams and rivers and migrate to the sea. Some of the eels, however, remain in fresh water during the winter. That this migration to the sea is for the purpose of spawning is conclusively proved by the fact that about the end of spring and beginning of summer, immense numbers of young eels enter the fresh water streams from the sea. While most authorities are agreed that the eels spawn only in salt water, some are of the opinion that they also spawn in fresh water. Roosevelt * maintained that eels were hatched in fresh water in his trout ponds in Great South Bay, Long Island. Sawyer † also considered that the eels do not all return to salt water to spawn, but spawn wherever they find suitable places in ponds and rivers. A description of the spawning of the eel is given by the Rev. J. E. Fraser. ‡ From the following extract it appears possible that the observer has mistaken the lamprey for the eel. The spawning was observed 'in an old stream which has not been known 'to run dry, and about a dozen yards from the lake Lochness, 'into which the burn flows. The time or season was early in May, 'and for three weeks in June. The establishment consisted of four 'males and two females. The female adhered to or attached her head '(mouth) to a firm stone or pebble, then the male fixed himself to her 'head by suction or pressure, and put one coil of his tail around the middle 'of her body, then slid or glided down that section until it reached the 'desired spot. From the moment of connection there is a very lively play 'of tails, and so strong as to disturb the coarse sand and ova recently 'deposited. The female apparently passes four or five eggs simultaneously 'with the withdrawal of the male organ. The ova, as a rule, fell to the 'bottom, and lay on the coarse sand or pebbles as small white globular 'bodies.' No further description of the ripe egg is given in the report. In this connection Benecke § says that 'eels planted in land-locked ponds 'increase in size, but never increase in numbers. In lakes which formerly 'contained eels, but which by the erection of impassable weirs, have been 'cut off from the sea, the supply has diminished, and after a time only 'scattered individuals, old and of great size, are taken in them. If an 'instance of the reproduction of the eel in fresh water could be found, 'occurrences such as these would be quite inexplicable.' At the meeting of the Scottish Microscopical Society on the 16th of February 1894, Mr George Sandeman called attention to some remarkable eels from a warm and stagnant loch on the Isle of May, which has no communication with the sea. He remarked that it was not known how long ago the eels were placed in the loch, but it did not appear to have been within the memory of man. They are not known to breed, their ovaries and testis being somewhat atrophied, though still apparently functional. In the specimens examined, atrophy is also marked in the muscles, liver and spleen. The ovaries and ova are very small, fatty, and the nuclei of the

* *Trans. of the American Fish. Cultural Assoc.*, 7th Meet., 1878.

† *Bulletin U.S. Fish. Commission*, vol. vi., 1886.

‡ 'Notes on the Spawning of the *Anguillidæ*,' *Report of Brit. Assoc. for Adv. of Science*, 60th Meet., 1890.

§ Brown Goode 'Notes on the Life History of the Eel,' *Bulletin U.S. Fish. Comm.*, vol. i., 1881.

ova obscured. In appearance these eels are singularly bony. The specimens were all about 26 inches long, but weighed only one-half the normal weight. Perhaps the most interesting feature about them was their eyes, which in some examples were eight times larger than normal. The cornea is opaque, and attacked with Gregarines and other organisms. These very remarkable abnormalities Mr Sandeman believes to be due to senility.* Gunther also, in the article on 'Ichthyology' in the *Encyclopædia Britannica,* writes—'So much only is known that they do not 'spawn in fresh water, that many full-grown individuals, but not all, 'descend the rivers during the winter months, and that some of them at 'least must spawn in brackish water, or in deep water in the sea; for in 'the course of summer, young individuals from 3–5 inches long ascend 'the rivers in incredible numbers, overcoming all obstacles, ascending 'vertical walls and floodgates, entering every larger and swollen tributary, 'and making their way over terra firma to waters shut off from all com'munication with rivers.' 'It is probable,' writes Brown Goode, 'that the 'truth lies somewhere between the two extremes, and that it will be here'after ascertained that the eel, like the majority of other fishes, has flexible 'habits, sometimes deviating from the ordinary custom, which appears to 'be to spawn in salt or brackish water.'

The eels leave the rivers and enter the sea in autumn, but according to Benecke,† the migration begins in the upper stretches of long rivers in April and May, and in the lower reaches and shorter streams later in the season. Feddersen ‡ says that the migration of the male eel to the sea happens most usually earlier in the year than that of the female in a body (*en masse*) take place. The time of migration in any locality seems to vary a little, and to be dependent on the state of the river. The eel fishermen § on the Eden notice that the migration takes place on that river in the first heavy spate in October or November. The main body of the eels come down during the first night; by the third night they have all passed down to the sea. Hinkelman ¶ observed that the migration of the eel is carried on during the night, beginning about one hour after sunset, is strongest from midnight until two o'clock in the morning, and ceases about one, or one and a half hours before sunrise. The body of migrating eels consists of males as well as of females. Among 1200 (more or less) migrating eels taken at Comacchio, 520 were found by Jacoby to be males measuring from 24–48 cms. All the eels were caught during their migration to the sea. A further advanced development of the lobe-organ in contradistinction to those caught during summer near Trieste could not be noticed in any of them. The Swedish Superintendent of Fisheries, Dr R. Lundberg,‖ has published an interesting pamphlet on the eel-fisheries, with so called 'hommor' (eel-baskets), on the Swedish coasts along the Baltic and the Sound, giving accurate observations on the migrations of eels on the coasts of Sweden, which, in the main points, strengthen the supposition that the mature eels seek the water of the Kattegat and the North Sea—which is salter than the Baltic—for the purpose of spawning. These observations agree with those of Mr Dallmer, which have been reported in the Circulars of the German Fishery Association, 1880, 1881. After Dr Lundberg has given a sketch of the extent of the 'hommor'

* *Annals of Scottish Nat. History*, July 1894.

† From article by Brown Goode. *Loc. cit.*

‡ Feddersen, in *Dansk Fiskeri-forenings Medlemsblad*, No. 35, 1893.

§ Messrs Pinckney, Guardbridge, courteously gave me much valuable information regarding the eel-fishing on the Eden.

¶ Hinkelman 'The Mode of Life of Eels,' *Bulletin U.S. Fish. Comm.*, vol. iv., 1884.

‖ Hermes, 'The Migrations of Eels,' *Report U.S. Fish. Comm.*, 1884, Washington, 1886.

fisheries, he arrives at the conclusion that the route taken by the eels during their migrations along the coast can easily be recognised from the position of these fisheries. It appears that the eels, after having avoided certain portions of the Swedish coast, such as the coast of Sodermanland, &c., cross from the Cape of Falsterbo towards the Danish coast, and do not again approach the Swedish coast till they have reached the narrowest part of the Sound near Helsingborg. That the eels migrate along the coast is proved by the position in which the fishing apparatus or 'hommor' has to be placed, if the fisheries are to be successful. On the East coast the 'hommor' are placed in such a manner that the eels have to enter them from the North, while on the South coast the fish have to enter them from the East, and in the Sound from the South. On the Danish coasts, in the Great and Little Belts, the eels coming from the East and South as likewise reported to wander in a north-westerly direction towards the Kattegat. The time when the eel-fisheries are carried on along the Swedish coast corroborates the supposition of the migration along the coast referred to above. These fisheries commence at Grissleham and Landfort in July, in East Gothland and the Kalmar district towards the end of July and last till October, while in Schonen the fisheries commence in August, and do not yield many fish till September and October. At Humlebeck, on the Danish coast, about a mile from Elsinore, the eel-fisheries commence towards the end of October, and do not come to a close till the 10th of November. This shows that the ideas relative to the migrations of the eel along the coast toward the Kattegat, expressed above, are very probably correct.

A comparison between the reproductive organs of the migrating eel, and those of the eel at other seasons of the year, would naturally be expected to afford conclusive proof that the migration of the eel is for the purpose of spawning. This is only partially the case. Although, in some instances, comparatively large ova have been found in the migrating eels, still none of the migrating eels which have hitherto been examined have shown any considerable advance in the development of the ovum. Benecke* found that, in the earlier months of the year, the eggs were at the utmost 0·09 mm. in diameter. In September he found (on an average of numerous measurements) a diameter of 0·10 mm.; in October 0·16 mm.; in November 0·18–0·23 mm., while the eggs showing other characters connected with approaching maturity earlier in the season were not to be seen. Möbius found in eels measuring from 48–70 cm., which he examined in September 1884, October, November, and December 1885, and January 1886, that the greatest eggs measured 0·215 mm. On October 29th, 1885, one eel measuring 53 cm., obtained from the Baltic, had ova 0·129 mm. in diameter, while in January 1886, 3 eels, measuring 50–56 cm., which had been caught in the Baltic in October 1885, and had been kept in a box sunk in Kiel harbour, had ova measuring 0·198 mm. in diameter. On February 9th, 1886, 4 eels from the box in Kiel harbour, measuring 52–60 cms., had ova 0·193 mm. in diameter; 3 eels from Amrum, Feb. 20, 1885, which measured from 34–40 cm., had ova 0·086 mm. in diameter. On March 5th, 1885, in two eels which were caught at Keitum, and which measured 40 and 60 cms., the ova were found to measure 0·186 and 0·129 mm. respectively. Certain eels were placed in a sea aquarium of the Physiological Institute of the University of Kiel, in October 1884. Of these, one examined in May 1885 had large eggs of 0·215 mm., and another, which died on June 13th, 1886, had ova of the diameter of 0·277 mm. He found that in the eels placed in the box in Kiel harbour the ova did not increase in size, and that in January the ova had the same diameter that they had in October. It is thus apparent, from the

* From article by Brown Goode, *Loc. cit.*

experiments of Möbius, that, although the average size of the ova in eels of 52 cm., and more, is greater in autumn than during the rest of the year, still even in autumn eels are found having ova much smaller than the average size of ova during that season, and in other months of the year ova are found of as great a diameter as those observed in autumn. Möbius found no spermatozoa in the testes of the eels kept in the aquarium. In the migrating eel, when it has been examined, the ovaries are in a very undeveloped condition. Eels which have been caught in salt water have not shown much, if any, further tendency to ripeness of the ova. Whether the eels captured in salt water were eels which had migrated during the autumn is not known. These may have been eels which are found during summer near the shore in salt water. An interesting question suggests itself—What becomes, in the winter months, of the eels of all sizes which are found during the greater part of the year in the estuaries of rivers? Whether they join the body of migrating eels, and proceed to the sea, or whether they, as some think, burrow into the mud during cold weather remains to be solved. The eel which is commonly caught in the estuary of the Eden during the summer is the yellow variety of eel. Before the second week in May, the eels which are captured there are only about 12 inches in length. On and after that date, however, it is observed that larger eels, about 20 inches long, come up the river with the flood tide, and go down again with the ebb. In the month of July large eels come up from the sea, and proceed right up the river into the fresh water. These eels are about the size of the migrating eel, and are accompanied by small eels. With the cold weather, at the beginning of winter, the eel-fishing on the Eden ceases ; none but very small eels are then caught. The eel fishermen are of the opinion that the eels burrow into the mud in the bed of the estuary, and become dormant during winter. This belief is to some extent corroborated by the fact that occasionally during winter the musselmen on the Eden bring up small eels among the mussels and mud in the mussel rake. On February 25th, 1895, two eels measuring 11½ and 12½ inches respectively were captured in this manner. They were both females having ova which measured ·045 mm. in diameter. It is only during winter that eels are procured with the rake, and they are all small, viz., under 18 inches in length. In summer they sometimes bring up eels in the rake, but they always escape at the surface of the water. This fact seems to point to the probability that certain of the eels do hibernate, but perhaps only those eels which are immature do so, while the larger estuary eels proceed to the sea. No eels are caught in winter by means of the 'tot,' * which is used with success in summer. The fishermen are of the opinion that if the eels were in the river, they would be able to catch them by this method. If the eels hibernate, the same non-success would attend the efforts of the fishermen as if the eels left the estuary altogether. That they do not all leave is proved by the capture of certain individuals, and the latter appear to be in a semi-dormant condition, for they could, without the slightest difficulty, escape between the prongs of the rake. During the summer, eels of various sizes, from 10 inches to 2 feet or more in length, are quite common in the salt water pools among the rocks near St Andrews. In May of this year (1895), the rock pools were carefully examined, on several occasions, at low water during spring tides. Two eels only, measuring 10 inches in length, were obtained, while one which appeared to be less than 18 inches long was seen. The larger eels, which are to be seen there in summer, were absent.

* The so-called 'tot' is composed of a number of sand-worms (*Arenicolæ*), which are threaded on worsted and rolled up into a ball. The teeth of the eel are caught in the worsted, and it is then easily lifted into the boat. This method of fishing is also known as 'bobbing.'

Jacoby and Comisa * consider that there is an eel found throughout the year in very many, Comisa thinks all, brackish waters, which is a barren female. This sterile female, according to Comisa, may possibly, under certain circumstances, develop into a normal female.

The important question, as to whether or not the eel takes food during its migration, was solved by Jacoby, who examined the stomachs of many hundreds of migrating eels. He invariably found the stomachs empty. He says that when the eels commence to migrate to the sea they take no food, just as other fish do during the spawning period. 'The 'stomachs of those which do not migrate, both of those which are not yet 'able to migrate, and of those which never go to the sea, but spend their 'whole life in the lagoons, were more or less filled with remnants of food.' Jourdain examined a large number of eels caught in the bay of La Hougue (Manche), where the numerous water-courses bring them. The stomachs of certain individuals contained *Arenicolæ* : those of the greatest number were empty.

Observers differ in opinion as to how far from the shore the spawning of the eel takes place. Packard thought that the eel probably spawns in shallow, salt, or brackish water in harbours, and at the mouths of estuaries and rivers, where it is well known eels are speared in winter. It is clear, writes Norny,† that the eels hibernate in winter to breed, the roe forms and matures during the period, and the young are hatched just at the end of this period. According to Jourdain, the eel which is ready for spawning descends to the sea, and remains in the neighbourhood of the coast. Jacoby, however, considered that the development of the reproductive organs takes place in the sea, not near the coast, but farther out in deep water. The latter view, to some extent, receives confirmation from the fact that the only ripe eel which is recorded as caught in salt water was captured 20 miles from land. The following facts seem to indicate that the eels, which come to St Andrews Bay from the Eden, do not remain near the shore but go out to deep water. During spring an active plaice fishing is carried on in the bay. The hooks are baited with sand-worms (*Arenicolæ*), and the lines are shot parallel, and close to the shore, across the mouth of the Eden. The bottom of the bay from low-water mark to a line drawn parallel to the shore, at a distance of about a mile, is practically covered with lines. No eel has ever been caught on any of these lines. The sand-worm with which the lines are baited is the worm which is used for the 'tot,' and by means of the 'tot' large numbers of eels are caught in the Eden during summer. The fact that no eels are captured in the bay at this time does not of necessity prove that the eels are absent. It may be due to their not taking food during the spawning period. As in the case of other fishes, however, it is not improbable that occasionally a spawing eel would be taken on the lines, if the eels were present in large numbers. Chemi and Desmarcst ‡ do not hesitate to state that the eel spawns upon the mud after a kind of copulation, that the eggs remain adhering together, joined by a glutinous secretion analogous to that which connects the egg of the fresh water perch, and forms little pellets or rounded globules. Each female, as they have succeeded in observing, produces annually many of these masses. Decker § claimed that eels spawn, and are hatched on muddy and slimy bottoms at a depth of 10–15 feet. According to Jacoby the

* Sennebogan Comisa on the 'Sex of Eels and on the Sterile Females,' in *Zeitschr. f. Fischerei*, von Dr C. Weigelt, 1893, No. 4.

† Norny, 'Artificial Propagation of Eels,' *Bull. U.S. Fish. Commission*, vol. v., 1885.

‡ Brown Goode. *Loc. cit.*

§ 'Les Anguilles mâles comparées aux femelles,' *Journal de l'Anatomie, etc.*, 1881. 'Zur Naturgeschichte der Aale,'—*Deutsch Fischerei-zeitung*, 1881.

river eels have their settled spawning-places on mud banks in the sea, not near the coast.

It has sometimes been maintained that the eel was viviparous, but such assertions have been founded on the discovery in the eel of thread-worms. In this connection, Robin * says that 'the disposition of the 'male organ permits of the understanding that these might be coupling, 'and the possibility of the introduction of the sperm of the male into the 'cloaca of the female. But the absence of the oviduct in the eel renders 'impossible the arrival of the sperms as far as the ovaries, and from there 'to the ovules. Valenciennes states, on the authority of the fishermen, 'that the eels spawn while in contact, two to two, or with the interlacing 'of several individuals of different species. But no one has anatomically 'proved—1st. If there had been an individual provided with testes; 2nd. 'If in the interlacing of several eels, there had been a mixture of *pim-'peneaux* with the ordinary female eels. These facts, which it would be 'easy to prove, still remain an open question. The same remark applies 'to the assertions of certain persons, as to the eels, male and female, 'rolling themselves up in a ball, the size of a man's head, and allowing 'themselves to roll to the sea for the purpose of spawning.' In Sardinia, Jacoby mentions, the fishermen cling to the belief that a certain beetle, the so-called water-beetle, *Dytiscus Roeselii*, is the progenitor of the eel, and they therefore call this beetle 'mother of eels.' A similar belief is stoutly maintained by Cairncross,† who gives a very circumstantial account of the birth of the eels from a beetle; he does not mention the species of the beetle. He observed, on many separate occasions, these beetles give birth, at the expense of their lives, to one or two hair eels. He claims to have kept two of the eels born of a beetle for two years, and at this age they measured 8½ inches in length. He admits, however, that he lost sight of them for a period of nine months.

There can be no doubt that the eel spawns just as other fishes do. Whether the egg is pelagic or not, is unknown. It is well known that many fishes which have demersal eggs, deposit their spawn during the winter months. Pelagic ova are rarely found in the Firth of Forth until late in January, and during that month and February they are very few in number. If the eel has a pelagic egg, it is remarkable that it has not been captured in the tow nets of the 'Garland.' In December and January, during which months it appears probable that the eel spawns, the tow net is regularly used in the Firth of Forth. The large number of migrating eels, and the great shoals of fry, lead one to infer that the ova must be shed in immense numbers. It is not probable that a pelagic egg, present in such quantities in the Forth, would have eluded capture up till the present time. One must conclude that, if the egg is pelagic, it must be desposited out at sea. Professor M'Intosh thinks it probable that the eels deposit their ova on or in the sand, somewhat after the fashion of the sand eel. The little transparent eel is sometimes dug up out of the sand. The attendant at the Laboratory has on two occasions when in search of sand eels dug up the little eel. Although the ripe eggs of neither the conger nor common eel are known, 'Grassi and Calan-'druccio state that they have been able from their own observations to 'confirm with complete certainty the suggestion of Raffaele that certain 'pelagic eggs described by him belong to the family of the Muraenidae.'‡

What becomes of the eels after spawning? According to several writers the eels never return to fresh water, but disappear altogether.

* 'Les Anguilles mâles comparées aux femelles,' *Journal de l'Anatomie, etc.*, 1881.

† Cairncross, 'The Origin of the Silver Eel,' 1862, G. Shield, London.

‡ Cunningham, 'The Larva of the Eel,' *Journal of Marine Biological Assoc.*, New Series, vol. iii., No. 4, 1895.

The view of Siebold that the eel, like the lamprey, dies after the reproductive act, has been accepted by Jacoby, Cattie, Benecke and others. The ovaries of the migrating eel are very immature, and if the swarms of elvers, which ascend the rivers in May, are produced from the eels which migrated in the preceding autumn, the reproductive organs must arrive at a ripe condition with extraordinary rapidity. It is considered probable that the excessively rapid development of their organs of generation exhaust them to such a degree that they die a physiological death soon after they have spawned. Brown Goode quotes an important statement of Dr Schock, published by him in No. 8 German Ficherei Zeitung, 1878. Dr Schock says, on the authority of Jacoby, that occasionally the sea, in the neighbourhood of the mouths of rivers, has been found covered with dead eels, whose ovaries were empty. '*When, where, and by whom the ' observations were made, and who pronounced upon the empty ovaries of ' the dead fish are unfortunately not mentioned. Benecke considered that ' the eel lays its eggs like most other fishes, but that like the lamprey it ' only spawns once, and then dies. All the eggs of the female eel show ' the same degree of maturity, while in the fishes which spawn every year, ' beside the larger eggs which are ready to be deposited, there exist very ' many of much smaller size, which are destined to mature hereafter, and ' to be deposited in other years.' The equality in size of the ova seems to Benecke to indicate that all the eggs ripen simultaneously and are shed at one time; and since no ova would remain to become mature in the following year, that the eel, being therefore useless for further reproduction, dies. Blanchard † also states that the eel which has quitted fresh water never returns. He appears to be of the opinion that the eels after having migrated, remain in the sea. With regard to the conger, Cunningham ‡ drew the conclusion that each conger only breeds once in its life, or, in other words, that every specimen, whether male or female, dies after shedding its milt or roe. He found that the congers kept in confinement at Plymouth ceased to feed when the sexual organs began to mature, and died on becoming ripe. On examining certain ripe females and a ripe male, he noticed that the teeth were nearly all gone, and that the bones of the head were soft and flexible. From a comparison between a ripe and an immature female as regards total weight of body, and weights of ovary and alimentary organs, he found that the ovaries increase very much in size and weight during the fasting period at the expense of the rest of the body, while in the total weight of the fish a great reduction takes place. The strongest evidence in support of his conclusion that the conger dies on shedding its milt or roe, was derived, he thought, from the loss of teeth, and the atrophy of the bones of the head, which occurs during the ripening of the sexual organs. 'A conger after it had shed ' its milt or roe would in all probability be incapable of feeding itself; ' without teeth it would be unable to hold its prey, and without food it ' could not recover its former condition.' Petersen § also believes that the silver eel, which he considers to be the yellow eel in its 'marriage dress' (Parungskleid), dies after spawning. Hermes,¶ however, has stated that, according to his knowledge, there are wanting observations which will give scientific foundation to the statement that the common eel dies after spawning. The same view is held by Günther, who says that the

* From 'Notes on the Life-history of the Eel,' by Brown Goode.

† Blanchard, 'Étude de l'Anguille, aprés son passage de l'eaux douces,' in *Comptes Rendus*, t. 109, 1889.

‡ Cunningham, 'Reproduction and Development of the Conger,' *Journal of the Marine Biological Assoc.*, New Ser., vol. ii., No. 1, May 1891.

§ Petersen, 'Das Parungskleid des Aales,' in *Mittheilungen des Deutschen Seefischereivereins*, b. xi., No. 2, Februar 1895.

¶ Hermes 'On the Conger,' *Bull. U.S. Fish. Comm.*, vol. i., 1881.

majority of the eels which migrate to the sea, appear to return to fresh waters, but not in a body, but irregularly throughout the warmer parts of the year. Robin in this connection says, 'As to the return of the 'females from the sea, this cannot be denied; indeed I have received from 'M. Dufourcet some female eels of the variety *Sardias*, taken in January 'and February in the Adour, at about 40 kilometres from the sea, one 'half of which had their stomachs filled with examples of *Eunice sanguinea* 'and *Doris*, which are exclusively marine invertebrates.' Confirmatory evidence is given by the eel-fishermen on the Eden, who state that silver eels, which are as large as the migrating eels, come up from the sea in July, and go right up stream. They are in fairly large numbers and are accompanied by small eels.

THE YOUNG EEL, ELVER, CIVELLE, MONTÉE, ETC.

Nothing is known of the life-history of the eel between the migration of the adult eels to the sea in autumn, and the arrival of the transparent young eels at the mouths of the rivers in spring and summer. The young eel, 'elver,' in England, 'civelle,' and 'montée,' in France, is eaten in some places in England, and gives rise to an extensive fishery in certain parts of France. The civelle is only of value for food while it is transparent; with the appearance of pigment the young eel loses its delicate flavour. The elver, which is found ascending our fresh water streams in immense numbers during spring and summer, is a little transparent eel about 6–7 cm. long. Benecke gives 1–3 cm. as the size of the young eels when they begin their wandering in the sea towards the rivers. When the civelles appear at the mouth of the Loire they measure 4–5 cm. Kuppfer observed great quantities of young eels of about 3 cm. in length in the brackish water of the Eider at Friederickstadt. According to Packard, the little eels which appear in April and May measure 3–4 inches. Ryder* says that the young eels which come up in spring are about 2 inches long. Mr John Sear † of Danvers, Mass., claims to have found during March, young eels somewhat less than an inch in length, with the yolk-sac still attached. In the elver, while there is yet no trace of sexual organs, there are present all the essential characters of the adult eel, viz., the swim-bladder, the projecting lower jaw, and the dorsal fin commencing much nearer the middle of the body than that of the pectorals. There is no pigment in the skin. In the elvers examined at St Andrews the vertebral column, from the presence in it of a large quantity of black pigment, shows itself distinctly through the transparent body wall as a dark line. The eyes are large and very black. The nasal tubes are proportionally larger than in the adult eel. The dorsal fin in the elver commences a very little further forward than in larger eels. This fact is shown by a consideration of the ratio, which the total length of the eel bears to the distance from the tip of the lower jaw to the beginning of the dorsal fin. In fifteen eels of from 15·8–92·03 cm. in length, this ratio was found to vary from 3·03 to 3·42. In thirteen elvers, measuring 66–87 mm., the ratio varied from 3·36 to 3·83. The point at which the dorsal fin commences is not a fixed one; it varies considerably both in elvers and adults. By taking the *average* ratio, however, it is seen that the dorsal fin is carried distinctly further forward in the elver than in the larger eel. It is also found that the

* Ryder, 'Note on the Male Organs of the Eel,' *Bull. U.S. Fish. Comm.*, vol. v., 1885.

† Packard. *Loc. cit.*

average position of the anus is, in the young eel, nearer the snout than in the adult. The ratio of the total length, to the distance from the tip of the lower jaw to the anus was calculated, and it was found that in the fifteen larger eels, of from 15·8–92·03 cm. in length, the ratio varied from 2·22 to 2·54, while in the fourteen elvers (63–87·5 mm.) the ratio varied from 2·37 to 2·72. In a young conger, 25·7 cm. long, the ratio of the total length to the distance of the beginning of the dorsal fin from the tip of the upper jaw was 5, while the ratio of the total length to the distance between the tip of the snout and the anus was 2·5. It is thus seen that in the conger while the dorsal fin commences much further forward, the anus occupies a position coincident with that of the anus in the *Anguilla*. * The continuous fin of the elver is broadened sensibly at the tail; the rudimentary caudal fin is marked off from the dorsal and anal fins by the presence on it of black pigment.

* The sexual organs only become visible at the superior part of the abdominal cavity when the animal reaches the length of 20 cm. or thereby.

According to Robin, the civelles in the sea as in fresh water lose their transparency when they arrive at the length of 6, 7, or 8 cm. 'At this 'period they take on the yellowish brown tinge of the adult. From the 'length of 9 cm. and better, 10 or 11 cm., they retain the preceding 'colour. They are then opaque, being with difficulty examined by trans-'mitted light. It has, except for its length, the external appearance of 'the adult. These peculiarities are still more marked in individuals of 'the length of 12, 13, or 14 cm. According to Valenciennes it is at this 'period (April or May), three or four months after their being hatched, 'that they receive the name of civelle. At this period, according to this 'author, they would be of a beautiful sulphur yellow colour.' From observations made on elvers here, it seems probable that the appearance of pigment is not solely dependent on the length of the eel. Some fully pigmented young eels were found to be much smaller than others which were still quite transparent. Transparent elvers, measuring from 63–75 mm., were procured in the neighbourhood of St Andrews in April 1895. A dark coloured eel, 66 mm. in length, was found among the rocks in a pool near a spring. The latter was quite opaque, in colour exactly resembling an adult. The head and dorsum were covered with stellate black pigment corpuscles on a brownish-yellow ground; the belly was light coloured. Different stages of pigmentation were noticed in certain transparent elvers. One little eel, measuring 67·5 mm., procured from a salt water pool, had black pigment corpuscles laid down in certain definite areas. Round pigment spots were present on the snout. On the top of the head were two patches of large pigment corpuscles, one on each side. A beautiful green coloration was present over the dorsal half of the body. Beginning just behind the head where it was most intense the colour grew fainter as it neared the tail. Black pigment corpuscles were also present over the whole extent of the dorsum. Four transparent eels from the Eden exhibited different stages in pigmentation. They were captured on April 16th and were kept in fresh water in the Laboratory until May 14th when they were examined. They all had black pigment on the snout, head, dorsum and superior portions of the sides. The green coloration described above was present. The two patches of black pigment corpuscles on the head had united to form a heart-shaped area. The pigment on the dorsum was more marked than in the eel mentioned above. The pigment on the sides was continuous in one specimen, 68 mm. long; in the remaining three, 63, 68, and 73

* Robin. *Loc. cit.*

mm. in length, portions of the sides were free from pigment. All the elvers which showed more pigmentation than the above, had attained the full coloration similar to that of the adult. They were of various sizes, 66, 71, 83, 85, 87 mm. in length. The colour of the dorsum approached very nearly that of *Laminaria*, and was due to the presence of stellate black pigment corpuscles on a yellowish ground. Jourdain * 'was able to 'get all the intermediate forms between the montée and the young eel 'perfectly characterised. The young eels, at first transparent, become pig- 'mented little by little; the scales appear in those individuals whose 'length approaches 10 cm., and it is on the abdominal region that they 'are first seen to appear.' Large numbers of young eels, from 3–4 inches in length, were noticed on the Elbe, by Von Ehlers; they were all dark coloured.

† 'The development of the eel from the civelle to the adult is regular 'without metamorphosis, without the replacement of foetal organs, which 'disappear, by others which replace them permanently.'

The elvers, which are recorded as caught in the sea at some distance from the shore, are few in number. Robin procured them by means of the dredge at several kilometres from the shore, and also captured them on the shore at low water. Certain transparent eels which were caught in salt water are preserved at the Laboratory. The sizes, dates, and localities of capture are given in the following Table:—

Date.	Number of Specimens.	Size in mm.	Locality.
Jan. 12–14, 1891, .	1	66	Bottom townet, off Sarclet, Caithness, s.s. 'Southesk.'
Jan. 28–30, 1891, .	2	65	Bottom townet, a little E. of May I., Forth, 'Garland.'
March 1, 1895, .	1	70	M'Intosh net, Inverkeithing Bay, Inside, Forth, 'Garland.'
March 21, 1891, .	1	67·5	M'Intosh net, off Anstruther, Forth, 'Garland.'
March 28, 1889, .	1	65	Midwater net, St Andrews Bay, 'Dalhousie.'
April 1885, . .	1	66	Dug up on E. sands, St Andrews.
April 12, 1892, .	1	71·5	M'Intosh net, vicinity of Culross, Forth, 'Garland.'
May 8, 1895, .	1	67·5	From saltwater pool, E. rocks, St Andrews.

The view has been generally accepted that the elvers which appear in spring are the young of the eels which had migrated to the sea in the preceding autumn. The age of the young eels has been reckoned at from three to four months. The adult eels which migrate in October or November, probably will not spawn earlier than December. What age then must we assign to the elvers captured in January? They are as large as those procured in March, April, and May, and it is exceedingly improbable that they are younger than the latter. Questions such as these it is impossible to answer until further information is obtained regarding the spawning of eels.

Regarding the rate of growth of eels Packard states that several thousand of young eels, about 2 inches in length, were placed in a mill-pond, by Mr D. G. Colwell in June 1879. In November of the same

* Jourdain. *Loc. cit.*

† Robin. 'Note sur quelques caractères des Anguilles, des Congres, et des Lepto- 'céphales,' in *Journal de l'Anatomie et de la Physiologie*, 1880.

year he caught one 7 inches long in the pond. This shows that it had grown 1 inch per month. According to Benecke, eels of 4 inches in length, which in May are plentiful in fish-ponds, by the end of October reach a length of 10 inches, and the thickness of a man's little finger; in the following fall they measure 20–24 inches, and in the third year are ready to be eaten.

Robin * discusses the question as to whether the civelle, or the adult eel, is or is not the young of the conger,—a belief held at the present time by certain fishermen. He shows that both the adult eel and the elver differ very much from the conger and its larva (*Leptocephalus Morisii*) in the skeletal structure of the tail.

The time at which the montée (schools of elvers) appears, varies very much in different countries, and even in different parts of the same country. Robin says that, in the Landes, and no doubt other places in the south, the ascent of the young fish takes place as early as the second half of December, instead of in March as in the Channel. '† According 'to French reports,' Benecke writes, 'the young eels in February, having 'attained the length of 4–5 cm., appear in the brackish water at the 'mouth of the Loire, in immense numbers soon to begin their wandering 'up stream. Redi has recounted that from the end of January to the 'end of April, the young eels continue wandering up the Arno. In the 'lagoons of Comacchio they pour from February to April. Von Ehlers 'noticed, at Drennhausen, on the Elbe, on a day towards the end of June 'or beginning of July, young eels from 3–4 inches in length, the thickness 'of the body was about that of a goosequill. All of them, even the 'smallest, were dark coloured. According to Von Stenmann, every year, 'from April to the end of June, there appear large masses of young eels, 'which are present in large schools near the Upper Eider, seeking in 'every way to pass each other. In Connecticut the young eels, 3–6 'inches long, appear in the basin of the Still Water Falls in August.' Day ‡ says that the young eels pass up the Parret with the tides of March. According to the fishermen, a few ascend in February and those by June are about 3–4 inches long. Packard states that the young eels appear in April and May. Much interesting information regarding the montée, in connection with the civelle fishery on French rivers, is given by Vaillant.§ The following is an extract from his paper on 'Observations relatifs à la 'Montée des Anguilles,' 'From the inquiries, conducted by the Com-'missaires de l'Inscription in their localities, by the order of the Minister 'of Marine it was learned that the phenomenon of the montée is known 'to the fishermen, and gives rise to an industry only in relatively few 'places, twelve in number, all situated on our oceanic coast, generally 'where there are important water-courses. As regards the times of com-'mencing and ending of the montée certain variations are observed 'according to the locality. At Caen, Dinan, Saint Nazare, Nantes it 'appeared in February; at Maraus, Rochefort, Pauillac in January; at 'Bayonne in December. There is more regularity about its ending; all 'over the indication is, that it takes place in April, except at Nantes 'and Rochefort, where the montée is prolonged more or less into May. 'In countries north of France the termination is later; according to the 'statements of authors it takes place in May on the Thames; at the end 'of July in Ireland; the end of June on the Elbe. Admitting these 'dates, with certain reservations, one could conclude that the phenomenon

* Robin. *Loc. cit.*

† From article by Brown Goode. *Loc. cit.*

‡ Day, British Fishes, p. 244.

§ Vaillant, "Observations relatifs à la Montée des Anguilles sur les côtés de France," in *Comptes Rendus Ac. Sc. Paris*, t. 109, No. 1, 1889.

'takes place the later the higher the latitude. Observations made on 'the Orne show that the sea exercises a sensible influence on the arrival of 'the little eel. The fishing is especially fruitful during the two days which 'precede, and the three days which follow, either the new or full moon. 'The fry, unable to stem the current, take advantage of the spring tides 'to enter the rivers. This explains why on our Mediterranean water-'courses the fishing of the civelle is not practised. The montée there 'is known; it has been thoroughly investigated and described by various 'authors. There, in a sea without any very sensible ebb or flow, the 'phenomenon could take place over the whole of the post-larval period, 'and this does not permit of a regular and easy fishing as on the ocean 'coasts. One is equally struck by the fact that the army of young eels 'only appears at a certain distance from the river's mouth, and also 'rapidly ceases in amount. Thus in the case of the Gironde, where the 'investigations have been most complete, and have been carried over at 'least 35 leagues of the river, the fishing is of very little value at Royan, 'has considerable importance at Verdon, diminishing sensibly from 'Dignac, more still at Pauillac, to become insignificant or nothing at 'Blaye, Bordeaux and Langon for the Garonne, at Libronon for the 'Dardogne. This decrease in the fishing depends above all on this, that 'the metamorphosis of the civelle during the montée takes place very 'rapidly, once the fish arrives in fresh water, and greatly modifies 'its nature. In its first state the animal is gelatinous in appearance, 'betraying itself in the midst of the liquid by its black eyes, and the 'reddish coloured spot formed by the heart and gills. It dies rapidly out 'of water, whatever care is taken to preserve it. In the second stage the 'skin is thickened and charged with black pigment, which colours all 'the upper parts, the under parts remaining a silver white. Under its 'changed appearance it represents, save in dimensions, a true eel. 'Taken out of the water it resists asphyxiation in a remarkable fashion, 'provided it is kept in a humid medium, a fact well-known in aquiculture, 'and it is under this form of montée, properly speaking, that it can 'be carried to a distance to replenish lakes and water-courses. This 'difference in appearance is accompanied with modifications in the 'edible qualities of the fish, so that the civelle, which is much sought 'after under its first form in the localities where it is taken, for it will 'not stand transport, is rejected under the second form as indigestible 'and of unpleasant taste. The civelle, indeed, is constituted of tissues 'largely embryonic, and above all includes in its abdomen a noticeable 'quantity of nutritive reserve material (*vitello-umbilicale*), a substance 'easy of assimilation, but the montée properly speaking, that is, immedi-'ately after the absorption of the embryonic reserve materials to form 'definite tissues, is lean, and offers none of the qualities sought after in 'an article of diet, a fact which explains the abandonment of the fishing.'

The young eels on entering a river swim eagerly up stream. Numbers leave the main body and follow the course of each tributary. They overcome obstacles in a remarkable manner, ascending even perpendicular rocks by creeping through the *algae* or wet moss covering the stones. They burrow readily into the soft mud. The ascent of the young eels has been described by many authors. Parnell,* in this connection, says, 'In June the 'young are seen, from 2–3 inches in length, making their way up the 'fresh-water rivers in innumerable multitudes, keeping a few inches below 'the surface, and at a short distance from the bank. No obstacle appears 'to arrest their progress. They have been known to climb up posts, and 'to ascend into trees. They have also been observed crawling over land 'from one pond to another.' That eels very often travel over wet grass

* Parnell, 'Fishes of the Forth,' 1837.

from one piece of water to another, is a well-known fact. The presence of eels in ponds, into which they have not been introduced, and which are isolated from all other waters, can only be accounted for by the passage of the eels over land from some stream connected with the sea. Some persons have asserted that eels crawl over fields in search of slugs, etc. 'The adult eel,' says Jourdain,* 'will travel over wet grass to ponds or 'water-courses which have no direct communication with the sea. Out 'of water, the eel swallows air into its branchial chamber, the straight 'opercular opening of which closes very exactly. The gill is then in a 'humid chamber, where the air gives up a portion of its oxygen to the 'branchial lamellae, which can be partly separated from one another by 'the play of the muscles of the respiratory apparatus. This is one of the 'conditions which favour the long survival of the fish out of the water.'

Problems remaining to be Solved.

'No one,' Comisa remarks, has yet observed—

(1). The development of the young eel from the egg.

(2). That the so-called syrski's organ contains spermatozoa.

(3). That eels whether male or female, that have migrated to the sea ever return.

(4). Eels in the sea that have spawned.

And to the above there may be added, the problem—

(5). The determination of the life of the eel in the sea, and the place and manner of the extrusion of the ova.

Jacoby asks, 'why, at some distance, one to two nautical miles from 'the coast, none of the many thousands of grown eels which have migrated 'to the sea are seen? [One female has been obtained by Calderwood, *vide* 'above]. This phenomenon is explained,' he says, 'when one thinks of 'the methods of fishing, and the nets employed by the sea fishermen. The 'nets, which, like those employed in the lobster fisheries, are intended to 'be dragged along the bottom of the sea, have very wide meshes, much too 'wide to retain an eel which can slip through a very small hole. And 'those nets which have narrow meshes never reach the bottom of the sea; 'the eels, however, can only be brought up from the bottom of the sea. 'The drag nets, which the fishermen employ, are, moreover, deficient in 'this respect that they do not have an apparatus to dig up the sand which 'is the favourite habitation of the eel, but glide over it gently. To catch 'a river eel in the open sea, which is an essential condition of solving the 'most perplexing question of the eel problem, will, therefore remain an 'impossibility so long as we do not possess vessels, and apparatus specially 'adapted to this purpose.' 'It is only,' writes Robin, 'in the common 'eels taken at sea from November to February that it will be necessary to 'seek spermatozoids and ova. I have ascertained that in October there 'are as yet no fecundating elements, and that in January there are no 'longer any.'

Brown Goode, in this connection, says, 'The eel eggs can only be found 'by the systematic investigation of the sea-bottom with the dredge 'and microscope. The investigation might also include the sinking of 'the migrating eel, in special boxes, to the bottom of the sea, in order to 'determine whether under these circumstances the eggs would ripen 'more rapidly. By using the largest eels for this purpose we could 'arrange, by means of small openings in the cases, to permit the entrance 'of the small male eels.' This experiment was tried by Möbius, who placed twenty-three female and three male eels in a box which was kept

* Jourdain. *Loc. cit.*

floating just above the bottom in Kiel harbour, from October 1885 to February 1886. He examined the reproductive glands of the eels at intervals of eight to fourteen days. The eggs did not increase in size; they retained the diameter of 0·215 mm., which they already had in October. In the testes of the male eels he found no spermatozoa.

As to the return of the eels from the sea, authors are divided in opinion. While the bulk of the evidence seems to point to the return of the migratory eel to fresh water, still additional proof is required to make that contention final. On the other hand, the statement that the eel dies from exhaustion immediately after the reproductive act, is supported by very few facts; and these facts have only an indirect bearing on the question. Another view is held by some zoologists, viz., that the eel which has migrated to the sea never returns to fresh water, but remains in the sea.

Blanchard * suggests, as a means of finding out the life-history of the eel in salt water, the labelling of a large number of migrating eels. He is of the opinion that the eels never return to fresh water. 'It is known,' he says, 'that in the Salmon Fisheries of Scotland and Ireland, the life-'history of the salmon has been learned by attaching to a large number 'of specimens labels by which they may be recognised on their return 'from the sea. It would be necessary, when the large eels descend the 'water courses to return to the sea, to capture numerous individuals at all 'points on our shores, and to attach to these little metallic labels, and 'then to set them at liberty. In all probability it would happen that 'some labelled specimens would be refished after a sojourn in the sea of 'some months or a year, and these specimens bearing the mark of their 'origin would enlighten us regarding a phenomena, as yet remaining 'without demonstration. There is in the knowledge of the complete life-'history of the eel a scientific question of very great interest, on economic 'question of perhaps great importance.'

Conclusion.

We must, in conclusion, admit that, notwithstanding the fact that time and attention has been ungrudgingly devoted to this question by many eminent zoologists, we know really nothing concerning the most important point connected with the life-history of the eel, as it is of every animal, viz. its reproduction. The whole question rests upon the problem, how to capture the eels after they have entered the sea. When we consider that the eel may without difficulty travel a very considerable distance from the coast, and when we remember that spawning is supposed to take place in winter, a season during which an examination of the sea-bottom could be made only under very great disadvantages, it is at once apparent that a problem of great difficulty remains for solution.

I beg to acknowledge my indebtedness to Professor M'Intosh and Dr Fulton for much assistance with the literature of the subject.

* Blanchard, 'Étude de l'Anguille de rivière après son passage de l'eau douce 'dans les eaux salées,' *Comptes Rendus Ac. Sc. Paris*, t. 109, 1889.

IV.—CONTRIBUTIONS TO THE LIFE-HISTORIES AND DEVELOPMENT OF THE FOOD AND OTHER FISHES. By Professor M'Intosh, M.D., LL.D., F.R.S., F.R.S.E., &c., St Andrews Marine Laboratory. (Plates VI., VII., and VIII.)

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1. On the Eggs and Larvæ of the Long-Rough Dab (*Drepanopsetta platessoides*).

During the trawling expeditions of 1884, an egg was frequently found in spring, especially during March and April, which was distinguished from all others by the large size of the perivitelline space,—that is, the space within the transparent capsule or zona in the early stages of the egg. It was mentioned in the report on trawling that these ova were one-third larger than the majority of the pelagic eggs, and resembled hydropic ova. The latter condition, however, was only apparent, and they were in all respects healthy, the advanced embryo with its yolk-sac lying in the centre of the transparent capsule. These eggs were widely distributed all along the eastern coast from the south of St Abbs Head to the Moray Firth, so that they evidently belonged to a common species. Though ripe long-rough dabs were seen in the dead condition in March 1884, and the eggs observed to be pelagic, yet, as this occurred during a violent storm, no opportunity was available of doing more than noting their condition, which, on issuing from the ovary, differs, as will by and by be shown, from their subsequent state, and thus the connection between them and the foregoing was not made out. Every season (viz., in March, April and May) since that date these eggs have been brought in greater or less numbers to the Marine Laboratory and hatched. A figure of the same egg was also shown me by Mr J. T. Cunningham in 1885, but he likewise had not ascertained the form to which it belonged, for in 1887 * he observes that he had not been able to hatch it, and that no similar egg had been obtained from an adult fish. Further remarks on the egg and newly-hatched larva were made in the 'Pelagic Fauna of St Andrews Bay;' † the advanced embryo tending to the upper arch of the egg in floating, and presenting, along the sides, minute yellowish (chrome) and black chromatophores, which in most cases were still unbranched after hatching. In the 'Researches' ‡ the same egg was again alluded to, and the early post-larval fish figured. It 'presents 'three distinct yellowish bars behind the vent, another at the latter,

* *Trans. Roy. Soc. Edin.*, vol. xxxiii., p. 105, Pl. vii., fig. 2.

† *Seventh Annual Report of the Fishery Board for Scotland*, p. 270, Pl. iii. figs. 1–3, 1889.

‡ *Trans. Roy. Soc. Edin.*, vol. xxxv. part iii., p. 853, Pl. xviii. fig. 2, Feb. 1890.

'and a line along the dorsum of the intestine, besides various touches 'of the same on the head and elsewhere. Stellate black chromatophores 'occur along with the yellow, and in the early condition are present 'on the yolk. The eyes soon assume a silvery aspect. The larval fish 'is active and comparatively large, resembling in certain respects the 'plaice. It is probably a pleuronectid.'

When surveying the fishing grounds off the West Coast of Ireland with Mr Green and Prof. Haddon in 1891, Mr Holt found that these eggs pertained to the long-rough dab, and thus their comparative abundance was readily explained. A similar relationship had been suspected at St Andrews, since the ova of almost all the other pleuronectids except the halibut had been examined. These ova are especially abundant on the fishing grounds to the east of the Island of May. So far as my experience goes, they chiefly abound in March, rarely a few occur in February, and in all probability, though nearly ripe, none are discharged before January. Off the West Coast of Ireland Mr Holt found the adults spawning during the same months, viz., from March to the beginning of May.

It is remarkable that the obscurity surrounding the eggs of so common a fish should have remained so long. In a recent Scandinavian work * nothing more definite than hearsay evidence is afforded, though the statement of the fishermen of Bohuslän that the roe runs in February, and that the fish is spent by the month of March, is near the truth. Moreover, comparatively small specimens, both male and female, attain maturity.

By the energy of Dr Fulton, a large consignment of living specimens was forwarded to the Laboratory in excellent condition this spring, so that an opportunity was given for a re-examination of the development of this species. The ripe females ranged from 7 to 13¼ inches, and all were distinctly distended with the enlarged ovaries. Moreover, as they lay on the dark bottom of the tank, the prominent ovarian region of the coloured surface was readily distinguishable as a broad pale pinkish streak. Some of the females were also marked with white touches, generally in pairs over the interspinous regions dorsally and ventrally,—very much in the position the dark touches hold in the pelagic post-larval forms. The males, on the other hand, were much smaller, ranging from 5¼ to 6¾ in total length, and presenting little or no distention,—a fact due to the minute size of the testes, which are wholly confined to the abdominal cavity, and are only about ½ to ¾ of an inch in length in a male of 6¾ inches. No larger male occurred in this collection, which consisted of nearly sixty specimens, so that the question may be raised as to the reasons for the limitation of the size of this sex and the small size of the male organs.

Most of the females were very ripe, and a considerable quantity of ova escaped on the slightest pressure, and fell in a mass into the water, and then slowly mixed with it. In the experiments made in the laboratory, the smallest trace of milt fertilized every egg in the vessels, which were about a foot across, so that the activity of the sperms was characteristic. The quantity of ripe ova discharged at a given time was quite as large in proportion as in the plaice, in the turbot, and in the flounder. Fishes in which the testes are small, as in the torsk, plaice, long-rough dab, and sole, do not appear to differ much—in regard to the rapidity of issue of the ripe eggs—from those with large testes. The small size of the testes in the horse, compared with the large size of the testes in the porpoise, is another instance of the caution requisite in drawing conclusions on this head. At any rate, in regard to fishes, the ascertained facts up to date do not seem to warrant strong statements on the subject. The ripe female sole in Scottish waters discharges a considerable number of eggs, and a large

* *Scandinavian Fishes*, Fries, Ekström and Sundevall. 2nd Edit., 1893.

number are also discharged by the ripe lemon dab. The quantity of ripe eggs which issue from a torsk is about as large in proportion as in a cod, yet the testes of the two differ much in size.

The egg of the long-rough dab, on issuing from the oviduct, is beautifully translucent (Pl. VI. fig. 1), and measures from 1·0668 mm. to 1·1430 mm. The capsule (*zona radiata*) clings somewhat closely to the contained yolk, and is wrinkled all over—quite as much as in the lemon-dab. The perivitelline space is small, and thus differs from the condition as ordinarily seen in the tow-nets. As a rule, the yolk or egg proper has a diameter of 1·0668 mm., while the capsule has a diameter of 1·1430 mm. When placed in sea-water, and whether fertilized or not, a gradual change takes place in the perivitelline space, so that next morning—that is, in 12 hours, the diameter of the capsule is from 1·7907 to 1·8669—probably by the imbibition of water, as in the case of desiccated eggs, while the diameter of the egg proper in the centre remains nearly the same (Pl. VI. fig. 2). This distention removes many of the wrinkles from the surface, but not all, since these were visible in almost every example up to the period of hatching. Many of the eggs had groups of minute fatty granules dotted all over the yolk, as shown in the figure. Next day (22nd March), at 12.30, considerable progress had been made (Pl. VI. fig. 3), the disc being in the mulberry condition, the cells of the blastoderm being often prominent, and at 5.40 P.M. much more finely divided. The minute granules of oil occur over the yolk, beneath the protoplasmic investment (Pl. VI. fig. 4), and they appeared to be fewer next day, so that probably they were gradually used up in the progress of development. The minutely cellular disc (Pl. VI. fig. 5) presents an inward curvature at its edge, which is not quite regular—from the occurrence of minute projecting cells. The disc does not always occupy the centre of the yolk under examination. Occasionally a group of large oleaginous globules lies under the developing disc—not at the uppermost pole of the egg.

On the 24th, the embryo was outlined—with the optic enlargements (Pl. VI. fig. 6). The blastopore in some was almost closed (Pl. VI. fig. 7), and Kupffer's vesicle was represented by a few granules or minute vesicles. The notochord formed a pale streak extending forward to the middle of the trunk, and the margins of the body were faintly indicated.

Next day the blastopore had closed, and Kupffer's vesicle was large (Pl. VI. fig. 8). Numerous muscle-plates had formed, and the notochord could be traced forwards almost to the head. On each side a delicate cellular border stretched backward outside the muscle-plates. The granules had now disappeared from the surface of the yolk.

On the 26th March, the embryo resembled Mr Holt's fig. 58, Pl. VII.,* and traces of blackish pigment appeared along the body,—best seen by placing white paper beneath the specimens. Besides, there are in some the pale precursors of the pigment-specks, which appear blackish by transmitted light. The notochord was visible throughout, the lenses in some were faintly indicated, and the otocysts appeared as elongated thickenings with a longitudinal slit, as in the green cod.† The heart was also distinct. The zona was thin, and readily ruptured even when the egg was carefully lifted.

The following day the blackish pigment formed dark bands, especially when viewed on a white surface, and the next day a faint yellowish tint was visible under a lens. The tail formed a blunt knob projecting beyond the yolk.

* On the Eggs, larval and post-larval stages, of Teleosteans. *Trans. Roy. Soc. Dub.*, v.

† *Twelfth Annual Report Fishery Board for Scotland.* Pt. iii. p. 219, Pl. ii. fig. 8.

The yellowish hue was more distinct on the 30th March. On the head it was somewhat diffused, as the chromatophores had given off branches. The rows of rounded specks along the sides were only faintly tinted (Pl. VI. fig. 9). Both yellow and black pigments were present. The latter (black) were very finely ramose on the dorsum of the snout and on the head, as well as behind the otocysts. Distinct muscular twitchings of the body occurred to-day.

On the 1st April, the embryo more than stretched across the egg (Pl. VI. fig. 10); but in most the pigment-corpuscles remained simple. The heart was minutely papillose internally and trumpet-shaped. Slow contractions occurred at intervals. Most of the yolk was absorbed, and the alimentary canal formed a pale band in front. The otocysts sometimes differed in size. The day after, most of the yellow chromatophores in some were ramified, so that the colour was diffuse, but in others the pigment-specks remained circular. A few small black points were mingled amongst the yellow along the sides of the body. At this stage the yolk was quite free from pigment.

A few were hatched on 3rd April, and many next day. It is possible that the conditions as regards still water and low temperature may have considerably delayed hatching. A specimen removed from the capsule on the latter date (4th April, Pl. VI. fig. 11) differs in some respects from that figured by Mr Holt, viz., a larva about half a day old, since the pigment is not definitely marked in his sketch. Moreover, the former presented no embryonic rays in the caudal; indeed, these did not appear for some time. Mr Holt's specimens therefore were probably more advanced at the period of hatching. No mouth is visible, and the esophagus ends blindly in front. With the exception of those on the head, the yellow chromatophores are still rounded, though, as a rule, the pigment is branched at or shortly after hatching. In a lateral view, the yellow chromatophores are grouped chiefly at the dorsal and ventral margins of the muscle-plates, and on the rectum; the tip of the tail is devoid of them. Besides the yellow, very finely ramose black pigment-corpuscles occur on the head, and amongst the yellow along the body, but it is not easily seen after the yellow chromatophores become stellate, and in some specimens it is late in appearing. The upper part of the head is chiefly occupied by black pigment. A change must thus ensue before the pigment is grouped into bars, for it is somewhat general at this stage. The lumen of the gut has not entered the oblique portion of the rectum, and the pre-anal region of the marginal fin is small at this stage. A more advanced condition of the pigment is shown in a specimen (also removed from the capsule) on the 5th April. Both yellow and black chromatophores are finely branched (Pl. VII. fig. 1). The variability in regard to the development of the pigment is further shown in the sketch of an example three days later, viz., 8th April, in which the pigment has now been grouped in bars,—that is to say, at certain parts the extension of the chromatophores is more pronounced than at others (Pl. VII. fig. 2). Thus the head and the region of the body-proper have yellowish and black pigment, the latter along the dorsal and ventral edges of the muscle-plates, with a special area at the rectum, and three bars behind the latter, that near the tip of the tail being mostly black, though a few yellow chromatophores are present. The eyes also have pigment-specks; the caudal shows embryonic rays. The yolk has considerably diminished. The otocysts are still elongated from before backward, but present a double outline from the differentiation of the capsule.

The larvæ daily increased in activity and size, and the five groups of chromatophores became very distinct, viz., one on the body over the middle of the yolk, another at the rectum, two conspicuous bars behind the latter,—often broken up into a dorsal and a ventral band—and a small fifth near the tip of the tail. In the more advanced and more active larvæ, with the yolk much diminished, the pigment is more continuous. Those with a large amount of yolk swim with a wriggling movement. By reflected light, the colour of these larval forms is greenish-yellow, and thus it differs from the chrome-yellow of the younger stage. This change of hue appears to be due to the development of the black pigment amongst the yellow. The increase in the size of the pectorals in a few days became marked, and though usually carried more or less obliquely they were fan-shaped when viewed from above (Pl. VII. fig. 3).

The chief changes till the 20th April were the deepening of the marginal fin both dorsally and ventrally, and the extension of the chromatophores —both yellow and black—from the line of the body into the marginal fin at the two conspicuous bars behind the vent, and the appearance of stellate black pigment-corpuscles along the ventral edge of the fin. Stellate black corpuscles also occur on the abdomen, and the eyes are bright silvery. The yellow pigment still forms a line over the medulla and the first part of the cord. The caudal pigment-bar is chiefly of black corpuscles, only two or three yellow being present. The pectoral fins are larger and have rays; the upward slant of the mandible and the reduction of the yolk to a small round ball complete the features at this stage.

2. On the Eggs and Larval Form of the Turbot, with Remarks on the Gravid Forms at Dunbar.

In several of the communications on this subject, an element of uncertainty was present—since the eggs or larvæ had been captured in the free-swimming condition, and so little was known of the ripe eggs and the larvæ that the identification in most cases was open to question. It is true the ripe eggs were removed from the female turbot by myself in 1884, and by Mr Holt in 1892, but in neither case could a ripe male be obtained. Recently, Dr Canu, who is carrying out similar investigations for the French Government at the marine station at Boulogne-Sur-Mer, was able to fertilise the eggs and give a brief note of the development. The perseverance of Dr Fulton, and the practical skill of Mr Dannevig at the Dunbar Hatchery of the Board have at length made it possible to give a definite account of the development of this species in Britain.

After the operations connected with the spawning of the plaice were concluded last year, the turbot was one of the species next taken in hand, for its period of reproduction is considerably later, and therefore fitted in very well with the earlier plaice. Though fine examples of both sexes were obtained, spawning did not occur. The turbot were first kept in the closed creek, and then removed to the spawning pond, which, when soles arrived, was divided by a canvas partition into two compartments. Subsequently they had the entire space. The reason why the ripe turbot did not spawn, under conditions of food and environment that were deemed to be most favourable, and which had succeeded in the case of the plaice, merit careful consideration. Injury during capture in some cases may have weakened the gravid fishes, but not in all, and the plaice did not seem to be seriously affected by this cause. They suffered at first: not after they were accustomed to confinement. In examining the turbot in the spawning pond in September, a considerable number had patches of superficial ulceration on the white (right) side, chiefly on the opercular region and the tail. A single patch occurred on the former—varying in size from $\frac{3}{4}$ to $1\frac{1}{8}$ inches in length and $\frac{3}{4}$ inches broad at its widest part, and one on each side of the tail of smaller size. These were the points where friction with the wood on the bottom of the spawning pond had evidently occurred—probably in the preliminary movements during progression; and the fact that spaces of about $\frac{3}{4}$ of an inch existed between the planks, thus presenting sharp angles, may have increased the liability to injury. While the plaice did not suffer in this way, the heavier turbot after a time did. These patches of ulceration, which readily healed when the fishes were removed to the enclosed creek, however, cannot be held to be the sole cause of the arrest of spawning. Round and flat fishes labouring under grave tumours and other affections, just as in the higher forms of animals, spawn freely, and extensive distortion of the spine in the cod and other fishes, also as in the higher forms, is no bar to complete fecundity. Ripe flat fishes in confinement are prone to a disease, which may in common language be termed "egg-bound,"—that is to say, though they have pure sea-water, a certain space, the presence of males and abundant food, yet they refuse to shed their eggs. This condition, indeed, was specially referred to in the case of the flounder at St Andrews Marine Laboratory, in the Third Annual Report of the Board.* Though the ovaries are enormously distended with ripe eggs, or eggs that have been ripe, occlusion of the ducts by spasm or otherwise prevents their issue, and in some instances leads to the death of the adult. In the ovaries of the female turbot at Dunbar, degeneration had already taken place to a considerable extent on the 7th September. In the centre of the enlarged ovary was a large space filled with glairy mucus, containing degenerating ova, which had formerly been ripe. The mucus was mixed with fatty dèbris and granules with shrunken egg-capsules. The fishes were evidently getting rid of the eggs of the season, chiefly by disintegration, while in the walls of the ovary a crop of minute eggs were developing in a healthy condition. The turbot sheds a considerable quantity of ripe eggs at a given time, as, for instance, when landed on the deck of a ship, but in the ripe turbot confined at Dunbar, it required gentle, though steady, pressure, continued for some time, before the stream of ripe eggs issued, and thus they are in contrast with many flat fishes. Muscular spasm was evidently the cause of the retention of the ripe eggs. Some might be inclined to urge that it is useless to experiment with such fishes as the turbot and the sole, which spawn in deep water, and which require this great pressure (of water) to aid them in discharging their eggs. They would argue also that such fishes have a slow rate of spawning, and that there is no great pressure of ripe eggs in the ovary. Unfortunately, pressure, even to rupture, in the ovaries of such as the flounder, on the one hand, will not force the eggs outward, and on the other, the deep-water theory is effectually disposed of by the fact that the soles spawn in the tanks of the Plymouth Laboratory.

As already mentioned, the turbot recovered from the ulcers when they were removed to the enclosed creek having sand on the bottom, and, moreover, they lived there throughout the severe winter till April, thus showing remarkable vitality under the circumstances, especially when it is remembered that the creek was at this time somewhat overcrowded.

The following was the condition of the ovaries of five examples taken at random in the beginning of April.

1. Length of adult, $27\frac{1}{4}$ inches. The interior of each ovary formed a chamber, the rugose walls of which were covered with degenerating eggs—wrinkled, collapsed, and opaque—the contents in each egg consisting of minute granules of yolk and various oil-globules, which, by transmitted light, had a slightly yellowish colour. In most, the capsule had ruptured and permitted the contents to escape. The wall of each ovary consisted of rugose laminæ, chiefly longitudinal, in the elongated posterior region,

* 1885, p. 62.

or slightly oblique anteriorly, where trending to the oviduct. These laminæ were covered with developing ova, which were considerably larger than the ova found on the 7th September 1894. The largest ranged from ·2286 to ·3810 mm., whereas these of September barely reached ·0762 mm. It is clear, therefore, that the environment of the turbot had been favourable for the development of the eggs, and that, initial difficulties being overcome, it will yet be possible to retain the spawners from season to season. This is the method, I think, to get over the egg-bound condition, which is voluntary, and would disappear when the fish felt itself to be in favourable surroundings and accustomed to confinement. The anterior region of the ovary appeared to be somewhat thicker than the posterior, and the ova slightly larger, but this may have been accidental. The oviduct was occupied by a mass of the degenerating eggs.

In an example 26 inches in length, the rugose laminæ of the ovary presented no degenerating eggs on their surface. The developing eggs were somewhat smaller than in the previous example, viz., about ·2286 mm. In a third, 25¼ inches long, a few degenerating eggs were found in the interstices of the ovarian folds, though they were not seen on the surface; none of the eggs exceeded ·1524 mm. In a fourth, measuring 25½ inches, small masses of collapsed eggs lay on the surface of the ovarian folds. The developing eggs in the wall of the ovary of this and the fifth and sixth specimens had the same size as last, viz., ·1524 mm. The fifth turbot measured 23 inches, and the ovarian walls were somewhat thin, and the rugose folds little developed. Small masses of degenerating eggs existed here and there in pockets. In the sixth, which reached 21¼ inches, no broken-down eggs occurred. In all, the remnants of the previous season's eggs were being slowly got rid of, and apparently without serious interference with the condition of the adults.

Adults were again collected this year, and placed in the creek, but though some unfertilised eggs were found in the water, no general spawning has yet taken place voluntarily. Accordingly, it has been necessary to remove the ripe eggs from the females, and the milt from the males, and fertilise, a process which Mr Harold Dannevig has very successfully carried out. The sketch of the development which follows is taken from eggs thus manipulated, and already—that is, before the beginning of July—600,000 active larval turbot have been placed in the sea.

The ripe egg of the turbot (Plate VIII. Fig. 1) has an average diameter of 1·0287 mm.; the oil-globule measures 0·21 mm., and thus is slightly less than the egg described in last Report,* which so nearly approaches it in size. On extrusion, the healthy eggs are perfectly buoyant—floating at the surface of still water, or suspended midway, as, indeed, was observed in 1884. In some instances at Dunbar, however, many of the eggs went to the bottom, probably because changes had occurred by long retention in the ovary. The capsule is very distinctly wrinkled—both in the fertilised and the unfertilised egg—quite as much as in the lemon-dab. The oil-globule presents no special tint, and retains a nearly uniform diameter in all the specimens, as Mr Holt has already noticed. Like other forms, these eggs are sensitive in the early stages, and with difficulty bear a journey, especially in warm weather, and it would be well in such cases to delay until the blastopore has closed. Those fertilised at 6 A.M. on the 22nd June were in the multicelled condition at 6 P.M. (Plate VIII. Figs. 2 and 4), but the disc showed certain peculiarities, the result of the journey in glass † vessels. Many of the marginal spheres were much elevated, and the nuclei clearly defined as slightly pinkish bodies by transmitted light (Plate VIII. Fig. 3). Many

* Part III. p. 222 *et seq.*, 1894. † Earthenware jars are better.

free nuclei were in the protoplasmic belt (periblast) around the disc. It seemed as if a somewhat abnormal activity, due to external conditions, had ensued in the eggs thus transported. In some, the outlines of the spheres were invisible in the central area, though the nuclei were sufficiently evident, while those at the margins (fig. 3) presented elevated contours, some being almost isolated from the disc. By-and-by, the nuclei became less distinct. That the condition of the disc was somewhat abnormal was shown by the death of the entire series before next morning.

Another series, fertilised on 21st June at 5 P.M., and which bore the journey and the heat more satisfactorily, presented at the twenty-fourth hour, viz., about 5 P.M. on the 22nd, the germinal area and embryonic shield (Plate VIII. fig. 5). As the embryo became outlined next day (23rd), a tendency to the formation of numerous large vesicles (at the ordinary site of Kupffer's, and extending in groups forward along the body) was a conspicuous feature (Plate VIII. figs. 6 and 7). How far this was due to the vicissitudes which the eggs had encountered is an open question, but it was pronounced. On the 24th June, the embryo was distinctly outlined with optic vesicles, lenses, cardiac thickening, and other features; and the large vesicles found at the time of Kupffer's vesicle were fewer; in some, two in front and a smaller vesicle posteriorly (Kupffer's). Moreover, a series of chromatophores is thickly dotted along the trunk, and a few over the brain, but no colour is yet visible under a lens, though the embryo is indicated by a distinct opacity.

On the 25th June, the eggs presented a slightly reddish hue under a lens. It was also interesting to note that the diameter of some of the eggs had increased in the direction of the long axis of the embryo, so that they were ovoid (Plate VIII. fig. 8). The head and body were studded with rounded, reddish (ruby-red by transmitted light) chromatophores, several, however, being feebly tinted. Some extended here and there over the yolk, while others faintly tinted or quite pale were present. The oil-globule had a few black chromatophores in its protoplasmic investment. The otocysts were well formed, the lenses distinct, and the heart pulsated feebly at intervals. The tail had extended considerably beyond the yolk, yet one or two vesicles occurred on the site of Kupffer's. The yolk had a streaky granular aspect, probably from the development of the minute vesicles on its surface. The notochord was multicellular.

Next day (26th), the pigment-corpuscles presented a deeper ruby-red, and black chromatophores had also appeared (Plate VIII. fig. 9). The pectoral expansions were distinct, the vesicles have disappeared from the ventral aspect of the trunk of the embryo, while the tail is longer and has a few black corpuscles near the tip. The black pigment at the oil-globule has increased. The heart beats more regularly. The yolk has considerably diminished—with thread-like bands projecting here and there from its margin. Only a few red chromatophores exist in the minute vesicular yolk-sac, and one or two stellate black corpuscles. The latter seem to form a band along the body-lines superiorly and inferiorly.

On the 27th June, the embryo under a lens appeared to be of a brick-red colour from the branching of the chromatophores, and ramified black pigment is also present, especially posteriorly, where it has much increased. The eyes are somewhat darker. The yolk has still further diminished.

Most of the eggs hatched about the 6th–7th day, the larval turbot between the 1st and 2nd day having the aspect shown in Pl. VIII. fig. 11. The increase in the red pigment is characteristic, the body under a lens having a brick-red hue with black chromatophores scattered over the surface. The rounded, reddish chromatophores of the embryo had now largely increased their branches, on the head, trunk, two caudal bars, and the rectal process, and some had appeared around the oil-globule and at the throat and cardiac region. The two brownish bars (dorsal and ventral) at the tail had a somewhat triangular or bluntly conical form, and extended from the trunk nearly to the border of the marginal fin. A slight patch also occurred in the dorsal marginal fin about midway between the caudal bar and the head. The reddish pigment at the rectum passed downward to the termination of the gut, and abruptly ceased, a pale strand of tissue being continued from it to the edge of the marginal fin. The heart lies somewhat low in the sub-opercular region, which is deeply pigmented. The finely ramified black chromatophores covered the entire region tinted reddish, so that only the middle of the yolk was translucent, and even on this were a few finely branched red corpuscles. The ventral surface of the yolk, as well as the other parts, had numerous black chromatophores. By transmitted light the coloured parts had a fine ruby-red hue. The eyes had a similar brownish hue—a few dark touches, as in the figure, also being present. The otocysts and their two otoliths were difficult to observe, from the abundance of pigment. Even at this stage the larval fishes darted about at intervals, resting on the bottom, or floating with the yolk-sac uppermost and the tail inferior.

After two days, the changes in the larval turbot were—the increase of pigment in the eyes, which were now slightly iridescent. The black chromatophores over the body were more abundant. The bars behind the vent were broader, especially the superior, which almost touched the margin of the fin. The mouth was open, and the mandible protruded (Pl. VIII. fig. 12). The oil-globule adhered to the remnant of the yolk nearly in the middle of the abdomen. Since the 29th June, the oil-globule has occupied various positions in different examples, in some having moved upward and backward with the yolk.

On the 1st of July, the larval turbot evinced greater activity—darting through the water at intervals, and again resting on the bottom. The increase in the black pigment renders the body dusky brown. The two posterior brownish bars have spread outward, and finely ramified black pigment exists in both. The mid-dorsal patch now touches the body-line, and also presents a few black chromatophores. The same hue tints the marginal ridge over the head and the front of the snout. The black pigment renders both dorsal and ventral surfaces dark when viewed on edge, two long, blackish bands occurring dorsally—separated by the brownish area in the mid-dorsal line. The skin is finely dotted with minute vesicles. The eyes have a greenish iridescent lustre. The marginal fin continues as a prominent border over the vertex to the tip of the snout (Plate VIII. fig. 13). This fin is still proportionally broad, though the body has lengthened to fully 3·46 mm. No fin-rays are yet visible in the caudal expansion. Movements of the mandible and hyoidean apparatus occur occasionally. The pectoral fins have considerably increased in size, and are used in balancing. The clavicular bar is also evident. The oil-globule is difficult to see, but in diminished size it is still present with the remnant of yolk—in some near the lower border of the abdomen. A feature of moment in these larval turbot is their hardihood, for after exposure on a slide in a few drops of water for two hours they survived, and became active when transferred to their vessel.

The yolk was entirely absorbed on the 3rd July—that is, about the 7th day. The marginal fin over the head has increased in depth, and the black and other pigments have ramified outward in all directions at its inner border. The caudal expansion now shows embryonic rays, which, however, are very faint. Blood-vessels with pale blood are now observed at various points, *e.g.*, the sub-intestinal coursing upward in front of the rectum and passing towards the liver, the mandibular, and the sub-notochordal aorta which can be traced backward to the inferior line of pigment behind the posterior brown bars.

The yolk having now disappeared, the turbot may be considered as having attained their early post-larval condition, and they swim throughout the water by rapid strokes of the tail and vibrations of the pectorals. In still water they often remain suspended with the head downward, but there can be little doubt that, like the plaice observed by Mr H. Dannevig, they would luxuriate—with their heads directed to the current—in the fresh streams of water either in the open sea or in the apparatus at Dunbar. The body is dull reddish (more or less ruby-red) by transmitted light, but by reflected light it has a dull ochreous or pale brownish hue (Plate VIII. fig. 14), and finely marked with black. The outer margins of the two dorsal patches are paler, and the pigment immediately behind the prominent posterior bars is also pale, these lighter touches being very conspicuous during the vigorous movements of the animals. The abdomen is deeply pigmented with black all over. The head and anterior region are conspicuous—both from the great depth at the opercular region and the development of pigment on the abdomen, so that the general aspect is tadpole-like. The eyes are greenish-silvery. The pectorals are large and fan-shaped, with reddish and black pigment at the base, the latter extending outward into the fin as long branching lines, which resemble very much the ramifications of rivers in a map. The angles of the mandible project prominently downward—as it were enclosing the anterior hyoidean region in a deep furrow. The vent now gives passage to minutely granular matter.

Besides the movements above noted, the little turbot occasionally swim at the surface on the side—skimming along with rapidity and with active motion of the hyoidean region. They are extremely quick in noticing the movements of the minute crustaceans and other forms in the vessel, and seem to dart at them for the sake of food. No form hitherto observed at St Andrews appeared to be more hardy, or to undergo the vicissitudes of temperature and manipulation with greater impunity. There are grounds, therefore, for expressing the hope that they may yet be reared in great numbers from the post-larval to the adolescent and adult conditions in suitable enclosures.

3. On a Larval Pleuronectid (Dab ?) with a Deep Body.

A larval flounder (Plate VIII., fig. 15), with a peculiarly deep body, a remarkably narrowed tail, a broad pre-anal fin, and an ovoid mass of yolk, with a finely reticulated series of chromatophores over it, was procured in the bottom net, about a mile beyond the pier, on June 29, 1895.

Under a lens the eyes are whitish, and the top of the head, the margin of the body, alimentary canal, and the edges of the marginal fin are all tinted of a dull whitish, most of the slender tail-region being transparent—a single opaque white speck occurring at the end of the notochord, near the tip of the tail. The gut goes backwards for some distance behind the yolk, bends down, and comes to the margin of the fin. The whitish parts by transmitted light show much ramified chromatophores in the various areas. The yolk-sac is finely reticulated with these—ventrally and laterally; and black dots are also present over the same region, the head and the tail. These have not yet ramified. The yolk is slightly granular. The white spot near the tip of the tail is due to the same ramified white chromatophores, and there are also branched black corpuscles at the body line, dorsally and ventrally. The pectoral fins have similar pigment—a feature worthy of note. This larval fish was unusually active for a form with its mouth as yet closed, its eyes devoid of pigment, and the yolk in considerable bulk. It swam near the bottom of the vessel, resting at intervals on its side.

Next day (30th June) the hue of the pigment was distinctly yellowish (lemon-yellow), though the whitish tint was still present along the upper and lower borders of the muscle-plates. The finely ramified yellow and black chromatophores not only occur on the body and yolk-sac, but also on the marginal fin. The mouth is opening (Pl. VIII., fig. 16), and in some hours after the sketch was made a little pigment appeared in the eyes.

No similar form had previously been obtained in the tow nets, for the majority of those with a yolk still bulky and the mouth closed have a comparatively narrow translucent marginal fin of nearly uniform breadth, without the marked caudal narrowing so characteristic of this form. It belongs therefore to a stage apparently undescribed, unless it be an abnormal example. In the larval flounder, the yellowish pigment-grains are characteristic, and the body is slender and elongated; in the dab, the lemon-yellow pigment is grouped in two lines (dorsal and ventral), and this is the form to which the present example most probably belongs. The condition in the plaice, lemon dab, long-rough dab, and other common pleurorectids offers no resemblance. It is true some of the topknots have not been investigated, but in Muller's topknot the eggs have an oil-globule. The larval fish from an unknown egg (*C*) mentioned in the 'Researches' * appears to approach it most closely, but it differs in the absence of the pre-anal portion of the marginal fin, and in the fact that the mouth is open on issuing from the egg, as in the plaice. Moreover, the pigment is from the first brownish-yellow.

4. On the Spawning Period of the Armed Bullhead and the Vitality of its Eggs.

Parnell gives May as the spawning period of this species. Couch says nothing more than that the spawning period is stated to be spring; while Day describes a female, 5 inches long, from Southend, in February, as having its comparatively large eggs nearly ripe. In the 'Researches' † it was stated that the females caught in the sprat-nets in the Tay showed nearly ripe ovarian eggs on the 16th December, and that they had a dull golden colour, while the structure of the zona (capsule) is given. The males at the same time showed well-formed sperms. It is added that the species seems to spawn from January (or perhaps December) to April. In the recently published 'Scandinavian Fishes' the authors observe ‡ that "the males are so rare that neither Kröyer nor Ekström " has met with a full-grown example; nor, during late years, has the " Royal Museum met with a single example. It is probable that it is " only during the spawning season that they live in so shallow water as to " be in any danger from the nets used in shore fishing. The spawning " season is in spring; in March and April, or the beginning of May. We " have no information as to the way in which the roe is deposited, or the " development of the fry." So far as our observations go the males are by no means rare, and they accompany the females into the shallow water, and pass into the estuaries of the Eden and the Tay. The remarks published on the subject have escaped the notice of the authors.

The occurrence of a small mass of ova of this species, on 1st October,

* *Trans. Royal Soc. Edin.*, vol. xxxv. part iii., p. 835, and Pl. xviii. fig. 1.
† *Op. cit.*, p. 674. ‡ p. 210.

1894, considerably extends the spawning-period. It was procured at low water near the pier-rocks at St Andrews, attached to the root of a tangle. The eggs measured from 1·7526 mm. (·0705 inch) to 1·9050 mm. (·075 in.), showing that the ovarian examples, mentioned in the 'Researches,' as indeed had often been observed, were nearly ripe. Each egg at this date (1st October) had a large oil-globule and an advanced embryo. The circulation was in active operation on the 27th November, the exterior of the egg being further coated with many parasites. In January and February 1895, the eggs were frozen, and they remained so nearly a month, yet, on the 2d March, some of the embryos were alive, and, though the water could not be changed, as the pumping apparatus was under repair, were safely hatched. The remarkable hardihood of such eggs is in contrast with the pelagic ova, which, as a rule, would have been killed.

The egg-capsule is very tough, and rebounds from the needle under pressure like a ball of india-rubber. Under a low power the torn edge shows layer upon layer of the secretion. It is thus difficult to extrude a perfect embryo.

The larvæ immediately after hatching closely correspond with that captured in the bay, and figured by Prof. Prince '(Researches,' Pl. XVIII., fig. 11). The body is about 7 mm. long, the tail being somewhat longer than in the sketch, and has embryonic fin-rays. The head has large silvery eyes, with greenish yellow pigment behind them, and around and below the widely-open mouth. The trunk, generally, is dotted over with the same greenish-yellow pigment (ochreous by transmitted light), which is also present in streaks on the basal region of the pectoral fins, on the yolk-sac, and on the prominent anal cone. The three dorsal patches in the marginal fin are distinctly separated, the first being small, and nearly in a line running upward from the posterior border of the vent; the second about the widest part of the fin, and the third about the posterior region of the same dilatation. Opposite the two latter is a corresponding patch ventrally. A similar touch of yellow occurs at the commencement of the tail. Numerous stellate black pigment-spots are present on the yolk-sac, a few on the pectoral, and a series along the dorsal and ventral margins of the body as far as the third patch of yellow on the marginal fin. One or two occur on the border of the marginal fin, and a considerable number in the ventral patch of yellow (second) in the latter, while only a very few are found in the dorsal patch opposite it. Two exist in the ventral touch behind the former and only traces in the dorsal patch opposite. One or two chromatophores also occur ventrally in the patch at the root of the tail. The black pigment would seem to be better developed ventrally than dorsally.

In connection with the appearance of eggs at this period it may be mentioned that on the 10th October a larval form resembling *Cottus* was captured in the tow-net. In general outline it resembled that figured in the 'Researches' (somewhat younger than in fig. 9, Pl. XVI.), with the vessels coursing over the yolk-sac. The oil-globule remained at the anterior part of the yolk-sac. Small specks of black pigment occurred along the sides of the body, one set forming a row near the upper lateral region. No distinct coloration was visible on the pectorals. The eyes were iridescent-greenish, like the inner surface of *Haliotis*.

Hitherto it has been unusual to get larvæ at this season of the year, so that the deposition of such eggs must have been ante-dated by some months on this occasion—if the interpretation of the nature of the larvæ be correct.

5. On the Post-Larval Stage of *Crystallogobius Nilssonii.*

In the Ninth Annual Report of the Board, Part III., p. 332, an unknown elongated post-larval form, with prominent teeth and long pectorals, procured on the 20th July 1889, was described. A further examination of this young fish, which was only 7 mm. long, shows that in all probability it is the post-larval stage of a male of *Crystallogobius nilssonii*, which, at that date, had only once been found in Scotland, viz., by Mr Edward, in a rock-pool at Banff. The very early stage at which the special sexual characters occur in this species is interesting, yet Dr Day considered that in the young males the head is more pointed, indeed, almost as in the females—in which the jaws are short, straight, and toothless. It is clear, however, that such a statement requires amendment, especially the supposition that the teeth ('canines') are only developed as maturity is reached. In the small example from St Andrews, it was the presence of these characteristic teeth and the shape of the mandible that attracted attention, and yet the larval marginal fin was still present. The description given in the Ninth Report may be supplemented by the remark that in the adult male the pectoral fins are remarkable for their "broad (multiradiate) and somewhat lobate form, "with their semi-circular muscular root, and elongated, roundish shape. "When expanded the pectoral fins are as deep as the body." In life they are boldly speckled with black on a yellowish ground, the latter being brightest inferiorly. The remarkable coloration of these fins in the post-larval stage is an addition to the series in developing Teleosteans. When the eyes of a fresh form are examined from above they are finely iridescent and greenish-blue; even when seen laterally they are silvery with a bluish sheen. Since this specimen was captured Mr Cunningham has procured many adults of both sexes near the Eddystone Lighthouse, while Mr Holt has been equally successful off the West Coast of Ireland, and on the East Coast of England. It appears to be generally distributed round British shores, though the adults have not yet been secured here. It is sometimes found in as great abundance in Norway as in the South of England. The authors (Fries, Ekström and Sundevall), of the recently published work on Scandinavian Fishes, observe that June is approximately the spawning season of this species, and the development of the post-larval example would appear to point to May or early June as the probable period on our shores.

6. On a Post-Larval Form resembling a Goby.

In the account of the Pelagic Fauna of the Bay of St Andrews in 1888, a post-larval fish, procured off the Tents' Moor on the 20th February, was figured and described,* but its actual relationship could not then be ascertained. Since that period no less than five examples have been examined, mostly procured from the 18th to the 20th of March each year, one only having been found in the bottom-net off Sarclet, Caithness, on the 14th January. Of the others one was captured in the surface-net off the River Eden, one in the bottom-net at Station IV., Forth, that is, along a line parallel to the shore between Joppa and Gullane Ness, and two in the bottom-net at Station VIII., Forth, east of the Bass. There is thus nothing very diagnostic in regard to environment—except that the majority have not been far from estuaries; while the post-larval season seems to range between January and March, the latter, especially, being characteristic.

This post-larval form is distinguished by its comparatively large size,

* *Seventh Annual Report, Fishery Board for Scotland*, Part III., p. 263, Pl. III., figs. 5, 6, and 7.

viz., from 9 to 11 mm., whereas preparations of *Gobius niger* immediately after hatching measure only about 5 mm., often less. The eyes are large and silvery, abutting on the maxillary margin, and no trace of the choroidal fissure remains. The silvery hue of the eyes is present in the newly-hatched larvæ, in which also the choroidal fissure is indicated. The marginal fin shows no rays until the caudal is reached, the whole of the latter region being furnished with well-developed embryonic rays. Moreover, inferiorly, hypural elements form a thickened region. In the newly-hatched *Gobius niger* only very fine embryonic rays occur in the tail, and they do not proceed so far forward. The notochord is straight in both. The pectoral fins are large and fan-shaped. In one an extension of the marginal fin dorsally occurred in front of the tail, but no rays were present, and the condition may have been accidental. The myotomes along the sides are very distinctly indicated. No swim-bladder is yet visible. A marginal fin also occurs along the ventral edge of the abdomen, and traces of this are visible in the larval black goby. The abdomen is translucent—with a solid opacity (yolk) in front, beneath which lies a small yellowish oil-globule. The vent is prominent and opens about the middle of the body, though in one or two it is in front of the middle line. In this respect it appears to agree with the newly-hatched form above mentioned.

The head is large, the snout short, and the upper arch of the gape, therefore, is high, the elongated mandible having to bend upward at the tip. The dental margin is quite smooth. The opercular region covers branchial arches, which show a papillose or crenate margin in those specimens procured in March. The otocysts are large, and lie close behind the eyes.

The arrangement of the pigment in the examples is as follows:—Over the faintly-yellowish mid-brain are from 5 to 10 isolated black specks, three being median, the others grouped in rows at the sides. Then, after an interval a median-dorsal row commences, two chromatophores broad, and tapers off to one, terminating before the next row is reached. The latter consists of a regular and well-marked series of chromatophores on each side of the dorsal (marginal) fin, and extending to the base of the caudal. A similar arrangement occurs ventrally, for, after a short series in line appears, behind the vent, a row of isolated black chromatophores occurs on each side of the anal (marginal) fin. Black pigment-corpuscles are grouped along the roof of the abdomen in the usual position, and extend to the vent. A streak of similar pigment also runs on the ventral surface from the cardiac region backward in the middle line. In the newly-hatched black goby black pigment-corpuscles are scattered over the ventral surface of the yolk-sac, and a marked belt occurs at the region of the anal fin in front of the caudal.

In the post-larval examples, probably of the freckled goby (*Gobius minutus*), about 3 mm. in length—the black pigment is chiefly grouped along the ventral surface—from the hyoidean region to the tail. A row also occurs along the roof of the abdomen, and a large black chromatophore at the angle of the mandible on each side. At this stage the chromatophores form a double row in the posterior half of the abdomen to the vent—after which they occur as a single row of widely-radiating corpuscles, then at a spot in front of the caudal pass up on the sides of the body to meet the golden-yellow area on the dorsum. A few of the same yellow corpuscles appear also toward the ventral border, and near the vent. The air-bladder is conspicuous, and the eyes are greenish-silvery.

An interesting account of a form considered by Mr Holt to be a post-larval black goby from the West Coast of Ireland was given in 1891,*

* *Trans. Roy. Soc. Dub.*, iv. (ser. ii.), p. 441, Pl. 47, fig. 12.

but it offers certain points of difference with our examples, which were only a little less. Thus permanent fin-rays occur in the second dorsal, and the number of embryonic rays in the tail is much less. The snout is more produced, the notochord slightly bent up, and an air-sac is present. The black pigment, moreover, is much more general, and there are four reddish-brown bands. Certain of these features are in agreement with the post-larval form above described, yet others, such as the arrangement of the pigment on the head, the more extensive development of embryonic rays on the tail, and the absence of an air-bladder diverge. Some of these, it is true, may be modified by growth, and there are not many species of gobioids with which to confound the example. It is much too large for a similar stage of *Gobius minutus* and *G. flavescens*, while *G. niger* has never been procured at St Andrews, though it has been found in the Forth. Its size would appear to correspond more with this than the two previous species, though it approaches in this respect also the female *Crystallogobius nilssonii*, yet it is somewhat larger than that form at the same stage. But it has to be remembered that the season at which this post-larval form appears is quite different from that in which such gobioid forms are found, viz., in June and July.

7. On a Peculiarly Coloured Plaice.

A plaice—measuring 10 inches in length and 5⅝ inches at its broadest part—caught by hook in St Andrews Bay on the 20th April, presented the following pecularities in colour. The right side (coloured) was dotted all over with black specks and touches, viz., a broad belt of these from the head to the base of the tail in the median line; then, after a paler belt on the tail, the specks continue to the tip. The dorsal and anal fins were much speckled, even to the tips, and a few specks occurred here and there in the pale regions on the sides of the median broad belt. Small red touches (less than usual), are uniformly scattered over the right side. The white (left) side was speckled throughout with black, the granular pigment being grouped in little masses, forming here and there larger rosettes. The black specks invaded the fins—caudal, dorsal, and anal; while the white pigment was likewise curiously mottled.

DESCRIPTION OF PLATES.*

PLATE VI.

Fig. 1. Egg of long-rough dab immediately after its escape from the ovary, and before impregnation, 21st March 1895. × about 31.

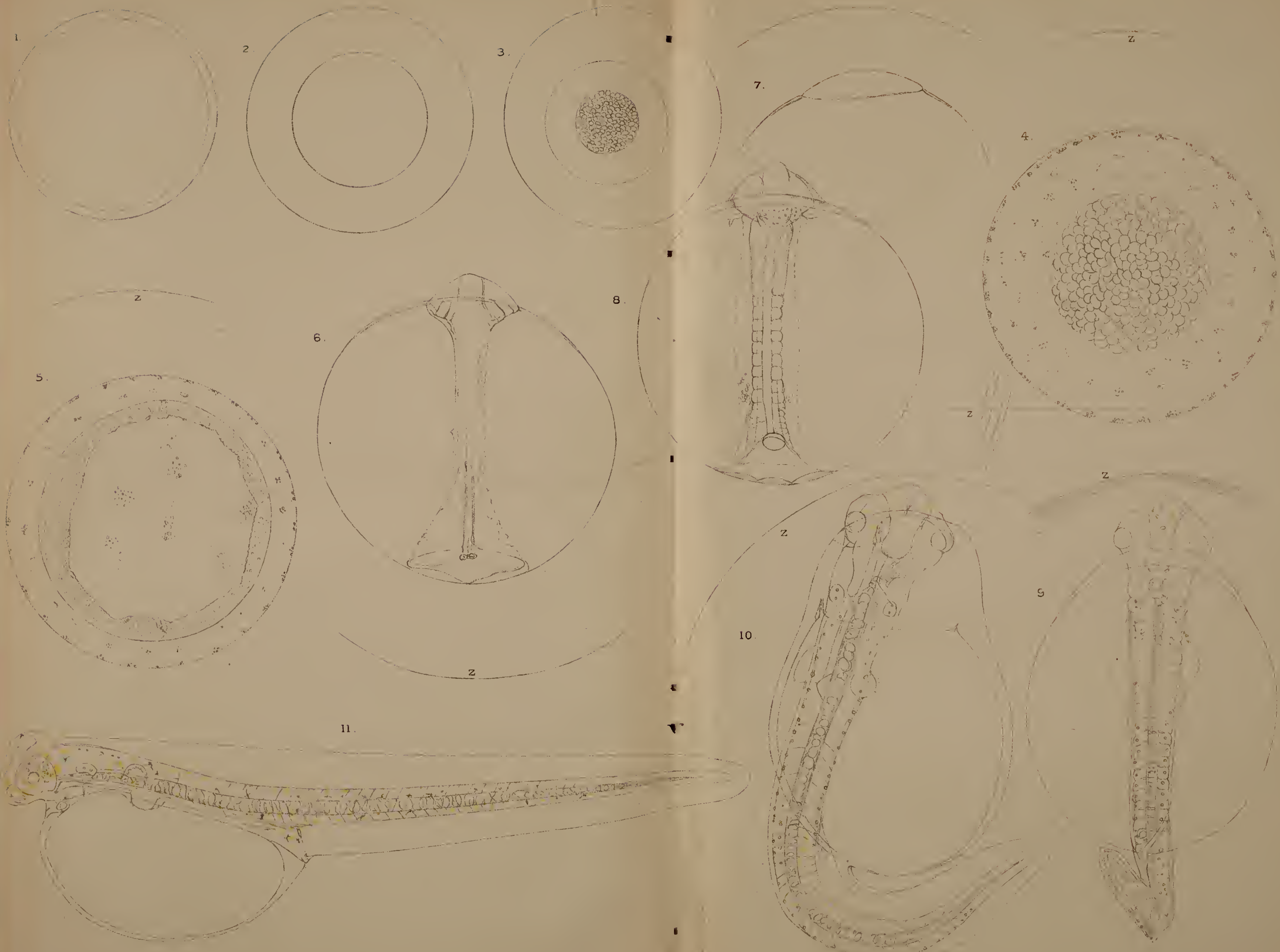
Fig. 2. The same egg, next morning (22nd March), showing the enlarged perivitelline space. × about 18.

Fig. 3. Fertilized egg of the same species (fertilized at 5·20 P.M. on the 21st) at 12.20 P.M. on the 22nd March. × about 18.

Fig. 4. A similar egg at the same hour, showing minute oil-globules scattered over the yolk. A portion of the capsule (zona) is indicated at z. × 52.

Fig. 5. An egg one day older, showing the early blastoderm. The groups of minute oil-globules are still numerous. × 52.

* I am much indebted to Mr A. T. Masterman and Mr H. C. Williamson for their kind aid with the figures indicated.



W. C. M. del.

F. Huth, Lith^r Edin^r

LONG ROUGH DAB.

Fig. 6. Egg of long-rough dab on the third day (24th March), at 8 P.M. The embryo is now outlined, and traces of Kupffer's vesicle have appeared, though the blastopore has not yet closed. × 52.

Fig. 7. A portion of an egg of the same age (viz., at 8 P.M. on the 24th), showing an open blastopore. × 52.

Fig. 8. Blastopore now closed, and Kupffer's vesicle and muscle-plates distinct, 25th March. × 52. The zona is indicated at z, and the fine creases are still present.

Fig. 9. Embryo now presents yellowish pigment, and the tail is free from the yolk, 30th March. × 52.

Fig. 10. Embryo of the 1st April, with the pigment still unbranched, both yellow and black chromatophores being present. × 52.

Fig. 11. Larva removed from the egg on 4th April. The pigment has only branched on the head, and the esophagus and rectum are solid. × 33.

PLATE VII.

Fig. 1. Larval long-rough dab removed from the egg-capsule, 5th April, and showing a more advanced condition of the pigment than in fig. 11 of the previous plate. × about 33.

Fig. 2. Larval specimen three days older, viz., on the 8th April, and in which the pigment has now been grouped in bars. × about 33.

Fig. 3. Older larval form in which most of the yolk has been absorbed, and the pigment boldly arranged in bars. The pectorals are fan-shaped ; 10th April. × about 23.

Fig. 4. Dissection to show the caudal portions of the ovaries in *Anguilla vulgaris.* RO, right ovary ; LO, left ovary ; Rpr, *Pars recurrens* of right ovary ; Lpr, *Pars recurrens* of left ovary ; Rt, Rectum ; K, left kidney ; *frv, fissura recto vesicalis ;* Bl, urinary bladder ; a, Anus ; u, opening of urethra. (See p. 193.)

Fig. 5. Section of tumour from the stomach of saithe. Somewhat reduced.

PLATE VIII.

Fig. 1. Unfertilized egg of the turbot, immediately after extrusion, July 2nd, 1895. × 33.

Fig. 2. Egg of turbot, June 22nd, 1895, 6 p.m., in the multicelled condition, × 33.

Fig. 3. Egg of turbot, June 22nd, 1895. Nuclei seen in the blastodisc, which in this instance is peculiar, the egg having been subjected to a long journey on a hot day. × 33.

Fig. 4. Egg of turbot, 27th July, 1895, 8 p.m. (fertilized at 1.30 p.m. same day) ; blastodisc shown. × 40.

Fig. 5. Egg of turbot, 22nd June, 1895, 5 p.m. Fertilized June 21st, 5 p.m. The germinal cavity and margin of the shield are seen. × 33.

Fig. 6. Egg of turbot, 24th June, 1895, fertilized 5 p.m. June 21st. Peculiar vesicles are present in the caudal region of embryo. × 33.

Fig. 7. Egg of turbot, 23rd June, 1895, 4 p.m. Numerous vesicles are shown in the caudal region. × 52.

Fig. 8. Egg of turbot, 25th June, 1895. Red pigment-spots have appeared on the body of the embryo. × 52.

Fig. 9. Egg of turbot, ventral surface, 25th June, 1895. The red pigment-spots are larger. A few black pigment-corpuscles are seen in the yolk and in the caudal region of embryo. × 52.

Fig. 10. Egg of turbot, from ventral surface, 27th June, 1895. The red and black pigment corpuscles are now stellate. The tail overlaps the eye on the right, and is bent up. × 52.

Fig. 11. Embryo of turbot, 28th June, 1895, 8 p.m. The quantity of red pigment has increased very much. × 33.

Fig. 12. Head-region of embryo of turbot, about two days after the foregoing. The mouth is open. The yolk has decreased in amount. × 52.

Fig. 13. Embryo of turbot, 1st July, 1895. Later stage of the above ; oil globule indistinct. Pigment above the head. Eye greenish. × abt. 33.

Fig. 14. Larval turbot, hatched on 26th June, with yolk now absorbed and viewed by reflected light, on the 8th day, viz., 4th July, 1895. × 21.

Fig. 15. Pleuronectid larva (Dab ?), with deep body and pale pigment, June 29th, 1895. × abt. 50.

Fig. 16. Same larva, June 30th, 1895, 4 p.m. The whitish pigment still occurs along the dorsal and the ventral edges of muscle-plates. × 52.

V.—NOTE ON A TUMOUR FOUND ATTACHED TO THE STOMACH OF A SAITHE. By George Lawrence, Student of Medicine, University of Edinburgh. (Plate VII., fig. 5.)

The tumour, which was found attached to the stomach of a saithe caught on February 28th, 1895, was forwarded to St Andrews Laboratory by Mr P. Wilson, Fishery Officer, Girvan.

Naked eye appearance of tumour.—The tumour is well defined, somewhat spherical in shape, with a degree of flattening at the poles. It measures $1\frac{3}{16}$ inches in diameter, and weighs 2 oz. 6 drs. Its consistence might be described as putty-like, its shape being easily altered by compression. There is, however, some slight elasticity present marked by the tendency to return to its original shape. On section, it is seen to be composed of concentric laminæ, which can be readily separated from one another (Plate VII., fig. 5). The outermost layer is by far the thickest. The laminæ are arranged around a more compact centre of similar structure, the layers of which are not so readily separated.

Microscopic appearance.—A portion of the external layer was sectioned, micro-carmine being used for staining. The external part of the section was seen to be composed of dense wavy bundles of fibrous tissue, with flattened nuclei here and there interspersed. Amongst this fibrous tissue spaces, more or less elliptical in shape, were to be made out. These spaces were entirely filled with small round nucleated cells, evidently epithelioid in nature. The nuclei in certain of the spaces were very prominent; in others they were very indistinct. The internal portion of the section is also fibrous in nature, but of much looser structure, showing somewhat alveolar arrangement. A portion of the core or centre of the tumour was also sectioned. Its structure was fibroid also, and of a loose alveolar nature, similar to that observed in the internal part of the section of the external portion. In the sections of the core, blood-vessels were made out, and traces of hæmorrhage were visible here and there.

VI.—THE INVERTEBRATE FAUNA OF THE INLAND WATERS OF SCOTLAND.—PART V. By Thomas Scott, F.L.S. (Plates IX., X.)

During the past year a considerable number of the fresh water lochs of Scotland have been visited and examined. They include all, or nearly all, the lochs on the Island of Barra (Outer Hebrides); three of the principal Lochs of North Uist; three Lochs in Perthshire; one near East Tarbert, Argyllshire; and three in the vicinity of Glasgow. Not a few of them contain trout, and are more or less frequented by anglers. The following are the names of the various lochs referred to, and which are described in this report:—

Group I. Lochs in the Outer Hebrides	Sinclair's Loch or Loch Mór	1*st.* Lochs on the Island of Barra, Outer Hebrides.
	Loch na Doirlinn	
	Small Loch near Loch na Doirlinn	
	Loch Benloden	
	Loch Cadha Mór	
	Pools on the top of Ben Heaval	
	Loch an Ail	
	Loch Scotagary	
	Lochan nam Faoileann, North	
	Lochan nam Faoileann, South	
	Loch an Duin	
	Loch na Nighinn Ruaidhe	
	Loch Scadowa	2*nd.* Lochs on the Island of North Uist, Outer Hebrides.
	Loch Skealtar	
	Loch Fada	
Group II. Lochs on the Mainland	Loch na Kenna, or the Lilly Loch	1*st.* Loch near E. Tarbert, Argyllshire.
	Lochan a Chaite	2*nd.* Lochs in Perthshire.
	Lochan Lairig Eala	
	Loch Lubnaig	
	Possil Marsh	3*rd.* Lochs in the vicinity of Glasgow.
	Bardowie Loch	
	St German's Loch	

In describing the results of the examination of these lochs, I propose to take them in the order in which they are here arranged. It is not intended to describe in detail the various organisms obtained in each loch. A summary only of them will be given, along with notes on a few of the more interesting species; and at the end of the description of each group of lochs a Table will be added containing the names of all the species identified, and showing their distribution in the various lochs described.

Group I.—LOCHS IN THE OUTER HEBRIDES.

1*st.*—The Lochs on the Island of Barra, Outer Hebrides.

Preliminary Note.

Last year, during the Herring Fishing season, I was requested by the Fishery Board for Scotland to proceed to the Island of Barra to make some inquiries concerning the mackerel, that are known to frequent the shores of the Outer Hebrides. Unfortunately, owing to the unfavourable state of the weather at the time, little could be done toward acquiring the information desired. Rather than that the time should be altogether wasted, it was decided to take advantage of the opportunity to make an examination of the fresh water lochs of Barra. A day was also devoted to the examination of three of the principal fresh water lochs of North Uist. Mr Robert Duthie, Fishery Officer, who also proceeded to Barra to assist in the same inquiry, rendered me very effective help in the examination of the lochs. I have also to acknowledge my indebtedness to Mr Donaldson, the Fishery Officer stationed at Barra. He endeavoured in every way he could, consistent with his official duties, to make our examination of the lochs successful.

When any of the lochs were to be visited, our outfit usually consisted of a hand-net, a tow-net, several bottles, and 60 to 100 fathoms of strong but light cord,—for the lochs were examined both by hand-net and tow-net. As we did not have the use of a boat for working the tow-net on any of the lochs visited, it was our custom to select for work those parts of the loch where the outline of the shore was more or less angular. One of us would then take hold of the tow-net, to which one end of the cord had been attached; while the other would, with the cord in his hand, work round the shore as far as the length of the cord would admit of. In this way a considerable space of water, more or less free from obstruction, would be obtained through which the tow-net could be dragged. On a signal being given, the one holding the net would let it go, while the other pulled it through the water: the net had to be pulled quickly, especially in shallow water, else it would sink and get filled with mud, or perhaps catch on stones at the bottom.

Many good gatherings were obtained in this way, and as a consequence the examination of the lochs of Barra was fairly successful.

Several of the Barra lochs contain trout, and are frequently fished during the summer months, but they are usually fished from the shore.

Sinclair's Loch (or Loch Mór), Loch na Doirlinn, and Small Loch near Loch na Doirlinn.

Near the hamlet of Tangusdale, and at the foot of the cliffs that form the northern boundary of the mass of high rocky ground known as Ben Tangaval, are situated the three small lochs mentioned above, the eastmost of which, in dry weather, is little better than a morass. They are all within a short distance of the sea, and not much above sea-level. It is asserted that sometimes during high water of spring tides the sea flows into Loch Mór, especially if there happens to be a fresh on-shore wind at the time. At the date when these lochs were examined, however, the water was quite pleasant to the taste and no trace of brackishness could be observed in it, so that evidently there had been no inflow of the sea for a considerable period previous to our visit. At a short distance from the east end of Loch Mór,—which is the eastmost and largest of the three,—is a small island containing the remains of a square keep or stronghold of some kind, a considerable part of the walls of which still exist.* The water around the island is of considerable depth, and, so far as could be ascertained, this appears to be the deepest part of the loch. The bottom at this part consists of fine mud, and large eels are said to be sometimes obtained here. During the summer months beds of aquatic plants—*Littorella*, Pondweeds, Rushes, &c.—occupy the shallower parts near the west end of the loch. A short distance northwestward of Loch

* This ruin is known by the name of *Dun Mhic Leoid*.

Mór is Loch na Doirlinn, which is considerably smaller and shallower than the other; while still farther to the west is the third loch. The overflow water from this loch drains into Loch na Doirlinn, but Loch na Doirlinn and Loch Mór have separate effluents, which unite before reaching the sea. Though, as already stated, we found the water of these lochs quite fresh to the taste, yet in the two larger ones, swarms of *Mysis vulgaris* were observed swimming about over the shallow sandy bottom and quite close to the shore, and numbers of them were caught by the hand-net. The *Gammarus* observed in these lochs, and in other lochs in Barra and North Uist, appear all to belong to the form described in Prof. G. O. Sars' *Crustacea of Norway* as *Gammarus duabeni*, Lilljeborg; the inner ramus of the last pair of uropoda is considerably shorter than the outer ramus, and the telson, uropods, and dorsal surface of urosome have a dense covering of strong hairs. Among the Copepoda observed in these lochs is a *Canthocamptus* apparently new to science—it is described and figured at the end of this report. The same species of *Canthocamptus* was subsequently obtained in a number of other localities in Barra, in North Uist, and in Shetland, and also near the head of Loch Tarbert. In these lochs there was also a greater variety of Ostracoda than was observed anywhere else in Barra or North Uist, and included among them was the somewhat rare *Darwinula Stevensoni*.

The total numbers of species of Mollusca and Crustacea obtained and identified in the gatherings from the three lochs just described are as follow:—Loch Mór,—six species of Mollusca, one of Schizopoda, one of Amphipoda, seven of Copepoda, nine of Ostracoda, and only one species of Cladocera. Loch na Doirlinn,—three species of Mollusca, one of Schizopoda, one of Amphipoda, five of Copepoda, six of Ostracoda, and three of Cladocera. Small Loch West of Loch na Doirlinn,—one species of Amphipoda, five of Copepoda, three of Ostracoda, and eleven of Cladocera. The names of all the species are given in the Table of Distribution (Table I.).

Loch Benloden.

This loch occupies a hollow on the south side and near the summit of the mass of the high rocky land called Ben Tangaval, already referred to, which forms the south-west corner of the Island of Barra. The altitude of Loch Benloden is about 750 feet above the level of the sea. Access to it is somewhat difficult, owing to the rough nature of the ground that has to be traversed to reach it. The surroundings of the loch consist largely of peat moss, and the variety of Crustacean life was not very great,—three species of Copepoda (including *Ophiocamptus sarsi*, Mrazek) and seven species of Cladocera, were the only Crustacea observed.

Loch Cadha Mór and Pools near the Summit of Ben Heaval.

I have placed these two together, as they are comparatively near to each other and were visited on the same day. Loch Cadha Mór is situated among the hills that rise immediately behind the village of Castlebay. Part of the water used for domestic purposes in Castlebay comes from this loch, and the following reference to the means adopted to obtain the water may be of interest. The loch occupies a natural hollow among the rocky uplands, rocky ground rises above the loch all round except at the north end, and the natural course for the overflow water is from this end away down the valley to the west coast, and therefore out of reach of Castlebay. In order to overcome the natural obstacles in the way of obtaining a supply of water for the use of the village, the following ingenious device has been adopted :—a series of metal pipes carefully fitted together have been laid from the loch up over the high ground and for some distance down the valley on the other side, thus forming a very effective siphon. The water, on leaving the outlet end of the siphon, runs down the natural water-way of the valley to the store-pond from which the village of Castlebay is supplied. Loch Cadha Mór is in this way made to contribute its share of the water required by the people of the village.

One of the most common of the organisms observed in this loch was *Diaptomus serricornis.* It is somewhat singular that this hitherto apparently rare British Copepod was the only *Diaptomus* observed in the Barra lochs, and it occurred in no fewer than eight of them. It was also the only species of *Diaptomus* observed in the North Uist lochs, and in several of the lochs of Shetland that were examined last year (see separate report on the Shetland Lochs by myself and Mr Duthie F.O.). Eight species of Copepoda, six of Ostracoda, and eleven of Cladocera, were obtained in Loch Cadha Mór ; *Gammarus* was also fairly common ; a few *Limnœa peregra* and *Pisidium pusillum* were the only Mollusca observed. The altitude of Loch Cadha Mór is over 500 feet above sea-level.

Ben Heaval, which is the highest hill on the Island of Barra, has an altitude of 1200 feet above the sea. At the time of my visit there were several pools that had been formed by the rain water collecting in the hollows scooped out of the peat, which, in some places near the summit of the hill, forms beds of considerable thickness. A comparatively large number of Crustacea were obtained in these pools, among which were *Diaptomus serricornis*, four species of *Cyclops*, three of *Harpacticidœ* two of Ostracoda, and seven of Cladocera. Fine specimens of *Acantholeberis curvirostris* were obtained in the Ben Heaval pools. *Alona rustica*, n. sp.—an apparently new Cladoceran—was obtained in the gatherings from Loch Cadha Mór (see Notes on rare Crustacea at the end of the paper).

Loch an Ail.

Loch an Ail is a small loch on the east side of, and a short distance from, the highway between Ruliess and Balnabodach, and occupies a natural hollow in the rocky ground forming one side of the narrow water-way through which the sea flows into Loch Obe. Its altitude is about 40 feet above sea-level. Some large specimens of (?) *Bosmina longirostris* were obtained here (see note on *Bosmina*, with drawings of specimen). The species observed and identified in the tow-net gatherings from Loch an Ail comprise *Planorbis nautileus*, *Gammarus duabeni*, together with nine species of Copepoda, four of Ostracoda, and four of Cladocera.

Loch Scotagary.

The south-east end of this loch almost touches the highway a short distance north of the village of Ruliess. It is one of several small lochs situated in a stretch of bog-land that extends for a considerable distance to the north and west of the village just referred to. Loch Scotagary is about 100 feet above the level of the sea, and moderately deep.

The Crustacea obtained in this loch comprised seven species of Copepoda (including *Diaptomus serricornis*), and nine species of Cladocera ; *Gammarus duabeni* was frequent.

Lochan nam Faoileann—North and South.*

These two lochs, which are situated in the same stretch of peat-bog with Loch Scotagary, from which the south loch is distant about 300 yards, are separated from each other by quite a narrow ridge of hard ground. There appeared to be no connection whatever between them; but though the distance that separated the one loch from the other was so small, there was a considerable difference in the number and variety of the organisms obtained in the two lochs. In the south loch one species of bivalve Mollusca (*Pisidium*, sp.), and *Gammarus duabeni* were observed, also the following Copepoda and Cladocera :—*Cyclops strenuus* (very common with ovisacs), *Cyclops serrulatus*, and *Cyclops fimbriatus*; *Diaptomus serricornis*, and *Attheyella crassa; Drepanothrix dentata*, *Bosmina longirostris*, *Alonopsis elongatus*, *Alona quadrangularis*, and *Chydorus sphæricus*,—in all twelve species, exclusive of species of Notonectidæ, Water-mites, Insect larvæ, &c.; whereas in the north loch twenty-four species were obtained. The organisms identified in the gatherings from this loch comprised two species of *Pisidium;* seven species of Copepoda (including *Cyclops affinis* (G. O. Sars) with oviscas); *Diaptomus serricornis*, and *Ophiocamptus sarsi*; and fifteen species of Cladocera. It is somewhat curious that there are no records of Ostracoda in this loch, where other groups of Crustacea are so well represented; but it is quite possible some species of them may exist in the loch, though not observed in our gatherings, for it is not pretended that our examination of the various lochs was an exhaustive one.

Loch na Nighinn Ruaidhe.

About 600 yards (or the one-third of a statute mile) north-west from the northernmost of the two lochs last described brings us to Loch na Nighinn Ruaidhe, which is surrounded on all sides by bog-land and heather; some low hilly ground separates this one from the others. When we reached this loch we discovered that it had an interest for other people as well as for us: two clergymen were at work angling for trout, and when the purpose of our visit was explained to them, they appeared greatly interested. The trout in this loch are small but are said to be very good. Twenty-two species of Crustacea and one of Mollusca were obtained as the result of our examination of Loch na Nighinn Ruaidhe; the common brown *Hydra* was observed to be frequent in this loch; Water-mites, Insect larvæ, Diatoms, &c., were more or less frequent. The Crustacea obtained comprised seven species of Copepoda, one of Ostracoda, and fourteen species of Cladocera. *Diaptomus serricornis* was found in this loch, and some large and fine *Acantholeberis curvirostris*.

Loch an Duin.

The distance from Castlebay to Loch an Duin as the crow flies is only about 3½ miles, but by the road, such as it is, the distance is at least 3 miles more. The road that crosses the Island from east to west between the head of Bay Hirivagh and Ard Allasdale passes close along the north side of Loch an Duin. This loch appears to be one of the largest lochs on the Island of Barra, and it is considered to be a fairly good loch for trout. It was examined by us on the 21st of May, and the result was rather disappointing,—only nine species of Crustacea altogether were obtained in the gatherings collected here. *Diaptomus serricornis* was

* Or, more correctly, North-west and South-east.

frequent, and several large *Bosminæ* (? *Bosmina longirostris*), were also observed.

This completes the list of Barra lochs that were examined. I will now proceed to describe the results of the examination of the lochs of North Uist.

2nd.—Lochs on the Island of North Uist, Outer Hebrides.

The inland portion of the Island of North Uist is low-lying and the surface gently undulating ; and owing to the peculiar conformation of this inland portion, a large part of it is simply a net-work of lochs and tarns. So much is this the case, that a person not acquainted with the island, who has happened to leave the highway to enjoy a stroll upon the moors, may have to wander for hours among an apparently endless entanglement of water-ways before he again finds the road. Through the kindness of the Fishery Officer at Castlebay, whose jurisdiction extends to Loch Maddy, I was introduced to Mr M'Kenzie (who was post-master at Loch Maddy at that time, but who has since been promoted to another locality), and by him to Mr Frazer, the Banker at Loch Maddy, a gentleman well acquainted with the peculiar features of the Island. Mr Frazer, as soon as he understood the object of my visit, endeavoured to help me all he could by giving me most useful information about the intricacies of the moors, and by lending me a map of the district and tracing upon it a route by following which I might make the most of the time at my disposal.

Loch Skealtar.

This was the first loch visited. The east end of it is easily reached by the road that at a short distance from Loch Maddy diverges towards the south. Leaving the road where Loch Skealtar impinges upon it, I followed its shore line as closely as circumstances would allow, and worked the hand-net wherever a suitable place was observed. The shore of this loch seems to be in general bare and stony, at anyrate very little vegetation other than *Litorella* and small species of *Juncus* was observed anywhere at the time of my visit ; so therefore, when the gatherings that had been collected were examined, I was somewhat surprised to find that they contained a large variety of micro-crustacea, including among them several rare species. No fewer than thirty-one different kinds of Crustacea were obtained, besides specimens of the bivalve Molluscan species *Pisidium pusillum* ; they comprised one species of Amphipoda (*Gammarus duabeni*), ten species of Copepoda, four of Ostracoda (including *Candona Kingslei*, and *Darwinula Stevensoni*), and sixteen species of Cladocera. Among the Cladocera there were besides *Drepanothrix dentata* and *Acantholeberis curvirostris*, the rare and curious *Monospilis dispar*. *Alona neglecta*, n. sp., an apparently new Cladoceran, was obtained here (see Notes on this and other rare Crustacea at the end of the paper).

Loch Scadowa.

Leaving the west end of Loch Skealtar, I struck across the moor south-west to Loch Scadowa. This is a beautiful loch, with long reaches of clear water. Its configuration is very irregular and confusing, especially till one can get upon some high ground from which a view of its general outline may be obtained. Only in some of the shallower parts of the loch is vegetation at all common ; nevertheless it has, like Loch Skealtar, a prolific crustacean fauna, particularly Cladocera, in which the gatherings collected at this time were very rich. Mollusca appear to be very scarce. I find there is no record among my notes of any species of Mollusca having been observed, yet it is almost certain that the more common species of *Pisidia* and *Limnææ* will be found in the loch,—in fact it would be rather interesting were it proved that no Mollusca existed in Loch Scadowa, considering its comparatively large size and its suitability as a habitat for such species. The Crustacea obtained in Loch Scadowa comprised, besides the commonly distributed *Gammarus* (?) *duabeni*, eight species of Copepoda, three species of Ostracoda, and nineteen species of Cladocera. Notonectidæ, Water-mites, Insect larvæ, Diatoms, &c., were also obtained in considerable abundance. Two of the species of Cladocera appear to be undescribed—they are described and figured at the end of the Report on the Shetland Lochs under the names of *Alona neglecta*, n. sp., and *Alona rustica*, n. sp.

Loch Fada.

Proceeding northward from Loch Scadowa, across the moor, I at length reached Loch Fada. In this loch, or rather in some of its arms that stretch for a greater or less distance up the hollows that branch off from the general shore line, and where the water shallows much, aquatic vegetation was more abundant than it appeared to be in the other two lochs visited. Yellow water-lilies just bursting into blossom filled up the shallow bays, while *Litorella* formed a green spongy carpet that extended up the almost level sandy beach to a considerable distance beyond the edge of the water. In the more swampy parts the long trailing stems of the Bog Bean formed an intricate net-work, from which arose at short intervals the ternate leaves and beautiful feathery flowers so characteristic of the plant. But this fine loch with all its floral beauty and apparent suitability as a habitat for an abundant micro-fauna was, if one may judge by the results of the examination of the gatherings collected here, much less prolific in such organisms than either Loch Skealtar or Loch Scadowa.

Eighteen species of Crustacea were obtained in the gatherings from Loch Fada, four of which were Copepoda, the other fourteen being Cladocera; neither Ostracoda nor Mollusca were observed, and this was the only loch in the group of Hebridian Lochs now described in which *Camptocercus macrurus* was obtained. The only effluent of Loch Fada is a stream of clear pure water which flows from the east end down into Loch an Aastrum,—a tidal loch much nearer Loch Maddy than this. On making a partial examination of this stream (it is called the Fada Burn), I found that Mollusca were, as regards numbers, well represented here, though no specimens had been obtained in the loch itself. Three species, —*Pisidium pusillum*, *Limnæa peregra* and *Ancylus fluviatilis*,—appeared to be of common occurrence, harbouring about the boulders in mid-stream. These species are entered in the Table (Table I.) under Loch Fada.

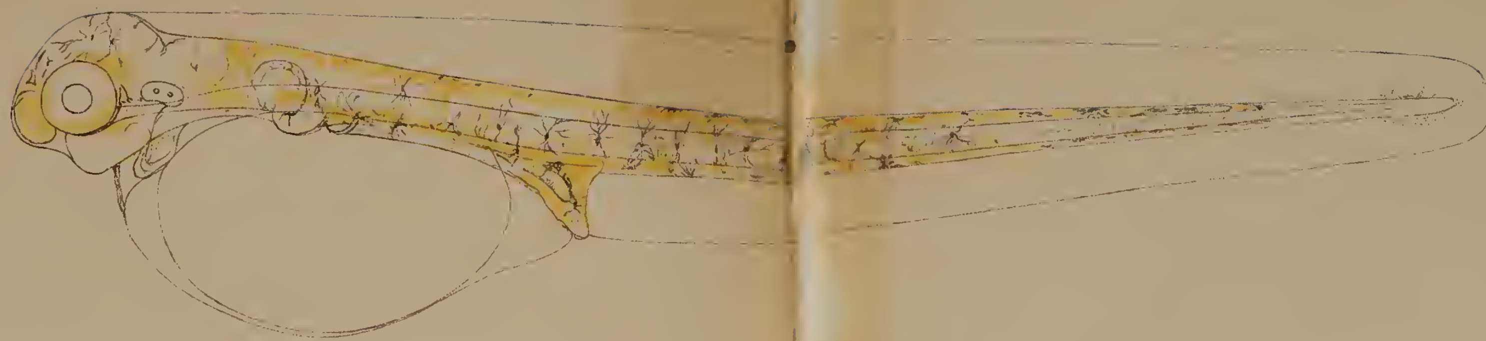
With the examination of Fada Burn my visit to Loch Maddy and the North Uist Lochs came to a close. No attempt appears to have hitherto been made to carry out a systematic investigation of the lochs of the Outer Hebrides, and it is evident, from what has now been done, that such an investigation might be expected to yield interesting results and extend very considerably our knowledge of the fresh water invertebrate fauna of our country. But this is a work that would require the services of several students—each with a special knowledge of one or other of the groups of organisms likely to be met with.

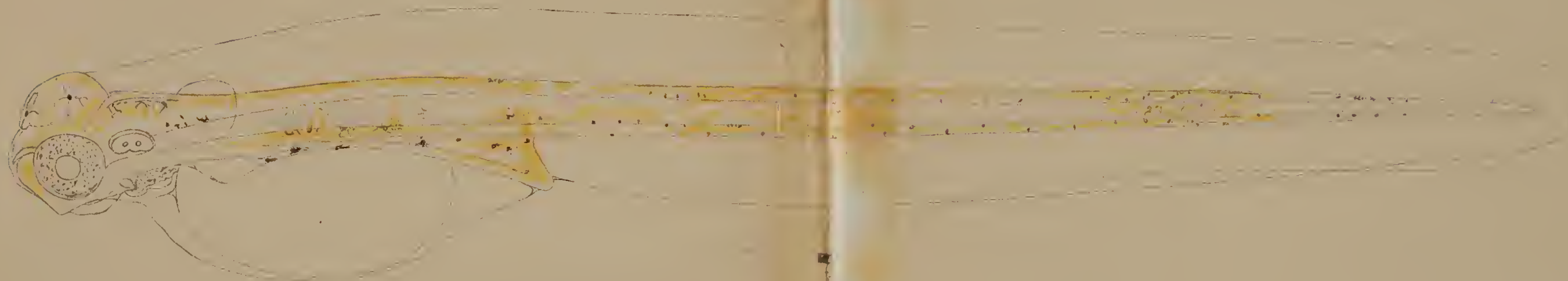
Appended hereto is a Table (Table I.) in which will be found the names of the species that have been obtained—and identified—in the lochs of Barra and North Uist described in the preceding notes, and showing their distribution in the various lochs.

TABLE I.—Containing the names of all the species identified in the Lochs of Barra and North Uist, described in the preceding pages, and showing the Lochs in which each species was found. An × is used to indicate the Loch or Lochs in which the species was obtained.

Names of the Species.	Barra Lochs.												N. Uist Lochs.		
	Loch Mór.	Loch na Doirlinn.	Small Loch near Loch na Doirlinn.	Loch Benloden.	Loch Cadha Mór.	Pools on the top of Ben Heaval.	Loch an Ail.	Loch Scotagary.	Loch an Duin.	Lochan na Nighinn Ruaidhe.	Lochan nam Faoile-ann, N.	Lochan nam Faoile-ann, S.	Loch Scadowa.	Loch Skealtar.	Loch Fada.
MOLLUSCA.															
Pisidium fontinale (Drap.), .	×														
,, *pusillum* (Gmelin),	×	×			×									×	
,, *nitidum*, Jenyns, .															
Planorbis glaber, Jeffreys, .	×								×						
,, *nautileus* (Linné), .	×	×					×								
,, *nautileus*, var. *cristata*, . . .	×														
Limnæa peregra (Müller), .	×	×			×										×
,, *truncatula* (Müller),	×														
Ancylus fluviatilis, Müller, .															×
CRUSTACEA—SCHIZOPODA.															
Mysis vulgaris, Thompson, .	×	×													
AMPHIPODA.															
Gammarus duabeni, . .	×	×	×		×		×	×				×	×	×	
COPEPODA.															
Diaptomus serricornis, Lilljeborg, ...					×	×	×	×	×	×	×	×		×	
Cyclops viridis, Jurine, . .	×				×				×				×	×	×
,, *signatus*, Koch, .	×		×		×	×		×	×	×				×	
,, *strenuus*, Fischer, .					×		×	×		×		×	×	×	
,, *bicuspidatus*, Claus, .		×				×									
,, *serrulatus*, Fischer, .	×		×	×	×	×	×	×	×	×	×	×	×	×	×
,, *affinis*, G. O. Sars, .							×			×	×				
,, *fimbriatus*, Fischer, .	×	×				×	×	×	×	×	×	×		×	
Canthocamptus hirticornis, n. sp., . .	×	×											×	×	
Attheyella crassa, (G. O. Sars), . .	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
,, *pygmæa* (G. O. Sars), . .	×	×	×		×	×	×	×					×	×	
,, *zschokkei* (Schmeil),					×								×	×	×
Ophiocamptus sarsi, Mrazek, .			×	×		×					×		×		

1.





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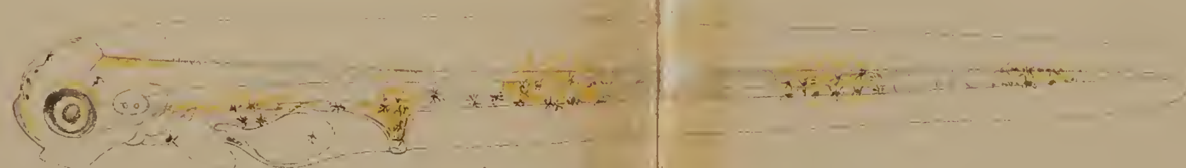

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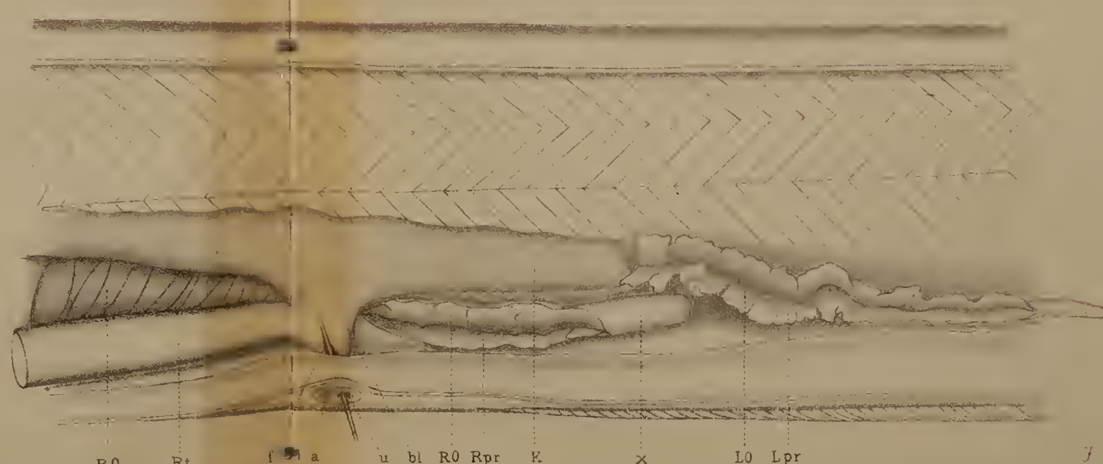


5.

Figs 1-3 W.C.M. Figs 4 & 5, H.C.W. del

F. Huth, Lithr Edinr

W.C.M. del. Fig. 5. H.C.W. Fig. 15. A.T.M.

F. Huth, Lith^r Edin^r

TURBOT &c.

TABLE I.—*continued.*

Names of the Species.	Barra Lochs.												N. Uist Lochs.		
	Loch Mór.	Loch na Doirlinn.	Small Loch near Loch na Doirlinn.	Loch Benloden.	Loch Cadha Mór.	Pools on the top of Ben Heaval.	Loch an Ail.	Loch Scotagary.	Loch an Duin.	Lochan na Nighinn Ruidhe.	Lochan nam Faoileann, N.	Lochan nam Faoileann, S.	Loch Scadowa.	Loch Skealtar.	Loch Fada.
OSTRACODA.															
Cypria ophthalmica (Jurine),	×				×	×	×								
,, *serena* (Koch), . .	×	×			×	×	×			×			×	×	
Cypris fuscata, Jurine, . .	×														
Erpetocypris reptans (Baird), .	×														
Cypridopsis vidua (Müller), .	×														
,, *villosa* (Jurine), .					×										
,, *aculeata* (Lilljeborg), . .		×													
Potamocypris fulva, Brady, .	×														
Candona candida (Müller), .	×	×	×		×		×						×	×	
,, *pubescens* (Koch), .	×	×	×												
,, *Kingsleii*, B. & R.,					×									×	
Darwinula Stevensoni, B. and R., ...		×												×	
Limnicythere inopinata (Baird), ...	×	×	×											×	
CLADOCERA.															
Sida crystallina (Müller), .								×		×			×		×
Daphnella brachyura (Lievin),		×									×				
Bosmina longirostris (Müller),				×	×	×	×	×	×	×	×	×	×	×	×
Drepanothrix dentata (Eurén),											×	×	×	×	×
Acantholeberis curvirostris (Müller), ...						×				×	×		×	×	×
Ilyocryptus sordidus (Lievin),		×	×		×	×				×	×				
Daphnia (?) *galeata*, G. O. Sars,													×		
Simocephalus vetulus (Müller),			×												
Ceriodaphnia (?) *quadrangula* (Müller), ...					×		×		×		×		(?)		
Eurycercus lamellatus (Müller),								×		×	×		×	×	×
Acroperus harpæ, Baird, .			×						×	×	×		×	×	
Camptocercus macrurus (Müller), ...															×
Alonopsis elongatus, G. O. Sars, ...			×	×				×		×	×	×	×	×	×
Graptoleberis testudinarius (Fischer), ...			×	×							×		×		×
Alona neglecta, n. sp., . .													×	×	
,, *rustica*, n. sp., . .					×								×		
,, *guttata*, G. O. Sars, .								×							
,, *quadrangularis* (Müller), . . .	×	×	×	×	×	×	×	×	×		×	×	×	×	×
Alonella exigua (Lilljeborg), .			×	×	×									×	
Alonella nana (Baird), . .			×		×	×		×		×				×	×
Peracantha truncata (Müller),										×	×		×	×	×
Pleuroxus trigonellus (Müller),			×												
Harporhynchus falcatus, G. O. Sars, ...								×		×			×	×	
Chydorus sphæricus (Müller),			×	×	×	×		×		×	×	×	×	×	×
,, *barbatus* (G. Brady), . .			×	×	×	×					×		×	×	×
Monospilus dispar, G. O. Sars,													×	×	
Polyphemus pediculus (De Geer), ...											×		×	×	×

Group II.—LOCHS ON THE MAINLAND.

1*st.* Loch na Kenna (or the Lilly Loch) near E. Tarbert, Argyllshire.

I now proceed to describe the second group of lochs—viz., those in the Mainland—that have been examined during the past year; and the first I propose to refer to is a little hill loch called Loch na Kenna, and sometimes the Lilly Loch, from the number of white water lilies that grow in it. It was examined in the month of July, and though minute organisms such as Infusoria, Rotifera, Diatoms and other algæ, &c., were abundant, comparatively few Mollusca or Crustacea were obtained. The Mollusca included two species of *Pisidia* and two of *Limnææ*, while the Crustacea comprised two species of Copepoda and six species of Cladocera, none of which are very uncommon.

2*nd.* Lochs in Perthshire.

Lochan a Chaite (on Ben Lawers).

This is a small loch situated fully half-way up the famous Perthshire mountain so well known to botanists for the many rare alpine plants that are to be obtained among its rocks and gullies. Lochan a Chaite occupies a hollow in a kind of natural recess at the foot of the precipitous ridge of rocks that extends from a little below the summit of Ben Lawers to the mountain on the east side, apparently as if it were binding the two together. As the two mountain masses extend some distance forward in a southerly direction, a kind of natural recess, as I have called it, is formed, the mountain summits forming the sides, while the ridge encloses it on the north; the ground within this recess is comparatively flat, with the loch near the middle. The nearest way to the loch is to 'make a Bee line' right up and across the moor from Lawers Inn; but an easier though longer way is by the hill road that joins the highway a short distance east from the Inn, and close beside the Lawers Burn, which is the effluent from Lochan a Chaite. This hill road follows the track of the Burn, more or less closely, nearly all the way up to the Loch.

The water in the loch is supplied by the streamlets that drain off the surface moisture from the adjacent sides of the two mountains, and which during a great part of the year consists chiefly of rain water or melted snow, or a mixture of both. The loch appears to be rapidly filling up with the sediment carried into it by its affluents, and even as it is a large portion of it is very shallow, so much so that a small tow-net with a ring about 12 inches diameter, when dragged across the loch some distance up from its lower end touched the bottom in several places, when part of the ring was still appearing above the surface of the water. The deepest part appears to be at the upper end, but I was unable at the time of my visit to ascertain its depth here.

The altitude of Lochan a Chaite is about 2400 feet above sea-level, and over 2000 feet above Loch Tay. It was examined about the middle of September.

Because of the great altitude of this little loch, I considered that it was just possible that organisms might be obtained in it that are not to be found in lochs lower down. The examination of the gatherings collected in September, however, does not seem to bear this out, for, with one or two exceptions, all the species obtained are similar to those frequently observed in lochs and pools within a few feet of the level of the sea. But though the results were somewhat disappointing, I was rewarded by the discovery of one organism—a Copepod quite distinct from any other

British fresh water species known to me,—a description of it is given at the end of this Report.

I was informed that the loch contains trout, and as a matter of fact a few post-larval specimens were found in my tow-net gatherings, but it is rarely visited by anglers. The invertebrates obtained and, so far, identified, in the tow-net and hand-net gatherings from Lochan a Chaite are as follows:—a few specimens of a variety of *Limnæa peregra*, a few specimens (apparently not mature) of *Gammarus*, seven species of Copepoda (including the form referred to above), four species of Ostracoda, and ten species of Cladocera, also some Insects, Insect-larvae, one or two spiders (probably recently washed into the loch), Diatoms, and some other minute organisms.

Lochan Lairig Eala.

The altitude of Lochan Lairig Eala is 984 feet above sea-level. It is situated close to the old Killin Passenger Station of the Callander and Oban Railway—on the side opposite from the Station—and the present Station at Killin Junction is about two miles north-west from the loch. It is not a very large loch, but appears to be a good loch for trout-fishing; a few boats are kept on it for the use of anglers, but permission to fish has to be obtained.

This loch was examined on the 13th of September by hand-net, from the shore. Micro-organisms appeared to be abundant and varied. When an examination of the gatherings that were collected was made, the following were obtained:—viz., seven species of Copepoda and sixteen species of Cladocera, or a total of twenty-three species of Crustacea. Mollusca were apparently scarce in Loch Lairig Eala, so also were Ostracoda. The somewhat rare *Cyclops affinis*—carrying ovisacs—was obtained here; *Latona setifera* and *Acantholebris curvirostris* were also obtained.

Loch Lubnaig.

An examination of this beautiful loch was made on September 29th. Loch Lubnaig is simply an expansion of the River Leny, which, flowing down through Strathyre, fills up the deepest part of the valley with its pellucid waters, before continuing its course amid the rugged and bewildering mazes of the Pass of Leny. Owing to the configuration of the valley of Strathyre the loch is narrow and elongate, being little more than a third of a mile across, while its length is nearly four miles. The lower half extends nearly in a north and south direction, but the upper half bends round to the north-west, and it is fully four hundred feet above the level of the sea. Among the organisms obtained in the gatherings from this loch are four species of Mollusca, seven species of Copepoda, four species of Ostracoda, and fourteen species of Cladocera, besides Insect-larvæ, Acaridæ, Notonectidæ, Diatoms and other algæ, Rotifera, &c. Among the more interesting Crustaceans found in this loch are *Cyclops macrurus*, G. O. Sars, which as a member of the British fauna has so far been recorded from only a few places in England and Scotland,—Loch Lubnaig being a new station for it; *Ophiocamptus brevipes* (G. O. Sars), another of the Loch Lubnaig Copepods, is new to Britain, it somewhat resembles *Ophiocamptus sarsi* in general appearance, but the structure of the fifth pair of swimming feet is very different. *Darwinula Stevensoni*, Brady and Robertson,—a rare British Ostracod—was also obtained in Loch Lubnaig, as well as an apparently new Cladoceran which I have described as *Alona neglecta* (see Notes at the end of the Report on the lochs of Shetland).

3rd. Lochs in the Vicinity of Glasgow.

Possil Marsh.

Though Glasgow continues to extend its boundaries on all sides, this loch or marsh continues to exist and to be the 'happy hunting ground' for naturalists of all sorts. This loch was visited on the 2nd of October, when a number of interesting Crustacea were obtained. *Eurytemora Clausii*, *Cyclops Thomasi*, and *Cyclops affinis*, *Attheyella pygmæa*, *Ilyocryptus sordidus*, *Ceriodaphnia reticulata*, and *Chydorus globosus*, are some of the organisms observed in the gatherings from Possil Marsh. Of the thirty-six species obtained five of them were Mollusca, ten were Copepoda, eight were Ostracoda, twelve were Cladocera, and one a fresh water Isopod, *Asellus aquaticus*. Many other things besides those named were observed, such as Acaridæ, Notonectidae, *Coleoptera*, Rotifera, Infusoria, Diatoms, &c. It may be mentioned that this is only the second time that *Eurytemora Clausii* has been obtained in a fresh water loch in Scotland.

Bardowie Loch.

Bardowie Loch is about six miles north of Glasgow, and a mile and a half from Milngavie, and the old Castle of Bardowie occupies a kind of headland on the north side. The water is pure and clear, and numbers of interesting things are to be obtained in it. Twenty-nine species of Crustracea were identified in the gatherings from Bardowie Loch, and among them were *Cyclops phaleratus*, *Scapholeberis mucronata*, and *Chydorus globosus*. Two species of fresh water Polyzoa—*Paludicella Ehrenbergi* and *Plumatella repens*—as well as a fresh water sponge, were obtained in this loch. Mollusca were not very plentiful at the time of my visit, one or two of the common Pisidia and Planorbi being the only species obtained. Among the Crustacea obtained there were *Asellus aquaticus*, eight species of Copepoda, four species of Ostracoda, and sixteen species of Cladocera.

St German's Loch.

This little loch is now so much surrounded by houses and hidden by trees and walls, that only those acquainted with the district can find their way to it. A stranger to the district can hardly believe that a loch can exist in the neighbourhood, but not only does such a loch exist, it is also still large enough to be the resort of numerous amateur anglers that come to it from various parts of the surrounding district. Though personally unacquainted with the locality, I was favoured with the company of a friend who has been familiar with Glasgow and its environs from his youth.

I found St German's Loch to contain an abundant micro-fauna, but there was scarcely so great a variety as in Possil Marsh or Bardowie Loch. The common *Asellus aquaticus* and fresh water *Gammarus* were both here, together with five species of Copepoda, three species of Ostracoda, and thirteen species of Cladocera. One of the Cladoceran species was the rare *Leydigia quadrangularis* (Leydig). I have obtained this in only two other localities in Scotland. A form of *Daphnia Jardini* was also obtained here. Only two species of Mollusca were observed —viz., *Planorbis albus* and *Physa fontinalis*. Many other micro-organisms belonging to other groups were noticed during the examination of the gatherings that were collected at this time, but they were not identified.

This completes the description of the Scottish lochs that form the subject of the present Report. A Table (Table II.) is appended containing the names of all the organisms obtained and identified in this second group of the lochs, similar to the Table appended to the first group. A description, with drawings of some of the rarer Crustacea obtained in the lochs included in both groups, is also added.

TABLE II.—Containing the names of all the species identified in the Lochs of Perthshire, Argyllshire, and in the vicinity of Glasgow, as described in the preceding pages, and showing the distribution of each species in the various Lochs. An × is used to indicate the Loch or Lochs in which the species was obtained.

Names of the Species.	Perthshire.			Argyllshire.	Vicinity of Glasgow.		
	Lochan a Chaite.	Lochan Lairig Eala.	Loch Lubnaig.	Loch na Kenna, East Tarbert.	Possil Marsh.	Bardowie Loch.	St German's Loch.
MOLLUSCA.							
Pisidium pusillum (Gmelin), . .				×	×		
Valvata piscinalis (Müller), . . .			×		×		
Planorbis albus, Müller, . . .			×		×	×	×
,, *contortus* (Linné), . . .			×				
,, *nitidus*, Müller, . . .					×		
Physa fontinalis (Linné), . . .					×		×
Limnæa peregra (Müller), . . .	×			×			
,, *truncatula*, ...				×			
Ancylus fluviatilus, Müller, . .			×				
CRUSTACEA—AMPHIPODA.							
Gammarus duabeni, Lilljeborg, . .	×		×				
ISOPODA.							
Asellus aquaticus, ...					×	×	×
COPEPODA.							
Diaptomus gracilis (G. O. Sars), . .		×	×			×	×
Eurytemora Clausii (Hoek), . . .					×		
Cyclops viridis, Jurine, ...	×	×		×	×	×	
,, *signatus*, Koch, ...		×	×		×	×	×
,, *Thomasi*, Forbes, . . .					×		×
,, *serrulatus*, Fischer, . . .	×	×	×	×	×	×	×
,, *macrurus*, G. O. Sars, . .			×				
,, *affinis*, G. O. Sars, . . .		×			×		
,, *phaleratus*, Koch, . . .						×	
,, *fimbriatus*, Fischer, . . .	×	×			×	×	×
Canthocamptus staphylinus (Jurine), .					×	×	
Attheyella crassa (G. O. Sars), . .	×		×		×	×	
,, *pygmæa* (G. O. Sars), . .	×				×		
,, *zschokkei* (Schmeil), . .		×	×				
,, *Macandrewæ*, n. sp., . .	×						
Ophiocamptus sarsi, Mrazek, . . .	×						
,, *brevipes* (G. O. Sars), .			×				
OSTRACODA.							
Cypria ophthalmica (Jurine), . . .	×				×		
,, *lævis* (Müller), ...	×						

TABLE II.—*continued.*

Names of the Species.	Perthshire.			Argyllshire.	Vicinity of Glasgow.		
	Lochan a Chaite.	Lochan Lairig Eala.	Loch Lubnaig.	Loch na Kenna, East Tarbert.	Possil Marsh.	Bardowie Loch.	St German's Loch.
OSTRACODA—*continued.*							
Cypria serena (Koch), ...			×		×	×	
Cyclocypris globosa (G. O. Sars), . .							×
Cypris fuscata, Jurine, ...					×		
Erpetocypris reptans (Baird), . . .			×		×	×	×
Cypridopsis vidua (Müller), . . .					×	×	×
Candona candida (Müller), . . .	×		×		×	×	
,, *pubescens* (Koch), . . .	×						
,, *rostrata*, Brady and Norman, .					×		
,, *fabæformis* (Fischer), . .					×		
Darwinula Stevensoni, B. & R., . .			×				
CLADOCERA.							
Sida crystallina (Müller), . . .						×	×
Daphnella brachyura (Lievin), . .		×				×	
Latona setifera (Müller), . . .		×	×				
Holopedium gibberum (Zaddach), . .	×						
Bosmina longirostris (Müller), . .	×	×				×	
Drepanothrix dentata (Euren), . .			×				
Acantholeberis curvirostris (Müller), .		×					
Ilyocryptus sordidus (Lievin), . .		×			×		
Ceriodaphnia quadrangula (Müller), .		×				×	×
,, *reticulata* (Jurine), . .					×		
Ceriodaphnia (?) *laticaudata*, . . .					×		
Scapholeberis mucronatus (Müller), .						×	
Simocephalus vetulus (Müller), . .					×	×	×
Daphnia pulex (De Geer), . . .	×						
,, *Jardini*, Baird, . . .							×
Eurycercus lamellatus (Müller), . .	×	×	×		×	×	
Acroperus harpæ, Baird, . . .	×	×	×	×	×	×	×
Alonopsis elongatus, G. O. Sars, . .	×	×	×	×		×	
Leydigia quadrangularis (Leydig), .							×
Graptoleberis testudinarius (Fischer), .	×	×				×	×
Alona costata, G. O. Sars, . . .							×
,, *neglecta*, n. sp., ...			×				
,, *guttata*, G. O. Sars, . . .			×				
,, *quadrangularis* (Müller), . .	×	×	×	×	×	×	×
Alonella exigua (Lilljeborg), . . .		×	×			×	×
,, *nana* (Baird), ...		×	×	×			
Harporhynchus falcatus, G. O. Sars, .		×					
Peracantha truncata (Müller), . .	×		×			×	×
Pleuroxus trigonellus (Müller), . .					×		
,, *lævis* (G. O. Sars), . . .					×		
,, *uncinatus*, Baird, . . .							×
Chydorus sphæricus (Müller), . .					×	×	×
,, *globosus*, Baird, . . .					×	×	
,, *barbatus* (G. S. Brady), . .	×	×	×			×	
Polyphemus pediculus (De Geer), . .		×	×		×		

NOTES AND DESCRIPTIONS OF SOME OF THE SPECIES CONTAINED IN THE TABLES I. AND II.

CRUSTACEA.

COPEPODA.

Calanidæ.

Eurytemora Clausii (Hock).

This Calanid, though frequent in some tidal lagoons and estuaries, is, so far, of rare occurrence in Britain as an inhabitant of purely fresh water. Its occurrence in Possil Marsh, near Glasgow, is therefore of interest, especially as it has been obtained in only one other fresh water locality in Scotland. The fifth feet of the female, of which I have given a drawing from one of the Possil Marsh specimens (Pl. IX. fig. 1), are quite characteristic of the species. The only apparent difference in the female fifth pair from Possil Marsh is that the terminal seta of each branch is plain, or so indistinctly plumose that the feathering was not distinguishable by my $\frac{1}{4}$-inch objective.

Cyclopidæ.

Cyclops Thomasi, Forbes, *Cyclops affinis*, G. O. Sars, and *Cyclops phaleratus*, Koch.

All these three species of Cyclops are comparatively rare. The first was obtained in two of the lochs near Glasgow—viz., Possil Marsh and St German's Loch. The second was found in three of the Barra lochs,—a few specimens from one loch bore ovisacs; it also occurred in one of the Perthshire lochs (a few specimens with ovisacs), and in Possil Marsh. The third species, *Cyclops phaleratus*, was obtained in only one of the lochs that form the subject of this paper—viz., Bardowie Loch, near Glasgow.

Cyclops macrurus, G. O. Sars.

This rare Cyclops was moderately frequent in the gatherings from Loch Lubnaig. The structure of the antennules is somewhat like that of the same appendages in *Cyclops serrulatus*, but they are considerably shorter. The long and slender abdominal stylets not only want the longitudinal row of minute teeth, but possess a peculiar fascicle of small setæ near the distal end. Discrimination of the species is easy when once the eye becomes familiar with it. The British localities for this species are very few, and Loch Achray—one of the lochs of the Trossachs, and within a comparatively few miles of Loch Lubnaig, but having no connection with it—is one of them.

Harpacticidæ.

Canthocamptus hirticornis, n. sp. (Pl. IX. figs. 13–26).

Description of the species.—Female, length ·58 mm. ($\frac{1}{44}$ of an inch). Body moderately robust. Antennules stout, seven-jointed; joints subequal in length except the first, which is considerably longer, and the fifth and sixth, which are shorter than the others; the first and second joints are densely covered with small hairs on the upper aspect,—especially the first joint; the proportional lengths of the joints are as follows (see also fig. 14):—

Proportional lengths of the joints,	14 · 10 · 10 · 9 · 6 · 7 · 9
Number of the joints,	1 · 2 · 3 · 4 · 5 · 6 · 7

Antennæ stout, secondary branch very small, one-jointed. Mandibles stout, the broad biting part is armed with three strong blunt teeth and a few small spines, there is also a papilliform lateral process, as shown by the drawing (fig. 17); mandible-palp very small, one-jointed, and furnished with one terminal and three lateral setæ. Anterior foot-jaws dilated, short, armed with a stout terminal claw and two marginal spiniferous processes. Posterior foot-jaws are less robust, and consist of two moderately long and nearly equal joints, and a very small terminal joint which forms the base of a moderately stout but not very elongate claw; the margins of the second joint are ciliated, and a setiferous spine springs from the upper distal angle of the first joint. The first pair of swimming feet have both branches three-jointed, the joints of the outer branches are subequal, and armed with strong spines at the outer distal angles; the first joint of the inner branches reaches to about the extremity of the outer branches; the second and third are shorter and subequal, their combined length being scarcely equal to the first joint (fig. 21). Outer branches of the second, third and fourth pairs elongate, and composed of three subequal joints; inner branches very short, two-jointed; in the second pair, the inner branches extend a little beyond the second joint of the outer branches; in the third pair, the inner branches extend to about the middle of the second joint of the outer branches, while in the fourth pair, the inner branches are still shorter, and do not extend much beyond the first joint of the outer branches (fig. 22). The fifth pair has the produced inner portion of the basal joint broadly subcylindrical, the rounded extremity is provided with six moderately long setæ, but the principal apical setæ is about twice as long as the one on either side of it; secondary joint small, subovate, and furnished with six setæ, arranged round the outer margin and end, the middle apical setæ being much longer than any of the others. Caudal stylets very short (fig. 26).

Male.—Antennules indistinctly eight-jointed, and strongly hinged; the third and fourth joints are very short but considerably dilated laterally, and the seventh and eighth form together a claw-like apex. Mouth organs and swimming feet similar to those of the female, except that the third pair are somewhat distorted, the first and second joints of the outer branches are dilated, while the third is small and armed with two strong terminal and two lateral spines—the inner apical spine being very large; the inner branches are composed of three small joints (fig. 23). The basal joint of the fifth pair is not much produced and broadly rounded, and carries two short but very stout blunt-pointed spines and a minute seta; the secondary branch is very small and provided with three setæ (fig. 25).

Habitat.—Lochs in Barra and North Uist, Outer Hebrides. In lochs in the Shetland Islands, and in shore-pools near the head of West Loch Tarbert, Argyllshire.

Remarks.—*Canthocamptus hirticornis* appears to be widely distributed throughout the Hebridian islands and in Shetland, but is apparently rare on the Mainland. The structure of the first feet resembles that of the first pair in *Canthocamptus trispinosus*, Brady, but the antennules, which are only seven-jointed, and the form of the fifth feet in male and female, clearly distinguish it from that species; and, taking the sum of its various characters described and figured here, there is no species known to me that it can be identified with. The hairy integument of the first two joints of the antennules—a character that suggested the specific name—is peculiar.

Attheyella Macandrewæ, T. and A. Scott (Pl. IX. figs. 1–12).

1895. *Attheyella Macandrewæ*, T. and A. Scott, Ann and Mag. Nat. Hist., ser. 6, vol. XV., p. 457, Pl. XVI. figs. 1–6.

Description of the species.—Female, length ·58 mm. ($\frac{1}{43}$ of an inch). In general appearance somewhat similar to *Attheyella pygmæa*, G. O. Sars, but rather smaller and less hirsute. Antennules moderately stout, eight-jointed; the end joint is distinctly more elongate than any of the others, and the first four joints are considerably stouter than the last four; the proportionate lengths of the various joints are nearly as in the formula—

Proportional lengths of the joints,	9 · 9 · 9 · 6 · 6 · 7 · 6 · 11
Numbers of the joints,	1 · 2 · 3 · 4 · 5 · 6 · 7 · 8

The secondary branch of the antennæ is two-jointed, but the end joint is only about half the length of the other (fig. 4). The second joint of the posterior foot-jaws has the inner margin fringed with short but stout seta arranged in a pectinate manner, the stout seta on the inner distal angle of the first joints plumose only on one side (fig. 8). In the first pair of swimming feet the end joint of the two-jointed inner branch is considerably shorter than the first joint,—being only about two-thirds of its length; the end joint is also narrower than the other; the entire length of the inner and outer branches is about equal (fig. 9). The inner branches of the next three pairs are two-jointed and very short,—they do not extend much beyond the end of the first joint of the outer branches; the outer branches, on the other hand, are elongate and robust, and consist of three nearly equal joints, as shown by the drawing (fig. 10). In the fifth pair the inner produced part of the basal joint is subcylindrical, rather longer than broad, and bearing on the rounded distal end six very unequal setæ arranged thus: two small setæ on the outer margin and four stout setæ round the apex,—the third one from the inside being stouter and much more elongate than the others; the secondary joint is in outline somewhat like the produced part of the basal joint but rather broader, it is furnished with a long stout and coarsely plumose apical seta, a small subapical seta interiorly also plumose, and with three small plain setæ on the distal half of the outer margin, as shown by the drawing (fig. 11). Caudal stylets short, narrow, with a considerable space between them, each provided with a very long, stout, and coarsely plumose seta articulated near the base; there is also a second and much smaller apical seta having a stout basal part (fig. 12).

Habitat.—Lochan a Chaite, a small loch on the south-east side of Ben Lawers, Perthshire, altitude about 2400 feet above sea-level. Rather rare; a few specimens only obtained.

Remarks.—The characters by which this species is distinguished are—the structure of the antennules, the armature of the posterior foot-jaws, and especially by the structure of the first and fifth pairs of feet; the difference in the structure of the first pair is so marked that neither my son nor I experienced any difficulty in distinguishing the species from among others when mixed up together with them, from the end joint being so distinctly shorter than the first in the two-jointed inner branches of the first swimming feet.

Ophiocamptus brevipes (G. O. Sars), (Pl. X. figs. 1–9).

1862. *Canthocamptus brevipes*, G. O. Sars, 'Oversigt. af de ind. Ferskvandscopepoder': Forhandl. Vedensk. Selsk. Christiania (1862).

1893. *Ophiocamptus brevipes*, Al. Mrazek, 'Beitrag zur Kenntniss der Harpacticiden fauna des Süsswassers': Zoologischen Jahrbüchern; Siebenter Band, p. 116, Taf. 5, fig. 66; Taf. 6, figs. 67–70.

Description of the species.—Female, length ·72 mm. (about $\frac{1}{35}$ of an inch). Body slender, in general appearance somewhat like *Ophiocamptus sarsii*, Mrazek; antennules seven-jointed, the end joint is rather longer than any of the others, as shown by the formula—

$$\begin{array}{ll} \text{Proportional lengths of the joints,} & \dfrac{9 \cdot 9 \cdot 8 \cdot 7 \cdot 8 \cdot 8 \cdot 12}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7} \\ \text{Number of the joints,} & \end{array}$$

Antennæ and mouth organs somewhat similar to those of *Ophiocamptus sarsii.* The first pair of swimming feet also resemble those of that species, but the inner branch is proportionally longer, being about equal in length to the outer branch; the end joint of the inner branch is proportionally rather longer and narrower in relation to the first joint than the end joint of the inner branch of the first pair in *Ophiocamptus sarsii*; the armature of the first pair also differs in the two species,—in *Ophiocamptus brevipes* the marginal spines are of greater length, and the apical setæ also more elongate (fig. 6).

The second, third, and fourth pairs are all very much alike; in the fourth pair, the end joint of the outer branches bears exteriorly two stout subterminal hairs of unequal length,—the inner being nearly twice the length of the outer; the apical seta is long and spiniform, it is fully one and a half times the entire length of the outer branch; on the interior side of the apical seta are two subterminal setæ, of nearly equal length and more slender than the others, they are each fully half the length of the apical seta; the first joint of the very short two-jointed inner branch bears a slender spine on the distal half of the inner margin, and four small setæ round the end of the last joint (fig. 7). In the fifth pair, the produced inner part of the basal joint is narrow, cone-shaped—the length being about one and a half times the breadth at the base; the secondary joint is narrow, subcylindrical, and reaches to the apex of the basal joint; both joints are furnished with setæ of considerable length, some of which are plain, they are arranged as shown on the drawing (fig. 8). Caudal stylets somewhat similar to those of *Ophiocamptus sarsii* (fig. 9).

Habitat.—Loch Lubnaig, Perthshire, altitude 405 feet above sea-level. Apparently rare.

Remarks.—This species, which somewhat resembles *Ophiocamptus sarsii* in general appearance, is at once distinguished from it by the form and armature of the fifth pair of thoracic feet, and, as a matter of fact, this forms its most marked characteristic. In most of the other characters it approaches very near to *Ophiocamptus sarsii.*

The species was described by G. O. Sars in 1862 as *Canthocamptus brevipes.* In 1893 it was re-described by Al. Mrazek under the new genus *Ophiocamptus* that he had instituted for the reception of this and one or two other aberrant forms of *Canthocamptus.* One of these others was *Canthocamptus gracilis*, Poppe (not the *Canthocamptus gracilis*, G. O. Sars), the name of which he changed to *Ophiocamptus sarsii.*

About the same time, the genus *Ophiocamptus* was instituted by Mrazek, a description of the genus *Moraria*, T. and A. Scott, was published in the Annals and Magazine of Natural History. It turned out afterwards that the characters of these two genera were found to be practically identical. I have not yet been able to ascertain satisfactorily which name was first published, and am therefore unable to say which has precedence of the other; in any case, the difference in the time of publication is not more than two or three months. Meantime, I have adopted Mrazek's *Ophiocamptus*,—leaving the question of priority to be settled afterwards.

Ostracoda.

Comparatively few Ostracoda were obtained in the lochs referred to in this paper. A few of them, however, may be noted here. *Cyclocypris globosa* (G. O. Sars) was obtained in St German's Loch, but in none of the others. *Candona rostrata*, Brady and Norman, and *Candona fabæformis* (Fischer), were both found in Possil Marsh, which appears to be a new station for them. *Candona Kingsleii*, B. and R., were obtained in Loch Cadha Mór, in Barra, and in Loch Skealtar, North Uist, and both are new stations for this species. *Darwinula Stevensoni*, B. and R., this interesting species was obtained in three lochs,—in Loch Doirlinn, Barra, Loch Skealtar, North Uist, and in Loch Lubnaig, Perthshire, which are all new stations for *Darwinula*.

Cladocera.

Several interesting species of Cladocera have been obtained in the lochs described in the preceding pages. *Sida crystallina* (Müller) was obtained in six of the lochs. *Bosmina longirostris* (Müller) was a comparatively common species, and the specimens varied greatly in size. In Plate II. figs. 22–25, I have shown figures of two specimens from two different localities: the larger measured ·84 mm. ($\frac{1}{30}$ of an inch), but the size of the smaller was only ·43 mm. ($\frac{1}{58}$ of an inch), yet the difference between them otherwise is very little, as shown by the drawings.

Latona setifera (Müller) was obtained in two of the Perthshire lochs—Lochan Lairig Eala and Loch Lubnaig, but in none of the others.

Holopidium gibberum, Zaddach, was only observed in one of the lochs—viz., Lochan a Chaite on Ben Lawers.

Drepanothrix dentata (Euren), was obtained in six of the lochs—in Lochan nam Faoileann (North and South), Barra; in the three lochs of North Uist; and in Loch Lubnaig, Perthshire.

Acantholeberis curvirostris (Müller). This fine species was obtained in seven localities—three in Barra, three in North Uist, and in Lochan Lairig Eala, Perthshire.

Leydigia quadrangularis (Leydig). This rare species was obtained in St German's Loch, which is the third station for it in Scotland; it appears to be quite distinct from its near ally, *Leydigia acanthocercoides*, Fischer, which I have not yet observed in any of the Scotch lochs.

Alona neglecta, n. sp., and *Alona rustica*, n. sp., are two species that are apparently undescribed. Descriptions and figures of them will be found at the end of the Report on the lochs of Shetland prepared by Robert Duthie, Fishery Officer, and myself. They are small species, and this may account for their apparent rarity in the gatherings from the lochs described in this paper. *Alona neglecta* was obtained in Loch Scadowa and Loch Skealtar in North Uist, and in Loch Lubnaig, Perthshire. *Alona rustica* was obtained in Loch Cadha Mór, Barra, and in Loch Scadowa, North Uist.

Ceriodaphnia reticulata (Jurine) is not unfrequent in Possil Marsh, but that is the only loch among those described in the present paper in which it was observed; its pectinate post-abdominal claw (Pl. X. fig. 10) appears to be a distinctive character.

Ceriodaphnia (?) *laticaudata*, P. E. Müller (Pl. X. figs. 11–14). This Ceriodaphnia, which appears to be of rare occurrence in Possil Marsh—the only loch in which it was observed—may belong to the comparatively common species *Ceriodaphnia rotunda* (Straus), but the figures of that species in C. L. Herrick's *Crustacea of Minnesota* shows the end of the post-abdomen to be evenly and boldy rounded, whereas the post-abdomen of the Possil Marsh specimens is subtruncate and angular (fig. 13). The few specimens obtained in Possil Marsh all agreed very closely in the form of the post-abdomen with the one figured.

Ceriodaphnia, sp. A. (Pl. X. figs. 15–17). This is a form from Bardowie Loch, near Glasgow, which may be *Ceriodaphnia quadrangula* (O. F. Müller), but the form of the post-abdomen differs somewhat from the post-abdomen of that species. It is considerably smaller than that of the last species.

Ceriodaphnia, sp. B. (Pl. X. figs. 18, 19). This *Ceriodaphnia* is from Scadowa Loch, North Uist. I am uncertain as to the species it belongs to. The post-abdomen is considerably narrower than that of *Ceriodaphnia* (?) *laticaudata*, and at the end it slopes more gradually and evenly downwards towards the claw, and in this respect it differs from the post-abdomen of *Ceriodaphnia*, sp. A.

Daphnia Jardinii, Baird (Pl. X. figs. 20, 21). Figs. 20 and 20A show two different forms of the head of this species from the same locality—St German's Loch. The posterio-distal angle of the head is more produced in fig. 20A than in the other specimen.

Note.—The drawings of Cladocera in Plate X. have been prepared by my daughter, Christina M. Scott. The drawings of the Copepoda are by my son, Andrew Scott, fisheries assistant, Liverpool.

DESCRIPTION OF THE PLATES.

Plate IX.

Eurytemora clausii (Hock).

Fig. 1. Fifth pair of thoracic feet—female, . . . × 200 diameters.

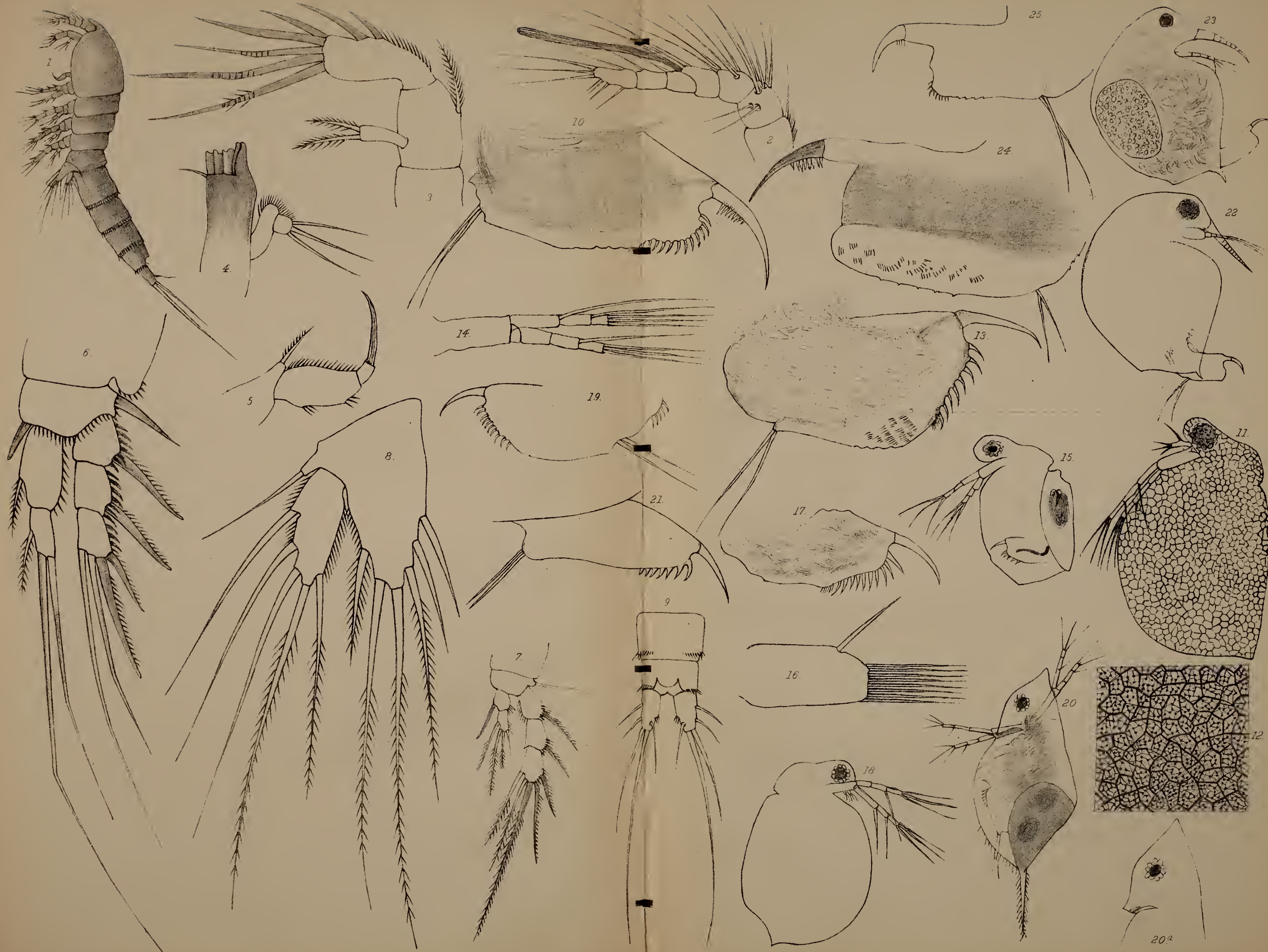
Attheyella Macandrewæ, n. sp.

Fig. 2.	Female—lateral view, ...	× 106	diameters.
Fig. 3.	Antennule—female, ...	× 506	,,
Fig. 4.	Antenna, ...	× 506	,,
Fig. 5.	Mandible and palp, ...	× 506	,,
Fig. 6.	Maxilla, ...	× 506	,,
Fig. 7.	Anterior foot-jaw, ...	× 506	,,
Fig. 8.	Posterior foot-jaw, ...	× 506	,,
Fig. 9.	Foot of first pair of swimming feet, . . .	× 506	,,
Fig. 10.	Foot of fourth pair, ...	× 380	,,
Fig. 11.	Foot of fifth pair, ...	× 506	,,
Fig. 12.	Last abdominal segments and caudal stylets, .	× 190	,,

PLATE IX.

Fig. 1, *C. Scott, del.*
The others, *A. Scott, del.*

Fig. 1.—*Eurytemora clausi* (Hock). Figs. 2-12.—*Attheyella MacAndrew*, n. sp. Figs. 13-26.—*Canthocamptus hirticornis*, n. sp.



Figs. 1-9, *A. S. del.*
The others, *C. S. del.*

Figs. 1-9.—*Ophiocamptus brevipes*, (G. O. Sars). Figs. 10-25.—*Cladocera*.

Canthocamptus hirticornis, n. sp.

Fig. 13.	Female—lateral view, ...	× 106 diameters.
Fig. 14.	Antennule—female, ...	× 506 ,,
Fig. 15.	Antennule—male, ...	× 506 ,,
Fig. 16.	Antenna, ...	× 506 ,,
Fig. 17.	Mandible and palp, ...	× 760 ,,
Fig. 18.	Maxilla, ...	× 760 ,,
Fig. 19.	Anterior foot-jaw, ...	× 760 ,,
Fig. 20.	Posterior foot-jaw, ...	× 760 ,,
Fig. 21.	Foot of first pair of swimming feet, . . .	× 380 ,,
Fig. 22.	Foot of fourth pair, ...	× 253 ,,
Fig. 23.	Foot of third pair—male, ...	× 506 ,,
Fig. 24.	Foot of fifth pair—female, ...	× 506 ,,
Fig. 25.	Foot of fifth pair—male, ...	× 760 ,,
Fig. 26.	Last abdominal segments and caudal stylets, .	× 190 ,,

Plate X.

Ophiocamptus brevipes (G. O. Sars).

Fig. 1.	Female—lateral view, ...	× 106 diameters.
Fig. 2.	Antennule—female, ...	× 506 ,,
Fig. 3.	Antenna, ...	× 760 ,,
Fig. 4.	Mandible and palp, ...	× 760 ,,
Fig. 5.	Posterior foot-jaw, ...	× 760 ,,
Fig. 6.	Foot of first pair of swimming feet, . . .	× 760 ,,
Fig. 7.	Foot of fourth pair, ...	× 380 ,,
Fig. 8.	Foot of fifth pair, ...	× 760 ,,
Fig. 9.	Last abdominal segments and caudal stylets, .	× 190 ,,

Cladocera.

Fig. 10.	*Ceriodaphnia reticulata* (Jurine), post-abdomen, .	× 200 diameters.
Fig. 11.	*Ceriodaphnia* (?) *laticaudata*, P. E. Müller, lateral view (from Possil Marsh), ...	× 63 ,
Fig. 12.	,, ,, portion of test highly magnified.	
Fig. 13.	,, ,, post-abdomen, . .	× 133 ,
Fig. 14.	,, ,, antenna, . .	× 66 ,,
Fig. 15.	*Ceriodaphnia*, sp. A., lateral view (from Bardowie Loch), ...	× 46 ,,
Fig. 16.	,, ,, antennule, . .	× 133 ,,
Fig. 17.	,, ,, post-abdomen, . .	× 133 ,,
Fig. 18.	*Ceriodaphnia*, sp. B., lateral view (from Loch Scadowa, North Uist), ...	× 63 ,,
Fig. 19.	,, ,, post-abdomen, . .	× 133 ,,
Fig. 20.	*Daphnia Jardinii*, Baird, lateral view (from St. German's Loch), ...	× 46 ,,
Fig. 20A.	,, ,, (another form from the same locality), ...	× 46 ,,
Fig. 21.	,, ,, post-abdomen, . .	× 133 ,,
Fig. 22.	*Bosmina longicornis* (Müller), lateral view, (from Barra), ...	× 48 ,,
Fig. 23.	,, ,, (a small form from N. Uist),	× 95 ,,
Fig. 24.	,, ,, post-abdomen (large form), .	× 133 ,,
Fig. 25.	,, ,, post-abdomen (small form),	× 300 ,,

VII.—LIST OF THE PELAGIC OVA, LARVÆ, AND YOUNG FISHES PROCURED BY THE s.s. 'GARLAND,' AND BOAT 'DALHOUSIE.' By H. Chas. Williamson, M.A., B.Sc., St Andrews Marine Laboratory.

The following lists contain a record of the ova and young fishes captured in the tow-nets of the 'Garland,' in the Firth of Forth and St Andrews Bay from January to June 1895, and in the Moray Firth in July 1894. The eggs were, in many cases, examined in the fresh condition. The collections from some stations were, however, preserved in a mixture, consisting of equal parts of methylated spirit (about 94 per cent.) and 2 per cent. acetic acid. Before preservation in the mixture, the ova were fixed with picro-hydrochloric acid (saturated solution of picric acid, in 5 per cent. solution of hydrochloric acid). The larvæ were preserved in spirit. While the classification of the live eggs is usually attended with comparatively little difficulty, it is by no means always easy to separate the ova after preservation. This difficulty is most felt in cases where the collection includes the eggs of different gadoids.* It is always possible to readily classify certain of the preserved ova, but there are usually a number of eggs which give rise to difficulty, either through unequal shrinkage, or from the obliteration of diagnostic features, such as pigment, markings on yolk, &c. The oil-globule present in certain eggs is of great service in the separation of the ova. The total number of eggs of any one species in a collection is, therefore, in the case of the preserved ova, approximate. The presence of the species recorded is certain; the exact number of the ova of any one species it is impossible to fix.

The tow-nets of the 'Garland' are usually down for two hours; on short stations, for a less period.

Plaice.—The earliest date on which ova were obtained in the tow-nets was 8th February, when two eggs of plaice were procured on Station VIII., Forth. On 6th March, the eggs of a number of other species were found on Station VIII., Forth. In addition to the ova of the plaice, the eggs of haddock, green cod (saithe), long-rough dab, and flounder were there obtained in fairly large numbers. The eggs of the plaice were found in the Forth until 23rd April, in varying numbers; in no collection were there more than fifteen eggs. In St Andrews Bay, the largest number of plaice ova (thirty-eight) was procured on Station II., on 14th March. The last date, upon which the tow-net was used in the bay during April, was the 8th. The ova of the plaice were found on that occasion.

Haddock.—The first egg of the haddock was obtained in the Forth, Station VII., on 11th February. They continued to appear in the tow-nets until 22nd April, on which date they were procured on Station IX. They were found in the greatest numbers on the 19th and 20th of March, when Stations V., VII., VIII., and IX. were examined.

Cod.—The ova of the cod were present in the tow-nets in greatest abundance in the month of April. They were first obtained on Station III., St Andrews Bay, on 14th March.

Whiting.—The ova of the whiting were found in great numbers on the stations of the Forth, especially so during the month of April. The first ova of this species were obtained on Station II., St Andrews Bay, on 14th March. They were very common during April and May.

* *Vide* "On the Variation in Size of certain Pelagic Ova." *Thirteenth Report Scottish Fishery Board*, p. 271.

Three ova of whiting were taken on 4th June, on Station VI., St Andrews Bay.

Green Cod (*Saithe*).—The ova of the green cod were found in a collection of ova procured on Station VIII., Forth, on 6th March. An egg of this form had been found in the tow-net of the 'Dalhousie,' in St Andrews Bay, on 1st March. The last occasion on which they appeared in the tow-nets of the 'Garland,' was on 16th April, on Station II., St Andrews Bay.

Sprat.—The eggs of the sprat were found in great abundance. First, procured in 17th April, Station II., Forth, they were obtained in the tow-nets on every station examined after that date, both in the Forth and St Andrews Bay.

Dab.—The ova of the dab were exceedingly common. A few were obtained in March, the first on 6th March, Station VIII., Forth. They were procured in large numbers during April and May, and were also found in the collections made in the beginning of June. During the period over which the tow-nets were used this year, the ova of the dab were obtained on more occasions than the eggs of the sprat, but the latter when present, usually greatly exceeded the number of the eggs of the dab found in the collection.

Turbot.—The eggs of the turbot were first obtained this year on Stations VII. and IX., Forth, on 28th May. They were found in St Andrews Bay during the first week of June.

Gurnard.—The ova of the gurnard were first met with this season on Station II., Forth, on 31st May, and from that date onwards were fairly common.

Long Rough Dab.—The eggs of this form were very common during March and April. They were not found in so large numbers as in March 1894. On 29th March 1894, on Station V., Forth, about 2000 eggs were obtained, while, on 20th March 1895, on the same station, 270 ova were obtained.

Flounder.—The eggs of the flounder were found in most of the tow-net collections during April, May, and June.

Dragonet.—The ova of the dragonet have been found on only one occasion this season, on 6th June, on Stations III. and IV., St Andrews Bay.

Motella (sp.).—The eggs of the rockling were abundant on all the stations during March, April, May, and June.

Solenette.—The egg of the solenette was captured on three occasions during April, by the 'Dalhousie,' in St Andrews Bay.

The absence of the ova of certain fishes, the main spawning periods of which are slightly later in the season than the fishes whose ova are recorded in the detailed list, is partially explained by the fact that the examination of the Forth and St Andrews Bay Stations by means of the tow-net ceased with 6th June.

Larvæ and Young Fishes.

The larval and post-larval fishes most commonly captured in the tow-nets were cottoids and sand-eels. On 27th December 1894, a rockling, 10 mm. long, was taken in the surface tow-net on Station III., Forth.

Of the food-fishes, pleuronectids were most frequently met with. On 9th February, a dab, 3·9 cm. long, was found in the tow-net on Station V., Forth. Small pleuronectids, 5–10 mm. in length, were procured, on 20th March, on Station V., Forth. During April and May post-larval flat-fish were common.

Post-larval clupeoids were captured in March and May.

A young example of the common eel, 7 cm. long, was got in the M'Intosh net, in Inverkeithing Bay, Firth of Forth, on 1st March.

The young forms of the gunnel, pogge, rockling, Montagu's sucker, lumpsucker, goby, and wolf-fish were captured on several occasions.

List of the Eggs and Young Fishes found in the Tow-Nets of the 'Garland.'

Firth of Forth—Station III. — 27th December 1894. — Surface. Post-Larval Fish; *Motella* (sp.), 10 mm.

— Station V.—9th February 1895.—Bottom. Young Fishes; dab, 39 mm.; goby, 33·5 mm.

— Station VII. — 11th February 1895. — Surface. 1 egg of haddock.

— Station VIII. — 8th February 1895. — Surface. 2 eggs of plaice.

— —— Bottom. Larvæ; Larval wolf-fish, 21·5 mm.

— Station IX.—12th February 1895.—Surface. 3 eggs of plaice; 1 egg of haddock.

— Station VIII.—6th March 1895.—Surface and bottom. 15 eggs of plaice (early to ¾ round); 45 eggs of haddock; 72 eggs of green cod (well-advanced); 2 eggs of dab; 20 eggs of long rough dab; 27 eggs of flounder; 2 eggs of *Motella* (sp.) (early).

— From Isle of May to Carr Lightship.—7th March 1895.—Surface and bottom. 1 egg of plaice; 2 eggs of green cod.

— —— Larvæ. 3 wolf-fish, 20 mm.; *Cottus*, 7·5 mm.

— From Carr Lightship to Barbertness.—7th March 1895.—Surface and bottom. 1 egg of plaice; 18 eggs of haddock; 17 eggs of green cod; 1 egg of dab; 2 eggs, resembling egg of turbot; 1 egg of long rough dab; 7 eggs of flounder; 7 eggs of *Motella* (sp.).

— —— Post-Larval Fishes. Clupeoid, 29 mm.; 3 sand-eels, 8·5 mm.

St Andrews Bay—Station II.—14th March 1895.—Surface. 38 eggs of plaice; 204 eggs of haddock; 2 eggs of whiting; 1 egg of green cod; 2 eggs of dab; 131 eggs of long rough dab; 107 eggs of flounder; 131 eggs of *Motella* (sp.).

— Station II.—14th March 1895.—Bottom. 2 eggs of *Motella*. Young Fish; goby, 3 cm.

— Station III.—14th March 1895.—Surface. 1 egg of plaice; 4 eggs of cod; 1 egg of dab; 1 egg of long rough dab; 37 eggs of flounder; 13 eggs of *Motella* (sp.).

— Station IV.—14th March 1895.—Surface. 6 eggs of plaice; 6 eggs of cod; 5 eggs of dab; 61 eggs of flounder; 7 eggs of *Motella* (sp.).

— —— Bottom. 1 egg of plaice. Fish; sprat, 8 cm.

— Station V.—13th March 1895.—Surface. 22 eggs of plaice; 2 eggs of dab; 8 eggs of long rough dab; 58 eggs of flounder; 6 eggs of *Motella* (sp.).

— —— Bottom. 1 egg of long rough dab; 1 egg of flounder.

Forth—Station V.—20th March 1895.—Mid-water. 4 eggs of plaice; 174 eggs of haddock; 1 egg of green cod; 3 eggs of dab; 270 eggs of long rough dab; 18 eggs of flounder; 12 eggs of *Motella* (sp.).

— —— Young Fishes; Clupeoid, 25 mm.; 4 pleuronectids, 5–10 mm.; gunnel, 13 mm.

— Station V.—20th March 1895.—Bottom. 1 egg of whiting; 1 egg of flounder.

St Andrews Bay.—Station VI.—20th March 1895.—Surface. 8 eggs of plaice; 31 eggs of haddock; 1 egg of green cod; 1 egg of dab; 40 eggs of long rough dab; 9 eggs of flounder; 228 eggs of *Motella* (sp.).

— —— Bottom. 1 egg of haddock. Larva; *Cottus*, 5 mm.

— Stations VIII. and IX.—19th March 1895.—Surface. 132 eggs of haddock; 3 eggs of cod; 18 eggs of whiting; 6 eggs of green cod; 3 eggs of dab; 192 eggs of long rough dab; 15 eggs of flounder; 9 eggs of *Motella* (sp.).

— —— Bottom. 15 eggs of haddock; 5 eggs of whiting; 1 egg of green cod; 3 eggs of long rough dab; 10 eggs of flounder; 1 egg of *Motella* (sp.).

— Station VII.—311 eggs of haddock; 6 eggs of cod; 4 eggs of whiting; 4 eggs of green cod; 582 eggs of long rough dab; 6 eggs of flounder; 30 eggs of *Motella* (sp.).

Inverkeithing Bay, Inside.—1st March 1895. — M'Intosh net. Young Fishes; young common eel (*Anguilla vulgaris*), 7 cm.; 18 clupeoids, 34–42 mm.

Inverkeithing Bay, Outside. — 1st March 1895. — Seine-net. Young Fishes; 14 clupeoids, 34–41 mm.

From Prestonpans to Middle of Firth of Forth.—5th April 1895.—Surface. Live Eggs—2 eggs of haddock; 32 eggs of cod; 1 egg of whiting; 2 eggs of dab; 4 eggs of long rough dab. Dead Eggs—27 eggs of plaice and long rough dab (mainly long rough dab); 123 eggs of cod and haddock (mainly cod); 30 eggs of dab; 2 eggs of green cod (?); 10 eggs of flounder; 47 eggs of *Motella* (sp.). The eggs, with the exception of a few eggs of flounder, dab, and *Motella* (sp.), were well advanced, about ready to hatch.

— —— Bottom. Live Eggs—12 eggs of cod (well advanced); 1 egg of dab (early); 1 egg of long rough dab. Dead Eggs—3 eggs of plaice; 57 eggs of cod (this collection may contain one or two eggs of haddock); 57 eggs of dab and flounder (mainly dab); 3 eggs of long rough dab; 12 eggs of *Motella* (sp.).

St Andrews Bay—Station I.—10th April 1895.—Bottom. 1 egg of plaice; 3 eggs of cod; 4 eggs of *Motella* (sp.).

— Station II.—10th April 1895.—Bottom. 2 eggs of plaice; 4 eggs of haddock; 5 eggs of cod; 3 eggs of whiting; 1 egg of green cod; 1 egg of flounder.

— —— Fishes; 2 *Agoni*, 5·4 mm.; 2 sand-eels, 4·5 and 8 mm.

— Station III.—10th April 1895.—Surface. 1 egg of plaice; 1 egg of haddock; 32 eggs of cod; 3 eggs of flounder; 2 eggs of *Motella* (sp.).

— —— Larvæ; 2 sand-eels, 2·7 and 5·4 mm.

— —— Bottom. 1 egg of plaice; 5 eggs of cod; 2 eggs of flounder.

— —— Larval and Post-Larval Fishes; 10 *Agoni*, 5·5–5·8 mm.; 3 sand-eels, 2·5, 4·9, 5·4 mm.

— Station IV.—10th April 1895.—Surface. 2 eggs of plaice; 21 eggs of haddock; 76 eggs of cod; 4 eggs of whiting; 19 eggs of dab; 100 eggs of flounder; 10 eggs of *Motella* (sp.).

— —— Fishes; flounder, 3 mm.; 2 sand-eels, 5 and 8·25 mm.

— Station V.—8th April 1895.—Surface. 3 eggs of plaice; 40 eggs of whiting; 1 egg of long rough dab.

— —— Post-Larval Fishes; 3 pleuronectids, 8–13 mm.; 2 sand-eels, 5, 11 mm.; 3 *Agoni*, 5·5 mm.; 7 *Cotti*, 5–6·5 mm.

Firth of Forth—Station I. — 17th April 1895.—Surface. Post-Larval Fishes; pleuronectid, 12 mm.; gadoid, 8 mm.; 31 *Cotti*, 6–7 mm.; 3 sand-eels, 7–11 mm.

— Station II.—18th April 1895.—Surface. 19 eggs of plaice; 1142 eggs of whiting; 860 eggs of sprat; 383 eggs of dab; 390 eggs of long rough dab; 380 eggs of poor cod; 191 eggs of flounder; 1035 eggs of *Motella* (sp.).

— —— Post-Larval Fishes; pleuronectid, 9 mm.; gadoid, 5·5 mm.; 22 *Cotti*, 6·5–7 mm.; 3 gunnels, 11–14 mm.

— —— Bottom. Post-Larval Fishes; 2 pleuronectids, 6·5 and 8 mm.; 2 gadoids, 6 mm.; 2 sand-eels, 5·5 and 7 mm.

— Station III.—17th April 1895.—Surface. 1 egg of haddock; 9 eggs of whiting; 14 eggs of sprat; 71 eggs of dab; 112 eggs of *Motella* (sp.).

— —— Post-Larval Fishes; 3 pleuronectids, 13 mm.; 2 gadoids, 6·5 mm.; 120 *Cotti*, 5·5–7·5 mm.; 12 sand-eels, 5·5–12 mm.; 2 gunnels, 10 mm.

— Station V.—23rd April 1895.—Surface. 7 eggs of plaice; 2010 eggs of whiting; 763 eggs of sprat; 511 eggs of dab; 930 eggs of *Motella* (sp.).

— —— Larval and Post-Larval Fishes; 27 gadoids, 4–8 mm.; 28 *Cotti*, 5·5–7 mm.; 9 sand-eels, 5–14 mm.; gunnel, 9 mm.

— —— Bottom. Larval and Post-Larval Fishes; gadoid, 5·5 mm.; 7 Montagu's suckers, 4–6·5 mm.; *Cottus*, 6 mm.; 2 *Agoni*, 6·5 and 10 mm.

— Station VI.—23rd April 1895.—Surface. 161 eggs of cod; 1500 eggs of whiting; 334 eggs of sprat; 268 eggs of dab; 64 eggs of long rough dab; 15 eggs of poor cod; 1194 eggs of *Motella* (sp.).

— —— Post-Larval Fishes; 7 pleuronectids, 6–7 mm.; 85 gadoids, 6–10 mm.; 16 *Cotti*, 5–10 mm.; 161 sand-eels, 7·5–11·5 mm.

— Station VII.—19th April 1895.—Surface. 1 egg of plaice; 114 eggs of whiting; 82 eggs of sprat; 26 eggs of dab; 14 eggs of long rough dab; 6 eggs of flounder; 57 eggs of *Motella* (sp.).

— —— Post-Larval Fishes; 4 *Cotti*, 5–6·5 mm.; 3 sand-eels, 7·5–10 mm.

— —— Bottom. Post-Larval Fishes; gadoid, 4·5 mm.; 3 *Agoni*, 5 mm.; 2 sand-eels, 6·5 mm.

— —— 22nd April 1895.—Surface. 2811 eggs of whiting; 1383 eggs of sprat; 1567 eggs of dab; 90 eggs of long rough dab; 775 eggs of poor cod; 249 eggs of flounder; 1364 eggs of *Motella* (sp.).

— —— Station VIII. — 22nd April 1895. — Surface. An aggregate of about 2066 eggs of haddock, cod, whiting, dab, and *Motella* (sp.); with a few eggs of sprat.

— —— Post-Larval Fishes; pleuronectid, 7 mm.; 173 gadoids, 4·5–8·5 mm.; 216 *Cotti*, 4·75–7·5 mm.; 3 gunnels, 9–11 mm.; 98 sand-eels, 7–15 mm.

— Station IX.—22nd April 1895.—Surface. 10 eggs of haddock; 1405 eggs of whiting; 183 eggs of sprat; 192 eggs of dab; 5 eggs of poor cod; 123 eggs of *Motella* (sp.).

— Station I.—22nd May 1895.—Surface. 210 eggs of whiting; 1134 eggs of sprat; 399 eggs of dab; 672 eggs of poor cod; 840 eggs of *Motella* (sp.).

— —— Bottom. Larval and Post-Larval Fishes; 3 pleuronectids, 5–11 mm.; clupeoid, 14 mm.; Montagu's sucker, 2·25 mm.; 4 *Cotti*, 2·7–4·5 mm.; goby, 2·7 mm.

— Station II.—31st May 1895.—Surface. 252 eggs of gurnard; 3220 eggs of sprat; 56 eggs of turbot; 203 eggs of dab; 140 eggs of poor cod; 224 eggs of flounder; 196 eggs of *Motella* (sp.).

— —— Post-Larval Fishes; 4 pleuronectids, 5·5–8 mm.; 2

clupeoids, 8·75 and 9 mm.; 8 sand-eels, 6–12 mm.; 3 rocklings, 4·5–5 mm.

FIRTH OF FORTH—STATION III.—22nd May 1895.—Surface. 12 eggs of whiting; 3800 eggs of sprat; 300 eggs of dab; 700 eggs of *Motella* (sp.).

— —— (Second Collection). 88 eggs of gurnard; 40 eggs of whiting; 2667 eggs of sprat; 187 eggs of dab; 44 eggs of poor cod; 154 eggs of flounder; 662 eggs of *Motella* (sp.).

— STATION IV.—21st May 1895. — Surface. 7 eggs of sprat; 1 egg of weever (?).

— —— Bottom. POST-LARVAL FISHES; 3 pleuronectids, 8–9 mm.

— STATION V.—29th May 1895.—Surface. 22 eggs of gurnard; 15 eggs of sprat; 5 eggs of turbot; 40 eggs of dab; 9 eggs of poor cod; 15 eggs of flounder; 265 eggs of *Motella* (sp.).

— —— POST-LARVAL FISHES; gadoid, 7·5 mm.; 2 Montagu's suckers, 4·5 mm.

— —— Bottom. POST-LARVAL FISHES; 6 clupeoids, 5–6·5 mm.; Montagu's sucker, 5 mm.

— STATION VI.—29th May 1895.—Surface. 2 eggs of gurnard; 6 eggs of sprat; 1 egg of dab; 32 eggs of *Motella* (sp.).

— STATION VII.—28th May 1895.—Surface. 125 eggs of gurnard; 18 eggs of whiting; 20 eggs of ling (?); 1400 eggs of sprat; 25 eggs of turbot; 73 eggs of dab; 240 eggs of poor cod; 255 eggs of *Motella* (sp.).

— —— Bottom. LARVAL and POST-LARVAL FISHES; 3 pleuronectids, 4·5–9 mm.; 3 Montagu's suckers, 4·5–5·8; goby, 5 mm.; 2 *Cotti*, 4·5 mm.

— STATION VIII.—28th May 1895.—Surface. 16 eggs of gurnard; 10 eggs of whiting; 95 eggs of sprat; 92 eggs of dab; 48 eggs of poor cod; 207 eggs of *Motella* (sp.).

— —— LARVAL AND POST-LARVAL FISHES; gadoid, 4 mm.; 4 rocklings, 3·5–6 mm.; 2 sand-eels, 6 and 7 mm.

— —— Bottom. POST-LARVAL FISHES; 2 pleuronectids, 8 and 8·5 mm.; pogge, 18·5 mm.; rockling, 4 mm.; 5 Montagu's suckers, 2·5–5·5.

— STATION IX.—28th May 1895.—Surface. 27 eggs of gurnard; 9 eggs of whiting; 1260 eggs of sprat; 9 eggs of turbot; 81 eggs of dab; 371 eggs of poor cod; 540 eggs of *Motella* (sp.).

— —— LARVÆ; gadoid, 3·25 mm.

ST ANDREW'S BAY—STATION II.—6th June 1895.—Surface. 33 eggs of gurnard; 439 eggs of sprat; 7 eggs of turbot; 65 eggs of dab; 6 eggs of poor cod; 3 eggs of dragonet; 13 eggs of *Motella* (sp.).

— —— Bottom. 10 eggs of sprat; 1 egg of poor cod; 1 egg of flounder.

— — LARVÆ; gadoid, 3 mm.

— STATION III.—6th June 1895.—Surface. 25 eggs of gurnard; 250 eggs of sprat; 65 eggs of dab; 5 eggs of dragonet; 20 eggs of *Motella* (sp.).

— —— POST-LARVAL FISHES; gadoid (injured), about 4 mm.; sand-eel, 7 mm.

— —— Bottom. 3 eggs of gurnard; 39 eggs of sprat; 1 egg of dab; 9 eggs of dragonet; 2 eggs of *Motella* (sp.).

— STATION IV.—6th June 1895.—Surface. 12 eggs of gurnard; 57 eggs of sprat; 1 egg of turbot; 12 eggs of dab; 1 egg of dragonet; 5 eggs of *Motella* (sp).

— POST-LARVAL FISH; pleuronectid, 12·8 mm.

— —— Bottom. LARVAL AND POST-LARVAL FISHES; 6 pleuronectids, 6–7 mm; gadoid, 3 mm.; lumpsucker, 5·5 mm.

— Station V.—4th June 1895.—Surface. 15 eggs of gurnard; 23 eggs of sprat; 21 eggs of dab; 2 eggs of poor cod; 12 eggs of *Motella* (sp.).

— —— Larval and Post-Larval Fishes; pleuronectid, 9·5 mm.; young cod, 16·5 mm.; gadoid, 3·5 mm.

— —— Bottom. 9 eggs of gurnard; 20 eggs of sprat; 2 eggs of turbot; 7 eggs of dab; 5 eggs of poor cod; 1 egg of flounder; 3 eggs of *Motella* (sp.).

— Station VI.—4th June 1895.—Surface. 40 eggs of gurnard; 6 eggs of cod; 3 eggs of whiting; 46 eggs of sprat; 13 eggs of turbot; 12 eggs of dab; 23 eggs of poor cod; 70 eggs of *Motella* (sp.).

— —— Bottom. 4 eggs of sprat; 2 eggs of *Motella* (sp.).

List of the Eggs and Young Fishes from the Tow-Nets of the Boat 'Dalhousie.'

St Andrews Bay.

The tow-nets of the 'Dalhousie' are usually down for about 20 minutes.

1st March 1895.—1 egg of saithe.

13th March 1895.—5 eggs of flounder.

14th March 1895.—6 eggs of flounder.

18th March 1895.—1 egg of long rough dab; 8 eggs of flounder.

19th March 1895.—2 miles north of pier.—1 egg of haddock; 1 egg of dab; 1 egg of long rough dab; 23 eggs of flounder.

5th April 1895.—Half-mile north west of pier.—Surface. 16 eggs of haddock; 4 eggs of cod; 1 egg of dab; 1 egg of sprat (?); 1 egg of long rough dab; 9 eggs of flounder; 4 eggs of *Motella* (sp.).

— — Mid-water, 3 eggs of haddock.

About 1 Mile East of Pier.—8th April 1895.—Surface. 16 eggs of haddock; 19 eggs of cod; 1 egg of sprat; 6 eggs of dab; 2 eggs of long rough dab; 23 eggs of flounder; 6 eggs of *Motella* (sp.).

Larval sand-eel, 3·6 mm.

— —— Bottom. 1 egg of haddock; 1 egg of cod; 1 egg of *Motella* (sp.).

1½ Mile North of Pier.—12th April 1895.—Surface. No eggs. 1 sand-eel, 4 mm.

— —— Bottom. Post-Larval Fishes; pleuronectid, 10 mm.; pleuronectid (long rough dab (?)), 4 mm.; *Cottus*, 6·5 mm.; 17 sand-eels, 4–4·5 mm.

1½ Mile North of Pier.—13th April 1892.—Surface. 28 eggs of haddock; 20 eggs of cod; 4 eggs of dab; 10 eggs of long rough dab; 58 eggs of flounder; 3 eggs of solenette; 338 eggs of *Motella* (sp.).

— —— Bottom. Larval and Post-Larval Fishes; *Agonus*, 8 mm.; 2 sand-eels, 4·5 mm.

1 Mile East of the Pier.—18th April 1895.—Surface. A good number of eggs consisting mainly of *Motella* (sp.), with a few eggs of cod (1); whiting (2); dab (1); flounder (3); long rough dab (2).

— —— Bottom. Post-Larval Fish; sand-eel, 6 mm.

1½ Mile North of the Pier.—19th April 1895.—Surface. 4 eggs of dab; 36 eggs of *Motella* (sp.). Larva; sand-eel, 4·5 mm.

— —— Bottom. Larval and Post-Larval Fishes; pleuronectid, 8·5 mm.; 6 *Agoni*, 2·9–4·5 mm.; sand-eel, 4·6 mm.

Half-way between Eden Mouth and Pier.—20th April 1895.—Surface. 2 eggs of dab; 2 eggs of flounder; 17 eggs of *Motella* (sp.).

2 Miles East of the Pier.—22nd April 1895.—Surface. 3 eggs of cod; 1 egg of sprat; 3 eggs of dab; 3 eggs of flounder; 8 eggs of solenette; 13 eggs of *Motella* (sp.).

2 Miles off East Pier.—Bottom. Larval cod (just hatched); sand-eel, 7 mm.

Off Kinkell Point.—23rd April 1895.—Surface. 2 eggs of sprat; 2 eggs of *Motella* (sp.).

— —— Bottom. Post-Larval Fishes; gadoid, 4·5 mm.; 3 sand-eels, 5·8 mm.

2 Miles East by South of the Pier.—24th April 1895.—Surface. 1 egg of cod; 1 egg of whiting; 1 egg of gurnard; 5 eggs of sprat; 18 eggs of dab; 1 egg of poor cod; 16 eggs of flounder; 1 egg of solenette; 39 eggs of *Motella* (sp.), eggs early.

Half Mile East of Pier.—25th April 1895.—Surface. 1 egg of flounder; 3 eggs of *Motella* (sp.), early.

— —— Bottom. Post-Larval Fish; sand-eel, 7·5 mm.

Off Boarhills.—29th April 1895.—Surface. 1 egg of plaice; 1 egg of cod; 5 eggs of whiting; 5 eggs of sprat; 5 eggs of dab; 5 eggs of flounder; 44 eggs of *Motella* (sp.), eggs early.

— —— Bottom. 1 egg of sprat; 1 egg of dab; 1 egg of *Motella* (sp.).

One Mile North of Pier.—2nd May 1895.—Surface. 3 eggs of gurnard; 1 egg of haddock; 57 eggs of sprat; 5 eggs of dab; 22 eggs of *Motella* (sp.).

One Mile North of Pier.—3rd May 1895.—Surface. 2 eggs of gurnard; 1 egg of whiting; 9 eggs of sprat; 2 eggs of dab; 3 eggs of flounder; 29 eggs of *Motella* (sp.).

Two Miles East of Pier.—4th May 1895.—Surface. 5 eggs of gurnard; 13 eggs of sprat; 1 egg of flounder; 12 eggs of *Motella* (sp.).

Two Miles North East of Pier.—6th May 1895.—Surface. 2 eggs of whiting; 1 egg of sprat; 9 eggs of dab; 5 eggs of poor-cod; 5 eggs of flounder; 42 eggs of *Motella* (sp.).

— —— Bottom. 2 eggs of sprat; 4 eggs of dab; 1 egg of poor-cod; 1 egg of flounder; 6 eggs of *Motella* (sp.).

One Mile and a Half North of Pier.—20th May 1895.—Bottom. 1 egg of sprat; 1 egg of *Motella* (sp.).

— —— Larvæ; gadoid, 2·5 mm.; sand-eel, 3 mm.

Off Kinkell Ness.—22nd May 1895.—Bottom. 1 egg of dab.

Two Miles East of Pier.—23rd May 1895.—Bottom. 4 eggs of gurnard; 66 eggs of sprat; 1 egg of turbot; 2 eggs of dab; 4 eggs of *Motella* (sp.).

Off Kinkell Ness.—25th May 1895.—Surface. 33 eggs, consisting of eggs of sprat, dab, and *Motella* (sp.).

From Kinkell Ness to Beacon.—27th May 1895.—Bottom. 1 egg of gurnard; 3 eggs of sprat; 1 egg of dab.

Two Miles East of Pier.—3rd June 1895.—Surface and Bottom. 1 egg of gurnard; 57 eggs of sprat; 3 eggs of dab; 3 eggs of *Motella* (sp.).

TABLE SHOWING THE NUMBERS OF OVA OBTAINED BY THE 'GARLAND' ON THE STATIONS OF THE FIRTH OF FORTH AND ST ANDREWS BAY.

	Firth of Forth.					St Andrew's Bay.				Firth of Forth.				
	Feb.		March.			March.				March.				April.
Date.	8	11	6	7	7	13	14	14	14	19	19	20	20	5
Station.	VIII.	VII.	VIII.	May to Carr.	Carr to Barbertness.	V.	II.	III.	IV.	VII	VIII. and IX.	V.	VI.	Prestonpans to Mid. of Forth.
Species.														
Plaice, .	2	..	15	1	1	22	38	1	7	..	..	4	8	12
Haddock, .	..	1	45	..	18	..	204	..	..	311	147	174	32	50
Cod, . .	..	..	..	..	..	..	..	4	6	6	3	..	..	170
Whiting, .	..	..	..	..	..	..	2	..	..	4	23	1	..	..
Green cod,	..	..	72	2	17	..	1	..	..	4	7	1	1	..
Gurnard, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sprat, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Turbot, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dab, . .	..	..	2	..	1	2	2	1	5	..	3	3	1	60
Long rough dab, .	..	..	30	..	1	9	131	1	..	582	195	270	40	30
Poor cod, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Flounder, .	..	..	27	..	7	59	107	37	61	6	25	19	9	12
Dragonet, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Motella (sp.)	..	..	2	..	7	6	133	13	7	30	10	12	228	60

	St Andrews Bay.					Firth of Forth.							
	April.					April.							
Date.	8	10	10	10	10	18	17	19	22	22	22	23	23
Station.	V.	I.	II.	III.	IV.	II.	III.	VII.	VII.	VIII.	IX.	V.	VI.
Species.		B.	B.										
Plaice, .	3	1	2	2	2	19	..	1	..	*	..	7	..
Haddock, .	..	..	4	1	21	..	1	..	..	..	10	..	..
Cod, . .	..	3	5	37	76	..	..	..	..	..	..	..	161
Whiting, .	40	..	3	..	4	1142	9	114	2811	..	1405	2010	1500
Green cod,	..	..	1	..	..	..	..	..	..	..	..	..	..
Gurnard, .	..	..	..	..	..	..	..	..	..	..	..	..	..
Sprat, .	..	..	..	..	..	860	14	82	1383	..	183	763	334
Turbot, .	..	..	..	..	..	..	..	..	..	..	..	..	..
Dab, . .	..	..	..	..	19	383	71	26	1567	..	192	511	268
Long rough dab, .	1	..	..	..	..	390	..	14	90	..	..	..	64
Poor cod, .	..	..	..	..	..	380	..	..	775	..	5	..	15
Flounder, .	..	..	1	7	100	191	..	6	249	..	..	..	..
Dragonet, .	..	..	..	..	..	..	..	..	..	..	..	..	..
Motella (sp.)	..	4	..	2	10	1035	112	..	1364	..	123	930	1194

	Firth of Forth.										St Andrews Bay.				
	May.										June.				
Date.	21	22	22	22	28	28	28	29	29	31	4	4	6	6	6
Station.	IV.	I.	III.	III.	VII.	VIII.	IX.	V.	VI.	II.	V.	VI.	II.	III.	IV.
Species.															
Plaice, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haddock, .	..	..	..	..	...	..	..	..	..	..	..	..	..	..	..
Cod, . .	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..
Whiting, .	..	210	12	40	18	10	9	..	..	..	..	3	..	..	..
Green cod,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gurnard, .	..	..	..	88	125	16	27	22	2	252	24	40	33	28	12
Sprat, .	7	1134	3800	2667	1400	95	1260	15	6	3220	43	50	449	280	57
Turbot, .	..	..	..	..	25	..	9	5	..	56	2	13	7	..	1
Dab, . .	..	399	300	187	73	92	81	40	1	203	28	12	65	66	12
Long rough dab, .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poor cod, .	..	672	..	44	240	48	371	9	..	140	7	23	7	..	..
Flounder, .	..	..	..	154	..	..	..	15	..	224	1	..	1	..	..
Dragonet, .	..	..	..	..	..	..	..	..	..	..	..	..	3	14	1
Motella (sp.)	..	840	700	662	255	207	540	265	32	196	15	72	13	22	5

* The tow-net on this station contained an aggregate of about 2050 ova, consisting of the eggs of haddock, cod, whiting, dab, and *Motella* (sp.), with a few eggs of sprat. In the above table the ova procured in surface and bottom nets are added together. The columns marked thus (B.) contain only the contents of the bottom-net.

Moray Firth.

In July 1894 very few eggs of fishes were found by the 'Garland' in the Moray Firth, and these belonged to a small number of species. This fact was one to be expected, as the spawning seasons of most of the food-fishes were over. The eggs most commonly met with were those of the gurnard, lemon dab, dab, and Müller's topknot, with occasionally the eggs of the turbot, cod, flounder, and solenette. The eggs of the weever, bib, poor cod, and rockling were found on a few stations. On all the stations, except Stations II. and VIII., the eggs of the gurnard were procured. The eggs of the dab were plentiful on Stations IV. and V., but were found in small numbers on the remaining stations. The numbers of eggs obtained on the different stations are shown in the accompanying Table. In addition to the ova of fishes, numbers of hydromedusae, larval annelids, crustaceans, and mollusks, and a few larval fishes were obtained.

During May 1893, the eggs of the following fishes were obtained in the Moray Firth:—Long rough dab, plaice, gurnard, brill, haddock, bib, whiting, witch, lemon dab, green cod, poor cod, cod, ling, turbot, sprat, flounder, dab, and rockling. All the eggs, with the exception of those of long rough dab, bib, poor cod, and rockling, were the eggs of food-fishes. At that time most of the food-fishes were spawning. The eggs of the plaice were still got. The eggs of the gurnard were found in large numbers. A good number of the eggs of haddock, whiting, green cod, cod, and lemon dab were captured. The eggs of the gurnard were most common. On most of the stations the eggs of turbot, sprat, and flounder were obtained. The eggs of the dab were plentiful, though they were not found in such profusion as those of the gurnard.

In July 1894, the eggs of the following food-fishes were met with in the Moray Firth:—Gurnard, megrim, lemon dab, cod, turbot, flounder, and dab. No eggs of the plaice, brill, haddock, whiting, witch, green cod, ling, or sprat were obtained.

TABLE showing the number of Fish Ova obtained in the Moray Firth during July 1894:—

Station.	Gurnard.	Greater Weever.	Lesser Weever.	Megrim.	Müller's Topknot.	Lemon Dab.	Cod.	Bib.	Poor Cod.	Turbot.	Flounder.	Dab.	*Motella* (sp.).	Solenette.
I.	1	1	.	.	5	1	.	4	5	5	.	5	3	3
II.	.	.	1	.	2	.	.	.	.	.	.	5	6	11
III.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
IV.	33	5	5	.	6	1	13	.	.	.	47	172	94	22
V.	27	.	.	.	8	.	3	.	.	2	2	125	2	.
VI.	4	13	13	.	2	3	3	.	.	.	.	27	9	.
VII.	1	4	4	.	19	4	3	15	.	1	2	10	.	.
VIII.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
IX.	32	.	.	24	42	11	5	.	.	4	.	5	2	.
X.	16	.	.	.	1	1	.	.	.	.	.	2	.	.
XI.	29	.	.	.	.	9	2	.	.	.	.	1	.	.
XII.	60	.	.	.	.	28	4	.	.	3	.	4	.	.
XIII.	52	.	.	.	.	9	.	.	.	.	.	14	.	.
XIV.	5	.	.	.	8	9	.	.	.	6	.	8	1	.
XV.	33	.	.	.	4	17	.	.	.	.	.	.	.	.
XVI.	36	.	.	.	.	12	1	.	.	5	.	3	3	.
	329	23	23	24	97	105	34	19	5	26	51	383	120	36

List of Ova and Larvæ collected by the 'Garland.' *

Moray Firth.

Station I.—Surface, 3rd July 1894. 1 egg of gurnard; 1 egg of greater weever; 1 egg of lemon dab; 4 eggs of Müller's topknot; 4 eggs of bib; 1 egg of torsk (?); 5 eggs of poor cod; 5 eggs of turbot; 14 eggs of turbot; 2 eggs of *Motella* (sp.); 2 eggs of solenette.

— . Bottom. 1 egg of Müller's topknot; 1 egg of dab; 1 egg of *Motella* (sp.); 1 egg of solenette.

Larvæ—Station I.—Surface. 2 larval solenettes, 2 mm.

,, Bottom. Gadoid, 2·25 mm.

Station II.—Surface, 3rd July 1894. 1 egg of plaice (?); 1 egg of lesser weever; 2 eggs of Müller's topknot; 5 eggs of dab; 5 eggs of *Motella* (sp.); 11 eggs of solenette.

— . Bottom. 1 egg of *Motella* (sp.).

Post-Larval Fish—Station II.—Surface. Lumpsucker, 6 mm.

Station III.—Surface, 7th July 1894. 2 eggs of dab.

Station IV., First Trawl.—Surface, 4th July 1894. 14 eggs of gurnard; 5 eggs of greater weever; 5 eggs of lesser weever; 6 eggs of Müller's topknot; 1 egg of lemon dab; 13 eggs of cod; 46 eggs of flounder; 121 eggs of dab; 92 eggs of *Motella* (sp.); 22 eggs of solenette.

— . Bottom. 10 eggs of gurnard; 2 eggs of dab.

— . Second Trawl.—Surface. 9 eggs of gurnard; 33 eggs of greater weever; 1 egg of flounder; 49 eggs of dab; 2 eggs of *Motella* (sp.); young lobster.

Station V.—Surface, 4th July 1894. 27 eggs of gurnard; 2 eggs of turbot; 2 eggs of flounder; 114 eggs of dab; 3 eggs of cod; 1 egg of *Motella* (sp.).

— . Bottom. 8 eggs of Müller's topknot; 9 eggs of dab; 1 egg of *Motella* (sp.).

Station VI.—Surface, 5th July 1894. 13 eggs of lesser weever; 1 egg of Müller's topknot; 1 egg of lemon dab; 5 eggs of dab; 2 eggs of *Motella* (sp.).

Station VI.—Bottom, 5th July 1894. 4 eggs of gurnard; 3 eggs of cod; 2 eggs of lemon dab; 1 egg of Müller's topknot; 22 eggs of dab; 7 eggs of *Motella* (sp.).

Station VII.—Surface, 5th July 1894. 2 eggs of Müller's topknot; 3 eggs of cod; 2 eggs of flounder; 4 eggs of dab.

— . Bottom. 1 egg of gurnard; 4 eggs of greater weever; 4 eggs of lesser weever; 17 eggs of Müller's topknot; 4 eggs of lemon dab; 15 eggs of bib; 1 egg of turbot; 6 eggs of dab.

Station IX., First Trawl.—Surface, 9th July 1894. 24 eggs of megrim; 42 eggs of Müller's topknot; 11 eggs of lemon dab; 2 eggs of cod; 4 eggs of turbot; 4 eggs of dab; 1 egg of *Motella* (sp.).

— . Bottom. 2 eggs of gurnard; 1 egg of cod; 1 egg of *Motella* (sp.).

— . Second Trawl.—Surface. 30 eggs of gurnard; 2 eggs of cod; 1 egg of dab.

Post-Larval Fish—Station IX., Second Trawl.—Surface. Gadoid, 5 mm.

* I am indebted to Mr J. R. Tosh, M.A., B.Sc., for assistance in measuring the ova from the Moray Firth.

Station X.—Surface, 13th July 1894. 14 eggs of gurnard; 1 egg of lemon dab; 2 eggs of dab.

— . Bottom. 2 eggs of gurnard; 1 egg of Müller's topknot.

Larvæ—Station X.—Bottom. 7 gobies, 4·9 mm.

Station XI.—Surface, 16th July 1894. 29 eggs of gurnard; 8 eggs of lemon dab; 2 eggs of cod.

— . Bottom. 1 egg of lemon dab; 1 egg of dab.

Station XII.—Surface, 16th July 1894. 60 eggs of gurnard; 27 eggs of lemon dab; 4 eggs of cod; 3 eggs of turbot; 4 eggs of dab.

— . Bottom. 1 egg of lemon dab.

Young Fish—Station XII.—Trawl net. Montagu's sucker, 20 mm.

Station XIII.—Surface, 17th July 1894. 52 eggs of gurnard; 9 eggs of lemon dab; 14 eggs of dab.

Station XIV.—Surface, 17th July 1894. 4 eggs of gurnard; 8 eggs of Müller's topknot; 7 eggs of lemon dab; 6 eggs of turbot; 7 eggs of dab; 1 egg of *Motella* (sp.).

— . Bottom. 1 egg of gurnard; 2 eggs of lemon dab; 1 egg of dab.

Station XV.—Surface, 17th July 1894. 33 eggs of gurnard; 17 eggs of lemon dab; 4 eggs of Müller's topknot.

Larvæ—Station XV.—Bottom. Goby, 4 mm.; pogge, 4·5 mm.; injured larva, 5 mm.

Station XVI.—Surface, 17th July 1894. 36 eggs of gurnard; 12 eggs of lemon dab; 5 eggs of turbot; 3 eggs of dab; 3 eggs of *Motella* (sp.).

— . Bottom. 1 egg of cod.

Larvæ—Station XVI.—Gadoid (injured).

ORKNEY.

Station I.—Surface, 21st July 1894. 8 eggs of gurnard; 9 eggs of dab; 20 eggs of *Motella* (sp.); 11 eggs of dragonet.

— . Bottom. 3 eggs of *Motella* (sp.); 5 eggs of dragonet.

Larvæ—Station I.—Bottom. 3 gobies, 4-5·5 mm.; pogge, 5 mm.

Station II.—Surface, 21st July 1894. 1 egg of gurnard; 1 egg of *Motella* (sp.); 2 eggs of dragonet.

— . Bottom. 1 egg of *Motella* (sp.).

Station III.—Surface, 27th July 1894. 1 egg of bib; 1 egg of dab; 3 eggs of *Motella* (sp.).

— . Bottom. 1 egg of gurnard; 1 egg of dragonet.

Station IV.—Surface, 24th July 1894. 5 eggs of turbot (?); 3 eggs of dragonet.

Larvæ—Station IV.—Surface. Lumpsucker, 3·25 mm.; unknown larva, 4 mm.

Midwater Net—Near Station IV.—25th July 1894. 1 egg of plaice. Fish in midwater net—Whiting, 42 mm.

FORTH.

Larval and Post-Larval Fishes—Vicinity of Station II.—Bottom, 12th January 1894. Larval wolf-fish, 16 mm.

Station II.—Bottom, 30th August 1894. Pleuronectid, 7 mm.; goby, 4 mm.

Station III.—Bottom, 21st June 1894. Whiting, 22 mm.; pleuronectid, 10 mm.

Station III.—Bottom, 24th August 1894. 4 gobies, 4·5-7 mm.

Station V.—Bottom, 30th August 1894. Clupeoid, 19 mm.; goby, 5 mm.

Station VI.—Bottom, 30th August 1894. 13 clupeoids, 5-7 mm.; 3 gobies, 5 mm.

Vicinity of Station VII.—Bottom, 10th January 1894. 2 *Cotti*, 10 mm.; goby, 2 mm.

Station VIII.—Bottom, 29th August 1894. 3 gobies, 4·5-5·5 mm.

Station IX.—Bottom, 29th August 1894. Gurnard, 16 mm.; 22 *Motellae*, 4-11 mm.

Ova—Station IX.—Bottom, 29th August 1894. 2 eggs of Müller's topknot; 1 egg of turbot; 14 eggs of cod; 3 eggs of *Motella* (sp.).

MORAY FIRTH.

Larval and Post-Larval Fishes from Tow-nets.

Between Covesea and Burghead.—29th October 1894. 18 lemon dabs, 8·5-18 mm.; gurnard, 12 mm.; 23 clupeoids, 10·5-21 mm.; *Agonus*, 11 mm.; 3 *Cotti*, 7·5-8·5 mm.; 12 gobies, 5·5-14 mm.; post-larval *Syngnathus acus*, 5·1 cm.; 4 weevers, 6·75-9 mm.

Station II.—4th October 1894. *Cottus*, 10 mm.; goby, 4·5 mm.

Station III.—6th October 1894. Five-bearded rockling, 28·5 mm.

Station VI.—22nd October 1894.—Clupeoid, 16 mm.; five-bearded rockling, 34 mm.; *Motella* (sp.), 7 mm.

Station VII.—9th October 1894. Clupeoid, 13 mm.; 3 five-bearded rocklings, 9 and 10 mm.; dragonet, 10·5 mm.; goby, 14 mm. There was also in this collection a *Pleurobrachia*, which had swallowed a young rockling.

Station VIII.—23rd October 1894. 2 clupeoids, 16 and 20 mm.

Station IX.—23rd October 1894. 2 clupeoids, 13 and 25 mm.

Station XIV.—11th October 1894. 3 gobies, 11-14 mm.; Montagu's sucker, 9 mm.

Station XV.—12th October 1894. 2 clupeoids, 18 and 21 mm.; 2 gobies, 7 and 21 mm.

Station XVI.—12th October 1894. Clupeoid, 15 mm.

Off Sutors of Cromarty.—Surface, 26th October 1894. Five-bearded rockling, 32 mm.

Off Sutors of Cromarty.—Bottom, 26th October 1894. 2 lemon dabs, 20 mm.; 8 clupeoids, 13-32 mm.; 4 young *Syngnathi aci*, 34-60 mm.; goby, 21 mm.; young swimming crabs.

VIII.—ON THE VARIATION IN SIZE OF CERTAIN PELAGIC OVA. By H. Charles Williamson, M.A., B.Sc., St Andrews Marine Laboratory.

It has been noticed that the ripe eggs of any one fish vary slightly in size. In the case of certain closely allied species this variation in the size of the ova makes their separation a matter of some difficulty, when, as with preserved eggs, the size has chiefly to be relied upon for diagnosis. The average diameter of the ova of the haddock is 1·458 mm., while that of the eggs of the cod is 1·386 mm. The largest eggs of the cod, however, have been found to exceed in diameter the average size of the eggs of the haddock, and at the same time the smallest eggs of the haddock have been found to be almost equal to the average size of the eggs of the cod. A similar relation exists between the eggs of the whiting and green cod. These facts will be easily seen on reference to the accompanying table, in which a comparison is instituted between the sizes of the ova of several species. A detailed list of the variations in size of the ova of each species which was examined is given below.

GADIDÆ.

Haddock.

(*Gadus æglefinus.*)

A collection of the eggs of the haddock were sent by Mr Dannevig from Dunbar Hatchery on March 27th, 1895. They had been fertilized on March 22nd.

97 eggs were measured.

Of these :—

2	eggs	measured	1·368	mm.	in diameter.
1	„	„	1·377	„	„
4	„	„	1·386	„	„
8	„	„	1·395	„	„
6	„	„	1·404	„	„
5	„	„	1·413	„	„
1	„	„	1·422	„	„
21	„	„	1·44	„	„
2	„	„	1·449	„	„
7	„	„	1·458	„	„
6	„	„	1·467	„	„
4	„	„	1·476	„	„
12	„	„	1·485	„	„
2	„	„	1·494	„	„
2	„	„	1·512	„	„
1	„	„	1·521	„	„
1	„	„	1·53	„	„
1	„	„	1·566	„	„
5	„	„	1·575	„	„
1	„	„	1·597	„	„
2	„	„	1·62	„	„
1	„	„	1·629	„	„
1	„	„	1·638	„	„
1	„	„	1·665	„	„

The average size was 1·458 mm.

M'Intosh and Prince* give 1·45 mm. as the size of the eggs of the haddock. Fulton† found in the ovary of the haddock clear ova 1·39–1·2 mm. in diameter.

Cod.

(*Gadus morrhua.*)

A collection of the eggs of the cod were received from Dunbar hatchery on March 27th; they had been fertilized on March 22nd, 1895.

92 eggs were measured.

Of these :—

24	eggs	measured	1·35	mm.	in diameter.
10	„	„	1·359	„	„
9	„	„	1·368	„	„
3	„	„	1·377	„	„
5	„	„	1·386	„	„
16	„	„	1·395	„	„
2	„	„	1·404	„	„
4	„	„	1·417	„	„
18	„	„	1·44	„	„
1	„	„	1·467	„	„

Average size, 1·386 mm.

M'Intosh and Prince found that the ova of the cod measured 1·375 mm. in diameter. The ripe intra-ovarian ova of the cod examined by Fulton varied from 1·2–1·4 mm.

Whiting.

(*Gadus merlangus.*)

The eggs of the whiting were obtained from a St Andrews fishing boat. They were fertilized by Mr R. Duncan on April 6th, 1894.

Of 56 ova which were measured :—

1	egg	measured	1·161	mm.	in diameter.
7	„	„	1·17	„	„
3	„	„	1·179	„	„
3	„	„	1·188	„	„
8	„	„	1·197	„	„
4	„	„	1·206	„	„
19	„	„	1·215	„	„
9	„	„	1·224	„	„
1	„	„	1·228	„	„
1	„	„	1·257	„	„

Average size, 1·2042 mm.

According to M'Intosh and Prince, the size of the ova of the whiting is about 1·125 mm. Fulton found that the ripe intra-ovarian eggs of this species measured from 1·2–1·3 mm.

* M'Intosh and Prince, 'Development and Life-Histories of Teleostean Fishes.'

† Fulton, 'The Comparative Fecundity of Sea Fishes,' *Ninth Annual Report Scottish Fishery Board.*

GREEN COD.

(*Gadus virens.*)

The eggs of the green cod were fertilized by Mr A. W. Brown, St Andrews Marine Laboratory, in February 1894.

17 eggs were measured.

Of these :—

1 egg	measured	1·125	mm.	in diameter.
1 "	"	1·147	"	"
14 eggs	"	1·17	"	"
1 egg	"	1·188	"	"

Average size 1·161 mm.

M'Intosh * found that the ova of this form measured 1·143 mm.

FIVE-BEARDED ROCKLING.

(*Motella mustela.*)

A ripe five-bearded rockling was procured from Mr A. H. Gourlay, St Andrews, on May 8th, 1895.

63 of the ova, which were extruded by gentle pressure, were measured.

Of these :—

1 egg	measured	·711	mm.	in diameter.
18 eggs	"	·72	"	"
19 "	"	·729	"	"
18 "	"	·738	"	"
5 "	"	·747	"	"
1 egg	"	·756	"	"
1 "	"	·765	"	"

Average size, ·729.

M'Intosh and Prince state that the unimpregnated egg on its escape has a diameter of ·73 mm., the measurements given by Mr Brook ranging from ·655–·731 mm. Fulton found that the ripe eggs varied in diameter from ·77–·72 mm.

PLEURONECTIDÆ.

PLAICE.

(*Pleuronectes platessa.*)

Some eggs of the plaice were procured by Prof. M'Intosh from Dunbar Hatchery. They were, however, unfortunately dead before they were measured, and probably dilated.

* M'Intosh 'On the Eggs of the Saithe,' *Twelfth Report, Scottish Fishery Board.*

Of 22 ova :—

1 egg	measured	1·845	mm.	in diameter.
1 „	„	1·867	„	„
7 eggs	„	1·89	„	„
2 „	„	1·90	„	„
3 „	„	1·935	„	„
4 „	„	1·98	„	„
2 „	„	2·025	„	„
1 egg	„	2·07	„	„
1 „	„	2·088	„	„

Average size 1·93 mm.

M'Intosh and Prince give 1·65–1·75 mm. as the size of the eggs of the plaice. Fulton found in the ovary of the plaice clear mature ova, 1·65 mm. in diameter. Cunningham gives 1·95 mm. as the diameter of this egg.

Turbot.

(*Rhombus maximus.*)

A collection of eggs of the turbot were sent to Professor M'Intosh by Mr Dannevig, on June 22nd, 1895.

30 eggs were measured.

Of these :—

4 eggs	measured	1·035	mm.	in diameter.
7 „	„	1·044	„	„
6 „	„	1·053	„	„
5 „	„	1·062	„	„
6 „	„	1·071	„	„
2 „	„	1·08	„	„

Average size 1·054 mm.

According to Fulton, the ripe intraovarian ova of the turbot measured ·9–·97 mm. Holt found that the ripe unfertilised ova varied from ·99–1·06 mm. in diameter.

Flounder.

(*Pleuronectes flesus.*)

The eggs of the flounder were fertilized by Mr Alex. Greig, St Andrews, on April 2nd, 1894.

Of 17 eggs from one fish :—

8 eggs	measured	·9	mm.	in diameter.
2 „	„	·909	„	„
1 „	„	·936	„	„
4 „	„	·945	„	„
1 „	„	·967	„	„
1 „	„	·972	„	„

Average size ·9216 mm.

Dab.

(*Pleuronectes limanda.*)

The ova of the dab were fertilized by Mr A. H. Gourlay, St Andrews, on April 12th, 1894.

33 eggs were measured.
Of these :—

2	eggs measured	·823	mm.	in diameter.
2	„ „	·828	„	„
4	„ „	·846	„	„
22	„ „	·855	„	„
1	„ „	·864	„	„
1	„ „	·868	„	„
1	„ „	·877	„	„

Average size, ·8514.

The size of the egg of the dab is given by M'Intosh and Prince as about ·825 mm. Fulton found ripe intra-ovarian eggs of from ·9–·94 mm. in diameter.

The following Table is intended to give a comparison between the average size of the ova of each species, and the largest and smallest eggs found in each collection; and, by a comparison with the sizes given by M'Intosh and Prince, and Fulton, to show the comparatively large variation in the size of the ova of different individuals :—

GADIDÆ.

Species.	Number of Eggs measured.	Size of *Largest* Egg in mm.	*Average* Size in mm.	Size of *Smallest* Egg in mm.	Size given by M'Intosh and Prince.	Size given by Fulton.
Haddock, . .	97	1·665	**1·458**	1·38	1·45	1·39–1·2
Cod, . . .	92	1·467	**1·386**	1·35	1·375	1·4–1·2
Whiting, . .	56	1·257	**1·204**	1·161	1·125	1·3–1·2
Green Cod, .	17	1·188	**1·161**	1·125	1·143	...
Five-bearded Rockling . .	63	·765	**·729**	·711	·73	·77–·72
PLEURONECTIDÆ.						
Plaice * . .	22	2·088	**1·935**	1·845	1·75–1·65	1·65
Turbot . .	30	1·08	**1·054**	1·035	...	·9–·97
Flounder . .	17	·972	**·921**	·9	...	...
Dab . . .	33	·877	**·851**	·823	·825	·94–·9

* The eggs of the plaice were dead when measured.

IX.—ON THE LARVAL AND POST-LARVAL DEVELOPMENT OF THE BRAIN OF THE LESSER SAND-EEL (*Ammodytes tobianus*, L.). With Plates XI.–XIII. By J. H. Fullarton, M.A., D.Sc., F.R.S.E.

In noticing some points in the development of the brain of the Lesser Sand-eel, after that organ shows the typical division of the vertebrate brain into five main portions, I may first allude to the primary conditions which obtain for fishes before the brain can be distinguished into the five portions exhibited in larval, post-larval, and adult life.

In Osseous fishes the brain at first consists of a median axial plate originating from dorsal epiblast, situated at the anterior end of the body, and in continuation with the spinal chord. In the Sand-eel, as well as in other Teleosteans, this axial plate forms a wedge-shaped mass of cells with the blunted apex pointing downwards and forming the prominent keel-like ridge, which is so characteristic in embryonic osseous fishes. A lumen is formed in this solid axial structure, and the brain is divided by transverse furrows, seen on the upper surface, into the three primary divisions of fore, mid and hind-brain. Till this early stage the primary brain consists of a mass of cells, its walls being several cells in thickness. With advance in growth, fibres begin to appear in the midst of the cellular substance of the brain, and other changes take place which make the brain a more complex organ.

The general shape of the whole brain-mass, as viewed from the exterior, is a narrow fore-brain ending in a rounded shape anteriorly, a mid-brain joined to the primary fore-brain and widening towards its posterior aspect, where it narrows or becomes contracted to give rise to the primary hind-brain. These three divisions are well marked off from each other by two transverse constrictions, one of which forms a furrow between the fore and mid-brain, and the other between the latter and the hind-brain.

In the earlier stages the lumen in the brain, from its commencement in the fore-brain, maintains a fairly uniform calibre, but as development progresses, the lumen, though remaining of small calibre at some places, becomes greatly dilated at other parts to form the ventricles or cavities, which remain more or less prominent throughout life. The cavities in the brain serve to mark off the dorsal from the lateral and ventral portions. The roof and the floor, which are united at the sides, become more complicated as growth takes place, and advances in development are associated with these changes.

As might be expected from the embryo being formed along the peripheral surface of a sphere (the egg), its ventral surface is more or less concave, and surrounds the yelk towards the vegetative pole, and its upper surface is convex. But even this flexure observable in the body of the embryo, and partaken in by the embryonic brain, is not sufficient to account for the marked cranial flexure exhibited. This flexure is occasioned by the greater growth of the mid-brain, and although it is most marked by the great eminence of the mid-brain, still the flexure, when observed from the side, is greatly reduced during post-larval life. But when vertical longitudinal sections are examined, the floor of the vesicles being taken as axis, shows that the flexure is on the whole increased. The flexure causes the axis to be ղ-shaped, and from the changes that take place in the floor it ultimately becomes ⌢‿⌢-shaped. By the greater growth of the mid-brain the fore-brain becomes inferior, so that transverse vertical sections of early stages cut mid- as well as fore-brain. This is rectified afterwards by changes in the floor of the brain (cf. Plate XI., fig. 5, XII., fig. 10, XIII., fig. 11, with Plate XIII., figs. 4, 5, 6).

The three primary divisions of the brain—fore-, mid-, and hind-brain—as development advances can be further distinguished, the fore-brain consisting of the cerebrum and the thalamencephalon, the mid-brain forming the optic lobes, and the hind-brain constituting the cerebellum and medulla oblongata.

The constitution of the brain before the embryo is freed from the egg-membrane has been described by most authors who have written on the embryology of the brain; and the subsequent changes till before the adult condition is attained will be here considered.

THE FORE-BRAIN.—In the larva of eight days (Plate XI., figs. 1, 2, *f.b.*), the cerebrum, for the most part, consists of vesicular matter. In vertical longitudinal sections towards the side, the cells of the fore-brain are packed closely together. Dorsally, the posterior aspect of the fore-brain is covered by the anterior portion of the mid-brain. At the sides, the first two primary divisions of the brain are indistinctly marked off from each other by the closer aggregation of cells of the first, and the less compactly arranged cells of the succeeding mid-brain. Ventrally, the fore-brain is almost divided by a patch of non-cellular substance which does not stain, and which almost corresponds in position with the anterior commissure distinctly seen in older embryos. In median vertical longitudinal section, the posterior limit dorsally can be approximately ascertained by the position of the pineal body (Pl. XI., fig. 2, *pn.*), and the mass of cells of the pituitary body, *pt.*, appearing on the ventral surface of the brain, marks the hinder portion of the cerebrum. At this stage the anterior cavity is seen in section, and its greatest dimensions is in the dorso-ventral plane. It seems to be filled with a gelatinous-like fluid, which does not respond to stains like Borax Carmine. This cavity is covered dorsally by a layer of cells, two or three in depth, and it is separated from tissue below the brain by a thin layer of cells, in places not above one row in thickness.

In larvæ, two days older (Pl. XI., figs. 3–11), the cavity in the fore-brain is nearly cruciform, and under low magnification the floor and roof appear so thin (figs. 3, 4) in the most anterior sections of the flexed brain as to be almost imperceptible. This is especially noticeable in fig. 3, below the pineal body, and in the region close to the roof of the mouth. The cells of the roof at this point are spindle-shaped, and the tissue between the lateral halves of the cerebrum is also made up of spindle-shaped cells. The cerebral portions are seen in fig. 3, *ce.*, as two lateral cushions, which, by cranial flexure, have become ventral, and they are no longer composed only of vesicular matter. The vesicular substance is made up of round cells interrupted by two distinct areas of fibres, one being found on either side. The fibrous tracts, which are uncoloured in the drawings, separate each of the two lobes of the cerebrum towards the outer sides into a dorsal and a ventral cellular portion. The fibres of these tracts remain distinct through several sections behind fig. 4. They become united to each other across the middle line, leaving a small ventral cap of nerve cells close to the roof of the mouth. The tracts are continued posteriorly and laterally into the optic thalamus, maintaining a position external to the vesicular matter, and form in sections further back (Pl. XI., fig. 5) a lateral covering to the cellular substance of the fore-brain and the anterior dorsal part of the mid-brain.

The optic thalamus comes to lie on the dorsal side of the fore-brain (Pl. XI., fig. 4, *t.o.*). Its position, dorsal to the cerebrum, is brought about by the great extent of the cranial flexure in the larva. While both cerebrum and optic thalamus at this stage are in the form of lateral cushions, the cerebral structures are larger than the latter. As in the lobes of the cerebrum, a fibrous tract is seen in each half of the optic thalamus, which, in fig. 5, appears to be continuous with the white tract of the cerebrum, the only interruption on either side being a scattered group of cells running outwards and downwards.

Longitudinal vertical sections of larvæ of this age, (Plate XI., figs. 10, 11,) show the distribution of fibrous and vesicular substance at this time. In an obliquely median section, (fig. 11), the anterior and ventral portion of the fore-brain is composed almost entirely of white fibrous-like tracts with embedded cells scattered through the mass. Towards the side, (fig. 10), the white fibrous portion is greatly reduced, the only area being a ventral patch in the region where the anterior commissure (*c.a.*) is seen crossing from one lobe to the other. A small cap of loose cells is noticed above the olfactory organ, but this appears to be due to the tearing of the tissue in sectioning, and it is not connected with the fibrous tract shewn in fig. 11, as might be imagined. In figs. 10, the ventral fibrous portion is divided into two, a short distance in front of the pituitary body, the posterior limb corresponding to the anterior commissure which is more sharply defined in older sand-eels.

The pituitary body, (Plate XI., fig. 10, *pt.*), which was noticed in larvæ two days younger, as a solid mass of cells in close apposition to the tissue at the base of the third ventricle, is now seen as a mass of tissue quite distinct from the basal tissue of the brain. In none of the larvæ freed from the embryonic covering does the pituitary body possess the structure which Stieda* describes and figures in *Gadus lotus*, (Plate II., fig. 30). In the post-embryonic stages it is a solid accumulation of cells, in close opposition to the base of the brain. In transverse section it lies under the mid-brain.

In larvæ of four days older, (Plate XI., fig. 12, 13†), the cerebrum is arched over by a thin layer of tissue, where the cerebrum (fig. 12*ce.*), consists of two lateral masses of tissue, partly fibrous and partly vesicular, the cellular portion abutting on the ventricle. The fibrous portion, which is small and rounded in cross section at the most anterior point, increases till it runs the whole length of the dorso-ventral axis of the brain. Behind the section figured 12, it contracts, till it again becomes of small dimensions. In succeeding sections, (fig. 13*ce.*), the fibrous tract again increases dorso-ventrally till it is only interrupted as a lateral covering by a group of cells situated at the pointed ventral end. At this level the roof is thicker, and is entirely vesicular, and the contained cavity which was T. shaped becomes oblong and ovate.

Larvæ four days older, (Plate XIII., figs. 11, 12,) also show the passage of the cerebrum (*ce.*), into the optic thalamus (*t.o.*), and thence into the covering of the mid-brain (*t.l.o.*). The distribution of the fibrous matter in the anterior of the cerebrum (fig. 11, *ce.*), is the same as that exhibited in Plate XI., figs. 3, 4, ; viz. two round longitudinal tracts in section. The anterior rounded fibrous tract of the optic thalamus is shown on the left of Plate XIII., fig 11. A similar distribution is exhibited about the same level in Plate XIII., fig 12. These tracts appear to be divided into two, one connecting with the white fibrous matter of the tectum lobi optici, and the other continuous with the white fibres of the cerebrum. In three sections taken immediately behind fig. 12, the commissure between both sides of the cerebrum is seen, and it is connected with the ventral part of the tract shown in fig. 12. The cavities of the fore and mid-brain exhibit a shape similar to that in younger forms. Figs. 11, 12 are

* Stieda. Studien über das centrale Nervensystem der Knockenfische. Zeitsch. f. wiss. Zool. 1868, Bd. 18, Taf. I. *u.* II.

† The sections, figs. 12, 13, have been cut in an oblique direction, the upper part being much further forward than the lower. This accounts for the sections not showing the mid as well as the fore-brain.

taken, the first (fig. 11), through the separate fore-brain and optic cavities, and the latter through the communicating third and optic venticles.

In post larvæ sand-eels, the cavity of the fore-brain is greatly lessened, and approximates the condition found in adults. In specimens, 5 mm., in length (Plate XII., figs. 7, 8), the third ventricle is covered by the thin pallium (*pa.*), immediately in front of the pineal body (*pn.*) The pallium at this stage is a thin layer of cells arching over the space between the cerebrum and the pineal body. In longitudinal sections (figs. 7, 8), the cavity of the fore-brain is shown to be a dorsal space, but cross sections, (Plate XII., fig. 10), show that it is a longitudinal space (*v.*3), dividing the right and left sides of the fore-brain, with lateral diverticula separating the two cerebral lobes (*ce.*) from the right and left halves of the optic thalamus (*t.o.*). The shape of the whole cavity, as seen in transverse section is a narrow cross with elongated arms. The anterior commissure is sharply marked off from the vesicular part of the brain, and is narrower in the central region than towards the sides (Plate XII., fig. 7, 8, *c.a.*). The fibrous and vesicular portions of the fore-brain in post-larval specimens, exhibit relations similar to what is found in larval forms.

In sand-eels, 12 mm. long, the two cerebral lobes at their anterior end show two fibrous patches on either side of the middle line, (Plate XIII., fig. 4, *ce.*), and anticipate the early formation of the olfactory lobes. The brain has now undergone a change in the relative position of the parts to one another, and the flexure which was so marked in larval stages has become lessened, so that it is now possible to obtain vertical transverse sections of the fore-brain by itself. With this change in the cranial flexure, the fore-brain apparently becomes compressed laterally, and at places the two lobes of the cerebrum are divided off from one another by a very narrow, but deep canal (Plate XIII., fig. 5, *v.* 3). This canal is the third ventricle, and divides the brain where the optic nerves (II.) enter the base of the brain nearly into two symmetrical halves. The distribution of the fibrous matter has become more ventral on the one hand, and more dorsal on the other.

Associated with the fore-brain are certain structures which are pre-formed during embryonic life, and undergo further development during larval and even post-larval life. The pineal body is developed in the angle between the fore and mid-brain dorsally, and the pituitary body arises on the ventral surface above the roof of the mouth, and comes to lie in close contact with the ventral surface of the brain. The pineal body is situated in young larval forms, some distance behind the anterior end of the brain (Plate XI., fig. 2, *pn.*). At this stage it is a rounded body, composed of a number of cells, and in some forms it appears to fit closely into a small depression on the roof of the brain. It is in such close apposition in some of the earlier larvæ (fig. 2, *pn.*) that the bounding wall between is difficult to make out. But this may be due to the contraction brought about in the manipulation of the larvæ necessary to obtain sections. As the flexure of the brain increases, and the fore-brain is arched over by the anterior margin of the mid-brain, the pineal body of the sand-eel, as Holt,* has already noticed in the herring, comes to occupy a more anterior position. Sections through the anterior of the fore-brain (Plate XI., fig. 3) exhibit the pineal body, (*pn.*), placed dorsally and medianly. When the cranial flexure increases in larvæ some days older than fig. 3, the transverse section, cutting both fore and mid-brain, shows the pineal body placed between the thin layers of mid and

* Holt. Observations on the development of the Teleostean Brain, with special reference to that of Clupea harengus. Zool. Jahrb. Abth. f. Anat. und Ontog. der Thiere, 1891, Bd. iv., Taf. xxix.-xxxi.

fore-brain. The pineal body as noticed, is a rounded mass of cells, but when post-larval life is reached, it becomes wedge-shaped at its base, (Plate XIII., fig. 5, *pn.*), and it developes a stalk which runs backwards underneath the tectum lobi optici (Plate XII. fig. 8, *pn.*). This stalk, which is at first thick, gradually thins out as it is developed in a backward direction. At its posterior rounded end in later post-larval life it shows a fibrous structure, the posterior commissure. The pineal body, situated in the posterior roof of the fore-brain, serves to mark off mid from fore-brain.

The solid proliferation of cells in the ventral region of the fore-brain, that was noticed in Plate XI. fig. 2, *pt.*, is the pituitary body. Like the pineal, the pituitary body is developed during embryonic life, and in larvæ it is seen as a solid mass of cells in close apposition to the thin ventral wall of the fore-brain. It lies in the interval between the anterior and posterior limbs of the ventrally prolonged third ventricle (Plate XI. fig. 2, *pt.*) At this stage in longitudinal section its cells are almost indistinguishable from the cells of the base of the brain, but in larvæ two days older (Plate XI. fig. 7, *pt.*), it is distinct from the brain tissue, and lies in open mouth of the infundibulum. It is situated in fact, at the ventral apical end of the prolonged third ventricle (Plate XI. fig. 10, *v.* 3), and it is a solid mass of cells, acting like a plug to the opening of the infundibulum. It is rounded in transverse section, but a section through its antero-posterior diameter shows it to be oval in shape in this direction. During post-larval life when the brain is somewhat flattened, the pituitary body is compressed from above downwards, and in sand-eels of 12 mm., it is markedly oval in cross section, and it is composed of cells closely packed together (Plate XIII., fig. 6, *pt.*).

The third ventricle, during early larval stages, is prolonged downwards to the base of the brain, and its posterior and ventral portion forms the infundibulum. The ventral limb is prolonged posteriorly as the larva advances in age, so that it comes to lie under the base of the mid-brain. The infundibulum of a larva of ten days (Plate XI., fig. 7, *inf.*), is surrounded by a mass of cells, and its ventral mouth is closed by the plug of tissue which represented the pituitary body. A *cul-de-sac* canal runs backwards from the sub-ventral third ventricle, and in sections behind the infundibulum it is seen as an oval canal surrounded by vesicular matter, which is separated off from the base of the hind brain. This is the recess of the third ventricle (Plate XI., fig. 8, *r.v.* 3), the recessus ventriculi tertii of Holt.* The lumen of the infundibulum is prolonged into transverse arms, one of which is seen in the left hand side, in Plate XI. fig. 7, *inf.* In post-larval sand-eels, the lateral arms of the lumen, which during larval life are very short, are greatly lengthened (Plate XII., fig. 9, *inf.*, and Plate XIII., fig. 6, *inf.*) The recess, which was oval during larval life, is now in cross section a wide and uniformly shallow canal (Plate XIII., fig. 7, *r.v.* 3). The covering of cells around the infundibulum, which was somewhat thick during larval life, has, by the extra pressure exerted on it from below by the cartilages of the base of the brain decreased in thickness. The base of floor of the brain has now become very thin, and a layer of fibres runs between the upper layer of tissue round the infundibulum and the substance of the brain. The recess is continued backwards till the forward end of the notochord is met, and it is inserted above the notochord, *i.e.* between the latter and the floor of the brain.

The Mid-brain.—The second primary division of the brain does not undergo such alterations in fish as in the higher vertebrates. In fish while the mid-brain remains comparatively simple, certain changes take

* Holt. *Ut supra.*

place both in external form and in internal structure. In post-larval stages its increasing size and importance is evidenced by the development of the roof. Morphologically, we may consider it as forming a dorsal and lateral position—the optic lobes; a ventral part—the floor—which is a continuation of the base of the brain from behind; and the cavity which places the third and fourth ventricles in communication, and gives off lateral diverticula, forming the optic ventricles.

The mid-brain in young larvæ of eight days, in longitudinal section, has not laterally the compact arrangement of cells exhibited by the fore-brain at the same stage (Pl. XI., fig. 1, *m.b.*). It is slightly distinguished from the anterior division of the brain by a transverse marking, and a transverse deep furrow separates it from the hind-brain, especially in the central line. This deep cleft is seen in longitudinal vertical sections (Pl. XI., fig. 2), and extends more than half way to the base of the brain. The forward bulging of the mid-brain makes its anterior dorsal portion overlie the postero-dorsal aspect of the fore-brain, so that transverse vertical sections of early larvæ through the anterior of the mid-brain (Pl. XI., fig. 4, *m.b.*) also cut the posterior part of the fore-brain dorsally, and the anterior cerebrum ventrally. The anterior and dorsal part of the mid-brain consists of vesicular matter, which lies on either side, and both cellular cushions are arched over by a thin layer of tissue, in which are spindle-shaped cells. These cushions which appear at the anterior end, are the two halves of the tectum lobi optici, which forms such a conspicuous feature in the adult. In sections slightly posterior to this in larvæ of the same age (Pl. XI., fig. 5, *t.l.o.*), the area of the cellular portion is less in proportion to the fibrous part, which forms a dorso-lateral covering to the vesicular matter surrounding the outer border of the large optic ventricle. The fibrous tracts of the tectum are marked off from the lateral and ventral fibrous tracts of the fore-brain by a series of cells running downwards towards the eye. The fibrous area is not continued to the posterior end of the tectum (Pl. XI., figs. 6, 7, 8, 10, 11, *t.l.o.*), which is here, as at the anterior extremity (Pl. XI., fig. 4, *m.b.*), made up entirely of cellular matter. The tectum at this time has a pair of longitudinal thickenings on either side of the dorsal central furrows, and they are afterwards very conspicuous in post-larval stages and in adults. These longitudinal ridges are some distance away from the middle dorsal line, and are not to be confounded with the median dorsal ridges—the tori longitudinales—which appear about this stage. In larvæ of ten days (Pl. XI., fig. 6), the roof of the optic lobes in the middle is merely a thin covering, and towards the posterior end of the lobes this thin roof extends over the greater part of the optic ventricle, *v.o.* In Plate XI., figs. 6 and 7, the rounded mass of the tectum is shown not to be attached along its whole outer edge to the thin roof, and in the latter figure the backward prolongation of the optic ventricle on the right has been sectioned, and its ventro-lateral tissue is continued into the fibrous area of the base of the brain. The band of tissue connecting it to the basal portion at this level is entirely cellular. In Plate XI., fig. 8, the free margin of the posterior extremity of the optic lobe (*t.l.o.*) is seen overlapping the cerebellum (*cb.*). The optic ventricle at this time communicates by wide openings anteriorly with the third ventricle, and posteriorly with the fourth ventricle (Pl. XI., fig. 11), the constriction between it and the fourth ventricle being at the incipient valvula cerebelli (*v.c*).

As the larvæ advance in age, besides the lateral thickenings constituting the tectum, two other longitudinal thickenings appear below the sulcus on the dorsal surface of the mid-brain (Pl. XII., fig. 1, 2, *t.l.*). These are the tori longitudinales already mentioned. They are formed by a proliferation of cells from the thin roof, and are developed ventrally and laterally from the dorsal sulcus. At this point the external covering of the brain, which is for the most part a thin layer of tissue, is greatly thickened, and the tegmen of the cranium, composed of loose cells, fills up the deepened and broad sulcus. Along with the corresponding elevations in the floor of the mid-brain, they form constrictions of the lumen, marking off the two lateral limbs of the optic ventricle from the median portion. Here the ventricle becomes H-shaped, the ventral prolongations of either limb being directed slightly outwards.

In post-larval forms, the tectum increases greatly in thickness, and the resulting predominance of the mid-brain is never lost. Owing to this great increase, which takes place from above downwards, the capacity of the space forming the optic ventricle is greatly lessened (Plate XII., fig. 5, *et seq.*, *v.o.*).

In sand-eels of about 5 mm. in length, the fibrous tract of the tectum, as seen in longitudinal section, is a rounded cap (Plate XII., figs. 6, 7, 8), and only covers about half the optic lobes along their anterio-posterior axis. The anterior and posterior extremities are composed of cellular matter as in larval stages, but the vesicular area has greatly increased with the advance in growth. The anterior boundary is subtended by the pineal body lying in front, only a deep cleft separating them. This deep cleft is immediately above the fibrous tract or labium invaginatum noticed by Holt* (figs. 19 and 32, *t.f.*), and it is seen below the anterior ventral cornu of Plate XII., fig. 8. The posterior part of the optic lobe has a thin roof, where it is about to bend downwards and forwards to form the fornix or valvula cerebelli (Pl. XII., fig. 9, *v.c.*) The fornix bounds the optic ventricle posteriorly, and it has attained a great development both downwards and forwards since it was noticed in larvæ ten days old (Pl. XI., fig. 11, *v.c.*). In sand-eel embryos, before and after hatching, the fornix is the anterior border of the transverse furrow noticed on the dorsal aspect dividing off the mid from the hind-brain, and the deepening of this furrow underneath the tectum lobi optici lengthens the fornix as well as the cerebellum.

Where the cellular portion extends over the whole of the tectum as is seen in the slightly oblique vertical longitudinal section (Pl. XII., fig. 9, *t.l.o.*), the cells in the roof are packed closer together than on the ventral side of the tectum, where they are fairly uniform, but more loosely arranged. A reference to Pl. XIII., figs. 6, 7, *t.l.o.*, which are sections of a 12 mm. post-larval sand-eel, shows how it is possible to obtain a longitudinal vertical section through the tectum, which exhibits no patch whatever of fibrous matter in the roof. The sections taken on either side of Pl. XII. fig. 9, in the same post-larval form, viz. Pl. XII., figs. 5 and 6 on one side, and figs. 7 and 8 on the other, have fibrous elements in the roof of the tectum.

In 18 mm. sand-eels the tectum has greatly extended laterally and ventrally on both sides, till it partially covers the inferior lobes (Pl. XIII. figs. 6 and 7, *t.l.o.*), being separated in fig. 6 from the lobi inferiores (*l.i.*) by the oculo-motor nerve (III.). The fibrous tract in the tectum is not united to its fellow of the opposite side, but a double median cap of cells intervenes, and the tissue abutting on the oculo-motor nerve is also cellular. Scattered nerve cells are found in the fibrous tracts. Further back (Pl. XIII., fig. 7) the tectum (*t.l.o.*) is almost entirely cellular, the only fibrous matter being a shallow tract on the outside; and the tectum itself contains a Y-shaped prolongation of the optic ventricle (*v.o.*) between its halves. At its posterior border, the tectum is composed of two cellular prolongations which cover the adjoining portion of the hind-brain

* Holt. *Ut supra.*

(Pl. XIII., fig. 8, *cb.*), and the cells are arranged as a central patch surrounded by peripheral cells slightly larger in size.

The finer structure of the tectum lobi optici has been distinguished by Stieda * into the following:—(1) a small border of "Grundsubstanz" encloses (2) a layer of nerve fibres—the outer longitudinal layer of fibres; this again is succeeded on the inside by (3) a broad layer of granular "Grundsubstanz" with spindle-shaped cells running through it and giving it a transversely striated appearance. Proceeding inwards is (4) the inner layer of longitudinal fibres, then (5) a layer of transverse fibres, (6) a layer of small round cells, (7) a layer of net-like "Grundsubstanz," and in the inside of this (8) cylindrical epithelium. While this may be the structure of the tectum of the adult, I have failed to distinguish such an elaborate ground plan in larval or post-larval sand-eels.

The Hind Brain.—The third primary division of the brain is early marked off from the mid-brain, but at its posterior end it gradually merges into the spinal chord. The deep cleft, which runs transversely between the mid and hind-brain (Plate XI., fig. 2) has been already noticed, but laterally and ventrally, there is no sharp line of demarcation from the lateral and basal portion of the mid brain in the early larva (Plate XI., fig. 1, *h.b.*). The cells of the hind-brain are more closely arranged than those of the mid brain, and this serves to distinguish at the sides the region of each. It is a homogeneous mass of cells, which is only interrupted by the fourth ventricle. Its anterior and dorsal portion—the cerebellum—attains only a minimum development, till post larval stages are reached. In fact, it is a very small structure, and only in the latest post larval stage does its significance become manifest. The posterior portion of the hind brain—the medulla oblongata—is ventral, and it is connected to the other parts of the floor of the brain, though what Stieda * calls the pars commissuralis with the pars peduncularis (taf. II., fig. 32, *a.i.k.*).

The posterior portion, or medulla oblongata of a ten days old larva is shown in Plate XI., figs. 7, 11, *m.o.* It forms the basal surface of the fourth ventricle (*v.* 4), which is covered only by the thin tectum ventriculi quarti (*t.v.* 4). The changes that take place in the third primary division of the brain, might be summed up by saying, that in the roof, while the anterior portion becomes greatly, but slowly thickened, the posterior dorsal part remains thin, and separates the fourth ventricle from the tissues above the hind brain, and that the floor is greatly developed.

The cerebellum in larvæ of ten days (Plate XI., figs. 8, 11, *c.b.*), is very small, and only represents the upturned posterior border of the second transverse cleft, of which the fornix forms the anterior. It is at this stage a cellular thin layer of tissue, only two or three cells in depth. In early post-larval forms, the cerebellum is still a thin plate under the posterior border of the tectum lobi optici, and it only arches over the most anterior portion of the fourth ventricle. In specimens 5 mm. in length (Plate XII. figs. 5-9), the cerebellum (*cb.*), lies close under the fornix, and even its posterior border is all but covered by the posterior tips of the optic lobes. When the sand-eel has attained a size of 12mm., it projects beyond the optic lobes (Plate XIII., fig. 9, *cb.*), and it has increased in size, especially in thickness. At its anterior end, where it joined to the fornix, it is attached laterally to the base of the brain by tissue, which is partly vesicular and partly fibrous. In Plate XIII., fig. 7, which is a transverse section, through the united fornix and cerebellum, it overlies the small dagger-shaped posterior portion of the aqueduct of sylvius (*aq.*) and the cerebellar portion of the united parts is indicated on its upper side by a line of cells, which makes its apex look like a mound. Its breadth, when completely separated from the posterior border of the

* Stieda. *Ut supra.*

tectum lobi optici is increased, and it arches over the base of the hind brain just as the tectum lobi optici does over its corresponding base, at the point of origin of the third pair of nerves (Plate XIII., fig. 6, III.). When it has attained this great breadth, the fourth ventricle is extended laterally nearly across the whole brain (Plate XIII., fig. 8, *v.* 4). These lateral extensions, represent the expanded lateral arms of the dagger-shaped aqueduct of Sylvius, seen in the preceding figure (Plate XIII., fig. 7, *a.q.*), as succeeding sections (Plate XIII., fig. 9), are examined, the lateral prolongations of the fourth ventricle (*v.* 4), diminish in size, and the deep furrow separating the two halves of the base of the brain, as seen in a previous section, becomes also less. This contraction in the fourth ventricle is due to the narrowing of the hind brain. The cerebellum at this point consists of two lobes, separated from one another by a Y-shaped upward prolongation of the cavity of the ventricle, and from the basal portion of the hind brain, by the transverse arms of the fourth ventricle. The ventral prolongation which was so marked in the aqueduct of Sylvius, and in the fourth ventricle anteriorly, has now almost disappeared, and there is in the posterior part of the hind brain only an indication of partial separation into two longitudinal halves. The cerebellum in post larval-forms of this size ends in a small tongue-shaped mass, not unlike what is found in adults.

Behind the cerebellum the fourth ventricle is covered by a thin layer of tissue in close union with the pia mater (Pl. XIII., fig. 10, *t.v.* 4). In post larval sand-eels, the tectum of the fourth ventricle has become much less in size. This is chiefly due to the posterior elongation of the cerebellum. In larval fishes (Pl. XI., figs. 7-9, 11, *t.v.* 4), the tectum covers the whole of the base of the hind brain from side to side, and from the posterior margin of the tectum lobi optici to the junction of the medulla oblongata with the spinal chord, but when post larval stages are reached, its transverse as well as its longitudinal dimensions do not increase with the increase of the brain. In larval sand-eels it is only a thin layer of tissue, but in post-larval forms it has attained to the tela vasculosa condition exhibited in the adult, although it is not further complicated by foldings found in other vertebrates.

The Base of the Brain.—The medulla oblongata forms the floor of the fourth ventricle, and gradually merges posteriorly into the spinal chord. The open fourth ventricle, which is arched over by the cerebellum and the thin layer, its tectum, is continued into the central canal of the spinal chord. The forward boundary of the medulla is not marked off from the floor of the brain in front. Anteriorly it is a flattened cushion with a furrow on its dorsal surface dividing it into two longitudinal halves. This apparent flattening is gradually lost posteriorly till in section it has the appearance of a more or less round rod which passes into the rounded spinal chord.

In larvæ of ten days (Pl. XI., figs. 7–11, *m.o.*), the dorsal longitudinal furrow, which is the prolonged ventral limb of the aqueduct of Sylvius as already mentioned, cleaves it nearly into two halves, the sulcus being broader at its open end than at the bottom (fig. 7, 8.) As we proceed posteriorly (fig. 9) the two lateral halves of the medulla are brought close to one another, and the furrow is deep but narrow. The furrow shallows behind, but at its lower end it is continued into the canalis centralis of the neurochord (fig. 9, *sp.c.*). The distribution of the vesicular and fibrous matter remains fairly constant. The base of the floor of the brain from below the widened optic ventricle is composed chiefly of two areas of white fibrous substance with nerve cells interspersed in it. In the region near the mid-brain, the base is flattened against the basal parts of the anterior portion of the brain which come to lie under it. Behind the region of the infundibulum and recess of the third ventricle (Pl. XI., fig. 8, *r.v.3.*), where the notochord is first seen anteriorly (Pl. XI., fig. 9, *n.c.*), a longitudinal ventral furrow appears opposite the notochord, dividing the base of the brain into two longitudinal ridge-like prominences. This furrow serves for the reception of the dorsal ridge of the notochord. A plane through the dorsal and ventral longitudinal furrows divides the medulla oblongata into two symmetrical halves. Towards the posterior end of medulla, there are numerous nerve cells imbedded in the white fibrous substance, but towards the anterior end the nerve cells similarly placed are few in number. The fibrous tracts which are seen in the base of the medulla are continued forward (Pl. XI., fig. 11) to the fore-brain and the vesicular matter has a like distribution on the upper floor.

In larvæ of eighteen days the base of the brain becomes more rounded in the region of the medulla oblongata, and the fibrous tracts are in some places richly supplied with nerve cells (Pl. XII., figs. 3 and 4, *m.o.*). The base of the medulla at this stage, as well as in younger larvæ, is much narrower than its upper surface towards the posterior end. This is seen in Pl. XI., fig. 9, *m.o.*, and a similar appearance is presented in sections of eighteen days larvæ behind (Pl. XII., fig. 4). This narrowing is brought about by the pressure exercised by the enlarging auditory capsules (*au*).

In post-larval sand-eels of 5 mm., the floor of the brain has been considerably thickened from the optic thalamus backwards, and the vesicular area has correspondingly increased (Pl. XII., figs. 5–9; Pl. XIII., figs. 1–3.) In the fibrous tract which is fairly constant, an increased number of nerve cells is noticed. These nerve cells, which are larger than the cells in the upper part of the floor, are generally present at the point of origin of the different cranial nerves. The chief interruption, however, to the fibres, is in the anterior floor of the brain, where the vesicular matter in the lobi inferiores, and in the neighbourhood of the infundibulum is interposed (Pl. XII., figs. 5, 7, 9 ; Pl. XIII., figs. 2, 3).

In older post-larval forms the medulla oblongata is narrow ventrally, especially where the auditory capsule has attained its maximum capacity (Pl. XIII., figs. 9, 10). Here the fibrous substance is at a minimum, and is a thin layer bordering the ventral and lateral sides of the medulla. Posteriorly towards the spinal chord (Pl. XIII., fig. 10) the fibrous and vesicular substances are very much mixed. Anteriorly, the medulla is broad above, and narrower ventrally, and the fibrous substance is confined more to the ventral prominence (Pl. XIII., fig. 8, *m.o.*). In front the floor of the brain is embraced by the overhanging tectum lobi optici, and the fibres increase and take up in cross-section a large part of the area of the floor (Pl. XIII., fig. 7). In the region of the infundibulum the fibrous tract is a central core, being bounded peipherally by cells, those surrounding the infundibulum forming the base of the core.

Below the tectum lobi optici the floor of the mid-brain on either side of the longitudinal furrow, which runs along its middle, shows two ridge-like eminences—the tori semicirculares running parallel to the sulcus. In larvæ of ten days (Pl. XI., fig. 6, *t.s.*) they are gently rounded, and are not continued through many sections. The ridges become more pronounced as the larvæ advance in age, and are developed towards the tectum above. In eighteen days larvæ (Pl. XII., fig. 1, 2), in the region of the *tori longitudinales* (*t.l.*), the ventral eminences (*t.s.*), almost meet the dorsal ridges, and so between them the lateral parts of the optic ventricle are nearly shut off from the middle portion. Posteriorly the *tori semicirculares* are not so prominent, as they gradually lessen in height into the floor of the brain. In early post-larval forms of 5 mm., the eminences are also prominent (Pl. XIII., fig. 1, *t.s.*), and a section of a

12 mm. post-larval form (Pl. XIII., fig. 7) shows the tori semicirculares as only slight elevations towards the outer surface of the floor. These slight elevations, as they are traced forward, increase in height, and they approach nearer to the middle line.

The upper part of the base of the mid-brain is composed of cells, and the fibrous portion which is underneath the cellular is only interrupted by the cells bordering on the ventral prolongation of the third ventricle, and by the inferior commissure (Pl. XII., figs. 5, 8, *c.i.*). The backward as well as the ventral development of the third ventricle carries with it the associated parts, so that portions which belong to the more anterior brain come to lie under the posterior. Towards the middle of the base of the mid-brain, the lobi inferiores are developed. In larvæ of ten days (Pl. XI., fig. 6, 7, *l.i.*), they are separated off from the base of the mid-brain by a slight development of fibres. In older larvæ this line of demarcation is more distinct (Pl. XII., figs. 3, 4, *l.i.*), and the inferior lobes are seen in close relation to the infundibulum. In post-larval sand-eels (Pl. XIII., fig. 6, *l.i.*) the lobi inferiores are arched over dorsally and laterally by the tectum lobi optici which, as has been noticed, has become greatly extended. The lobi inferiores consist of a mingled mass of vesicular and fibrous matter. In the region of the extended third ventricle, cells are developed very plentifully in the lobi inferiores, but elsewhere the much fibrous matter is present in their substance. In early larvæ (Pl. XI., fig. 6, *l.i.*) each lobe anteriorly has a patch of white fibrous matter surrounded by vesicular matter, and this again may be bordered by a thin layer of fibres. Towards the posterior (Pl. XI., fig. 7, *l.i.*; Pl. XII., figs. 3, 4, *l.i.*), they are composed entirely of vesicular matter, which is indistinguishable from the cellular coat of the infundibulum. At this early stage they are very small, and during the whole of larval life they are unimportant. In post-larval forms they grow larger, and the same relation of vesicular and fibrous matter met with in younger specimens obtains (Pl. XIII., figs. 2, 3, *l.i.*). In later post-larval forms they assume more of the shape which they exhibit in adults, and in sections at some points they are seen as a fibrous mass with scattered nerve cells surrounded by vesicular matter (Pl. XIII., fig. 6, *l.i.*).

Further forward, the base of the mid-brain is continued into the optic thalamus. In early stages, owing to the flexure of the brain, the optic thalamus is seen in section above the cerebrum, (Pl. XI., figs. 3,4,5, *t.o.*), but its ventral position is made manifest in older sand-eels in connection with the base of the mid and hind brain. I have already described the optic thalamus as it appears in young forms. Into the base of it, the optic nerves are seen to enter, and the decussation of the roots of the nerves is exhibited at Pl. XII., fig. 2, *op. ch.* The optic commissure is seen in Pl. XII., fig. 8, *c.o.* The crossing optic nerves leave a patch of vesicular matter, below them at the ventral termination of the brain. In post-larval forms, the optic nerves can be traced from their distribution to the eye, to their origin in the base of the brain (Pl. XIII., figs. 3 and 5, II.), and in the latter figure the nerve fibres of either side can be seen crossing in the base of the brain.

The auditory organ is developed in connection with the hind brain, and in larval and post larval forms it is seen pressing against the medulla oblongata. In embryonic stages, as in other fish, the first appearance of the auditory organ in the sand-eel, is as a solid mass of cells found near the surface on the dorsal side. But in the stages under review, it is first noticed as a mass of cells, with a small lumen in the centre (Pl. XI., fig. 1, *au.*). The walls become thinner, and pouches are developed into the central cavity; these are the auditory canals (Pl. XI., fig. 10, *can.*). The capsule lies in close contact with the lateral wall of the medulla, and in post-larval forms its cavity stretches forwards (Pl. XIII., fig. 8, *au.*). When the cartilages of the capsule are developed, it presses on the ventral portion of the medulla oblongata, and causes this to become narrow ventrally. At the same time a marked pouching from the exterior is seen constricting the dorsal part of the capsule (Pl. XIII., fig. 8, *au.*).

In connection with the cerebrum, the olfactory organs are developed. They are seen in early larval stages as a solid ingrowth from the external epiblast of the snout, (Pl. XI., figs 3, 4, *ol.*), and they come to lie on the lateral and ventral surface of the cerebrum. In larvæ of eighteen days (Pl. XIII., fig. 12, *ol.*), they are seen as an oval mass of cells on the surface and towards their inner end become rounded in section. Their direct connection with the fore-brain at the time is not yet manifest. In older post-larval sand-eels, they appear at the most anterior end of the brain, and they are now open to the exterior. In (Pl. XIII., fig. 4, *ol.*), the cresentic openings are seen, and on the left hand the olfactory nerve passes from the base of the organ to the side of the fore-brain.

LETTERS OF REFERENCE.

au., auditory capsule.
au.c., auditory cushion.
aq., aqueduct of Sylvius.
c.a., anterior commissure.
can., auditory canal.
cb., cerebellum.
ce., cerebrum.
c.i., inferior commissure.
c.o., optic commissure.
f.b., fore-brain.
f.g., fore-gut.
h.b., hind-brain.
inf., infundibulum.
l.i., lobi inferiores.
m.b., mid-brain.
m.o., medulla oblongata.
nc., notochord.
ol., olfactory organ.
op. ch., optic chiasma.
pa., pallium or thin roof of forebrain.
pn., pineal body.
pt., pituitary body.
r.v.3., recess of third ventricle.
sp.c., neural canal.
t.l., tori longitudinales.
t.l.o. tectum of optic lobes.
t.o, optic thalamus.
t.s., tori semicirculares.
t.v. 4, tectum of fourth ventricle.
v.c., valvala cerebelli or fornix.
v.o., optic ventricle.
v. 3, third ventricle.
v. 4, fourth ventricle.

II. optic nerves.
III. oculor-motor nerves.

LIST OF DRAWINGS.

Plate XI.

Fig. 1. Vertical longitudinal section through the brain, and auditory capsule of a larva of eight days. Z. comp. oc. 8 × Apo. 16 mm.

Fig. 2. Similar section in median line, through the brain of the same, as fig. 1. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 3. Oblique transverse section through forebrain of a larva of ten days. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 4. Similar section through fore and mid-brain, of the same as fig. 3. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 5. Similar section through conjoined fore and mid-brain of the same as fig. 3. Z. comp. oc. No.8 × apo. 16 mm.

Fig. 6. Similar section through optic lobes and lobi inferiores, of the same as fig. 3. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 7. Similar section through optic lobe on one side, and medulla oblongata on the other, of the same as fig. 3. Z. comp. oc. No. 4 × apo. 8 mm.

Fig. 8. Similar section through optic lobe, cerebellum and medulla oblongata of the same as fig. 3. Z. comp. oc. No. 4 × apo. 8 mm.

Fig. 9. Similar section through medulla oblongata, of the same as fig. 3. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 10. Obliquely vertical longitudinal section through fore and mid-brain, pituitary body and auditory capsule of a larva of ten days. Z. comp. oc. No. 8 × apo. 16 mm.

Fig. 11. Similar section through fore and mid-brain, and medulla oblongata of the same as fig. 10. Z. comp. oc. No 8 × apo. 16 mm.
Fig. 12. Oblique transverse section through fore-brain of a larva of twelve days. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 13. Similar section through same as fig. 12, but more posterior. Z. comp. oc. No. 4 × apo. 8 mm.

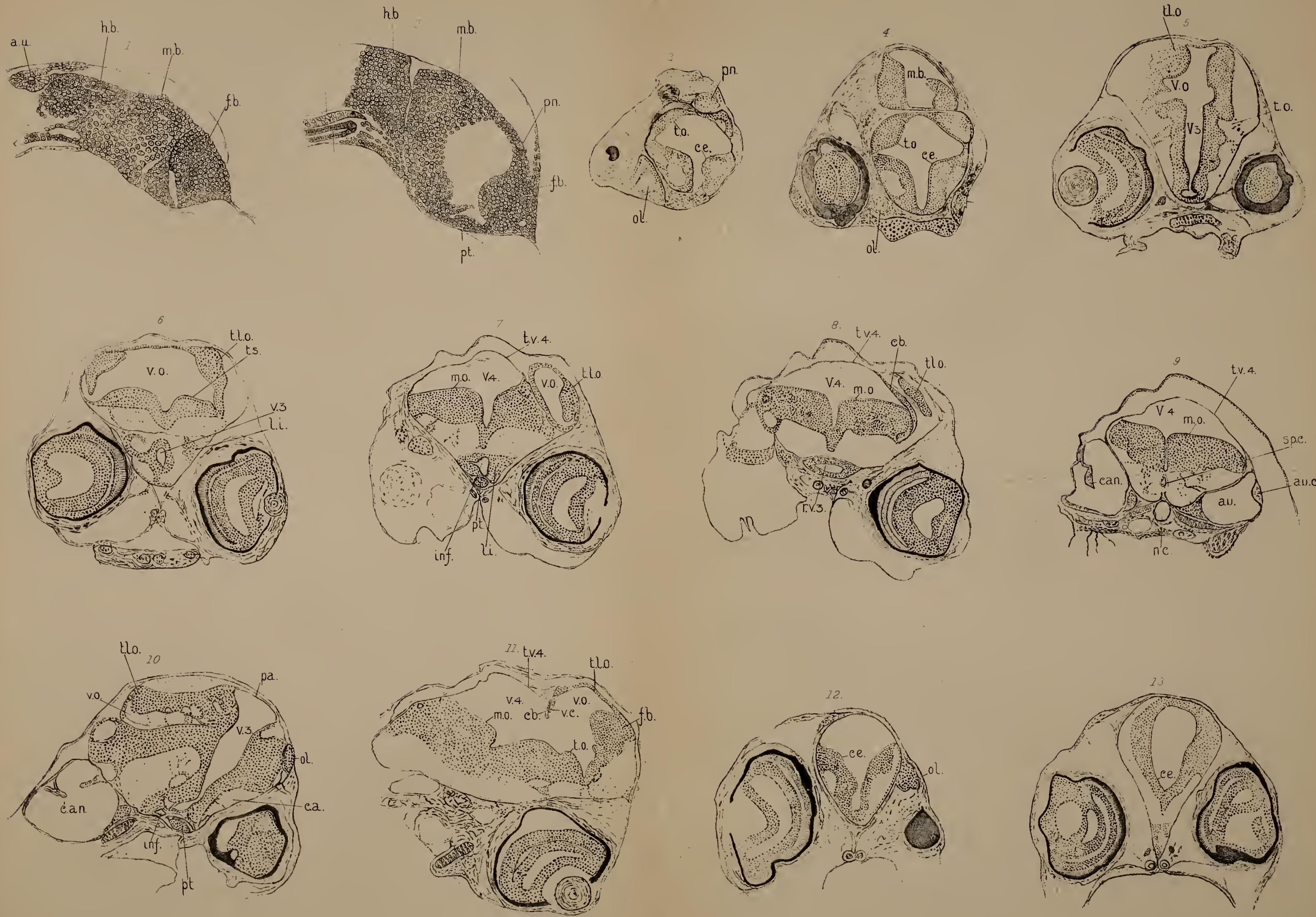
Plate XII.

Fig. 1. Transverse section through the mid-brain and the ventrally prolonged third ventricle of a larva of eighteen days. Z. comp. oc. No. 8 × apo. 16 mm.
Fig. 2. Similar section through same as preceding and immediately posterior to it. Z. comp. oc. No 8 × apo 16 mm.
Fig. 3. Similar section through same as preceding cutting the medulla oblongata and infundibulum. Z. comp. oc. No. 8. × apo. 16 mm.
Fig. 4. Similar section through same as preceding and immediately posterior to it. Z. comp. oc. No 8. × apo, 16 mm.
Fig. 5. Vertical longitudinal section through mid and hind-brain, to one side of middle line of a post-larval form of 5 mm. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 6. Similar sections through same as fig. 6., but more lateral. Z. comp. oc. No. 4. × apo. 8 mm.
Fig. 7. Similar section through same as figs. 5 & 6, but cutting the fore, mid, and hind-brain almost in the middle line. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 8. Similar section near the middle line of the same as the preceding. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 9. Similar section through the same as the preceding, but more lateral. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 10. Transverse section through the mid and fore-brain and olfactory organs of a post-larval form of 5 m.m. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 11. Similar section through same as preceding, but slightly posterior to it. Z. comp. oc. No. 4 × apo. 8 mm.

Plate XIII.

Fig. 1. Transverse section through hinder end of optic lobes of post-larval form of 5 m.m. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 2. Similar section through same as preceding, but slightly posterior to it. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 3. Similar section through same as preceding, cutting the medulla oblongata and second pair of nerves. Z. comp. oc. No. 4 × apo. 8 mm.
Fig. 4. Transverse section through anterior of fore-brain and olfactory organ of a post-larval form of 12 m.m. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 5. Similar section through fore-brain and second pair of nerves, of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 6. Similar section through optic lobes and infundibulum of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 7. Similar section through optic lobes and cerebellum, of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig, 8. Similar section through posterior of optic lobes, and cerebellum of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 9. Similar section through cerebellum and medulla oblongata of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 10. Similar section through fourth ventricle, and medulla oblongata of the same as preceding. Z. comp. oc. No. 4 × apo. 16 mm.
Fig. 11. Transverse section through mid and fore-brain of a larva of eighteen days. Z. comp. oc. No. 8 × apo. 16 mm.
Fig. 12. Similar section through the same as preceding, but somewhat posterior to it. Z. comp. oc. No. 8 × apo. 16 mm.

PLATE XI.



J. H. Fullarton, *delt.*

J. H. Fullarton, *delt.*

PLATE XIII.

J. H. Fullarton, *delt.*

X.—ON THE RATE OF GROWTH OF THE MARINE FOOD AND OTHER FISHES. I. THE RATE OF GROWTH OF THE PLAICE. By ARTHUR T. MASTERMAN, B.A., Assistant Professor of Natural History in the University of St Andrews. (Plate XIV.)

The rate of growth of Teleostean fishes seems to be one of a class of subjects upon which reliable statistics are very hard to obtain, and it is remarkable what divergent opinions are held in regard to it. In dealing with the same, it would be well to first consider the various factors which enter into, and which may be considered the direct causes of, diversity in the rate of growth of various members of a species of Teleostean fish, such as, for instance, the plaice.

Limit of Growth.—The problem of the growth of fishes is very different in many ways from that of the growth of amniota. As one would expect, from theoretical considerations, the fish as an organism shows itself to be more directly susceptible to the influence of its environment. Thus, as mentioned below, the period of incubation can be altered at will between very wide limits by simply varying the temperature, whereas one would hardly expect to alter the period of mammalian gestation, or even of avian incubation, except within extremely narrow limits. Other instances could easily be given to show that the direct effect of the environment upon the piscine organism is much greater than that upon land organisms. Without considering the effect of environment, it is probable that the life-cycle of the individual fish also differs in very important respects from that of the higher animals.

In the mammalia there is a definite duration of growth in bulk and of life quite apart from the environment, and either period can only be altered by continued action of the environmental factors through many generations. There are some experiments which point to the conclusion that the duration of life of the individual fish is only limited in the widest sense (with immunity from environment), but leaving this out of the question there is no proof forthcoming of the hypothesis that the individual fish ceases to grow at any period of its life; on the contrary there are considerations which point to the other view, *i.e.*, that a fish continues to grow throughout its life.

Thus, if a mammalian or avian species be subjected to the destroying agency of man, there follows a *diminution in numbers;* whereas, if a fish be subjected to like conditions a *reduction in the size of the individuals* is the immediate result. These facts can be explained as follows:—In the former case very little, if any, growth in size takes place after the attainment of sexual maturity, whereas, in the latter case, growth continues indefinitely after that event. The amount of growth *per annum* may be expressed as a certain proportion of the whole, and must form an ever-decreasing geometrical series, so that the total amount of growth is only limited in the same sense as $1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}$, etc., is limited in a finite series to less than 2. A study of the average sizes of fish shows that the annual increase is practically distinctly appreciable. There is no reason, therefore, to believe that there is any definite limit to the size of a fish, as used in the sense in which we speak of a definite size attained by mammals and birds, beyond which growth in bulk does not proceed. In other words, the matured state of the reproductive organs is the only criterion by which we may pronounce on the maturity (arrival at adult state) of any given specimen, and the connection between this stage and the size then attained seems to be very variable. It follows from this that the term "*immature*," if it is to signify anything definite whatever, must apply only to the fish which have not yet ripened their sexual organs. If a mean average length could be fixed by scientific observers, under which the individuals of the species under consideration are not sexually mature, and above which they are sexually mature, then one would have a scientific basis for prohibitive legislation. To fix any other significance to the terms "immature" and "mature," is to make these terms absolutely meaningless, and to make apparent a scientific distinction where none such exists.*

If the maturation of the sexual organs takes place in a certain district at a smaller size than is the case with the average, then a "race" or variety of smaller fish ensues. Thus the plaice in the south of England, as far as statistics go, appear to be smaller on an average on attaining maturity than those, *e.g.*, on the east coast of Scotland; and Petersen † deduces facts to show that a smaller "form" ‡ is present in the Baltic than in other Danish waters; whilst in Iceland a "giant race" predominates. If we assume that in all these "forms" the sexual organs mature at the same lapse of time from the hatching date, then the different rate of growth, due to the different environment, would account for the smaller size.

The other alternative is to assume an approximately constant rate of growth in each case, and an earlier (in time) maturation of the sexual organs.

Further investigation alone can show whether one has to deal with a case of a *hastening of sexual development* (paedogenesis) or a *retardation of growth.* Petersen is led to find that the period of attainment of maturity (roughly three years) in the Danish corresponds with that of our East Coast "form" of plaice, which rather indicates the latter.

The attainment of maturity also takes place at a different size in the two sexes, the male pretty generally being the smaller amongst Teleostei. Occasionally, as in the long rough dab and the salmon, this is very marked. Here again we have the same two alternatives by which to explain the facts. Does the male grow more slowly than the female, both maturing at the same time? or does the male mature at an earlier age, the rate of growth for the two sexes being the same? In other words, which varies—the rate of growth, or the period of development?

Here we have data which distinctly point to a variation in the duration of the development, the male sexual organs maturing at an earlier date

* It is difficult to understand the term 'fully-grown' as used by Cunningham (*Journ. Mar. Biol. Assoc.* 1890–91). One would naturally suppose that a fish which is 'fully-grown' must have reached a size beyond which further growth does not take place, but there is no proof that such a state is ever attained by fish. In the higher vertebrata, in which there is a definite limit of growth, the maturation of the sexual organs is more or less correlated with its attainment, and hence a 'mature' animal in these groups may be roughly defined either as 'fully-grown' or as 'sexually ripe.' The latter only of these standards can be applied in the case of fish, and the former term as applied to them has no meaning whatever.

† Petersen, *Rep. Danish Biol. Stat.*, 1893.

‡ Petersen goes over the grounds for and against regarding the "form" peculiarities as *racial*—he appears inclined to attribute them to *direct* influence of the different environments in each generation.

than the female. This is undeniably the case in *Myxine*, and also in the salmon. Thus we may assume that the rate of growth in the two sexes is closely similar. Both sexes are placed under the same environmental conditions, and hence a different rate of growth would be at least improbable, whereas the more *rapid* maturation of the male elements may be traced to a deep-seated origin.*

Factors of Environment.

Nutrition.—There is no doubt that the amount of nutrition is a factor coming into play on the assumption of the post-larval stage, which has a direct and marked effect upon the rate of growth. One need not do more than recall the fact.

Temperature.—The direct effect of temperature upon the duration of the hatching period in pelagic eggs is a well-known fact. Nearly all the common eggs hatched in the St Andrews Laboratory have been observed to have a shorter or longer period of incubation, according to the temperature of the water.

There are also facts to show that fish grow very little during the colder months of the year, so that the growth-rate must be rhythmic in the natural state.

Pathological.—Experiments with marked fish have shown that a slight abrasion of the surface may have a remarkable effect in retarding their growth.

Lastly, there is the important fact of an inherent tendency in each individual to grow at a greater or less rate than its companions. Variation in size of the eggs and contained larvæ of fish, such as the plaice, is a patent fact, and may account for a great deal of diversity of size in fish of an *equal age.* At the same time, it is probable that this factor, in natural surroundings, has been largely over-estimated. The mean average size of the species at every stage has been determined under natural selection, as that which has greatest immunity from destructive tendencies of every sort, and greatest chances of surviving; and the same destructive tendencies still act upon every generation to weed out the maxima and the minima to the preservation of the mean, so that after the early stages the largest or smallest are continually removed, the mean only surviving. This fact is exceedingly important, for it follows from the same, that if one takes a number of fish eggs or young larvæ, *already varying in slight degree* as regards size, and place them in artificial conditions —such as easy access to food, immunity from actual foes, &c.,—in tanks; then, all the slight variations in size tend to be emphasised, and in course of time fish of very various sizes will result. This is precisely what has been done recently by Cunningham.† He took roughly from "200–300" young flounders, varying in size from 1·15 to 1·2 cms. in length, and confined them in tanks (of different sizes). At the expiration of a year he found some to be 1·6 inch, whilst others were 7·5 inch. Cunningham has no doubt proved by this experiment the well-known fact that a species tends to vary in size as well as in structure, but so far as we can see, nothing else.

He points out himself that his data do not apply to natural conditions, but nevertheless proceeds to assign ages to caught specimens, which

* See 'Hermaphroditism in Cod.' A.T.M.

† *Jour. Marine Biol. Assoc.*, 1890-91.

must be based either upon conjecture or else upon his experiments narrated above. As Petersen quaintly remarks, his methods are 'dangerous!'

In natural conditions, especially in a gregarious fish such as the plaice, the environmental factors of temperature, nutrition, &c., must be very closely similar, if not identical, for all the individuals of one brood, so that, taking this into account, and also what has been stated about the variation, there are good grounds for supposing that the rate of growth is closely similar for each individual, and that a *mean average* length for any given species at a given age is a very fixed and determinable quantity. The greater the difference in environment the greater the difference in the mean average, till 'forms' may become marked.

Coming to the facts, however, we find that, in any sample of a number of young fry caught at the same time, they form a marked gradation in size. These fry are caught in close proximity, and their environmental influences being practically alike, their differences in size must be explained by inherent tendencies and a diverse rate of growth, or else by a difference in age. The latter is, I think, the true explanation of the facts, the difference in age being directly traceable to the prolonged spawning period. The facts with regard to the plaice are these:—A prominent feature of the fauna of St Andrews Bay is the great abundance of young pleuronectids, especially plaice, in the sandy shallows, and the specimens caught in any particular month show a marked gradation in size.

Thus in the month of September a series may usually be obtained, varying in length between $3\frac{1}{2}$ inch and $1\frac{1}{2}$ inch. Two instances will suffice:—

1. September 11, 1889.—Mouth of the River Eden.

Inches.	Inches.	Inches.	Inches.
3	2·5 (2)	2	1·5
2·75 (2)	2·4	1·95	1·41
2·7	2·39	1·92	1·37 (2)
2·65	2·35	1·81	...
...	...	1·63	...
...	...	1·62	...
...	...	1-53	...

2. September 15, 1889.—Near St Martin's Point.

Inches.	Inches.	Inches.	Inches.
3·4	2·9 (4)	2·5	2
3·26	2·85	2·4	1·95
3·2	2·65 (2)	2·35	1·92
...	2·5	2·3 (2)	1·9 (3)
...	2·55	2·25	1·85
...	...	2·2 (4)	1·82
...	...	2·15 (3)	1·8
...	...	2·1 (5)	1·55
...	...	2·05	1·6

Other series are found in the earlier months. Thus, below is a single instance from May :—

MAY 27, 1890.—RIVER EDEN.

Inches.	Inches.
1·15	·95
1·1	·92
...	·9
...	·86
...	·67
...	·63
...	·62
...	·6
...	·58
...	·55
...	·54

Both in May and September we find no break in the series, and we are led to the conclusion that all are of one season's growth—all being, in fact, less than one year old.

It is possible to assume that the fishes of 3·4 inch are of the same age as those of 1·6 inch, but there appears to be a perfectly valid reason for believing that there is as great a diversity in age as in size.

This reason arises from the fact that the spawning period of the plaice extends (at any rate on the East Coast of Scotland) over a considerable period. Facts indicate that the plaice commences spawning in mid January, and continues through February, more abundantly in March, April, and again spawning even into the middle of May. There are, doubtless, isolated cases of even later spawning. We thus find a maximum difference of age in one season's fry of no less than four months.

Proceeding on this basis, the young fish of 3·4 inches may approximately be eight months old, and those of 1·37 inch four months. The intermediate sizes represent fish hatched at the period of intermediate months.

Thus, the fish are placed above in rows, according to the purely arbitrary gradation of $\frac{1}{2}$ inch from $3\frac{1}{2}$ inches downwards, and it will be seen that they form series corresponding, to some extent, with the spawning months. Thus—

			Inches.
(1) January (latter half), . .	3	specimens	$3\frac{1}{2}$–3
(2) February, ...	14	,,	3–$2\frac{1}{2}$
(3) March, ...	24	,,	$2\frac{1}{2}$–3
(4) April, ...	18	,,	2–$1\frac{1}{2}$
(5) May (early half), . . .	4	,,	$1\frac{1}{2}$–1

The number of specimens in each section corresponds, to a large extent, with the curve formed by the spawning period. One does not wish to imply that all those exactly between $2\frac{1}{2}$ inches and 2 inches, for instance, are limited to March, &c. ; but the arbitrary adoption of ·5 inch per month suffices to show that the variation in numbers of specimens in the different divisions corresponds to the variation in number of spawning parents, the maxima and minima being co-related.

Applying the same principles to the May series, we find that there is far less diversity in size ; but the fish at the head of the series should, by the scale just laid down, be about 4 months old, which dates them just back to the commencement of the spawning period (mid-January). It is quite possible that the size attained in this series during four months may be less than that in the other series, for a fish developing from January to May had obviously more adverse conditions with which to contend than another developing from May to September. The higher mean temperature, and greater abundance of food in the latter case, are amongst the factors which at once suggest themselves. With these difficulties, it is hard to assign the age of the lowest of the series, but the difficulty may be approached in another way.

This series appears to date approximately within the spawning period of the plaice, so that if the plaice were hatched *in situ* one might expect to obtain a complete series, even up to the unhatched egg.

But the eggs of the plaice are shed, as a rule, in the case before us, outside the territorial waters, and the larval and post-larval plaice have a pelagic habit for a period of about five or six weeks; so that, including the hatching periods, we find that the smallest arrivals in the shallows (·5 inch) should be reckoned as 2 months old. Thus the May series (1·15 in., ·54 in.) extend from 4 months old to 2 months old, and represent those spawned from mid-January to mid-March, those spawned later than this date not yet having arrived from their pelagic life in mid-water. If we again divide these into those columns, 1·15 to ·8 in., and ·8 to ·5, the number in each division increases with the spawning intensity :—

January, mid, ...	1·15—·95	2
February, ...	·95—·75	4
March, ...	·75—·55	7

This arbitrary division is sufficient to bring out the point that, in the September series, the maximum number of individuals is found at the mean size, and in the May series the maximum is at the end of the series containing the smaller sizes. These results are exactly what might be expected, if the facts of diversity of size are to be interpreted by a diversity in time of spawning.

We thus see that a plaice in the first eight months of its life may attain an approximate length of 3 to 3½ inches, and that, considering the next four months from September onwards are mostly winter months, the plaice of a year old will not attain much more than 4½ to 5 inches in length.

Thus by January of the second year there will be a series of plaice gradating from 5 inches to 2½ or 3 inches, corresponding to a gradation in age from 12 months to 8 months.

Again, a series will then commence for the second year's brood, so that the plaice of any district should fall into a number of group-series, each of which presents a maximum and a minimum. By a study of these group-series, one may be able to work out the full growth-rate of any given species. This has recently been done for the plaice of Denmark by Petersen, and his graphic group-series show very perfectly the continual repetition of the annual broods, and, moreover, the predominating mean in each group, with a diminishing number at the maxima and minima. It will be noticed that the four months difference in the sizes of the individuals of each year becomes less and less evident with age, and also that as the growth curve becomes less marked, the rate of growth in length becomes less and less, until at maturity it is nearly or quite suspended. The annual curves will approach one another till they intersect at the year when maturity is reached, so that from a study of the growth-rate we derive independent evidence of the age and size at which maturity is reached in the species under consideration.

Petersen, as far as I understand him, does not attempt to account for the difference in size of the first year fry except as the result of unequal growth, although the group-series indicated upon some of his tables are quite as marked as those I have instanced from St Andrew's Bay.

He finds that the plaice in Danish waters has a spawning period from November till April inclusive, with a maximum in the heart of the winter; but he takes the age of his fry from the month of March, though he mentions that 'the birth-time for the great mass of plaice' is in the heart of winter.

From a spawning period of January to May we were able to date the mean-sized fish from March, a month which corresponds with that selected by Petersen in spite of the different spawning period, so that, by this fortunate coincidence, his results, as regards age, may be compared with those given above.

The great majority of his fry caught at Frederickshaven reach ½ inch in May, 1¼ inch in July, and 2 inches in September, results closely similar to mine. It is important to note that, although he reports a spawning period starting two months before that on the East Coast of Scotland, yet the young fry only commence to appear at the same date as those here (May). To explain this anomaly he has to assume that the November eggs actually take six months (November—May) to hatch and develop to the post-larval stage, when they resort to the sandy shallows. Such an immense retardation of development by low temperature from a duration of about two months (hatching ten days, development during pelagic period six weeks) to one of six months is scarcely likely! If the spawning really takes place to any extent in November and early December, it would probably be a less rash hypothesis to assume, until definite information is obtained, that this is more or less exceptional, and that the young of that date never grow to post-larval forms, but perish during their migration, or earlier.

It will be noticed that the same objection applies, to a lesser extent, to the eggs laid in January and February; but in this case we have not to assume such an enormous retardation of growth. It is well known that a low temperature will lengthen the period of incubation to eighteen or twenty days, and a like retardation in the larval period, from six to about ten or twelve weeks, would bring the period of inshore migration, even of the mid-January brood, well into May.

Upon somewhat the same lines as the recent work of Petersen, I have gone over the only available statistics of the capture of plaice on the East Coast. These were taken by the 'Garland,' and the measurements of those captured in 1891 and 1892 appear in the *Fishery Board Reports.*

The principle upon which the curves are plotted is obvious upon an inspection of Diagram I. and II., and they have been given here only to point out the fact that the number of fish captured do not form one complete curve, but fall into a succession of secondary groups, which, considering everything, are remarkably pronounced.

The measurements were not taken for this purpose, and are so widely approximated in the 1892 series that they are quite useless. Even in the 1891 series there are approximations of an inch or more which greatly vitiate the results; and when we remember that the observations were made promiscuously throughout the months, it is remarkable that there should be left any trace of recurring groups. Lastly, we find that the various hauls were made quite indiscriminately throughout the various stations, the number of hauls in each station in no way corresponding for each month; and we have also taken no account of the steady migrations of the plaice which are known to take place in the Firth and in St Andrew's Bay.

These are all factors tending to eradicate all trace of the group-curves, and that traces of them still remain speaks largely in favour of the probability that, with a properly arranged series of observations, valuable results might be obtained, and a mean average growth-rate might be decided.

At Diagram III. is set out the growth-curve of the first-year plaice. As shown in this paper, the curve after the first year is taken from the lowest group-curve of the St Andrew's Bay plaice (Diagram II.). It is probably too rapid, and is purely dependent upon unsatisfactory data.

If the question of the rate of growth of food-fishes is to be definitely settled, one must look to some such method as the above, which relies solely upon *facts* with regard to the fish *under natural conditions.*

DIAGRAM I.—Firth of Forth, 1891.

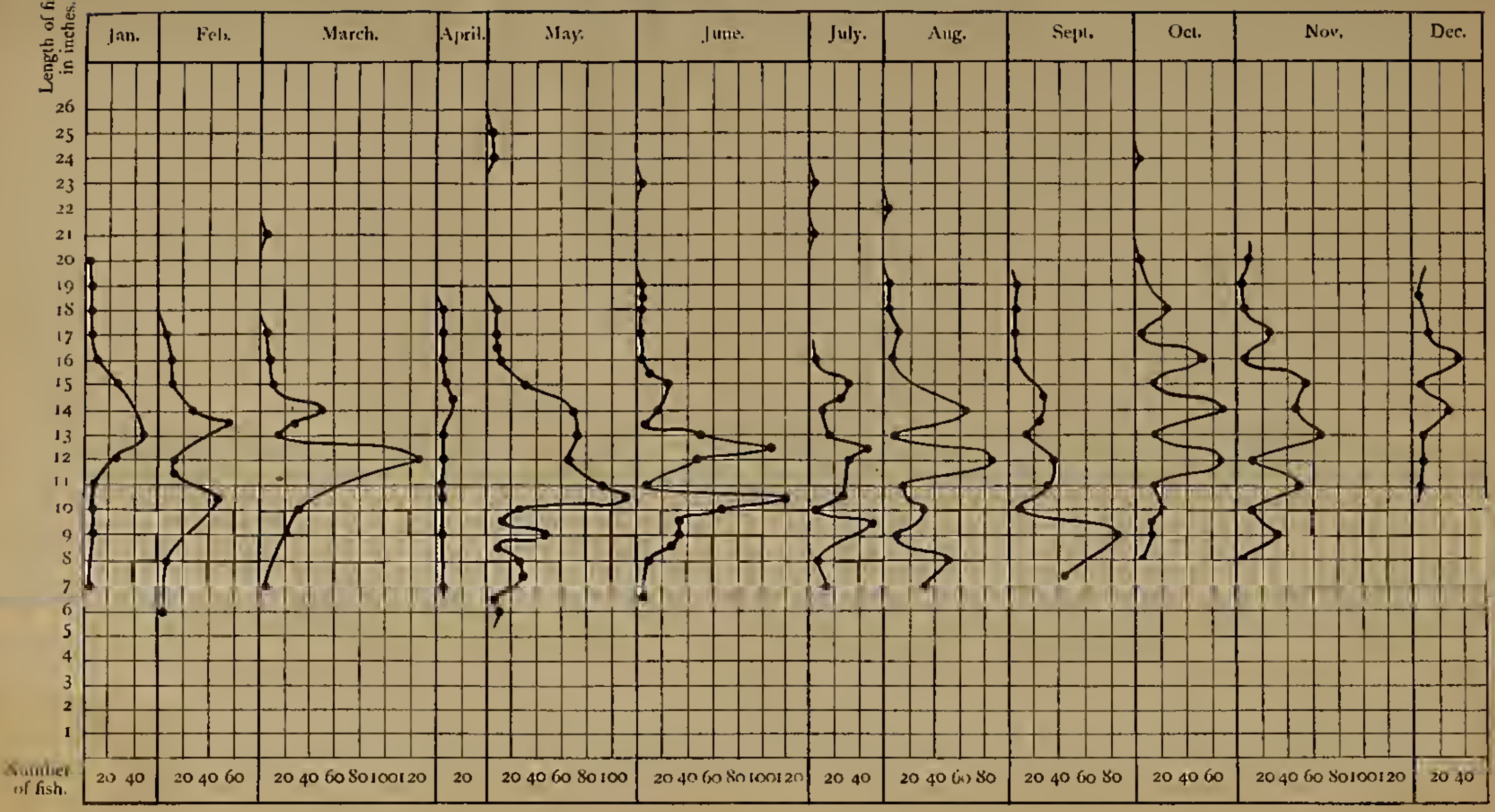


DIAGRAM II.—St. Andrew's Bay, 1891.

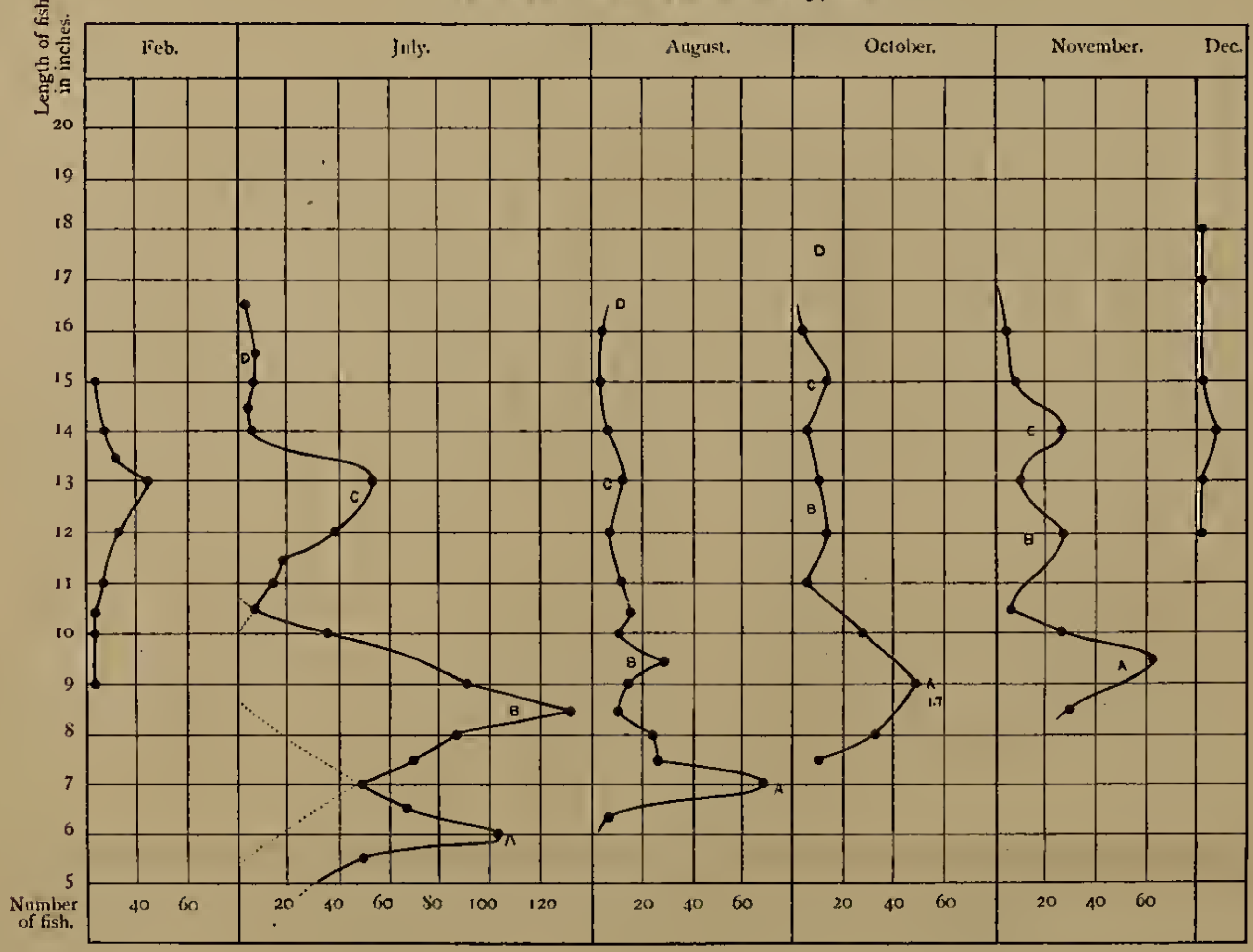
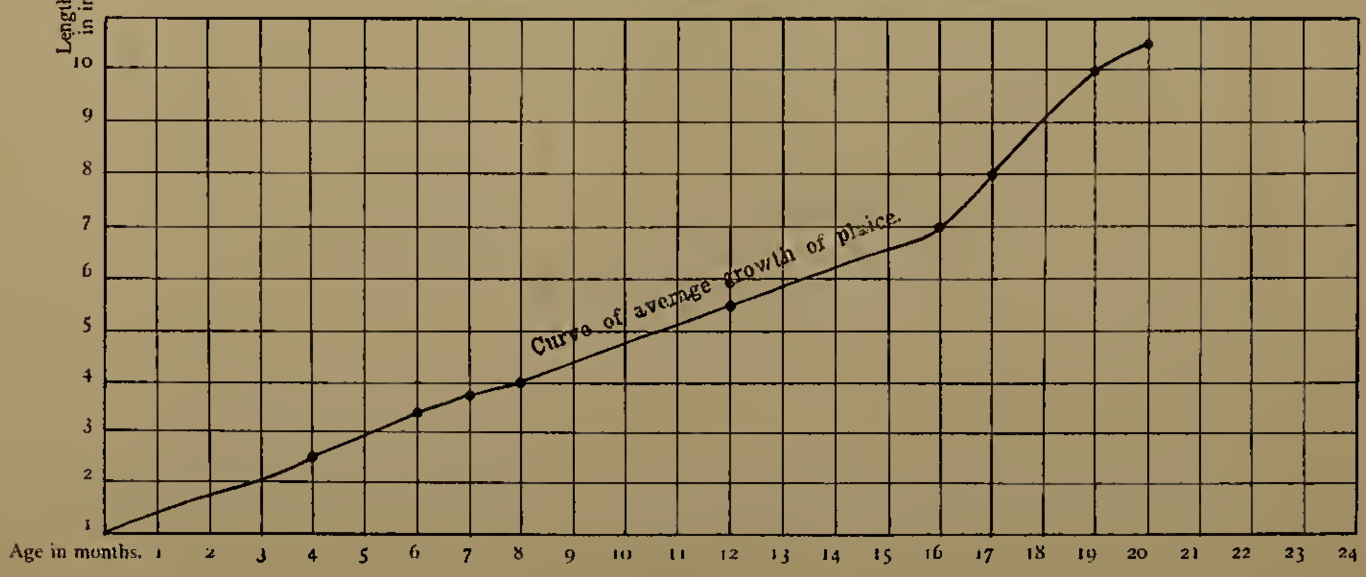


DIAGRAM III.—Average Rate of Growth of Plaice.



XI.—ON HERMAPHRODITISM IN THE COD. By Arthur T. Masterman, B.A. (Cant.), Assistant Professor of Natural History in the University of St Andrews.

Two interesting examples of this peculiar abnormality in *Gadus morrhua* have come under my notice and are described here.

The first specimen (the dorsal view of which, reduced by two-thirds, is shown in fig. 14, Plate IV., *Twelfth Report*) was taken from a cod which was caught at Dunbar in the month of February (?), and was forwarded to the University Museum. Through the kindness of Professor M'Intosh I was enabled to make a detailed examination of it, the results of which will be indicated below.

The second specimen (fig. 11, Plate III., *Twelfth Report*) was found in a cod which was caught in May, and its occurrence was notified by Mr Gibson, fish merchant, Leith. I have to thank this gentleman for allowing me a superficial examination of this specimen after it was preserved in spirit.

In No. 1 the two ovaries were apparently normal, their contents being at the same stage of development as those of most cod caught at that time of year. All appearances point to the conclusion that they were perfectly functional. The right ovary was $3\frac{1}{4}$ inches long (8·125 cms.) and the left was slightly shorter, being $2\frac{3}{4}$ inches (6·9 cms.); there was little difference in the breadth, and none discernible in the structure, except in that at the anterior extremity of the right ovary was attached a small testis (*te*), the comparative size of which can be seen in the figure.

This organ also, both in its external and internal structure, appeared to be perfectly normal, except perhaps for the fact that the testis was less deeply folded than is usually the case.

The fibrous covering of the ovary was continued directly on to the testis, forming a short tubular connection between the two.

The relations and appearance of the connecting duct are seen in fig. 15, Plate IV., *Twelfth Report.* Here we note that the duct, leading by branches from the inner cavity of the testis, is lined for some part of its length by small longitudinal ridges. It leads by a small aperture into the cavity of the ovary, and just ventral to this aperture there runs a horizontal ridge or fold of the ovary wall, which is to a large extent moveable, and can be conceived as capable of functioning as a valve for preventing the passage of the ova into the testis or testis duct, were such an arrangement needed.

The only other detailed account of the inner structure of the testis duct of abnormally hermaphrodite piscine organs is that of Professor Howes.* He gives a diagram of the structures, and describes them as follows:—
'On laying open the duct I found it to be a spacious tube, honeycombed
' in the manner of that of the normal male over its upper and inner areas.
' Its lower moiety was longitudinally subdivided by a kind of septum
' which shut off a small orifice, placing it postero-externally in communi-
' cation with the interior of the ovary. There arose from the postero-
' internal wall of the ovarian capsule a stout membranous fold which
' projected inwards and passed, for a distance of 1 cm., towards the orifice
' of communication with the testis-duct; on nearing that it expanded to
' form a well-marked valve-like structure.'

It will be seen from this that my specimen differed in the structure of its testis-duct only in the absence of the longitudinal 'septum,' which may be represented in this case by the longitudinal ridges already referred to.

It is interesting to note that the single testis in the specimen described by Professor Howes was situated at the *posterior* extremity of the *right*

* G. B. Howes, "Hermaphrodite Genitalia of the Codfish, &c.," *Linnean Society's Journal*, xxiii.

ovary, so that in each case there was present a fairly similar complicated apparatus in connection with the testis-duct, although the testes were in entirely different positions in regard to their appended ovaries.

The extremities of the left ovary, both anterior and posterior, showed no trace of a testis or a duct.

In No. 2 there was an even more peculiar hermaphroditic tendency. The ovaries in this case also differed in size, the left being $3\frac{5}{8}$ inches long and the right $3\frac{1}{8}$—the longer ovary, contrary to No. 1, being that on the left side. At the extreme posterior end of each ovary was situated a testis ($te_{,}$, $te_{,,}$); that attached to the right ovary was large and much convoluted (see fig.), that on the left being very much smaller and with a smooth surface. A closer examination revealed the presence of a very small piece of testicular tissue ($te_{,,,}$) attached to the anterior end of the left ovary and lying close to the ovarian vein running in the mesentery. This testis consisted of a larger lobe, to which were attached laterally two smaller ones.

All three of these testicular masses ($te_{,}$, $te_{,,}$, and $te_{,,,}$) were attached in a similar way to their respective ovaries by a continuation of their outer covering, but I could not pronounce with any certainty as to the presence or absence of any ducts putting them in communication with the ovaries, as a superficial inspection only was permitted. As far as one can conjecture from external appearance, I should be inclined to think that the two larger testes ($te_{,}$ and $te_{,,}$) had ducts, but that the smallest ($te_{,,,}$) had no communication with the ovarian cavity.

Of course, for the reason above referred to, I cannot pronounce upon the internal structure or contents of any part of this specimen, although a few ripe ova were found at the mouth of the oviduct. This is sufficient, however, to indicate the functional activity of the female element of these hermaphroditic organs.

Amongst the literature upon this subject there are three detailed descriptions of cases of hermaphroditism in the cod-fish, namely, that by Professor Howes,* already cited, in which he figures one specimen and tabulates the results of examination of five others from the College of Surgeons Museum; that by Mr Alex. Smith,† in which he describes two cases observed by himself; and lastly that by Professor Max Weber, in which, together with an exhaustive inquiry into similar occurrences in other fish, he figures and describes in great detail a specimen of *Gadus morrhua.*

We may conveniently compare the various cases mentioned by arranging them in a table somewhat after the manner which Professor Howes adopts in his paper already referred to:—

		Size of Ovary. Left.	Size of Ovary. Right.	Testis. (Position on Ovary.)
Smith, .	I.	22·5 cms.	22·5 cms.	(1) Right anterior, no duct. (2) Median, 5 ducts. (3) Ventral Left, duct (?). } Three pieces.
,, .	II.	11·25 ,,	7·5 ,,	Right dorsal, many ducts.
Weber, .		17·5 ,,	16·5 ,,	(1) Right posterior, duct. (2) Left posterior, duct.
Howes, .	I.	12 ,,	16 ,,	Right posterior, duct.
,, .	II.	17 ,,	13 ,,	Left posterior.
,, .	III.	19 ,,	20·5 ,,	Left dorsal.
,, .	IV.	12 ,,	12 ,,	Right posterior, duct.
,, .	V.	12 ,,	12 ,,	Right anterior, duct.
,, .	VI.	10·5 ,,	10 ,,	Right anterior, duct.
Masterman,	I.	6·9 ,,	8·1 ,,	Right anterior, duct.
,, .	II.	9 ,,	7·8 ,,	(1) Right posterior (2) Left posterior (3) Left anterior } ducts (?).

* *Loc. cit.* † *Jour. Anat. and Phys.*, 1869–70.

A comparison such as this, of ten cases, should be sufficient to show that there is extreme irregularity in the arrangement of the various parts, and the only case in which there is any approach to a bilateral symmetry is that of Weber. Here the resemblance of the right and left organs was complete, and both testes were apparently functional. The case cited above as Howes, I., had the right ovary and testis closely resembling in structure and mutual relationship the right organs of Weber's case; but, apart from these two cases, all the others appear to vary indefinitely, although the female element usually predominates. The asymmetry reaches a maximum in my second case described above and in the first one described by Smith, in which there were three testes of varying sizes, one median and attached 'a little above the mouth of the ovisac or 'oviduct,' another being 'towards the left side of the opening of the ovisac 'or oviduct, near its termination.'

Weber, in the paper already referred to, gives a list of the various species of Teleostean fish in which hermaphroditism occurs, and he classifies all these according to the frequency of the phenomenon, so that they form a series (commencing with forms like the cod, whiting, herring, etc., in which this condition occurs only in an occasional specimen, and even then with great irregularity, and culminating in the well-known *Serranus*, which is normally hermaphrodite).

There are obviously two theories which may be held regarding this phenomenon, and the reason of its occurrence; the more usual one is that held by both Howes and Weber, namely, that which accounts for the tendency to produce hermaphrodite individuals as due to atavism, the cases being regarded as a reversion to an ancestral hermaphrodite condition.

There are numerous facts in the ontogeny and structure of the Vertebrata which point to a hermaphrodite chordate ancestor.

Amongst these we may cite Nansen's* observation of the protandric hermaphrodite condition of the myxine and the important fact that amongst Teleostei, as a rule, the males are considerably smaller than the females, and there is in some cases (salmon, etc.) certain proof, and in others a great probability, that the males are mature at a much earlier date than the females. Above the fishes also, many of the Amniota show a tendency for an earlier maturation of the male products. The bearing of this may be seen as follows:—We may suppose the primitive hermaphrodite chordate ancestor to have a continual rhythmical and perhaps seasonal predominance of one sex more or less directly dependent upon the environment (*cf.* Yung's† observations upon Tadpoles). The tendency for a seasonal repetition of the same environment would then have the effect of causing a perfectly rhythmic sexual cycle, from male to female, in each individual. This would be a case of polycyclic hermaphroditism. (For this condition Howes used the terms '*multi*cylic,' and '*uni*cyclic' for monocylic!).

This condition appears to be exemplified in the abnormally hermaphrodite Teleostei. The lengthening of the cycles would result in a monocyclic hermaphrodite condition, as still persistent in myxine, and lastly, the reduction of the stage at the commencement of the cycle to vanishing point in some individuals (females), and hypertrophy of the former half in others (males), would cause a hemi-cyclic diœcious species, as exemplified by all other vertebrata. If we may regard this as, in a general way, the line upon which the diœcious condition has been

* *Aarsber. Bergens Mus.*, 1887, op. vii.
† *Arch. Zool. Expr.*, vii. *Arch. Sci. Phys.*, Nat. xiv.

evolved phylogmetically in the chordata, we have an explanation of the facts of earlier maturation of the males.

There appears also to be some proof for this in vertebrate ontogeny, for Laulanie* holds that the sexual glands in the fowl pass through three chief stages; first, that of sexual indifference or germiparity; second, that of hermaphroditism (very short in the fowl); and, thirdly, that of unisexuality. The same stages, with modifications, are found in mammals. The facts he gives are meagre, but are to some extent supported by other observers.

As regards the *comparative* frequency of hermaphroditism in the Teleostei, Howes † explains this upon the assumption that they 'have 'retained a more primitive condition of the genital glands than have 'the other Gnathostomata.'

From this follows the assumption that the intimate connection of the urinary and genital systems, as exemplified in the Elasmobranchii, Amphibia, and Amniota, is secondarily acquired in these groups. Without entering into a discussion on this subject, a consideration of the primitive relationships of the gonads and nephridia of other Cœlomata, such as the Annelida and Mollusca, would cause one to hesitate before accepting such a far-reaching hypothesis.* Although we have it given upon Professor Howe's authority that 'all recent discovery on the morphology of the 'uro-genital system' makes his hypothesis 'clear,' yet it is directly antagonistic to the facts of the ontogeny of this system as shown by Boveri ‡ in Amphioxus (where the gonadic cavity communicated directly by the pronephric funnel to the exterior), and Rückert, § Van Wyhe, and others.

In estimating the greater frequency of occurrence of this particular abnormality in the Teleostei, the immense number of specimens of this group which come under observation should be taken into consideration, the same factor probably accounting, to some extent, for the fact that, amongst the Amphibia, the Anura are similarly conspicuous.

The more frequent occurrence of this phenomenon in Anura would not warrant our trying to prove the arrangement of the uro-genital organs in them to be more primitive than in other Amphibia. The hypertrophy of the gonads in most Teleostei, in correlation to the necessity for the production of an immense number of young in order to maintain the existence of the species, may perhaps be a factor in the assumption of the idiodinic type in this group.

The second of the theories above referred to has recently been put forward by Pilseneer.|| He explains the appearance of hermaphroditism in Pisces and in Mollúsea, &c., as being due, not to atavism but to an incipient evolution of the hermaphrodite from the diœcious condition. In the Mollusca he traces the gradual specialisation from the indifferentiated hermaphrodite condition to that in which special organs and ducts occur; but quite granting that in this case and in the Teleostean fishes (*Serranus*, &c.), the hermaphrodite condition had been envolved within the group, we cannot follow him in his generalisation that '*hermaphroditism is secondary and succeeds a primitively diœcious state*,' and hence *that the unisexual condition is the more primitive.*

If we accept the generally received hypothesis that unisexuality is acquired and is the higher type, then we shall expect to find the hermaphrodite condition either *perpetuated* or *re-evolved* only in groups, which are in the first case *primitive*, or in the second case placed in an

* *Comptes Rendus*, 1885, p. 393. † *loc. cit.*

‡ *Zool. Jahrbücher, Abth. für Mysh.*, 1892.

§ *Ergeb. Anat. Enthick*, 1891 (Meikel und Bonnet).

|| Quart. Journal Mic. Sci., 1894.

environment in which a *reversion* to the primitive type of hermaphrodism is a necessity to the well-being of the organism. Hence, in any list of hermaphrodite animals, if inclusive, some will fall under the former category, such, perhaps, as certain sponges,—turbellaria, sagitta, myxine, &c. (the parasitic or commensal habit of the last has yet to be proved); whilst others, with isolated environment, &c., will come under the latter category. The most obvious of this *latter* class are selected to form a *general list* of hermaphrodite animals by Pilseneer, and doubtless as many could be selected from the former class to prove that hermaphroditism is a primitive state. To sum up on this point: though it may be shown in Mollusca, Pisces, or other groups, that certain members may revert to the ancestral hermaphrodite condition, yet this does not warrant our assuming that this reversion is a case of evolution *de novo* of the hermaphrodite condition from a primitive and general unisexuality.

The occasional occurrence, then, of cases similar to those described in this paper, are to be regarded as atavistic reversions to a primitive condition, occurring more abundantly in the groups in which adaptations are most numerous and the sexual organs are hypertrophied, and in some few cases being intensified and made permanent (*Serranus*, &c.) features under the action of natural selection.

Granting, however, that the occurrence of hermaphroditism predominates in the Teleostei and Anura, one may regard the fact as being correlated in its origin with the great diversity of form and shape assumed by the many species of these two successful and progressive branches of the Vertebrata.

In conclusion, I wish to thank Professor M'Intosh and Dr Fulton for the opportunity of examining these specimens, and Mr T. R. Cansh, of this University, for kind help with the foreign literature.

SECTION C.—PHYSICAL OBSERVATIONS.

I.—REPORT ON PHYSICAL OBSERVATIONS CARRIED ON BY THE FISHERY BOARD FOR SCOTLAND DURING 1893. By Andrew J. Herbertson, F.R.G.S.

GENERAL.

The year 1893 is one of special interest from a meteorological point of view, and we find that its peculiarities are also shown, though in a less degree, in the variations of the conditions of the water around our coasts. In the early weeks the weather was so cold that the temperature of the sea sank very low, and at one of the west coast stations fell below the freezing point. The spring and summer months were warm, and the sudden uprush of temperature from an unusually low to an unusually high value was a marked characteristic of the spring, while most of the stations show a series of maxima corresponding to periods of excessively warm weather. But while the extremes of the temperature are greater than usual, the average temperature of the surface water for the year is near the mean value derived from observations of the past years since the Fishery Board instituted these observations. In this respect it agrees with 1891, from which, however, it differs in the lowness of its minimum and the high value of its maximum temperatures. The year 1893 was much warmer than 1892, but somewhat cooler than 1890.

The following table gives a summary of the leading results, and may be compared with these published in previous reports :—

Temperature of Surface Water, 1893.

STATION.	Annual Mean.		Monthly Mean, 9 A.M.			Day.		
	9 A.M.	3 P.M.	Max.	Min.	Range.	Max.	Min.	Range.
East Coast—								
Bell Rock, .	8·5	8·6	13·2	4·5	8·7	15·5	4·0	11·5
North Carr, . .	...	...	12·2 ?	3·6	8·6 ?	14·6 ?	2·8	11·8 ?
Abertay, . . .	8·2	8·5	13·5	3·7	9·8	16·1	2·5	13·6
Oxcar, . . .	8·7	9·0	13·9	3·4	10·5	15·6	2·2	13·4
West Coast—								
Stranraer, . .	...	...	16·5	3·3	13·2	17·2	1·0	16·2
West Loch Tarbert,	...	...	17·0	5·4	11·6	20·4	1·0	19·4
Brodick,* . .	9·8	10·1	14·5	5·7	8·8	17·4	4·2	13·2
Ardrishaig,† . .	...	...	13·6	...	...	15·9	under zero	...
Carloway,‡ . .	...	...	14·8	...	...	19·6	...	...

* 10 A.M. and 4 P.M.
† Observations in early months uncertain when below zero.
‡ Carloway, no observations at beginning of year.

With respect to the other observations the influence of the hot weather is shown by the greater value of the mean density for 1893 at most stations than in the two previous years; and the absence of great floods makes the extremes less marked than in some seasons.

Now these years, since the physical observations were first begun, differ very much, each having its own characteristics, and the comparison of the physical results with the biological and economic data should not be delayed much longer. At the close of 1895 many of the stations will have the records of almost six years observations, sufficient to calculate approximate mean values with which the results of the various years may be separately compared. When the other statistics collected by the Board have been similarly treated and compared with the physical results, it is reasonable to hope that some conclusions of practical utility may be drawn, and it is highly desirable that their value should be tested by a thorough investigation of the relationship between them and the biological data at the Board's disposal. In this Report, as in past reports, a number of special peculiarities in the conditions of the sea water have been pointed out, and the investigation of their influence on fishes urged as possibly of considerable importance. Such special investigations should not be lost sight of in the general research as to the relationship between the various sections of the Board's scientific work.

In 1893 the stations were all inspected. As a considerable period had elapsed since the previous inspection, it was found that several of the instruments were out of order, more particularly some hydrometers whose stems were so badly made that the instrumental errors varied at all parts of the scale. The result is that the work of preparing the tables for the present Report has been excessively troublesome, almost every observation at some stations having to be specially corrected. Further, it must be noted that some of these imperfect instruments were in use before 1893, and the figures in the Eleventh Annual Report in many cases must be slightly modified when the means for a number of years come to be calculated. This will entail considerable labour; but it should be undertaken, as the practical worth of the present observations can be realised only when this is done and a comparison made between physical and biological observations during the same periods.

The degree of accuracy of the observations varies at different stations, and it is to be regretted that every observer cannot have some special training before he is entrusted with taking observations. Several months' observations have been lost through an observer not understanding how to read the thermometer below zero: in another case a small but constant correction had to be made because another observer held the instrument wrongly when reading it. The rolling of the lightships is another difficulty to be met, but it must be remarked that, while the North Carr observations are not altogether trustworthy, those made at Abertay and on the 'Garland' are quite satisfactory.

The tables in the present Report have been prepared from the observations as recorded in the books of the various stations, corrected for instrumental and observational errors. In the Eleventh Annual Report a full account was given of the way in which the hydrometer observations were treated, in order that they might be comparable, and that the proportion of salts might be calculated. The same method has been adopted in the present instance.

The result of recent hydrometric work (see Twelfth Annual Report, p. 345) is to show that the hydrometer is a very reliable instrument for the estimation of specific gravities and indirectly of salinity, provided a proper vessel be used to hold the water tested. The glass cylinders supplied by the Fishery Board are rather under the diameter which is now considered necessary for perfectly satisfactory results, and vessels of ampler dimensions are being sent to the stations where density determinations are made.

As regards the future, the completeness of the physical observations should depend on their value, which can be ascertained by the comparative study of physical and other results, as has been already pointed out. The Oxcar and Ardrishaig stations have been given up, owing to the removal of the observers, and it is highly desirable that satisfactory observations should be obtained from the North Carr lightship, which floats in comparatively deep water. The new lighthouse, forty miles west of the Orkneys, might be utilised, and would be an important station; and an attempt should be made to make observations at places detailed in the Eleventh Annual Report. The cruiser observations at fixed stations should be increased as far as possible; and the estimation of the colour of the sea undertaken by means of Forel's Xanthometer, as suggested by Mr Dickson in the Twelfth Annual Report (p. 347).

In the correction of the observations, in the reduction of specific gravities to constant temperatures, and in the preparation of the tables, I have had the assistance of Mr W. S. Bruce, Mrs F. D. Herbertson, B.A., and Mr James Wood, M.A., all of whom I desire to thank for their services.

TEMPERATURE OBSERVATIONS, 1893.

The mean annual temperature of the water at the East Coast Stations during 1893 was considerably higher than in 1892, being almost the same as in 1891 and lower than 1890. The morning surface temperature at the Bell Rock was 8°·5 in 1893, 7°·7 in 1892, 8°·6 in 1891, and 9°·0 in 1890; and a similar relationship exists between the means of the other East Coast stations, except for Oxcar in 1890, which had a relatively much lower annual temperature than the other stations that year, probably due, as Dr Mill has suggested (Ninth Annual Report, p. 356), to the summer readings being far too low. The very low temperatures that characterised the beginning of 1893 led to some confusion in the records, one of the observers being ignorant of how to read the thermometer properly when the temperature was below 0° C. This makes the tables for the west coast incomplete, but the comparison of the actual records for the west coast with those of past years shows that 1893 resembled 1891 in the mean, being much warmer than 1892.

The extremes of monthly temperatures were very marked in 1893, and differentiate it from 1891, when the minimum temperatures were much higher. The range of monthly temperatures at the Bell Rock in 1893 is about a degree above that for 1890 and 1891, and nearly a degree and a half above that for 1892, due more to the warmer summer temperature in the case of the Bell Rock, but the lowness of the minima at Abertay allows the same remarks about the range of temperature to be applied to this station, except for 1890, when the range then was exceptionally little. The west coast stations show high maxima and low minima, with greater range of temperature in 1893 than 1891 and still more so than 1892.

Coming to examine the actual extreme readings the same remarks apply. At the west coast stations many readings were below zero at Ardrishaig in the early weeks of 1893, while those at Stranraer and West Loch Tarbert were only 1°·0, whereas the maxima were at Ardrishaig 15°·9 (July 11 and August 16), Brodick 17°·4 (August 15), West Loch Tarbert 20°·4 (July 3), and Stranraer 17°·2 (June 8). The greatest temperature differences were thus over 16°·0 for Ardrishaig (the exact minimum cannot be ascertained, being below zero), 19°·4 for West Loch Tarbert, and 16°·2 for Stranraer, ranges markedly in excess of those of former years. This is true, although to a less degree, for the east coast stations. The maxima at the Bell Rock (15°·5), North Carr (14°·6?), and Abertay (16°·1) being the highest yet recorded at these stations; but that of Oxcar (15·6) was exceeded in 1891. The east coast maxima (except that of the Bell Rock) occurred between August 17 and 20, while the highest temperatures on the west coast were registered in June or July, except Brodick, where the August maximum was slightly in excess of the July one, and the monthly means on the east coast were greatest in August, and on the west coast in July. The minimum temperatures are also exceptionally low (Oxcar 2°·2, North Carr 2°·8, Abertay 2°·5), except at the Bell Rock (5°·0).

One of the most noteworthy features of the temperature of the water round the S.E. and S.W. coasts of Scotland in 1893 was its variability, both maxima and minima temperatures being excessive, while the mean annual temperature was near the average, so far as can be judged from the results of a few years' observations.

Looking at the distribution of temperature throughout the year, the curves plotted from monthly means show no unusual form, except at Stranraer and West Loch Tarbert, where the rise of temperature in early summer was very rapid and very high; while in June, July and August it was fairly constant, falling rapidly in September. The east coast curves show a slower rise, which is not only much lower but later; a marked maximum occurring in August.

The curves plotted from ten-day observations show a lower minimum at the very beginning of the year than in past years, and the curve does not rise so much in February, nor fall so low in March, so that the lowest minimum is the January and not the March one. But perhaps the most noticeable features of the temperatures of 1893 are the three well marked maxima in the middle of June, early in July, and in the middle of August; Abertay alone not showing the June rise, and the Bell Rock hardly indicating that of July, which is somewhat later, and not so marked on the east coast as on the west, where it forms the highest maximum. The heat of the summer of 1893 was exceptionally great in Scotland, and the water shows the same excessive temperatures. The Bell Rock station, that furthest from land, alone does not exhibit these three almost equal maxima, but rises slowly, with one uprush in the middle of June, to a clearly marked maximum in the middle of August, and then the temperature falls very slowly during the next month. This is a great contrast to the curves for the west coast, where the temperature rises sharply to each maximum and falls equally rapidly. From March 21–31 the temperature at Stranraer was 3°·6; a month later it had risen to 11°·2, a rise of 7°·6. At West Loch Tarbert at the same periods the temperatures were 7°·8 and 12°·5 respectively. From September 1–10 to 21–30 the temperature fell 4°·2, from 15°·1 to 10·9 at Stranraer, and 4°·4, from 16°·3 to 11°·9 at West Loch Tarbert; and from October 11–20 to November 21–30, at Stranraer it sank 6°·7, from 10°·8 to 4°·1, and at West Loch Tarbert 4°·5, from 10°·8 to 6°·3. The effects of such sudden changes of temperature on the oysters in these lochs should be studied.

A new station was founded at Carloway in Lewis in 1892, and observations were carried on there during 1893. The observer had not properly understood how to read the instruments at first, so that his observations prior to March 1893 had to be rejected. An inspection of the station was made by Dr Fulton, and the results forwarded by the observer have been treated in the same way as those from other stations. The highest temperatures observed were 19°·6 at the surface and 19°·2 at the bottom, on July 5th. The curve made from ten-day means shows the same outlines as that of other west coast stations, a marked maximum occurring at the middle of June and early in July; but while there is a slight rise in the curve in August, the prominent maximum is not until the first period of September. The curve is almost a mean between that of Ardrishaig and West Loch Tarbert.

SALINITY OBSERVATIONS, 1893.

The difficulty of preparing some of the specific gravity and salinity tables has been very great, and those for the North Carr cannot be regarded as perfectly satisfactory, though they certainly exhibit the general change of salinity day by day. Some of the observations made at the North Carr in summer are suspiciously constant. At the Oxcar station the hydrometer in ordinary use was broken at the beginning of the year, but mended by one of the observers. Although this was skilfully done, it was found on testing that the instrument was not reliable, and accordingly the readings taking from it have not been used. At Abertay there are some very curious afternoon readings in spring, and in December, when the salinity of the surface water were abnormally low compared with that of the lower strata. These might be caused by heavy floods in the river, but may also be due to an observational error, especially those of the 11th, 24th and 25th of February.

The salinity curves for 1893 show a great steadiness in the case of the Bell Rock, and considerable variation in that of Abertay; North Carr and Oxcar being intermediate, both as regards average density and range. The density for 1893 is higher than 1892 at all stations (the apparent exception of the North Carr being explained by the corrections made in 1893 and not on 1892 observations as has been explained), and only the Bell Rock observations show a higher density in 1891 than 1893. Both maxima and minima are higher, though the range is smaller than in 1892 or 1891, except for Abertay in 1892, and for North Carr in 1891. The mean annual density of the water at 9 A.M. at the Bell Rock for 1893 was 1025·9 (3·33 per cent. of salts), of the surface water at Abertay 1024·1 (3·01 per cent. of salts), and of the bottom water at Abertay 1024·8 (3·15 per cent. of salts). Eleven months at North Carr show a mean density of surface water of 1025·2 (3·21 per cent. of salts), and of bottom water 1025·3 (3·22 per cent. of salts). There are only ten months' observations at Oxcar, which give a mean value of 1025·2 (3·21 per cent. of salts), which is certainly considerably above the mean for the year, since the observations which are lacking are those of the months when the water is freshest.

The curves drawn from monthly means show a minimum of salinity in February at all stations, and a marked maximum in July at Abertay in the morning, in June and August in the morning. The maximum is not so sharply distinguished in the case of the other stations, though it is evident in the afternoon observations at the North Carr lightship.

There is no very striking rise in the salinity curves corresponding to the periods of excessive heat which affected the temperature of the surface water, especially on the west coast. The influence of these hot days is not immediately shown by the salinity curves, but rather by the general raising of the mean salinity for the year at all stations. The curve for the monthly mean density at the Bell Rock station, that furthest removed from fresh water influences, shows this clearly, for while it never was over 1026·0 in 1892, and in 1891 it was so only from June till October; in 1893 it did not sink below this figure after June until the end of the year, except in December afternoons when it was either 1025·9 or 1025·8.

The other stations are always influenced by the waters of the Tay and the Forth, especially the Abertay lightship which floats in the freshest water examined by the observers of the Fishery Board. But none of them show so remarkable vicissitudes of density in 1893 as happened in previous years, the range of density being considerably lower than usual: this may be explained by the dryness of the spring and the absence of very great floods. Rain and river water alter density much more effectively than evaporation which, indeed, does not counteract their influence in cloudy weather.

CRUISER OBSERVATIONS.

When observations were taken from the 'Vigilant' or 'Jackal,' with some regularity at any station, the results have been brought together in Section III. of the tables; and the more important stations have had ten-day and monthly means calculated when there existed sufficient observations to do so. At Rothesay the temperature in the winter months, for which there are records, was much above that of 1892 and considerably higher than 1891. In summer the exceptionally high temperature of the other stations was also recorded here; but September, October and November of 1890 were considerably warmer than in 1893. The surface water was generally warmer than that of the deeper water, except in November, when it was a little cooler. At most of the stations where any difference between surface and bottom temperatures was observed, the upper layers were warmer in summer and cooler in winter than those below. The Stornoway observations show a very marked surface heating in June and July. The Invergordon observations were made mainly in spring and autumn, and do not indicate so clearly the relationship of 1893 to other years. In August and October 1893 the surface water at 9 A.M. was about a degree and a half warmer than in 1892, and in the afternoon over a degree warmer.

'GARLAND' OBSERVATIONS.

The physical observations made on board the 'Garland' are among the most valuable the Board possesses. They are tabulated at the end of this report. The stations are indicated by numbers, and their positions for the Forth and Tay Districts are shown on a map published in the Ninth Annual Report.

The transparency observations, which are made by the same observer, and are therefore comparable, have been fully discussed in past reports. The following table contains a summary of the results in 1893, which may be compared with those of previous years.

MEAN TRANSPARENCY OF WATER OF FIRTH OF FORTH.

Station.	Mean Transparency.						Max. and Min.			
	West End.			East End.			West End.		East End.	
	Low Sun.	High Sun.	Mean.	Low Sun.	High Sun.	Mean.	Max.	Min.	Max.	Min.
I.	2·4	3·4	2·9	3·0	5·2	3·7	4·0	2·0	5·5	2·5
II.	2·7	3·8	3·3	3·1	4·1	3·7	4·5	2·0	5·0	2·5
III.	2·1	3·4	2·8	2·1	3·1	2·6	4·0	1·5	3·5	1·5
IV.	2·0	2·1	2·0	2·2	2·4	2·3	2·5	2·0	3·0	1·2
V.	3·3	5·3	4·4	3·4	5·7	4·7	6·8	2·5	9·0	2·0
VI.	2·9	4·5	3·8	2·8	4·6	3·8	6·5	2·0	7·0	2·0
VII.	1·9	3·1	2·5	2·5	3·7	3·1	4·0	1·5	4·5	2·0
VIII.	3·6	4·8	4·4	4·4	6·6	5·7	7·5	2·8	7·5	4·0
IX.	4·6	7·2	6·1	5·0	6·8	6·0	10·0	4·0	9·5	4·0
X.	1·7	0·5	1·1	1·8	0·6	1·1	4·0	0·5	3·0	0·5

Comparing these results with the means of the past four years it is found that in 1893, at the stations in the middle of the Forth, the summer values were higher, and the winter values lower than the mean, the range being greater, as is that of the temperature at all stations. The northern waters were more transparent in the west and less so in the east, both in summer and winter; and the mean was greater than usual in the west, but the same as past years in the east. On the south side in summer the transparency of the water was either equal to or a little lower than the mean; and in winter it was greater in the west, but equal or lower than usual in the east; while the range was extremely low in the west, somewhat greater further east, and the same as past years to the south-west of the Bass. The water on the whole, then, was somewhat more transparent on the average for the whole year at the majority of stations.

To study the temperature conditions the maximum and minimum for the year have been taken and the range calculated. The stations were then arranged according to their position in the Firth as follows:—

Northern Stations.

Stations.	I. W.	II. W.	II. E.	VI. W.	VI. E.
Maximum,	14·8	13·4	13·8	13·4	13·4
Minimum,	3·8	3·8	4·0	3·2	4·3
Range,	11·0	9·6	9·8	10·2	9·1

Central Stations.

Stations.	I. W.	III. W.	I. E.	V. W.	V. E.	VIII. E.	IX. W.	IX. E.
Maximum,	14·8	13·6	13·3	13·3	13·4	13·8	13·8	13·3
Minimum,	3·8	3·1	4·3	4·3	4·2	4·7	4·5	4·7
Range,	11·0	10·5	9·0	9·0	9·2	9·1	9·3	8·6

Southern Stations.

Stations.						
Maximum,	14·5	14·6	13·8	14·3	14·0	13·8
Minimum,	4·2	4·2	2·4	3·5	3·8	4·4
Range,	10·3	10·4	11·4	10·8	10·2	9·4

From these figures it is evident in the first place that the maximum is higher, the minimum lower, and consequently the range of temperature is greater the further up the Forth we go.

The extremes of temperature and the ranges thereof do not differ greatly from each other near the northern shores nor in the centre, but the minimum temperature is somewhat lower in the north. Near the south coast, however, the water is both warmer in summer and colder in winter than elsewhere, and the extremes are, therefore, somewhat greater.

The physical conditions of the Firth of Forth area have been more fully observed by the staff than those of other waters, the 'Garland's' monthly observations supplementing the work at the fixed stations. The 'Garland' obtains biological as well as physical records from these cruises, and it is desirable that the former should be tabulated and compared with the latter. In order that other physical data besides transparencies may be at the disposal of the biologists, the temperature records of the 'Garland's' cruises have been classified, and means and deviations therefrom calculated for the years 1889–93 inclusive. They are summarised in the following table:—

Surface Water, Firth of Forth, 1889–93.

Means and Deviations therefrom of Maxima, Minima, and Ranges of Temperature at Various Stations.

Temperatures.	Northern Stations.					Central Stations.								Southern Stations.					
	I. W.	II. W.	II. E.	VI. W.	VI. E.	I. W.	III. W.	I. E.	V. W.	V. E.	VIII. E.	IX. W.	IX. E.	IV. W.	IV. E.	III. E.	VII. W.	VII. E.	VIII. W.
Maxima.																			
Mean, 1889–93 .	13·2	12·9	13·0	12·7	12·8	13·2	13·2	13·4	12·8	12·8	12·9	13·2	13·0	13·8	13·8	13·2	13·3	12·9	13·1
Deviation, 1889 .	+0·1	+0·2	+0·1	+0·4	+0·5	+0·1	−0·2	+0·6	+0·2	+0·2	+0·2	+0·4	−0·1	+1·8	+1·6	+0·9	+1·2	+1·1	−0·2
,, 1890 .	−0·6	−0·5	−0·8	−0·2	−0·1	−0·6	−0·5	+0·2	−0·8	−0·8	−0·5	−0·2	+0·5	−0·9	−1·0	−0·9	−0·6	−0·3	−0·5
,, 1891 .	+0·1	+1·1	+1·7	+0·2	+0·3	+0·1	+1·8	+1·0	+1·1	+1·2	+0·4	+0·5	+0·3	−0·2	−0·5	+1·0	+0·5	−0·5	+1·1
,, 1892 .	−1·3	−1·2	−1·7	−1·3	−1·4	−1·3	−1·6	−1·6	−1·0	−1·4	−1·2	−1·4	−1·1	−1·2	−1·0	−1·4	−1·8	−1·3	−1·3
,, 1893 .	+1·6	+0·5	+0·8	+0·7	+0·6	+1·6	+0·4	−0·1	+0·5	+0·6	+0·9	+0·6	+0·3	+0·7	+0·8	+0·2	+1·0	+1·1	+0·7
Minima.																			
Mean, 1889–93 .	4·2	4·1	4·3	4·3	4·6	4·2	4·1	4·6	4·6	4·5	4·8	4·9	4·9	3·9	4·0	4·1	4·1	4·2	4·6
Deviation, 1889 .	±0·0	−0·1	−0·3	−0·2	−0·5	±0·0	+0·4	−0·2	−0·1	−0·3	−0·3	−0·4	−0·4	−0·4	−0·1	+0·5	−0·2	−1·1	−0·1
,, 1890 .	+1·0	+0·4	+0·2	+1·3	+1·0	+1·0	+1·1	+1·2	+1·0	+1·1	+0·8	+0·7	+0·7	+0·7	+1·0	+1·3	+1·5	+1·5	+1·0
,, 1891 .	+0·3	+0·9	+0·9	+0·4	+0·3	+0·3	+0·4	+0·7	+0·2	+0·2	+0·3	+0·6	+0·1	+0·3	−0·1	+0·1	+0·2	+0·6	+0·3
,, 1892 .	−0·8	−0·8	−0·6	−0·5	−0·7	−0·8	−0·8	−1·1	−0·7	−0·6	−0·9	−0·7	−0·4	−1·0	−1·1	−0·6	−0·8	−0·8	−0·9
,, 1893 .	−0·4	−0·4	−0·3	−1·1	−0·3	−0·4	−1·0	−0·3	−0·3	−0·3	−0·1	−0·4	−0·2	+0·3	+0·2	−1·5	−0·6	−0·4	−0·2
Ranges.																			
Mean, 1889–93 .	9·0	8·8	8·7	8·4	8·2	9·0	9·1	8·8	8·2	8·2	8·1	8·3	8·1	9·9	9·8	9·1	9·2	8·8	8·4
Deviation, 1889 .	+0·1	+0·3	+0·4	+0·6	+1·0	+0·1	−0·6	+0·8	+0·3	+0·6	+0·5	+0·8	+0·3	+1·2	+1·7	+0·4	+1·4	+2·1	±0·0
,, 1890 .	−1·6	−0·9	−1·0	−1·5	−1·1	−1·6	−1·6	−0·6	−1·8	−1·8	−1·3	−0·9	−0·2	−1·6	−2·0	−2·1	−2·1	−1·9	−1·4
,, 1891 .	−0·2	+0·2	+0·8	−0·2	±0·0	−0·2	+1·4	+0·3	+0·9	+1·1	+0·1	−0·1	+0·2	−0·5	−0·4	+0·9	+0·2	−1·2	+0·9
,, 1892 .	−0·5	−0·4	−1·1	−0·8	−0·7	−0·5	−0·8	−0·5	−0·3	−0·7	−0·3	−0·7	−0·7	−0·2	+0·1	−0·8	−1·0	−0·6	−0·3
,, 1893 .	+2·0	+0·8	+1·1	+1·6	+0·9	+2·0	+1·4	+0·2	+0·8	+1·0	+1·0	+1·0	+0·5	+0·2	+0·4	+1·7	+1·6	+1·4	+1·0

The stations have been classified into three groups, northern, central, and southern, and in every group the column on the left is that of a station further up the Forth than that on the right. The maximum tends to diminish as the station is nearer the influence of the North Sea, and the minimum notably increases in the more easterly stations, so that the range near Inchkeith or off Musselburgh is much greater than that off Anstruther, the May, or the Bass, or in the open sea, which shows the lowest range of all.

Perhaps the most interesting fact shown in the table is the great variation of temperatures from year to year. The maximum temperature was exceptionally high in the Forth, as at all other stations, in 1893, and exceptionally low in 1892; in 1891 it was little above the average, in 1890 decidedly below, and in 1889 distinctly above the mean. In 1893 the minimum temperature was under the average, but not so much so as in 1892, the exceptional lowness of the summer temperature in the latter year, however, making the range of temperature distinctly under the average, while in 1893 the extremes were the greatest yet experienced since the 'Garland's' observations began. During the early months of 1890 the water was warmer than it has been during the five years of which we have records; and this made the difference between winter and summer temperatures during that year much lower than usual. The range of temperatures in 1891 is very little above the average, while in 1889 both maxima and minima are more extreme than in the mean.

These years 1889–93 thus present marked differences in temperature conditions, as well as in transparencies. The salinities should be treated in a similar way, and also the biological observations. From a comparison of these data we should be able to learn something of the relationship between the physical conditions of the Forth and the organic life in its waters—and it seems to me that it is highly desirable that the Board should have this inquiry carried out at an early date.

PHYSICAL OBSERVATIONS, 1893.

I.—FIXED STATIONS.

TABLE I.—Temperature of Water—Abertay Light Vessel.

Ten-day Periods.

Ten-day Period.	Observations, 9 A.M.			Observations, 3 P.M.		
	Surface.	3 Fathoms.	Bottom.	Surface.	3 Fathoms.	Bottom.
1893.						
Jan. 1–10	3·7	4·4	4·6	4·2	5·4	5·4
,, 11–20	3·3	5·0	4·3	4·0	4·6	4·6
,, 21–31	4·2	4·6	4·8	4·4	4·7	4·8
Feb. 1–10	4·3	4·9	4·9	4·8	5·0	5·1
,, 11–20	4·3	4·7	4·7	4·6	5·0	5·1
,, 21–28	3·7	4·7	4·8	3·5	4·3	4·7
Mar. 1–10	4·1	4·4	4·5	4·6	4·7	4·9
,, 11–20	4·2	4·8	4·9	4·6	5·1	5·1
,, 21–31	5·0	5·2	5·3	5·5	5·5	5·5
Apr. 1–10	6·0	6·0	6·0	6·0	5·9	5·9
,, 11–20	6·0	6·4	6·3	6·1	6·3	6·3
,, 21–30	7·0	6·9	6·7	7·3	7·4	7·3
May 1–10	7·7	7·7	7·7	7·8	7·8	7·7
,, 11–20	8·6	8·5	8·3	8·7	8·4	8·4
,, 21–31	9·1	9·1	8·8	9·9	9·8	9·5
June 1–10	10·5	10·0	9·9	10·7	10·4	10·1
,, 11–20	11·1	10·8	10·8	10·9	10·6	10·4
,, 21–30	11·5	11·5	11·3	11·8	11·7	11·5
July 1–10	12·4	12·5	12·4	12·6	12·7	12·6
,, 11–20	13·0	13·3	13·2	12·9	13·1	13·1
,, 21–31	12·3	12·6	12·5	13·2	13·7	13·5
Aug. 1–10	12·4	12·6	12·6	13·1	13·1	13·1
,, 11–20	14·7	14·3	14·4	14·4	14·0	13·8
,, 21–31	13·5	13·9	13·7	13·4	13·4	13·4
Sept. 1–10	13·1	13·5	13·4	13·4	13·7	13·6
,, 11–20	12·7	13·1	13·1	12·9	13·1	13·1
,, 21–30	10·7	11·5	11·5	11·2	12·1	12·1
Oct. 1–10	10·5	11·1	11·2	10·9	11·4	11·5
,, 11–20	10·2	10·8	10·8	10·8	11·1	11·2
,, 21–31	9·4	10·3	10·5	9·9	10·7	10·7
Nov. 1–10	7·1	8·2	8·6	7·6	8·9	9·0
,, 11–20	7·0	8·0	8·1	7·5	8·4	8·4
,, 21–30	5·8	6·6	6·8	6·8	7·5	7·5
Dec. 1–10	5·7	6·4	6·6	5·7	6·5	6·7
,, 11–20	5·6	6·2	6·3	5·7	6·2	6·4
,, 21–31	5·4	5·9	6·1	6·0	6·4	6·4

TABLE II.—Temperature of Water—Abertay Light Vessel.

Monthly Means.

Month.	Observations, 9 A.M.			Observations, 3 P.M.		
	Surface.	3 Fathoms.	Bottom.	Surface.	3 Fathoms.	Bottom.
1893.						
January	3·7	4·7	4·6	4·2	4·9	4·9
February	4·1	4·8	4·8	4·3	4·8	5·0
March	4·4	4·8	4·9	4·9	5·1	5·2
April	6·3	6·4	6·3	6·5	6·5	6·5
May	8·5	8·4	8·3	8·8	8·7	8·5
June	11·0	10·8	10·7	11·1	10·9	10·7
July	12·6	12·8	12·7	12·9	13·2	13·1
August	13·5	13·6	13·5	13·6	13·5	13·4
September	12·2	12·7	12·7	12·5	13·0	12·9
October	10·0	10·7	10·8	10·5	11·1	11·4
November	6·6	7·6	7·8	7·3	8·3	8·3
December	5·6	6·2	6·3	5·8	6·3	6·5
Mean	8·2	8·6	8·6	8·5	8·9	8·9

TABLE III.—Temperature of Water—North Carr.

Ten-day Periods.

Ten-day Period.	Observations, 9 A.M.			Observations, 3 P.M.		
	Surface.	12 Fathoms.	Bottom.	Surface.	12 Fathoms.	Bottom.
1893.						
Jan. 1–10	.	.	.	.	.	.
,, 11–20	3·6	4·2	4·8	3·8	4·3	5·0
,, 21–31	3·9	4·6	4·9	3·9	4·7	5·1
Feb. 1–10	3·7	5·0	5·4	3·8	5·9	5·6
,, 11–20	3·6	5·0	5·3	3·7	5·2	5·2
,, 21–28	3·4	4·8	5·0	3·4	4·9	4·9
Mar. 1–10	4·0	4·9	5·2	4·3	5·5	5·1
,, 11–20	4·0	5·5	4·9	4·3	5·2	5·2
,, 21–31	4·6	6·6	5·3	5·0	6·7	5·5
Apr. 1–10	5·0	5·9	5·5	5·3	6·9	6·2
,, 11–20	5·3	6·0	5·8	5·7	6·9	6·2
,, 21–30	6·3	7·0	6·6	6·5	7·3	6·9
*May 1–10	6·9	8·2	6·7	6·0	8·5	7·0
,, 11–20	7·8	8·8	7·4	8·6	9·9	7·6
,, 21–31	9·0	9·9	7·6	9·2	11·8	8·2
June 1–10	10·0	10·3	8·8	10·1	10·6	8·8
,, 11–20	10·3	10·9	9·8	10·5	11·2	9·7
,, 21–30	10·3	11·1	10·2	10·3	11·1	9·8
July 1–10	11·8	12·6	11·1	11·9	12·8	11·2
,, 11–20	12·1	13·1	11·9	12·5	13·4	12·3
,, 21–31	12·2	13·4	12·0	13·0	13·6	12·4
Aug. 1–10	12·2	13·1	12·6	12·4	13·1	12·8
,, 11–20	13·2	14·0	13·4	13·8	15·0	13·2
,, 21–31	11·3	.	13·0	12·2	.	13·1
†Sept. 1–10	11·1	.	13·4	11·7	.	13·1
,, 11–20	7·9	.	13·0	8·2	.	13·2
,, 21–30	6·5	.	11·6	6·6	.	11·9
Oct. 1–10	6·2	.	.	6·2	.	.
,, 11–20	5·9	.	.	6·0	.	.
,, 21–31	6·6	.	.	7·0	.	.
Nov. 1–10	8·1	.	.	8·0	.	.
,, 11–20	7·2	.	.	7·5	.	.
,, 21–30	.	.	.	.	.	.
Dec. 1–10	.	.	.	.	.	.
,, 11–20	.	.	.	.	.	.
,, 21–31	.	.	.	.	.	.

* Surface doubtful after this. † Surface very doubtful.

TABLE IV.—Temperature of Water—North Carr.

Monthly Means.

Month.	Observations, 9 A.M.			Observations, 3 P.M.		
	Surface.	12 Fathoms.	Bottom.	Surface.	12 Fathoms.	Bottom.
1893.						
January	3·8	4·4	4·9	3·9	4·5	5·1
February	3·6	4·9	5·2	3·6	5·1	5·2
March	4·2	5·7	5·1	4·5	5·8	5·3
April	5·5	6·3	6·0	5·7	7·0	6·4
*May	7·9	9·0	7·2	7·9	10·1	7·6
June	10·1	10·8	9·6	10·3	11·0	9·4
July	12·0	13·0	11·7	12·5	13·3	12·0
August	12·2	13·6	13·0	12·8	14·1	13·0
†September	8·5	.	12·7	8·8	.	12·7
October	6·2	.	.	6·4	.	.
November	7·7	.	.	8·8	.	.
December	.	.	.	.	.	.

* Surface doubtful. † Surface unreliable

TABLE V.—Temperature of Surface Water—East Coast.

Ten-day Periods.

Ten-day Period.	Oxcar. 9 A.M.	Oxcar. 3 P.M.	Bell Rock. 9 A.M.	Bell Rock. 3 P.M.	Ten-day Period.	Oxcar. 9 A.M.	Oxcar. 3 P.M.	Bell Rock. 9 A.M.	Bell Rock. 3 P.M.
1893.					1893.				
Jan. 1–10	3·1	3·2	5·1	4·6	July 1–10	13·6	13·8	11·4	11·6
,, 11–20	2·9	3·4	4·6	4·8	,, 11–20	14·4	14·5	12·0	12·2
,, 21–31	4·1	4·5	4·7	4·9	,, 21–31	13·4	13·4	12·5	13·3
Feb. 1–10	4·6	5·0	4·7	4·8	Aug. 1–10	12·9	13·7	12·7	13·0
,, 11–20	4·4	4·6	4·5	4·8	,, 11–20	15·1	14·9	13·6	13·6
,, 21–28	3·4	4·2	4·3	4·5	,, 21–31	13·6	13·6	13·3	13·4
Mar. 1–10	4·1	4·8	4·5	4·5	Sept. 1–10	13·5	14·0	13·1	13·4
,, 11–20	4·5	4·7	4·8	4·8	,, 11–20	13·0	13·5	12·7	12·9
,, 21–31	5·1	5·6	4·9	5·0	,, 21–30	11·2	11·2	11·8	11·6
Apr. 1–10	6·2	6·5	5·5	5·3	Oct. 1–10	10·4	10·7	11·3	11·7
,, 11–20	6·9	7·3	5·7	5·8	,, 11–20	10·1	10·3	11·0	11·4
,, 21–30	8·1	8·7	6·2	6·7	,, 21–31	9·6	9·8	10·4	10·5
May 1–10	8·7	9·0	7·0	6·9	Nov. 1–10	7·7	8·0	8·8	9·1
,, 11–20	10·1	10·2	7·9	7·9	,, 11–20	6·8	6·8	8·7	8·4
,, 21–31	10·3	10·9	8·7	9·4	,, 21–30	5·7	5·9	7·7	7·8
June 1–10	11·4	11·9	9·8	10·5	Dec. 1–10	5·9	6·1	6·6	6·9
,, 11–20	13·7	14·1	10·9	10·8	,, 11–20	5·4	5·5	6·5	6·3
,, 21–30	13·3	13·7	10·6	10·5	,, 21–31	.	.	6·5	6·3

TABLE VI.—Temperature of Surface Water—East Coast.

Monthly Means.

Month.	Oxcar. 9 A.M.	Oxcar. 3 P.M.	Bell Rock. 9 A.M.	Bell Rock. 3 P.M.	Month.	Oxcar. 9 A.M.	Oxcar. 3 P.M.	Bell Rock. 9 A.M.	Bell Rock. 3 P.M.
1893.					1893.				
January	3·4	3·7	4·8	4·8	July	13·8	13·9	12·0	12·4
February	4·1	4·6	4·5	4·7	August	13·9	14·1	13·2	13·3
March	4·6	5·0	4·7	4·8	September	12·6	12·9	12·5	12·6
April	7·1	7·5	5·8	5·9	October	10·0	10·3	10·9	11·2
May	9·9	10·0	7·9	8·1	November	6·7	6·9	8·4	8·4
June	12·8	13·2	10·4	10·6	December	5·6*	5·8*	6·5	6·5
Year	.	.	.	.	Year	8·7	9·0	8·5	8·6

* Dec. 1–20 only.

TABLE VII.—Temperature of the Surface Water—Brodick.

Monthly Means.

1894.	10 A.M.	4 P.M.	Period.	10 A.M.	4 P.M.	Period.	10 A.M.	4 P.M.	Period.	10 A.M.	4 P.M.
Jan. 1–10	5·7	5·9	Apr. 1–10	6·9	7·2	July 1–10	14·1	14·6	Oct. 1–10	11·4	12·1
,, 11–20	5·7	5·7	,, 11–20	7·7	8·0	,, 11–20	13·9	14·0	,, 11–20	11·6	11·6
,, 21–31	6·0	6·1	,, 21–30	9·4	9·8	,, 21–31	13·5	13·6	,, 21–31	10·6	11·1
Feb. 1–10	6·0	6·1	May 1–10	9·2	9·5	Aug. 1–10	14·0	14·1	Nov. 1–10	8·7	8·9
,, 11–20	5·9	6·0	,, 11–20	10·2	10·4	,, 11–20	15·0	15·0	,, 11–20	8·1	8·4
,, 21–28	5·1	5·5	,, 21–31	10·8	11·0	,, 21–31	14·5	14·9	,, 21–30	8·6	8·6
Mar. 1–10	5·7	5·9	June 1–10	12·4	12·7	Sept. 1–10	14·4	14·4	Dec. 1–10	8·1	8·3
,, 11–20	5·7	6·0	,, 11–20	14·6	15·1	,, 11–20	13·7	13·9	,, 11–20	7·9	8·0
,, 21–31	6·2	6·6	,, 21–30	12·4	12·9	,, 21–30	12·2	12·3	,, 21–31	7·9	8·0

TABLE VIII.—Temperature of the Surface Water—Brodick.

Ten-Day Period.

1893.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
10 A.M.	5·8	5·7	5·9	8·0	10·1	13·1	13·8	14·5	13·4	11·2	8·5	8·0	9·8
4 P.M.	5·9	5·9	6·2	8·3	10·3	13·6	14·1	14·7	13·5	11·6	8·6	8·1	10·1

TABLE IX.—Temperature of Water—West Coast.

Ten-day Periods.

Ten-day Period.	1. Ardrishaig.		2. W. Loch Tarbert.		3. Stranraer.		4. Carloway.	
	9 A.M.	3 P.M.	3 P.M.		9 A.M.		10 A.M.	
	Surf.	Surf.	Surf.	Bot.	Surf.	Bot.	Surf.	Bot.
1893.								
Jan. 1–10	* .	.	.	.	.	.	.	.
,, 11–20	.	.	.	.	2·1	2·3	.	.
,, 21–31	.	.	5·4	5·6	4·3	4·5	.	.
Feb. 1–10	.	.	5·7	5·8	4·6	4·8	.	.
,, 11–20	.	.	5·3	5·4	3·7	3·9	.	.
,, 21–28	.	* .	5·2	5·4	2·8	3·0	.	.
Mar. 1–10	5·5	5·6	6·5	6·4	3·2	3·4	.	.
,, 11–20	5 9	5·9	6·5	6·6	3·0	3·2	5·1	5·4
,, 21–31	6·7	6·8	7·8	7·8	3·6	3·9	7·3	7·0
Apr. 1–10	7·6	7·7	9·8	9·9	5·4	5·6	8·5	8·2
,, 11–20	7·7	7·7	9·5	9·6	8·3	8·6	8·8	8·6
,, 21–30	9·0	9·1	12·5	12·3	11·2	11·4	10·9	10·5
May 1–10	8·9	8·9	12·4	12·4	11·7	11·9	11·0	10·6
,, 11–20	10·7	10·9	13·1	13·2	12·9	13·1	11·2	10·8
,, 21–31	11·1	11·2	14·4	14·2	13·4	13·6	12·6	12·3
June 1–10	11·4	11·7	16·5	16·0	15·1	15·3	12·8	12·6
,, 11–20	13·4	14·1	18·2	17·9	16·1	16·3	15·3	15·0
,, 21–30	10·9	11·0	16·2	16·1	15·4	15·6	13·8	13·6
July 1–10	13·1	13·3	18·2	17·9	16·6	16·8	16·6	16·3
,, 11–20	12·8	12·6	16·0	16·1	16·7	16·8	14·2	14·0
,, 21–31	11·1	11·9	16·5	16·5	16·2	16·4	13·7	13·6
Aug. 1–10	12·1	12·5	16·0	15·9	15·5	15·5	14·2	13·9
,, 11–20	14·7	14·9	18·1	17·8	16·3	16·3	13·8	13·3
,, 21–31	14·0	14·3	16·2	16·3	15·2	15·4	13·3	13·0
Sept. 1–10	13·1	13·5	16·3	16·0	15·1	15·2	15·3	15·0
,, 11–20	12·7	12·6	14·1	14·4	14·1	14·2	14·2	13·9
,, 21–30	10·6	11·1	11·9	12·2	10·9	11·1	12·7	12·6
Oct. 1–10	10·6	11·1	11·3	11·5	10·4	10·6	12·2	12·0
,, 11–20	11·2	11·3	10·8	10·8	10·8	11·1	11·2	11·0
,, 21–31	9·8	11·0	9·8	10·2	9·3	9·5	8·7	8·8
Nov. 1–10	8·5	9·1	8·0	8·4	5·9	6·1	7·9	7·9
,, 11–20	8·1	8·3	6·9	7·0	4·9	5·1	7·6	7·6
,, 21–30	8·4	8·6	6·3	6·6	3·9	4·1	5·9	6·1
Dec. 1–10	8·8	8·9	6·5	6·6	5·1	5·3	5·2	5·5
,, 11–20	7·4	7·5	5·7	5·7	4·9	5·0	5·3	5·5
,, 21–31	8·5	8·6	5·8	5·9	5·5	5·7	5·5	5·4

* Observations unintelligible.

TABLE X.—Temperature of Water—West Coast.

Monthly Means.

Month.	1. Ardrishaig.		2. W. Loch Tarbert.		3. Stranraer.		4. Carloway.	
	9 A.M.	3 P.M.	3 P.M.		9 A.M.		10 A.M.	
	Surf.	Surf.	Surf.	Bot.	Surf.	Bot.	Surf.	Bot.
1893.								
January	.	.	.	.	.	.	.	.
February	.	.	5·4	5·5	3·7	3·9	.	.
March	6·0	6·1	6·9	6·9	3·3	3·5	.	.
April	8·1	8·2	10·6	10·6	8·3	8·5	9·4	9·1
May	10·2	10·3	13·8	13·8	12·7	12·9	11·6	11·2
June	11·9	12·3	17·0	16·7	15·5	15·7	14·0	13·7
July	12·3	12·6	16·9	16·8	16·5	16·7	14·8	14·6
August	13·6	13·6	16·8	16·7	15·7	15·7	13·8	13·4
September	12·1	12·4	14·1	14·2	13·4	13·5	14·1	13·8
October	10·5	11·1	10·6	10·8	10·2	10·4	10·7	10·6
November	8·3	8·7	7·1	7·3	4·9	5·1	7·1	7·2
December	8·2	8·3	6·0	6·1	5·2	5·3	5·3	5·5
Year	.	.	.	.	.	.	.	.

TABLE XI.—Specific Gravity and Calculated Salinity of Abertay Lightship.

Ten-day Periods.

Period.	9 A.M.						3 P.M.					
	Surface.		3 fathoms.		Bottom.		Surface.		3 fathoms.		Bottom.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.												
Jan. 1–10	23·1	2·82	23·5	2·92	23·7	2·95	24·6	3·10	24·8	3·14	25·0	3·18
,, 11–20	23·5	2·92	23·8	2·97	24·3	3·05	24·2	3·02	24·6	3·10	24·8	3·14
,, 21–31	23·3	2·87	24·1	3·01	24·7	3·12	23·4	2·90	24·0	3·00	24·5	3·08
Feb. 1–10	22·7	2·76	23·4	2·90	23·8	2·97	23·5	2·92	24·3	3·05	24·8	3·14
,, 11–20	20·8	2·43	22·0	2·64	22·7	2·76	24·2	3·03	24·9	3·16	25·0	3·18
,, 21–28	24·1	3·01	23·0	2·80	25·0	3·18	23·1	2·82	24·2	3·03	24·6	3·10
Mar. 1–10	22·3	2·70	22·8	2·78	23·3	2·87	24·7	3·12	24·9	3·16	25·2	3·21
,, 11–20	22·6	2·75	23·5	2·92	24·0	3·00	23·1	2·82	24·6	3·10	24·8	3·14
,, 21–31	24·0	3·00	24·4	3·06	25·0	3·18	24·1	3·01	24·5	3·08	24·9	3·16
Apr. 1–10	24·1	3·01	24·4	3·06	24·6	3·10	25·0	3·18	25·2	3·21	25·4	3·24
,, 11–20	23·8	2·97	24·3	3·05	24·4	3·06	24·8	3·14	25·0	3·18	25·4	3·24
,, 21–30	24·6	3·10	24·9	3·16	25·3	3·23	24·4	3·06	24·7	3·12	25·0	3·18
May 1–10	24·8	3·14	24·9	3·16	25·0	3·18	25·2	3·21	25·2	3·21	25·4	3·24
,, 11–20	24·9	3·16	25·0	3·18	25·3	3·23	25·1	3·20	25·3	3·23	25·4	3·24
,, 21–31	24·9	3·16	25·1	3·20	25·4	3·24	24·8	3·14	25·0	3·18	25·2	3·21
June 1–10	25·3	3·23	25·4	3·24	25·6	3·28	25·0	3·18	25·2	3·21	25·5	3·26
,, 11–20	25·4	3·24	25·4	3·24	25·6	3·28	25·6	3·28	25·7	3·29	25·9	3·32
,, 21–30	25·3	3·23	25·4	3·24	25·6	3·28	25·5	3·26	25·6	3·28	25·7	3·29
July 1–10	25·6	3·28	25·9	3·32	26·0	3·34	25·5	3·26	25·6	3·28	25·9	3·32
,, 11–20	25·4	3·24	25·5	3·26	25·8	3·31	25·8	3·31	25·9	3·32	26·1	3·36
,, 21–31*	25·8	3·31	25·8	3·31	26·1	3·36	24·6	3·10	25·1	3·20	25·2	3·21
Aug. 1–10	25·9	3·32	25·8	3·31	26·1	3·36	25·3	3·23	25·5	3·26	25·7	3·29
,, 11–20	25·2	3·21	25·3	3·23	25·6	3·28	25·7	3·29	25·9	3·32	26·2	3·38
,, 21–31	24·1	3·01	24·6	3·10	24·9	3·16	25·5	3·26	25·8	3·31	26·1	3·36
Sept. 1–10	24·4	3·06	24·8	3·14	25·2	3·21	25·0	3·18	25·4	3·24	25·6	3·28
,, 11–20	25·3	3·23	25·4	3·24	25·5	3·26	25·2	3·21	25·4	3·24	25·9	3·32
,, 21–30	24·5	3·08	24·7	3·12	25·2	3·21	25·8	3·31	25·8	3·31	26·0	3·34
Oct. 1–10	23·8	2·97	24·2	3·03	24·8	3·14	25·1	3·20	25·5	3·26	25·7	3·29
,, 11–20	24·6	3·10	24·8	3·14	25·0	3·18	24·4	3·06	25·3	3·23	25·9	3·32
,, 21–31	23·0	2·80	23·5	2·92	24·1	3·01	25·3	3·23	25·5	3·26	25·8	3·31
Nov. 1–10	22·5	2·74	23·3	2·87	24·2	3·03	24·9	3·16	25·0	3·18	25·3	3·23
,, 11–20	24·6	3·10	25·0	3·18	25·1	3·20	25·0	3·18	25·3	3·23	25·4	3·24
,, 21–30	23·5	2·92	24·1	3·01	24·8	3·14	25·4	3·24	25·6	3·28	25·7	3·29
Dec. 1–10	22·5	2·74	23·8	2·97	24·3	3·05	23·9	2·98	24·6	3·10	25·1	3·20
,, 11–20	24·1	3·01	24·9	3·16	25·1	3·18	22·6	2·75	24·1	3·01	24·6	3·10
,, 21–31	21·9	2·62	23·2	2·85	23·9	2·98	23·7	2·95	24·9	3·16	25·2	3·21

* Only five days' observations.

TABLE XII.—Specific Gravity and Calculated Salinity of Abertay Lightship.

Monthly Means.

Month.	9 A.M.						3 P.M.					
	Surface.		3 fathoms.		Bottom.		Surface.		3 fathoms.		Bottom.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.												
January	23·3	2·87	23·8	2·97	24·2	3·04	24·1	3·01	24·5	3·08	24·8	3·13
February	22·5	2·73	22·8	2·78	23·8	2·97	23·6	2·92	24·5	3·08	24·8	3·14
March	23·0	2·82	23·6	2·92	24·1	3·02	24·0	2·98	24·7	3·11	25·0	3·17
April	24·2	3·03	24·5	3·09	24·8	3·13	24·7	3·13	25·0	3·17	25·3	3·22
May	24·9	3·15	25·0	3·18	25·2	3·22	25·0	3·18	25·2	3·21	25·3	3·23
June	25·3	3·23	25·4	3·24	25·6	3·28	25·4	3·24	25·5	3·26	25·7	3·29
July	25·6	3·28	25·7	3·30	26·0	3·34	25·3	3·22	25·5	3·27	25·7	3·30
August	25·1	3·18	25·2	3·21	25·5	3·27	25·5	3·26	25·7	3·30	26·0	3·34
September	24·7	3·12	25·0	3·17	25·3	3·23	25·3	3·23	25·5	3·26	25·8	3·31
October	23·8	2·96	24·2	3·03	24·6	3·11	24·9	3·16	25·4	3·25	25·8	3·31
November	23·5	2·92	24·1	3·02	24·7	3·12	25·1	3·19	25·3	3·23	25·5	3·25
December	22·8	2·79	24·0	2·99	24·4	3·07	23·4	2·89	24·5	3·09	25·0	3·17
Mean	24·1	3·01	24·4	3·07	24·8	3 15	24·7	3·12	25·1	3·19	25·4	3·24

TABLE XIII.—Specific Gravity and Calculated Salinity at North Carr Light Ship.

Ten-day Periods.

Period.	9 A.M.				3 P.M.			
	Surface.		Bottom.		Surface.		Bottom.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.								
Jan. 1–10	24·9	3·16	24·8	3·14	25·1	3·20	25·0	3·18
,, 11–20	25·2	3·21	25·3	3·23	25·3	3·23	25·4	3·24
,, 21–31	24·9	3·16	25·2	3·21	25·1	3·20	25·4	3·24
Feb. 1–10	24·8	3·14	24·8	3·14	24·8	3·14	24·9	3·16
,, 11–20	25·1	3·20	25·2	3·21	24·8	3·14	25·0	3·18
,, 21–28	23·9	2·98	24·5	3·08	24·3	3·05	24·7	3·12
Mar. 1–10	24·8	3·14	25·0	3·18	24·8	3·14	25·3	3·23
,, 11–20	25·4	3·24	25·5	3·26	25·6	3·28	25·6	3·28
,, 21–31	25·2	3·21	25·6	3·28	25·7	3·29	25·8	3·31
Apr. 1–10	25·2	3·21	25·2	3·21	25·2	3·21	25·4	3·24
,, 11–20	25·2	3·21	25·0	3·18	25·3	3·23	25·3	3·23
,, 21–30	24·9	3·16	25·0	3·18	24·9	3·16	25·1	3·20
May 1–10	25·4	3·24	25·4	3·24	25·4	3·24	25·5	3·26
,, 11–20	25·4	3·24	25·6	3·28	25·8	3·31	25·9	3·32
,, 21–31	25·4	3·24	25·7	3·29	25·5	3·26	25·8	3·31
June 1–10	25·4	3·24	25·6	3·28	25·4	3·24	25·6	3·28
,, 11–20	25·6	3·28	25·7	3·29	25·5	3·26	25·7	3·29
,, 21–30	25·5	3·26	25·5	3·26	25·3	3·23	25·5	3·26
July 1–10	25·5	3·26	25·6	3·28	25·7	3·29	25·9	3·32
,, 11–20	25·6	3·28	25·7	3·29	25·7	3·29	25·7	3·29
,, 21–31	25·6	3·28	25·8	3·31	25·9	3·32	26·0	3·34
Aug. 1–10	25·4	3·24	25·5	3·26	25·5	3·26	25·6	3·28
,, 11–20	25·8	3·31	25·9	3·32	25·9	3·32	25·9	3·32
,, 21–31	25·7	3·29	25·7	3·29	25·8	3·31	25·9	3·32
Sept. 1–10	25·2	3·21	25·3	3·23	25·4	3·24	25·6	3·28
,, 11–20	24·9	3·16	25·1	3·20	25·2	3·21	25·4	3·24
,, 21–30	25·1	3·20	25·1	3·20	25·2	3·21	25·3	3·23
Oct. 1–10	24·8	3·14	24·9	3·16	24·9	3·16	24·8	3·14
,, 11–20	24·5	3·08	24·6	3·10	24·7	3·12	24·7	3·12
,, 21–31	25·2	3·21	25·0	3·18	25·0	3·18	25·0	3·18
Nov. 1–10	25·1	3·20	25·2	3·21	25·2	3·21	25·1	3·20
,, 11–20	25·2	3·21	24·7	3·12	25·1	3·20	25·2	3·21
,, 21–30	.	.	.	.	.	.	.	.
Dec. 1–10	.	.	.	.	.	.	.	.
,, 11–20	.	.	.	.	.	.	.	.
,, 21–31	.	.	.	.	.	.	.	.

TABLE XIV.—Specific Gravity and Calculated Salinity at North Carr Light Ship.

Monthly Means.

Month.	9 A.M.				3 P.M.			
	Surface.		Bottom.		Surface.		Bottom.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.								
January	25·0	3·18	25·1	3·19	25·2	3·21	25·3	3·22
February	24·6	3·11	24·8	3·14	24·6	3·11	24·9	3·15
March	25·1	3·20	25·4	3·24	25·4	3·24	25·6	3·27
April	25·1	3·19	25·1	3·19	25·1	3·20	25·3	3·22
May	25·4	3·24	25·6	3·27	25·6	3·27	25·7	3·30
June	25·5	3·26	25·6	3·28	25·4	3·24	25·6	3·28
July	25·6	3·27	25·7	3·29	25·8	3·30	25·9	3·32
August	25·6	3·28	25·7	3·29	25·7	3·30	25·8	3·31
September	25·1	3·19	25·2	3·21	25·3	3·22	25·4	3·25
October	24·8	3·14	24·8	3·15	24·9	3·15	24·8	3·15
November	25·1*	3·20	25·0*	3·17	25·1*	3·20	25·1*	3·20
December	.	.	.	.	.	.	.	.

* Twenty observations only

TABLE XV.—Specific Gravity and Calculated Salinity of Surface Water at Bell Rock and Oxcar Lighthouses.

Ten-day Periods.

Period.	Bell Rock.				Oxcar.			
	9 a.m.		3 p.m.		9 a.m.		3 p.m.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.								
Jan. 1–10	25·6	3·28	25·6	3·28	.*	.	.	.
,, 11–20	25·6	3·28	25·6	3·28	.	.	.	.
,, 21–31	25·5	3·26	25·5	3·26	.	.	.	.
Feb. 1–10	25·5	3·26	25·6	3·28	.	.	.	.
,, 11–20	25·8	3·31	25·6	3·28	.	.	.	.
,, 21–28	25·8	3·31	25·7	3·29	.	.	.	
Mar. 1–10	25·9	3·32	25·8	3·31	.	.	.	.
,, 11–20	25·7	3·29	25·8	3·31	.	.	.	.*
,, 21–31	25·7	3·29	25·7	3·29	24·9	3·16	24·9	3·16
Apr. 1–10	25·6	3·28	25·5	3·26	24·9	3·16	24·9	3·16
,, 11–20	25·5	3·26	25·5	3·26	25·0	3·18	25·0	3·18
,, 21–30	25·8	3·31	25·7	3·29	25·0	3·18	25·0	3·18
May 1–10	25·9	3·32	25·8	3·31	25·3	3·23	25·1	3·20
,, 11–20	25·8	3·31	25·8	3·31	25·2	3·21	25·2	3·21
,, 21–31	25·9	3·32	25·7	3·29	25·4	3·24	25·2	3·21
June 1–10	25·6	3·28	25·6	3·28	25·5	3·26	25·4	3·24
,, 11–20	25·8	3·31	25·8	3·31	25·7	3·29	25·7	3·29
,, 21–30	26·2	3·38	26·0	3·34	25·5	3·26	25·6	3·28
July 1–10	26·1	3·36	26·0	3·34	25·7	3·29	25·6	3·28
,, 11–20	26·2	3·38	26·1	3·36	25·6	3·28	25·4	3·24
,, 21–31	26·3	3·40	26·1	3·36	25·5	3·26	25·4	3·24
Aug. 1–10	26·0	3·34	25·8	3·31	25·6	3·28	25·5	3·26
,, 11–20	26·2	3·38	26·2	3·38	25·6	3·28	25·5	3·26
,, 21–31	26·2	3·38	26·1	3·36	25·5	3·26	25·6	3·28
Sept. 1–10	26·2	3·38	26·1	3·36	25·6	3·28	25·6	3·28
,, 11–20	26·2	3·38	26·0	3·34	25·8	3·31	25·7	3·29
,, 21–30	26·1	3·36	26·1	3·36	25·8	3·31	25·8	3·31
Oct. 1–10	26·0	3·34	26·1	3·36	25·5	3·26	25·5	3·26
,, 11–20	26·2	3·38	26·1	3·36	25·0	3·18	25·0	3·18
,, 21–31	26·1	3·36	26·1	3·36	25·1	3·20	25·4	3·24
Nov. 1–10	25·8	3·31	25·8	3·31	24·6	3·10	24·7	3·12
,, 11–20	26·0	3·34	25·9	3·32	24·6	3·10	24·4	3·06
,, 21–30	26·1	3·36	26·2	3·38	24·8	3·14	24·9	3·16
Dec. 1–10	26·0	3·34	26·1	3·36	24 9	3·16	25·0	3·18
,, 11–20	26·0	3·34	25·9	3·32	24·5	3·08	24·1	3 01
,, 21–31	26·0	3·34	25·8	3·31	.	.	.	.

* Until March 21–31 a mended instrument used, giving readings too uncertain to be utilised.

TABLE XVI.—Specific Gravity and Calculated Salinity of Surface Waters at Bell Rock and Oxcar Lighthouses.

Monthly Means.

Month.	Bell Rock.				Oxcar.			
	9 a.m.		3 p.m.		9 a.m.		3 p.m.	
	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.	Sp. Gr.	Sal.
1893.								
January	25·6	3·27	25·6	3·27	.	.	.	.
February	25·7	3·29	25·6	3·28	.	.	.	.
March	25·8	3·30	25·8	3·30	24·9*	3·16	24·9*	3·16
April	25·6	3·28	25·6	3·27	25·0	3·17	25·0	3·17
May	25·9	3·32	25·8	3·30	25·3	3·23	25·2	3·21
June	25·9	3·32	25·8	3·31	25·6	3·27	25·6	3·27
July	26·2	3·38	26·1	3·35	25·6	3·28	25·5	3·25
August	26·1	3·37	26·0	3·34	25·6	3·27	25·5	3·27
September	26·2	3·37	26·1	3·35	25·7	3·30	25·7	3·29
October	26·1	3·36	26·1	3·36	24·9	3·21	25·3	3·23
November	26·0	3·34	26·0	3·34	24·7	3·11	24·7	3·11
December	26·0	3·34	25·9	3·33	24·7†	3·12	24·6	3·10
Year	25·9	3·33	25·9	3·32	.	.	.	.

* Ten observations only. † Observations 1–20 only.

II.—PHYSICAL OBSERVATIONS AT THE 'GARLAND'S' TRAWLING STATIONS, 1893.

TEMPERATURES AND TRANSPARENCIES—(1) FIRTH OF FORTH.

STATION I.

Date.	West End.						East End.					
	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
1893.												
Jan. 17	3.50 p.m.	29·71	5·6	3·8	4·2	2¾	1.40 p.m.	29·71	6·9	4·3	4·5	3
Feb. 21	4.20 p.m.	29·06	4·7	5·1	4·7	2	2.15 p.m.	29·05	4·5	4·6	4·7	3½
Apr. 20	10.40 a.m.	30·00	9·0	6·7	6·6	2½	12.45 p.m.	30·00	9·0	6·6	6·1	3½
May 27	1.15 p.m.	30·18	16·0	9·6	7·4	3	11.10 a.m.	30·18	14·5	9·7	7·2	3½
June 15	1.0 p.m.	30·27	14·4	13·3	12·1	4	11.5 a.m.	30·05	14·0	12·2	10·3	4½
July 31	4.5 p.m.	29·87	12·9	14·8	11·3	4	2.5 p.m.	29·87	14·0	13·3	10·4	5½
Aug. 24	12.55 p.m.	29·83	18·0	13·3	12·6	3¾	11.5 a.m.	29·79	17·0	10·6	13·0	5½
Sept. 20	10.25 a.m.	29·32	13·5	12·4	12·2	3	12.5 p.m.	29·35	12·7	12·7	12·3	3½
Oct. 25	2.10 p.m.	29·51	8·5	10·8	10·8	2	4.5 p.m.	29·52	8·7	10·9	10·8	2½
Nov. 15	11.5 a.m.	29·89	6·1	7·4	7·8	2½	12.55 p.m.	29·90	6·3	7·9	8·0	3
Dec. 20	12.30 p.m.	28·86	5·0	6·2	6·7	2¾	10.55 p.m.	28·85	4·6	6·4	6·8	3

STATION II.

Jan. 17	11.0 a.m.	29·70	6·7	3·8	4·0	2½	12.45 p.m.	29·70	7·8	4·0	4·9	3
Feb. 21	11.40 a.m.	29·32	5·2	4·5	4·7	3	3.50 p.m.	29·05	4·4	4·4	4·7	3
Apr. 19	2.55 p.m.	29·87	9·3	6·7	6·2	3½	4.30 p.m.	29·86	10·0	6·6	5·6	4
May 31	12.5 p m.	30·01	12·0	11·1	8·3	3¼	10.30 a.m.	30·03	10·7	10·5	8·5	3½
June 17	12.45 p.m.	30·27	20·0	12·8	12·8	3	11.20 a.m.	30·27	19·1	13·4	9·1	4
July 28	2.0 p.m.	30·12	17·0	13·4	11·4	4½	12.30 p.m.	30·15	16·8	13·8	10·9	5
Aug. 25	12.55 p.m.	30·09	15·5	13·3	13·0	5	11.25 a.m.	30·09	15·5	13·3	11·9	4½
Sept. 20	12.40 p.m.	29·35	12·9	12·9	12·5	3½	2.15 p.m.	29·35	13·4	12·7	12·2	4
Oct. 25	1.5 p.m.	29·52	8·6	11·0	10·9	2½	11.35 a.m.	29·54	9·4	10·8	10·8	2½
Nov. 16	10.50 a.m.	29·78	6·7	8·3	8·2	3½	12.50 p.m.	29·72	7·1	8·3	8·0	4½
Dec. 21	11.55 a.m.	29·06	4·2	6·1	6·2	2	1.35 p.m.	29·07	4·3	4·3	6·0	2½

STATION III.

Jan. 16	2.50 p.m.	29·67	6·7	3·1	4·8	2¼	12.10 p.m.	29·64	5·0	2·4	2·6	2½
Feb. 20	3.0 p.m.	29·35	6·6	4·6	4·7	2¾	12.40 p.m.	29·41	8·4	4·6	4·8	2
Apr. 19	2.0 p.m.	29·90	11·0	6·9	6·2	3¾	11.25 a.m.	29·92	10·0	7·3	5·7	3
May 24	10.20 a.m.	29·72	17·0	10·2	8·6	2½	12.25 p.m.	29·76	16·5	10·1	8·1	3
June 16	4.50 p.m.	30·09	19·0	13·1	11·6	3½	2.35 p.m.	30·90	13·9	13·0	11·6	3
July 31	1.40 p.m.	29·88	15·6	13·6	10·5	3½	11.10 p.m.	29·86	15·5	13·3	12·9	3
Aug. 24	1.20 p.m.	29·83	18·0	13·3	11·6	4	3.30 p.m.	29·89	17·8	13·8	12·6	3½
Sept. 21	12.45 p.m.	29·46	9·8	12·4	11·9	3¼	3.25 p.m.	29·48	8·5	12·6	12·4	3
Oct. 27	1.55 p.m.	29·77	9·7	10·7	10·7	1½	11.10 a.m.	29·80	7·5	9·8	9·8	2
Nov. 14	2.10 p.m.	29·79	7·9	7·4	8·0	2¼	11.25 a.m.	29·82	6·1	6·8	6·8	2½
Dec. 26	2.15 p.m.	30·19	7·5	5·8	6·1	1½	11.5 a.m.	30·19	5·7	5·8	5·8	1½

STATION IV.

Jan. 24	10.45 a.m.	29·74	7·8	4·2	4·5	2	1.50 p.m.	29·70	7·2	4·2	4·4	1¼
Feb. 17	1.50 p.m.	29·73	6.4	4·2	4·4	2	11.0 a.m.	29·72	4·8	4·3	4·5	2½
Apr. 20	4.20 p.m.	29·99	14·7	8·3	7·2	2	1.35 p.m.	30·00	13·0	6·6	7·1	2½
May 23	12.25 p.m.	29·66	15·5	10·0	10·8	2	2.35 p.m.	29·69	15·0	10·7	10·8	2¼
June 19	5.0 p.m.	29·96	15·4	14·5	15·4	2	2.45 p.m.	29·97	15·0	14·6	12·4	3
Aug. 1	5.55 p.m.	29·82	14·1	13·8	13·6	2	3.25 p.m.	29·84	15·9	13·4	12·7	3
„ 25	2.20 p.m.	30·10	15·7	14·1	13·8	2	4.55 p.m.	30·11	15·3	13·6	13·2	2
Sept. 22	10.30 a.m.	29·58	10·8	11·8	11·9	2½	12.50 p.m.	29·58	10·2	11·9	11·7	1½
Oct. 24	1.25 p.m.	30·09	12·7	11·1	10·9	2	10.50 a.m.	30·08	10·5	10·4	10·4	2
Nov. 15	4.0 p m.	29·91	6·0	7·2	7·0	2	1.40 p.m.	29·90	7·0	7·3	7·5	3
Dec. 19	10.30 a.m.	29·16	5·0	5·8	6·0	2	1.55 p.m.	29·00	7·4	5 8	6·0	2

Physical Observations—*continued.*

STATION V.

Date.	West End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.
1893.												
Feb. 6	10.35 a.m.	30·10	5·8	4·6	4·9	4	12.40 p.m.	30·10	6·9	4·7	4·7	5
Mar. 2	3.20 p.m.	29·90	5·3	4·3	4·7	3½	1.15 p.m.	29·83	5·4	4·2	4·6	3
Apr. 18	3.5 p.m.	29·91	9·2	5·9	5·7	4	1.0 p.m.	29·93	9·5	5·7	5·6	3½
May 30	3.45 p.m.	30·09	10·9	9·2	6·9	5	5.55 p.m.	30·08	10·0	9·6	7·1	4
June 13	2.35 p.m.	30·06	12·5	12·7	12·5	5½	4.20 p.m.	30·02	12·0	12·6	12·0	5
July 28	9.35 a.m.	30·18	14·8	12·8	9·5	6¾	7.30 a.m.	30·19	12·9	12·7	9·3	7
Aug. 29	5.5 p.m.	30·21	17·0	13·3	14·8	5½	2.55 p.m.	30·21	18·5	13·4	11·5	9
Sept. 18	10.45 a.m.	29·40	13·3	12·9	11·2	5	1.0 p.m.	29·42	14·2	12·4	12·1	5½
Oct. 31	7.40 a.m.	30·08	3·2	10·1	10·1	3½	9.40 a.m.	30·12	6·0	10·6	10·4	4¾
Nov. 27	2.45 p.m.	29·94	7·5	7·4	7·4	2½	12.45 p.m.	29·95	7·0	7·4	7·4	2
Dec. 28	3.40 p.m.	30·40	7·3	6·3	6·3	3	1.40 p.m.	30·39	7·4	6·4	6·5	2½

STATION VI.

Date.	West End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.
Jan. 20	11.30 a.m.	30·02	5·6	4·3	4·8	3	12.40 p.m.	29·02	6·1	4·5	5·0	2½
Mar. 2	4.5 p.m.	29·91	5·3	3·2	4·5	2½	5.5 p.m.	29·94	5·3	4·3	4·5	3
Apr. 18	3.55 p.m.	29·90	8·7	6·2	5·8	3½	4.30 p.m.	29·90	8·7	5·8	5·7	3¼
May 31	9.10 a.m.	30·05	10·9	8·9	8·1	4¼	8.5 a.m.	30·05	8·7	9·3	8·6	5
	N.											
*June 19	1.10 p.m.	29·97	16·0	11·1	9·7	3	12.5 p.m.	29·98	18·0	11·7	9·7	4½
July 28	11.20 a.m.	30·16	15·0	13·4	11·7	6½	10.30 a.m.	30·18	14·8	13·4	9·9	7
Aug. 30	8.20 a.m.	30·11	13·0	13·1	12·5	6½	9.10 a.m.	30·12	17·0	12·8	12·5	4½
Sept. 26	3.50 p.m.	29·82	8·0	11·7	11·5	3½	4.40 p.m.	29·83	7·7	11·7	11·4	3½
Oct. 31	11.5 a.m.	30·11	7·4	10·0	9·7	3½	12.5 p.m.	30·11	8·0	10·1	10·0	3½
Nov. 27	3.30 p.m.	29·88	7·6	6·9	7·0	2	4.25 p.m.	29·87	8·0	7·2	7·4	2
Dec. 29	9.40 a.m.	30·50	7·1	6·3	6·2	3½	10.35 a.m.	30·53	7·1	5·8	6·1	3¼

STATION VII.

Date.	West End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.
Jan. 25	11.25 a.m.	29·94	9·2	4·3	4·5	2	1.10 p.m.	29·96	8·3	4·3	4·4	2½
Feb. 28	10.20 a.m.	29·60	4·1	3·5	3·9	1½	11.50 a.m.	29·60	4·6	3·8	3·8	2
Apr. 17	3.15 p.m.	30·15	6·2	6·2	5·7	2½	1.15 p.m.	30·17	4·8	6·1	6·1	3
May 31	1.10 a.m.	29·77	16·4	11·3	8·2	3½	2.45 p.m.	29·80	15·8	10·1	8·9	3½
June 14	2.50 p.m.	29·97	13·0	10·6	9·4	2½	12.50 p.m.	29·97	11·0	9·4	8·3	4½
Aug. 1	2.35 p m.	29·87	14·7	13·4	12·4	4	1.0 p.m.	29·86	14·3	12·9	10·6	4½
Aug. 28	2.30 p.m.	30·27	17·4	14·3	13·4	3½	4.20 p.m.	30·27	16·0	14·0	11·9	4½
Sept. 26	2.40 p.m.	29·85	8·4	11·6	11·2	2½	12.40 p.m.	29·85	7·8	11·8	11·6	2
Oct. 24	...	30·10	11·6	10·7	10·8	2	7 45 a.m.	30·10	9·8	10·9	10·8	3
Nov. 21	11.40 a.m.	30·35	5·0	7·4	7·2	1½	1.35 p.m.	30·34	5·6	7·8	8·0	2¼
Dec. 28	8.45 a.m.	30·33	7·4	6·0	6·2	2½	10.30 a.m.	30.38	7·4	5·9	6·3	2¾

STATION VIII.

Date.	West End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Air.	Surf.	Bot.	Trans.
*Jan. 25	4.20 p.m.	29·92	S.W. 5·6	4·7	5·0	4½	2.15 p.m.	29·97	6·7	4·8	5·0	5½
Feb. 24	12.55 p.m.	29·32	5·0	4·4	4·8	3½	2.0 p.m.	29·30	4·0	4·7	4·9	4
Apr. 14	12.50 p.m.	30·11	10·6	6·6	5·2	4	3.0 p.m.	30·11	10·6	6·7	5·0	5
May 30	12.35 p.m.	30·10	10·0	10·6	7·2	4½	2.35 p.m.	30·10	10·1	10·2	6·3	6¾
June 14	12.25 p.m.	29·99	11·0	10·6	8·1	4	10.25 a.m.	30·01	11·0	10·2	8·1	5
July 27	12.15 p.m.	30·15	17·7	13·3	9·7	5½	2.40 p.m.	30·15	18·0	13·8	8·9	10
Aug. 29	1.10 p.m.	30·24	19·0	13·8	10·4	7½	10.45 a.m.	30·25	14·0	12·9	12·3	7½
Sept. 18	7.15 a.m.	29·80	14·8	12·9	12·5	3½	9.15 a.m.	29·46	13·7	12·4	11·0	5½
Oct. 30	12.20 p.m.	29·88	7·0	10·2	10·1	2¾	2.20 p.m.	29·90	6·7	10·6	10·5	4
Dec. 27	5.40 p.m.	30·19	7·0	6·1	6·3	...	3.40 p.m.	30·18	7·8	6·0	6·4	4

Physical Observations—*continued.*

STATION IX.

Date.	West End.						East End.					
	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
1893.			N.W.									
*Jan. 18	1.0 p.m.	29.75	7·2	4·8	5·5	6	3.0 p.m.	39·75	7·8	5·0	5·4	7
Feb. 24	3.30 p.m.	29·30	4·2	4·5	5·0	4½	5.35 p.m.	29·28	2·4	4·7	5·0	5
Apr. 14	3.50 p.m.	30·10	9·0	7·2	5·2	5	6.0 p.m.	30·10	8·6	6·6	5·2	5
June 2	2.20 p.m.	29·88	14·4	11·1	6·1	7	12.10 p.m.	29·87	15·0	10·1	6·3	7½
June 14	9.50 a.m.	30·01	...	...	...	6	7.50 a.m.	30·01	...	...	...	4½
July 27	3.30 p.m.	30·16	13·8	13·8	9·0	10	5.30 p.m.	30·18	14·9	13·3	8·6	9½
Aug. 29	9.50 a.m.	30·25	13·6	13·3	10·4	8	7.45 a.m.	30 25	13·7	13·2	10·6	7½
Oct. 30	3.0 p.m.	29·90	5·2	10·7	10·7	4	5.0 p.m.	29·92	5·7	10·7	10·4	4
Dec. 27	3.10 p.m.	30·19	7·5	6·1	6·5	4	1.15 p.m.	30·19	8·6	6·2	6·5	4

STATION X.

Date.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
Jan. 21	12.30 p.m.	30·25	4·4	2·6	2·9	½	11.25 a.m.	30·25	5·3	2·8	3·2	⅔
Feb. 23	11.30 p.m.	29·57	2·4	4·2	4·5	4	12.25 p.m.	29·57	2·5	4·4	4·6	3
Apr. 21	11.45 a.m.	29·87	8·3	7·8	7·8	¼	10.55 a.m.	29·87	7·9	7·8	7·6	¼
May 29	1.40 p.m.	29·14	10·3	10·3	10·0	¾	12.50 p.m.	29·13	9·9	10·0	10·0	1
June 20	1.15 p.m.	29·89	18·0	16·3	16·1	½	12.35 p.m.	29·89	17·5	15·7	15·2	½
Nov. 17	1.25 p.m.	28·73	5·7	6·7	6·8	¾	2.20 p.m.	...	...	...	...	...

* An asterisk before a date calls attention to the fact that at least one of the two observations was not made at the usual position, but at some other which is indicated by the special direction given for that particular observation. When a series of observations are taken at the same unusual position, the asterisk is put before all the dates, but the direction of the position may be given only for the first of the series. When no asterisk occurs in the date column the observations were made at the West or East Ends of the Stations.

Temperatures and Transparencies—(2) St Andrews Bay.

Date.	West End.						East End.					
	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
STATION I.												
1893.												
Jan. 12	2.30 p.m.	30·17	6·7	3·5	4·2	1¾	12.30 p.m.	30·17	5·6	4·2	5·1	3
Feb. 7	3.30 p.m.	29·83	7·7	4·6	4·8	3	1.25 p.m.	29·83	6·7	4·7	4·9	4
Mar. 8	7.30 a.m.	30·14	7·6	4·7	4·8	2¾	9.30 a.m.	30·16	7·5	4·5	4·7	3¼
June 8	5.15 p.m.	30·40	11·8	12·8	12·3	4	3.15 p.m.	30·42	12·8	11·6	9·6	4½
July 5	11.50 a.m.	30·08	13·5	12·3	12·0	3	9.45 a.m.	30·07	12·3	12·3	11·2	5
*Nov. 8	11.15 a.m.	30·40	7·9	7·5	8·3	2½	S.E. 1.30 p.m.	30·39	9·4	8·2	8·7	3
STATION II.												
Jan. 12	2.45 p.m.	30·17	6·7	3·5	4·2	2	4.35 p.m.	30·15	4·2	4·2	5·0	3
Feb. 8	11.0 a.m.	29·57	6·7	4·7	4·9	3	1.0 p.m.	29·62	6·7	4·6	5·0	4
Mar. 9	8.20 a.m.	29·87	8·2	4·8	4·8	2¾	10.15 a.m.	29·84	8·8	4·7	4·6	3½
June 9	2.15 p.m.	30·38	14·5	12·8	9·3	5¼	12.10 p.m.	30·38	13·5	11·7	8·9	4¾
*July 7	2.50 p.m.	29·88	15·0	13·9	11·8	4	S. 4.50 p.m.	29·86	15·9	13·3	11·2	6
Nov. 9	10.55 a.m.	30·48	6·3	8·0	8·0	2½	12.55 p.m.	30·45	7·8	8·4	8·8	2½
STATION III.												
Jan. 13	10.5 a.m.	29·94	3·6	3·6	5·0	2½	8 15 a.m.	29·96	3·1	3·4	5·0	2
Feb. 7	3.50 p.m.	29·81	7·2	4·7	4·9	3¼	5.25 p.m.	29·82	6·7	4·6	4·9	2½
Mar. 8	4.30 p.m.	30·12	8·4	4·9	4·8	2½	6.15 p.m.	30·12	7·4	4·8	4·8	2½
June 9	10.0 a.m.	30·38	11·3	12·2	9·3	5	11.40 a.m.	30·39	12·2	11·1	8·3	4
July 5	2.55 p.m.	30·08	13·0	13·3	11·7	4	4.40 p.m.	30·08	12·7	12·4	11·1	4¼
Nov. 9	10.40 a.m.	30·48	6·4	13·4	8·0	2½	8.30 a.m.	30·48	5·3	7·9	8·3	2½
STATION IV.												
Jan. 13	11.30 a.m.	29·92	5·4	3·3	4·4	2	2.0 p.m.	29·90	6·4	3·9	4·5	1¾
Feb. 8	10.35 a.m.	29·56	6·7	4·6	4·9	3½	8.15 a.m.	29·49	4·7	4·7	4·9	3
Mar. 8	3.15 p.m.	30·12	7·8	4·9	4·7	2½	12.40 p.m.	30·14	8·7	4·8	4·7	2½
*June 9	S.W. 9.30 a.m.	30·38	11·9	12·5	9·4	5	N.E. 7.5 a.m.	29·38	9·4	11·1	8·8	4½
*July 7	S.W. 11.45 a.m.	29·93	16·0	13·9	13·0	3	N.E. 9.0 a.m.	29·93	13·0	12·4	11·9	3½
Nov. 8	10.35 a.m.	30·39	7·8	7·1	7·3	1½	8.5 a.m.	30·38	5·2	7·4	8·5	1½
STATION V.												
*Jan. 13	W. 2.25 p.m.	29·90	4·4	4·0	5·0	2½	S. 4.25 p.m.	29·92	5·4	4·1	5·2	3
*Feb. 8	N. 3.40 p.m.	29·59	6·7	4·5	5·0	2¾	S. 1.35 p.m.	29·59	6·7	5·1	5·0	4
*Mar. 8	N. 12.0 a.m.	30·16	8·7	4·7	4·7	3½	S. 10.0 a.m.	30·16	6·6	4·5	4·6	3½
*June 8	N. 12.35 p.m.	30.45	12·2	11·8	8·1	5	S. 2.40 p.m.	30·42	11·9	11·9	8·3	4½
*July 5	N. 11.10 a.m.	30·05	11·4	12·7	10·8	7½	S. 9.10 a.m.	30·07	12·3	12·7	10·2	5
*Nov. 8	N. 4.5 p.m.	30·39	6·4	8·3	8·5	2¾	S. 2.5 p.m.	30·39	6·4	8·3	8·9	3
STATION VI.												
*June 7	S.W. 1.10 p.m.	30·34	14·8	12·2	7·9	6	N.E. 3.15 p.m.	30·33	13·0	12·2	7·2	6¾
*July 4	S. 2.40 p.m.	30·10	12·9	11·7	10·3	4½	4.45 p.m.	30·08	12·2	11·9	10·0	6

Temperatures and Transparencies—(3) Montrose.

STATION I.

Date.	West End.						East End.					
	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
1893. Jan. 14	11.50 a.m. S.W.	29·74	1·1	3·9	4·0	1½	9.55 a.m.	29·70 N.E.	0·0	4·8	5·0	4½
*Feb. 13	7.0 p.m. S.	29·39	2·4	4·2	4·6	...	5.13 p.m.	29·40	3·0	4·3	4·9	3
*May 19	6.55 a.m.	29·55	9·8	8·2	8·2	3	9.0 a.m.	29·55	13·8	7·8	7·8	4¾

STATION II.

Date.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.	Hour.	Bar.	Air.	Surf.	Bot.	Trans.
Jan. 14	8.5 a.m.	29·71	−0·8	4·1	4·4	1	9.10 a.m.	29·71	−0·8	4·3	4·9	2½
Feb. 13	3.25 p.m.	29·43	4·1	4·7	4·9	1½	4.30 p.m.	29·42	2·9	4·4	5·0	2
May 19	4.25 a.m.	29·54	8·3	7·7	7·8	1½	5.50 a.m.	29·54	...	...	...	3

* See Note, page 320.

Temreratures and Transparencies—(4) Aberdeen.

Date.		West End.					East End.				
		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
		STATION I.									
1893.		S.					N.				
*Feb.	11	8.40 a.m.	29 05	4·8	5·0	4	10.45 a.m.	29·12	4·8	5·0	4
*May	16	9.15 a.m.	29·92	8·4	8·5	3½	11.15 a.m.	29·90	8·3	7·9	3¼
		STATION II.									
Feb.	11	11.20 a.m.	29·13	4·9	5·2	4	12.30 p.m.	29·21	4·8	5·0	4½
May	16	11.45 a.m.	29·89	8·3	8·2	2¼	1.5 p.m.	29·88	8·5	7·4	4½
		STATION III.									
Feb.	10	2.40 p.m.	29·09	4·8	5·0	2¾	11.5 p.m.	29·01	4·7	5·0	3
May	16	3.15 p.m.	29·85	8·3	8·3	1¾	1.40 p.m.	29·86	7·8	7·8	1¾
		STATION IV.									
		S.W.					N.E.				
*Feb.	10	12.55 p.m.	29·00	4·6	5·0	...	11.25 a.m.	28·96	4·7	5·0	3½
*May	17	12.10 p.m.	29·71	8·5	7·9	3¼	...	29·72	8·3	7·8	3
		STATION V.									
		S.W.					N.E.				
*Feb.	10	11.0 a.m.	28·95	4·6	5·0	2¾	9.10 a.m.	28·86	4·7	4·9	3
*May	17	10.20 a.m.	29·75	8·5	8·4	2	8.25 a.m.	29·76	8·7	8·2	1½
		STATION VI.									
		N.					S.				
*Feb.	9	9.50 a.m.	29·40	4·8	5·0	4	11.20 a.m.	29·35	4·7	4·9	2¼
*May	17	4.30 p.m.	29·67	7·9	7·9	3½	6.0 p.m.	29·69	7·9	7·8	3½
		STATION VII.									
		W.					S.				
*Feb.	9	1.45 a.m.	29·22	4·9	5·1	4	11.55 p.m.	29·31	4·9	5·1	5½
		N.					S.				
*May	17	2.15 p.m.	29·72	7·8	7·7	5	4.15 p.m.	29·67	7·8	7·7	5

* See Note, page 320.

Temperatures and Transparencies—(5) Moray Firth.

STATION I.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
1893. Apr. 29	1.10 p.m.	29·64	8·3	7·8	6¾	11.15 a.m.	29·66	8·5	7·7	8½
Oct. 3	10.30 a.m.	29·24	11·1	11·5	3½	12.20 p.m.	29·23	11·2	11·5	4

STATION II.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
May 3	11.50 a.m.	30·08	8·1	6·4	5¼	10.5 a.m.	30·04	8·2	6·3	6½
Oct. 3	7.0 a.m.	29·23	11·0	11·9	3½	9.15 a.m.	29·24	10·9	11·8	3½

STATION III.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
May 3	2.5 p.m.	30·11	8·3	7·3	3½	12.50 p.m.	30·08	7·2	7·2	5½
Oct. 5	11.30 a.m.	29·10	11·2	11.7	3	12.30 p.m.	29·11	10·7	11·7	3

STATION IV.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
May 2	1.25 p.m.	29·87	8·6	6·7	8½	11.35 a.m.	29·89	7·8	7·2	8½
*Oct. 6	S. 9.25 a.m.	29·28	10·8	11·6	...	S. 11.30 a.m.	29·32	11·1	11·7	4½

STATION V.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
*May 2	S.W. 11.0 a.m.	29·89	7·3	6·6	9	N.E. 9.30 a.m.	29·89	7·7	6·4	8½
Oct. 6	12.30 p.m.	29·33	11·0	11·7	4	2.15 p.m.	29·36	11.3	11·8	5

STATION VI.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
May 2	1.40 p.m.	29·85	8·1	6·7	9	3.30 p.m.	29·85	7·7	6·4	6
Oct. 6	5.15 p.m.	29·41	11·1	11·2	3½	3.15 p.m.	29·37	11·3	11·8	3½

STATION VII.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
May 8	8.40 a.m.	30·57	8·3	6·8	7	10.20 a.m.	30·50	7·8	7·0	8½
Oct. 7	7.5 a.m.	29·53	11·6	11·8	5	8.50 a.m.	29·56	11·7	11·7	7¼

STATION VIII.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
*May 8	N. 2.55 p.m.	30·49	8·1	6·6	9	S. 1.5 p.m.	30·49	8·8	6·8	9½
*Oct. 10	N. 1.5 p.m.	29·53	11·7	11·4	8	S. 2.45 p.m.	...	12·2	11·3	...

STATION IX.

Date.	West End. Hour.	Bar.	Surf.	Bot.	Trans.	East End. Hour.	Bar.	Surf.	Bot.	Trans.
*May 8	N. 3.50 p.m.	30·47	8·5	6·5	9	S. 5.30 p.m.	30·45	8·6	6·3	8½
*Oct. 10	N. 10.15 a.m.	29·56	11·6	11·3	7¾	S. 12.0 a.m.	29·54	11·6	11·4	8

Physical Observations—*continued.*

STATION X.

Date.		West End.					East End.				
		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
1893. May	9	2.5 p.m.	30·39	8·9	6·4	9	3.45 p.m.	30·38	8·8	7·2	9½
*Oct.	2	N.W. 4.5 p.m.	29·35	11·7	11·5	4	S.E. 2.0 p.m.	29·39	11·8	11·2	4½

STATION XI.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
May	10	10.35 a.m.	30·33	8·3	7·7	6½	12.35 p.m.	30·31	8·3	7·8	7
Oct.	16	11.30 a.m.	29·50	11·4	11·3	9	1.30 p.m.	29·49	11·3	11·0	9

STATION XII.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
*May	16	N. 1.20 p.m.	30·30	8·3	7·7	6½	S. 3.25 p.m.	30·27	8·6	7·7	6
*Oct.	16	N. 2.20 p.m.	29·49	11·4	11·2	9½	S. 4.25 p.m.	29·52	11·3	11·1	9

STATION XIII.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
*May	10	N. 6.35 p.m.	30·25	8·5	7·6	8¼	S. 4.30 p.m.	30·27	8·5	7·7	8¼
*Oct.	17	N. 2.20 p.m.	29·92	11·4	11·0	11½	S. 4.5 p.m.	29·97	11·2	11·0	11¼

STATION XIV.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
*May	11	N. 6.50 a.m.	30·15	8·3	8·1	8	S. 4.50 a.m.	30·15	8·1	7·2	8
*Oct.	14	N. 11.0 a.m.	20·91	11·3	11·0	12	S. 12.45 p.m.	29·93	11·3	11·0	12

STATION XV.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
*May	10	N. 9.15 a.m.	29·34	8·3	7·2	7	7.15 a.m.	30·37	7·9	7·0	6½
*May	10	...	...	...	...	...	E. 8.50 p.m	30·23	8·2	7·7	6½
*Oct.	16	N. 10.35 a.m.	29·51	11·3	11·1	9	S. 8.35 a.m.	29·53	11·2	11·1	9

STATION XVI.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
*May	11	N. 9.45 a.m.	30·15	8·5	6·6	8	S. 11.50 a.m.	30·14	8·2	6·4	7
Oct.	17	N. 5.35 p.m.	29·96	11·2	11·0	8	S. 7.20 p.m.	29.99	11·1	11·0	...

SMITH BANK.

Date.		Hour.	Bar.	Surf.	Bot.	Trans.	Hour.	Bar.	Surf.	Bot.	Trans.
May	4	...	...	...	...	...	E. 5.20 p.m.	30·23	7·4	6·9	...

* See Note, page 320.

III.—TEMPERATURE OBSERVATIONS ON CRUISERS, 1893.

1. LOCH RYAN.

Date.	9 A.M.			3 P.M.		
	Air.	Surface.	0–5 fathoms.	Air.	Surface.	0–5 fathoms.
1893.						
January 17,	5·3	2·7	2·7 (4)*	5·3	2·3	2·3 (3)
,, 18,	7·4	3·2	3·2 (3)	8·2	3·3	3·3 (3)
,, 24,	.	.	.	9·4	5·4	5·4 (4)
,, 25,	5·9	5·0	5·0 (3)	6·1	5·3	5·2 (4)
,, 26,	6·3	5·3	5·3 (3)	.	.	.
February 22,	4·2	5·6	5·6 (3)	3·6	5·9	5·9 (4)
,, 28,	2·7	3·7	4·3 (4)	4·8	4·0	4·0 (3)
March 28,	8·1	6·8	6·8 (4)	12·6	7·0	6·9 (3)
October 11,	.	.	.	11·7	10·9	10·9 (4)
,, 24,	11·1	11·1	11·1 (4)	12·2	11·2	11·2 (4)
November 10,	5·6	7·8	{8·4 (5) / 9·2 (7)}	.	.	.
,, 21,	1·8	4·1	4·2 (3)	5·8	3·8	3·6 (4)
,, 22,	2·9	2·4	2·6 (3)	4·5	3·9	4·2 (4)
,, 23,	.	.	.	5·8	4·3	4·4 (3)
December 3,	.	.	.	8·2	5·7	5·7 (4)

2. CAMPBELTOWN LOCH.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.
1893.												
Mar. 7	9·7	6·3	6·2	.	6·2	.	9·6	6·2	6·2	.	6·1	6·1 (11)
,, 30	12·3	7·1	7·0	.	6·8	.	.	.	.	.	.	.
May 4	.	.	.	.	.	.	13·3	9·6	8·3	.	7·8	.
,, 10	13·1	10·6	8·4	.	7·9	.	15·7	11·3	9·0	.	8·3	.
June 1	15·9	11·3	10·0	.	9·1	.	.	.	.	.	.	.
,, 9	16·2	13·1	10·2	.	8·9	.	.	.	.	.	.	.
Oct. 26	5·7	11·1	11·1	.	11·1	.	.	.	.	.	.	.
Nov. 11	.	.	.	.	.	.	3·4	6·4	9·2	.	9·3	9·4 (11)

3. LAMLASH HARBOUR.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	10 fms.	10–15 fathoms.	Over 15 fms.	Air.	Surf.	5 fms.	10 fms.	10–15 fathoms.	Over 15 fms.
1893.												
Feb. 7	.	.	.	.	.	.	7·8	6·7	6·7	6·7	6·8 (15)	.
,, 8	.	.	.	.	.	.	5·4	6·6	6·6	6·6	6·7 (15)	.
Mar. 2	6·4	5·7	5·7	5·8	5·9 (15)	5·9 (19)	8·3	6·0	6·0	5·8	5·9 (15)	5·9 (19)
May 12	.	.	.	.	.	.	13·7	9·4	9·1	9·1	9·2 (15)	9·2 (16)
Oct. 9	.	.	.	.	.	.	12·2	11·7	11·8	11·9	11·2 (14)	.
Nov. 1	.	.	.	.	.	.	9·2	10·7	10·8	10·9	11·2 (13)	.
,, 2	6·2	10·6	10·6	10·7	10·8 (14)	.	7·3	10·7	10·8	11·0	11·2 (14)	.
,, 27	.	.	.	.	.	.	9·9	9·4	9·4	9·5	9·6 (15)	9·6 (16)
,, 28	11·9	9·4	9·4	9·5	9·6 (15)	.	11·9	9·4	9·4	9·5	9·6 (15)	9·6 (16)
,, 29	.	.	.	.	.	.	10·6	9·6	9·6	9·6	9·6 (15)	9·6 (17)

* The figures in brackets indicate the depth at which the temperature was taken.

4. FAIRLIE ROADS.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.
1893.												
Feb. 6	.	.	.	.	.	.	7·6	6·4	6·5	6·7 (9)	.	.
March 3	4·4	5·8	5·9	6·1 (7)	.	.	.	.	.	.	.	.

5. OFF GREENOCK.

Date.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.
Jan. 31	.	.	.	.	.	.	8·1	6·4	6·6	6·6(8)	.	.
Feb. 1	5·6	6·0	6·2	6·5(8)	.	.	5·8	6·2	6·5	6·7(8)	.	.
,, 2	5·1	5·9	6·4	6·6(7)	.	.	.	.	.	.	.	.
Mar. 13	.	.	.	.	.	.	6·6	6·6	6·5	6·5(7)	.	.
,, 14	6·7	6·2	6·2	6·2(8)	.	.	6·8	6·3	6·2	6·2(7)	.	.
,, 15	7·2	6·5	6·5	6·4(8)	.	.	5·7	6·6	6·4	6·3(7)	.	.
,, 16	2·5	6·0	6·1	6·3(8)	.	.	.	.	.	.	.	.
May 24	.	.	.	.	.	.	14·3	10·8	9·5	9·7(7)	.	.
Oct. 18	9·8	11·1	11·7	11·8(7)	.	.	12·1	11·9	11·8	11·8(7)	.	.
,, 19	11·7	11·1	11·3	11·8(7)	.	.	.	.	.	.	.	.
Nov. 15	.	.	.	.	.	.	6·4	10·0	11·0	11·3(9)	.	.
,, 16	5·2	9·8	10·2	11·0(9)	.	.	7·3	10·3	11·2	11·3(9)	.	.

6. ROTHESAY BAY.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	10 fms.	10–15 fms.	Over 15 fms.	Air.	Surf.	5 fms.	10 fms.	10–15 fms.	Over 15 fms.
1893.												
Jan. 20	5·0	7·1	7·1	7·1	7·1 (13)	.	.	.	.	.	.	.
,, 21	.	.	.	.	.	.	6·9	6·8	7·0	7·1	7·1 (14)	.
,, 28	3·3	6·7	6·8	6·8	6·9 (14)	.	.	.	.	.	.	.
,, 30	8·6	6·6	6·7	6·8	6·8 (14)	.	8·9	6·5	6·7	6·8	6·8 (13)	.
,, 31	7·2	6·5	6·6	6·7	6·7 (14)	.	.	.	.	.	.	.
Feb. 4	7·1	6·6	6·6	6·7	6·7 (13)	.	.	.	.	.	.	.
,, 6	6·1	6·5	6·4	6·4	6·6 (13)	.	.	.	.	.	.	.
,, 10	7·4	6·4	6·4	6·6	6·6 (13)	.	.	.	.	.	.	.
,, 11	4·9	6·3	6·4	6·7	6·7 (14)	.	.	.	.	.	.	.
,, 16	5·7	5·8	6·1	6·6	6·7 (13)	.	.	.	.	.	.	.
,, 18	10·4	6·2	6·3	6·4	6·6 (12)	.	9·4	6·3	6·3	6·4	6·5 (13)	.
,, 24	1·8	6·1	6·2	6·4	6·6 (13)	.	.	.	.	.	.	.
,, 25	0·4	4·4	6·2	6·6	6·7 (13)	.	.	.	.	.	.	.
Mar. 3	.	.	.	.	.	.	6·7	5·6	5·7	6·2	6·6 (13)	.
,, 9	8·6	6·4	6·4	6·4	6·6 (13)	.	.	.	.	.	.	.
,, 10	.	.	.	.	.	.	7·1	6·4	6·4	6·4	6·6 (13)	.
,, 21	7·0	5·8	6·1	6·1	6·2(13)	.	.	.	.	.	.	.
,, 27	5·8	6·7	6·1	6·2	6·4(13)	.	.	.	.	.	.	.
May 13	.	.	.	.	.	.	17·1	8·9	8·0	7·2	7·2(11)	.
,, 15	.	.	.	.	.	.	13·4	9·4	9·1	8·6	8·6(12)	.
,, 16	9·4	9·1	9·1	8·5	8·3(12)	.	.	.	.	.	.	.
,, 20	13·2	9·6	8·9	8·3	8·1(12)	.	16·0	9·4	8·9	8·4	8·3(13)	.
,, 26	.	.	.	.	.	.	13·3	10·2	9·7	8·9	8·3(12)	.
,, 27	14·6	10·2	10·2	9·3	8·1(13)	.	.	.	.	.	.	.
June 2	12 4	11·7	9·6	8·3	8·1(12)	.	.	.	.	.	.	.
,, 13	15·3	13·3	11·0	8·1	7·8(13)	.	.	.	.	.	.	.
Sept. 28	13·8	12·8	12·7	12·1	12·0(13)	.	.	.	.	.	.	.
,, 29	11·4	12·1	12·1	12·0	11·9(13)	.	.	.	.	.	.	.
Oct. 3	.	.	.	.	.	.	8·2	12·0	12·1	12·1	11·9(14)	.
,, 4	7·9	11·1	11·0	11·8	11·9(13)	.	.	.	.	.	.	.
,, 5	8·1	11·2	11·6	11·9	11·9(14)	.	.	.	.	.	.	.
,, 6	12·0	11·1	11·3	11·9	12·0(14)	.	.	.	.	.	.	.
,, 16	.	.	.	.	.	.	11·6	11·7	11·7	11·8	11·9(14)	.
,, 27	.	.	.	.	.	.	10·3	10·9	11·3	11·7	11·7(15)	.
Nov. 4	4·2	9·2	10·0	11·1	11·3(13)	.	.	.	.	.	.	.
,, 13	5·1	8·9	9·7	11·0	11·1(13)	.	.	.	.	.	.	.
,, 17	.	.	.	.	.	.	7·6	10·1	10·2	10·2	10·4(14)	.
,, 25	10·2	9·5	9·7	9·7	9·7(14)	.	12·3	10·2	10·4	10·2	10·3(14)	.
,, 27	8·4	9·4	9·4	9·6	9·6(13)	.	.	.	.	.	.	.
Dec. 2	—1·3	7·8	9·3	9·6	9·7(13)	.	.	.	.	.	.	.
,, 7	8·3	9·1	9·2	9·3	9·4(13)	.	4·11	8·6	9·1	9·1	9·2(14)	.
,, 8	.	.	.	.	.	.	5·6	9·6	9·6	9·7	9·7(13)	.
,, 9	4·9	8·7	9·2	9·4	9·6(14)	.	.	.	.	.	.	.
,, 11	3·8	8·6	8·9	9·1	9·4(14)	.	.	.	.	.	.	.
,, 19	5·1	7·9	7·9	8·1	8·3(14)	.	7·0	8·3	8·1	8·1	8·3(13)	.

7. KAMES BAY.

Date.	9 A.M.					3 P.M.				
	Air.	Surf.	5 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	10 fms.	Over 10 fms.
1893.										
Mar. 17	2·7	5·9	6·1	6·4	6·6(15)	.	.	.	.	.
,, 18	2·2	5·1	5·3	6·0	6·3(15)	.	.	.	.	.
Dec. 13	.	.	.	.	.	3·6	6·9	7·9	8·3	8·3(14)
,, 14	3·9	7·2	7·8	8·4	9·3(14)	5·2	7·9	8·4	8·3	8·3(14)
,, 15	9·0	8·9	9·1	9·1	9·0(15)	7·9	8·7	8·9	9·0	9·1(13)
,, 16	10·7	8·9	8·9	9·0	9·2(15)	.	.	.	.	.
,, 18	7·6	8·4	8·3	8·6	8·8(14)	.	.	.	.	.

8. OBAN BAY.

Date.	9 A.M.						
	Air.	Surf.	5 fms.	10 fms.	15 fms.	20 fms.	22 fms.
1893. September 20, . . .	9·2	12·6	13·1	13·1	13·2	13·2	13·2

9. STORNOWAY LOCH.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.
1893.												
June 15	.	.	.	.	.	.	21·0	15·8	14·1	11·9(9)	.	.
,, 16	17·7	15·8	14·1	11·9(9)	.	.	.	.	.	.	.	.
,, 17	19·4	14·7	11·6	11·9(9)	.	.	20·3	16·0	14·4	12·3(9)	.	.
,, 27	13·2	12·6	12·3	12·2(6)	.	.	.	.	.	.	.	.
July 1	17·7	13·8	13·4	12·8(7)	.	.	18·6	13·6	13·1	12·9(7)	.	.

10. KIRKWALL BAY.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	0–5 fms.	5 fms.	5–10 fms.	Over 10 fms.	Air.	Surf.	0–5 fms.	5 fms.	5–10 fms.	Over 10 fms.
1893.												
Aug. 19*	18·3	13·7	.	13·5	.	.	.	.	.	.	.	.
,, 21*	15·9	13·8	13·6(4)	.	.	.	18·8	13·8	.	13·8	.	.
,, 22*	14·1	13·8	.	13·8	.	.	14·4	13·4	13·8(4)	.	.	.
,, 23*	14·3	13·8	.	13·7	.	.	.	.	.	.	.	.

11. WICK BAY.

Apr. 10*	6·8	7·1	.	6·8	.	.	.	.	.	.	.	.
May 13*	10·0	12·6	.	12·6	.	.	13·3	12·8	.	12·6	.	.
,, 14*	13·2	12·7	.	12·6?	.	.	.	.	.	.	.	.
Aug. 25	13·0	12·6	.	12·4	12·2(6)	.	.	.	.	.	.	.

* Signifies that the Observations were made on the "Jackal." The rest were taken on the "Vigilant."

12. INVERGORDON, CROMARTY FIRTH.

Date.	9 A.M.						3 P.M.					
	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.	Air.	Surf.	5 fms.	5–10 fms.	10 fms.	Over 10 fms.
1893.												
Mar. 25	8·1	5·9	5·5	.	5·8	5·8(12)	10·1	6·6	6·3	.	5·6	5·6(13)
„ 26	7·5	6·5	6·1	.	5·5	5·5(12)	11·8	6·6	6·3	.	5·6	5·6(13)
„ 27	.	6·3	6·0	.	5·7	5·7(13)	.	.	.	.	.	.
Apr. 8c	.	.	.	.	.	.	*10·3	6·5	6·4	6·4(8)	.	.
„ 9c	4·9	7·4	6·9	6·8(7)	.	.	c8·3	6·8	6·4	6·4(7½)	.	.
„ 12	.	.	.	.	.	.	†10·8	7·2	7·2	.	6·5	6·5(11½)
„ 13	6·4	6·8	6·3	.	6.3	6·3(12½)	11·6	7·5	6·8	.	6·5	6·5(11½)
„ 14	8·2	7·0	6·8	.	6·5	6·5(13)	10·8	7·0	6·9	.	6·8	6·7(12½)
„ 15	9·4	7·0	6·8	.	6·8	6·8(13)	5·7	7·0	7·2	.	6.8	6·8 (12½)
„ 16	4·2	6·6	6·8	.	6·8	6·8(13)	4·8	6 7	6·9	.	7·2	7·1 (12½)
„ 17	5·7	6·6	6·4	.	6·4	6·4(12¾)	10·o	6·6	6·9	.	7·0	7·0 (13)
„ 18	11·0	6·8	6·8	.	6·8	7·0(12½)	15·4	7·2	7·3	.	7·4	7·4 (13)
„ 28	.	.	.	.	.	.	9·7	6·7	6·8	.	7·1	7·1 (12½)
„ 29	8·4	6·9	6·9	.	7·2	7·3(13)	.	.	.	.	.	.
May 1	.	.	.	.	.	.	c9·3	6·2	6·2	.	6·9	7·0(15)
„ 2	7·9	6·8	6·9	.	7·1	7·4(12½)	.	.	.	.	.	7·3(20)
Aug. 19cv	19·2	15·8	15·4	15·4(9)	.	.	.	.	.	.	.	.
Sept. 18	.	.	.	.	.	.	cv15·1	13·1	13·1	.	.	.
„ 19cv	13·4	12·7	12·8	.	.	.	.	.	.	.	.	.
„ 26	3·9	10·3	.	.	.	11·0 ?	9·4	10·0	10·2	.	10·0	.
„ 27	10·1	10·8	.	.	.	.	13·4	10·9	.	.	.	.
„ 28	11·2	10·5	.	.	.	.	13·3	10·2	.	.	.	.
„ 29	10·9	10·1	.	.	.	.	15·1	10·3	.	.	.	.
„ 30	12·5	10·3	.	.	.	.	12·7	10·5	.	.	.	.
Oct. 1	12·2	10·2	.	.	.	.	13·4	10·2	.	.	.	.
„ 2	.	10·2	.	.	.	.	12·4	10·0	.	.	.	.
„ 3	7·8	10·5	.	.	.	.	13·2	10·7	.	.	.	.
„ 4	8·1	10·7	.	.	.	.	9·9	11·0	.	.	.	.
„ 5	9·3	10·7	11·8	.	11·9	11·9(13)	12·1	11·0	11·9	.	11·9	.
„ 6	8·9	10·9	11·9	.	11·9	11·9(13)	.	.	.	.	.	.
„ 17	.	.	.	.	.	.	11·6	10·7	.	.	.	.
„ 18	8·4	10·5	.	.	.	.	13·1	11·0	.	.	.	.
„ 21	12·8	10·6	.	.	.	.	10·7	10·9	.	.	.	.
„ 22	10·5	10·2	10·4	.	11·0	11·0(11)	11·3	10·0	10·5	.	11·0	11·0 (11)
„ 23	10·0	10·2	10·4	.	10·0	11·0(11)	.	.	.	.	.	.

* 4·30 P.M. † 4 P.M. c Off Cromarty.
v. H.M.S. 'Vigilant,' all others H.M.S. 'Jackal' in 12.

TEN DAY AND MONTHLY MEANS OF OBSERVATIONS TAKEN ON BOARD CRUISERS 'JACKAL' AND 'VIGILANT' AT ROTHESAY, AND INVERGORDON.

Cruiser Observations—Rothesay.

Ten day Means.

Period.	9 A.M.			3 P.M.		
	No. of Observations.	Surface.	10 fathoms.	No. of Observations.	Surface.	10 fathoms.
1893.						
Jan. 11-20	1	7·1	7.1	...	...	...
,, 21-31	3	6·6	6·8	2	6·6	6·9
Feb. 1-10	3	6·5	6·6	...	...	...
,, 11-20	3	6·1	6·6	1	6·3	6·4
,, 21-28	2	5·2	6·5	...	...	...
Mar. 1-10	1	6·4	6·4	2	6·0	6·3
,, 21-31	2	6·2	6·1	...	...	...
May 11-20	2	9·3	8·4	3	9·2	8·1
,, 21-31	1	10·2	9·3	1	10·2	8·9
June 1-10	1	11·7	8·3	...	...	...
,, 11-20	1	13·3	8·1	...	...	...
Sept. 21-30	2	12·4	12·0	...	...	...
Oct. 1-10	3	11·1	11·9	1	12·0	12·1
,, 11-20	...	...	...	1	11·7	11·8
,, 21-31	...	...	...	1	10·9	11·7
Nov. 1-10	1	9·2	11·1	...	...	...
,, 11-20	1	8·9	11·0	1	10·1	10·2
,, 21-30	2	9·4	9·6	1	10·2	10·2
Dec. 1-10	3	8·5	9·4	2	9·1	9·4
,, 11-20	2	8·2	8·6	1	8·3	8·1

Cruiser Observations—Rothesay.

Monthly Means.

Month.	9 A.M.			3 P.M.		
	No. of Observations.	Surface.	10 Fathoms.	No. of Observations.	Surface.	10 Fathoms.
1893.						
January	4	6·7	6·8	2	6·6	6·9
February	8	6·0	6·5	1	6·3	6·4
March	3	6·3	6·2	2	6·0	6·3
May	3	9·6	8·7	4	9·5	8·3
June	2	12·5	8·2	...	...	...
September	2	12·4	12·0	...	...	...
October	3	11·1	11·9	3	11·5	11·9
November	4	9·2	10·3	2	10·1	10·2
December	5	8·4	9·1	3	8·8	9·0

Cruiser Observations—Invergordon, Cromarty Firth.

Ten Day Means.*

Period.	9 A.M.			3 P.M.		
	No. of Observations.	Surface.	10 Fathoms.	No. of Observations.	Surface.	10 Fathoms.
1893.						
March 21–31	3	6·2	5·7	2	6·6	5·6
April 1–10	1	7·4	6·8 at 7 fms.	2	6·6	6·4 at 7½ & 8 fms.
,, 11–20	6	6·8	6·6	7	7·0	6·9
,, 21–30	1	6·9	7·2	1	6·7	7·1
May 1–10	1	6·8	7·1	1	6·2	6·9
August 11–20	1	15·8	15·4 at 9 fms.	...	...	...
September 11–20	1	12·7	...	1	13·1	...
,, 21–30	5	10·4	11·0^{1}	5	10·4	10·0^{1}
October 1–10	6	10·5	11·9^{1} (13)	5	10·6	11·9^{1}
,, 11–20	1	10·5	...	2	10·8	...
,, 21–31	3	10·3	10·5^{2}	2	10·4	11·0^{1}

Cruiser Observations—Invergordon, Cromarty Firth.

Monthly Means.*

Month.	9 A.M.			9 P.M.		
	No. of Observations.	Surface.	10 Fathoms.	No. of Observations.	Surfaee.	10 Fathoms.
March	3	6·2	5·7	2	6·6	5·6
April	8	6·9	6·7	10	6·8	6·7
May	1	6·8	7·1	1	6·2	6·9
August	1	15·8	15·4 at 9 fms.	...	...	...
September	6	10·8	11·0^{1}	5	10·4	10·0^{1}
October	10	10·4	11·0^{3}	9	10·6	11·4^{2}

* The small figures following the temperature indicate the number of Observations from which that mean was calculated should it differ from that in the column giving the number of Observations.

SECTION D.—CONTEMPORARY WORK.

AN ACCOUNT OF CONTEMPORARY SCIENTIFIC FISHERY WORK AND FISHERIES IN THIS AND OTHER COUNTRIES By Dr T. Wemyss Fulton, F.R.S.E., Superintendent of Scientific Investigations.

1. UNITED KINGDOM.

In recent numbers of the *Journal of the Marine Biological Association,* Mr W. E. Holt gives further instalments of the results of his investigations on North Sea Fisheries, and especially on the capture and destruction of immature fish. He states that the size-limits for flat-fishes proposed by the Parliamentary Committee on Sea Fisheries, in 1893, 'would, if carried into effect, leave the North Sea Fishery practically *in* '*statu quo*'; and in view of the difference in size at which maturity is attained by fish in different districts, he recommends that the size-limit should be treated separately in each district.* The statistics collected by Mr Holt in regard to the quantities of flat-fish landed at Grimsby, show that in the six months, May to October 1892, a total of 86,000 boxes of plaice was landed at that port, compared with 125,000 boxes in the following year. The apparent increase of 39,000 boxes is for the most part accounted for by an increase of 30,000 boxes of Iceland fish, leaving a North Sea increase of 9000 boxes. An examination of the details shows that, with respect to the sizes of the fish, there was in 1893 a total of 71,000 boxes of 'large' fish and 22,000 boxes of 'small,' as against 73,000 boxes of 'large' and 11,000 boxes of 'small' in 1892. The increase therefore was entirely confined to Iceland and 'small' North Sea fish, while in 'large' North Sea fish there was a deficit of 2000 boxes. Mr Holt continues: 'That plaice are actually decreasing in the North Sea 'is a fact so generally recognized that it hardly needs illustration, but 'the present scarcity may not be so apparent from figures dealing with 'aggregate catches as it becomes when we examine the catches of individual boats. In examining the total figures it must be borne in mind 'that the fishing power is enormous, our own large fleet being supplemented not only by foreigners, but by vessels hailing from other British 'ports, such as Scarborough, Shields, Aberdeen, Glasgow, and even 'Milford Haven. The scarcity is most felt in the winter months, when, 'for whatever reason, the fish are very hard to catch. Thus in the last 'winter a smack failed to average two boxes of plaice in ten consecutive 'voyages along the neighbouring coast and off Flamborough Head, an 'area which has the reputation of being fairly productive for the season.' He also states that in February 1893, a steam trawler landed one plaice after ten days' fishing, and another one box after eight days'. Mr Holt also gives notes on a new species of ray (*R. blanda*), hitherto confounded

* *Journal Marine Biological Association*, vol. iii. No. 3, p. 169, 1894.

with *R. maculata;* on the 'recessus orbitalis,' an accessory visual organ he has discovered in flat-fishes; on the reproduction of the scad or horse-mackerel, &c. The eggs of the latter species were found to be pelagic. In the same number, Mr J. T. Cunningham discusses the young stages of *Zeugopterus punctatus*, and describes experiments he carried on on the rearing of the larvæ of whiting, flounder, and plaice. Some of the latter were kept alive until they were thirty-seven days old.

In the next number of the *Journal*,* Mr Holt gives further results of his enquiries on North Sea fisheries. He states that the Iceland trawl-fishery cannot be said to have been satisfactory last season, the trawlers for the first time having a difficulty in getting fish. In previous years the only difficulty was in getting a fair price for them; but out of twenty-five voyages in May 1894, twenty averaged but little more than 100 boxes each, and some of the best grounds appear to be already practically 'cleaned out.' In a paper on experiments and observations made at the Plymouth Laboratory, Mr J. T. Cunningham deals with several subjects, such as the diagnostic character in flat-fishes, the development of the egg in flat-fishes and pipe-fishes, the growth and distribution of young food-fishes, &c. Mr Cunningham also furnishes a review of our knowledge on the larva of the eel, and describes the results of recent investigations on the subject by two Italian naturalists, Grassi and Calandruccio, who have satisfied themselves that one of the Leptocephali (*L. brevirostris*) is the larva of the common eel. The number also contains brief papers by Mr Cunningham on the migration of the anchovy, and by Mr Holt on some supposed hybrids between the turbot and the brill. Professor M'Intosh's paper, 'Remarks on Trawling,' which appeared in the *Twelfth Annual Report of the Fishery Board*, is republished in this number of the *Journal*.

The Lancashire Sea Fisheries Committee, whose work has been referred to in previous Reports, continues to carry on a number of important investigations, both at the Fisheries Laboratory at University College, Liverpool, and by means of their steamer 'John Fell.' In the report on the work done at the Fisheries Laboratory † a detailed account is given of inquiries into the food of fishes and shell-fish, the distribution of immature fish, &c. From the further investigations into the food of young fishes, in order to discover the chief sources of nourishment after the contents of the yolk-sac have been used up, it seems pretty certain that, after the larval fishes have absorbed the food supply in the yolk-sac, they pass to the stage in which copepoda form the chief food, and when that stage is passed they take to feeding on larger invertebrata, such as small annelids, mollusca, &c. The food of young plaice, dabs, sprats, &c. is described, and also the results of the examination of the stomachs of 1664 fishes above three-and-a-half inches in length. It is shown that the food-material of the plaice on the Lancashire coast differs to some extent from what it is on the east coast of Scotland; in the former place they feed chiefly on molluscs, in the latter for the most part on annelids. A number of experiments are detailed regarding the vitality of trawled fish and their chance of survival when returned to the sea, and the subject of the hatching and culture of sea-fishes is dealt with. Concerning the latter it is pointed out that the northern area of the Irish Sea, in the centre of which the Isle of Man lies, and which contains the Lancashire Sea-Fisheries District, is by itself 'one large natural sea-fish area, with its own 'spawning-grounds, nurseries, and feeding-grounds, independent, so far as

* *Journ. Marine Biological Association*, vol. iii., No. 4, 1895.

† *Report on the Investigations carried on in* 1894 *in connection with the Lancashire Sea-Fisheries Laboratory at University College, Liverpool.* By Professor W. A. Herdman, D.Sc., F.R.S., and Mr Andrew Scott, Fisheries Assistant.

'the greater part of its fish population goes, of neighbouring seas, but having 'its inshore and offshore grounds interdependent and intimately connected 'with one another, by the successive stages and migrations in the life-'histories of the food-fishes.' The inference drawn is that 'the whole of 'the Irish Sea ought to be under the jurisdiction of one authority, so 'that fish may be protected, when necessary, in any part of it; so that 'the same bye-laws may, if required, apply to Lancashire, Anglesey, and 'the Isle of Man; and so that, to take a particular case, the sole may be 'protected when spawning in the deep water of the offshore grounds.' It is pointed out that the 3-mile limit 'is an absurdity from the fishery 'point of view.' The spawning-grounds of the sole in the district are tracts of deep water, 20 to 25 fathoms, lying off the east of the Isle of Man, or in the central part of the Irish Sea; and 'the supply of the 'inshore nurseries depends upon the preservation of the offshore spawning-'grounds.' It is stated that in addition to the protection of the spawning areas—at present impossible—sea-fish culture should be resorted to in order to increase the supply of young fishes in the inshore nurseries. Arguments are given in this Report for the selection of Port Erin, in the Isle of Man, as the site for the hatchery which the Lancashire Sea Fisheries Committee have decided to establish, the other site proposed being at Piel Island, in the Barrow Channel; and the subject is concluded as follows:—'In concluding this section of the Report, we desire 'to re-state what we regard as one of the most fundamental points which 'can come before the consideration of a Sea Fisheries Committee, namely, 'that there are two methods by which the decadence of a fishery may be 'checked (1), by killing fewer undersized fish, and (2), by adding to the 'total number of fish living in the district. Consequently it is most 'desirable and important that Sea Fisheries Committees all round the 'coast should, in addition to any restrictive legislation that may be 'required, undertake directly productive action, such as sea-fish hatching 'and rearing and aquiculture in general.' The Report also contains information regarding the food and spawning of the mussel, cockle, and shrimp; the destruction of young fishes by shrimpers; and the experiments carried out by Mr Dawson with a special net, with the view of showing how the destruction might be diminished. This net is called the 'Bar shank net' in contradistinction to the ordinary shank-net, and while it captures about the same quantity of shrimps, it takes considerably smaller quantities of immature fish. A preliminary account is also given of experiments with drift bottles which were made in order to ascertain the surface currents in the district, and their influence in transporting floating organisms, and fish eggs and larva, similar to those described in the present Report (p. 153), which were begun somewhat earlier than those off the Lancashire coast. One of the bottles was carried a distance of 180 miles—from Liverpool to Saltcoats, Ayrshire,—and nearly fifteen per cent of those found were recovered on the coast of Ireland.

The last quarterly Report of the superintendent of the Lancashire Sea Fisheries * contains much information regarding the fisheries of the district. Young plaice and dabs have increased at some parts of the district, which is attributed to the compulsory use of a large mesh in trawl-nets, and the preserving of certain grounds during the last four years. Power to raise funds to defray the cost of erecting and maintaining a hatchery has been sanctioned by the Board of Trade, the cost of plant and building not to exceed £1000, and the maintenance not to exceed £500; the site for the hatchery has not yet been decided.

* *Lancashire Sea Fisheries. Superintendent's Report for the Quarter ending June 30th*, 1895.

Several papers dealing with sea-fisheries and marine biology are published in the *Proceedings of the Liverpool Biological Society*,* in which is also contained an account of the Biological Station at Port Erin, in the Isle of Man. It may be stated that a measure has passed the House of Keys conferring powers to make fishery bye-laws and other regulations upon a Committee in the Isle of Man.

Once each year a conference is held between delegates from the various English Sea-Fisheries Committees and the officials of the Board of Trade, at which various questions concerning the sea-fisheries are discussed, the proceedings being afterwards officially published. At the conference in 1894 † the following were among the subjects discussed:—undersized fish, increase of minimum size of crabs allowed to be taken, protection of berried lobsters, scientific research and fish hatcheries. The representatives of the various districts were unanimous in recommending legislation against the landing or selling of immature flat-fishes, on the lines adopted by the Select Committee of the House of Commons in 1893; and it was generally agreed that the cost of scientific research and fish-hatching should be borne by the Imperial exchequer rather than by local rates.

2. NEWFOUNDLAND.

In the Annual Report of the Newfoundland department of fisheries for last year,‡ it is stated that, in the course of the season, 346,000,000 eggs of the cod were collected, of which 124,500,000 were rejected, and 221,500,000 hatched, the young fish being 'planted' in Trinity, Conception and Bonavista Bays. This shows an output of 64 per cent., which must be considered a satisfactory result when the large quantity of spawn that was handled is taken into account. During the five years that the hatching has been in operation the number of cod fry hatched has been as follows:—

1890,	17,100,000
1891,	39,650,000
1892,	165,254,000
1893,	201,435,000
1894,	221,500,000
Total	644,939,000

An extraordinary abundance of codfish of various sizes was found in Trinity Bay, and their presence there, while absent from the neighbouring bays, 'is exactly what might have been anticipated on the supposition 'that the active propagation of cod from the hatchery, during the previous 'four years, had proved successful in restocking waters which had been 'largely depleted.' Fishermen came from other parts to fish in the neighbourhood of Dildo, and it is pointed out that one-year-old cod were most abundant, and next to these two-year-old; 'fishermen,' it is added, 'who 'were previously sceptical about the process of artifical propagation, were 'unable to resist the evidence thus furnished of the success of the 'hatchery.' Fry from the hatchery were transported in suitable apparatus to other bays, up to a distance of 120 miles. Large numbers of the eggs

* *Proceedings and Transactions Liverpool Biological Society*, vol. viii., 1894.

† *Fourth Annual Meeting of Representatives of Authorities under the Sea Fisheries Regulation Act*, 1888, London, 1894.

‡ *Annual Report of the Newfoundland Department of Fisheries for the year* 1894, St Johns, N. F., 1895.

of the lobster, procured from the canning factories, were also dealt with, for the most part in floating boxes at various parts of the coast, the number incubated being 574,414,000 and the number hatched 463,890,000, or over 80 per cent. The total number of lobster-eggs hatched during the last five years amounts to 2,425,546,000, all of which would have been destroyed in the lobster factories. The report states that 'it is too soon as yet to look for marked results; but already, from 'many localities, where incubators have been operated from the first, 'accounts have been received of large increase in the number of young 'lobsters, which, the fishermen believed, were the product of the incubators.' During the last three years a marked improvement in the lobster fishery has taken place, and the export for 1894 exceeded that of the previous year by 10,374 cases, or $22\frac{3}{4}$ per cent.; 310 licences were issued to lobster-packers, as against 284 in 1893, and, according to the returns obtained, these factories made use of 89,133 lobster traps, employed 3,382 persons, the catch amounting to 6,231,768 lobsters. Regulations regarding the lobster fishery have been submitted to the Legislature for approval, comprising a close time, a minimum space of $1\frac{3}{4}$ inches between the two undermost laths in lobster traps, and a distance of at least 60 fathoms between the traps set by different persons.

An investigation has been begun respecting the decline of the Great Bank fishery for cod, which, it is said, 'threatens to terminate in its entire 'abandonment.' In six years—from 1889 to 1894, both inclusive—the number of vessels engaged in the Bank fishery declined from 330 to 58; in 1889, 236,821 quintals of fish were taken, as against 53,824 quintals in 1894. The report also contains much valuable information regarding the herring and other fisheries, the curing of fish, freezing of bait, &c.

3. NEW ZEALAND.

Considerable attention has of late been given in the colony to fishery questions, and several inquiries have been begun to ascertain something of the natural history and habits of the more important fishes found in New Zealand waters. The late Mr W. Arthur, president of the Otago Institute, when secretary of the Otago Acclimatisation Society, prepared forms which were supplied to various correspondents in order that they might note down sundry particulars regarding the fish caught, as the condition of the reproductive organs, the contents of the stomach, &c. By co-operation between Mr George M. Thomson and Mr Wilson of the Marine Department, this inquiry has been expanded and extended, and the first results have been published by Mr Thomson in the Transactions of the New Zealand Institute, dealing with about forty species of sea-fishes.

4. THE UNITED STATES.

In the Eighteenth Report of the United States Fish Commissioner, for the year 1892,* it is stated that for the current expenses of the work the appropriations made by Congress amounted to 295,000 dollars, of which 205,000 dollars were for the propagation and distribution of the food-fishes, 45,000 dollars for the maintenance of vessels, 20,000 dollars for the inquiries respecting the food-fishes, and the same amount for statistics. In connection with inquiries concerning the food-fishes,

* *Report of the United States Commissioner of Fish and Fisheries for the fiscal year ending Jnne* 30, 1892. Washington, 1894.

the principal investigation on the Pacific Coast related to the fur-seal fishery of the North Pacific Ocean and Behring Sea, with reference to the preparation of the United States' case before the Tribunal of Arbitration at Paris. This was undertaken by the steamer 'Albatross,' which, later, was occupied in an investigation of the fishery resources of Puget Sound and the Strait of Juan de Fuca. On the Atlantic coast the principal investigation was made, through the agency of the schooner 'Grampus,' into the distribution and abundance of the fishes in Chesapeake Bay and adjacent waters, and the conduct of inquiries off the southern coast of New England to determine the physical characteristics of the belt of water bordering the coast, through which, in their seasonal migrations north and south, so many important fishes pass. Investigations were also carried on by the steamer 'Fish-Hawk' as to the oyster-beds in Chesapeake Bay, on the food of the oyster, and for the purpose of determining some practical system for the collection of oyster-spat, so as to permit the utilisation of areas of muddy bottom not suitable for oyster-planting by methods now employed. The more important investigations, carried on at the Woods Holl Marine Laboratory, were in relation to the embryology of certain sponges; the anatomy, embryology, and habits of certain important crustaceans and molluscs; and continuous observations throughout the entire year in reference to the habits, abundance, and movements of the fishes of the New England Coast, and the temperature conditions existing and which influence their movements. In the department of statistics and methods of the fisheries, special information was obtained regarding the fisheries of the Great Lakes. In connection with fish-culture no less than 22 Stations were operated, and the total distribution of eggs, fry, adults, and yearlings amounted to 305,918,346. The number of pike perch (*Stizostedion vitreum*) reached 94,300,000, shad (*Clupea sapidissima*) 70,424,000, white-fish (*Coregonus clupeiformis*) 65,267,000, and cod (*Gadus morrhua*) 52,795,000. Sea-fish were dealt with at two Stations, namely, Gloucester and Woods Holl, Massachusetts. At the former, cod and pollock were hatched, and at the latter sea-bass cod, flat-fish, and lobster. The total number of the eggs of the cod, in good condition, obtained at Gloucester in the course of the season, was about 51,600,000, besides 5,475,000 eggs of the pollock. Of 51,597,400 eggs of the cod incubated, 19,519,900 succumbed in the process, the number of fry hatched and distributed being 32,077,500. Of the 5,475,000 eggs of the pollock, 3,001,600 were lost in incubation, and 2,473,600 were successfully hatched. The best results were obtained when the temperature of the water was between 38° Fahr. and 45° Fahr. Towards the latter end of January the temperature of the water sank to 34°·5 Fahr., causing retardation and non-uniformity in the development of the eggs; but this was met by utilising the warm water of the condenser of the boiler to heat the sea-water passing through. Unexpected difficulties were experienced in procuring a supply of cod-spawn; ripe fish were not procurable at Gloucester until the end of March, and most of the spawn obtained in Ipswich Bay died within 24 hours. At the Woods Holl Station cod were chiefly dealt with. An agreement was entered into with a fish-dealer to furnish 3000 live cod between 25th October and 25th December, but owing to a succession of severe storms which interfered with the fishing, only 1620 fishes were delivered. The number of eggs obtained by stripping the females was 45,627,200, from which 25,671,500 fry were obtained, 19,955,000 being lost. The number of eggs of the flat-fish procured was 8,527,800, which yielded 3,510,000 fry; and from 7,600,900 eggs of the lobster, 5,799,500 fry were hatched, and experiments were made as to the best time to procure the eggs for incubation.

The report also contains elaborate papers on the Myxosporidia or psorosperms of fishes, and the epidemics produced by them; on the fisheries of the Great Lakes; on the oyster industry of New Jersey, &c.

An important event in connection with the fisheries in the States in 1893 was the Chicago Exhibition, where a special department comprised exhibits relating to fisheries, and conferences were held at a Fisheries Congress convened for the discussion of various subjects relating thereto. Many important papers dealing with questions discussed are published in the last Bulletin of the Fish Commission. These include such subjects as Biological Research in relation to the Fisheries, Statistics of the Fisheries of the United States, Relation of Scientific Research to Economic Problems; the habits and development of the lobster, the hatching of sturgeon, fish-culture, fishery laws, salmon disease, fish-parasites, fishery investigations at St Andrews Laboratory, &c., &c. In the Official Catalogue of the British section,* Professor E. Ray Lankester gives a valuable review of the progress of fishery investigations in the United Kingdom during recent years, dealing chiefly with those of the Scottish Fishery Board and the Marine Biological Association.

The Report of the Boston Fish Bureau, as usual, contains brief but interesting notes about American Fisheries and the fish trade.†

5. SWEDEN.

As stated in previous reports, complete statistics in regard to the fisheries of Sweden are not published; but those relating to the fisheries of the Bohuslän Coast are pretty full.‡ The total value of these fisheries last year was 3,193,313 kroner, of which herring yielded 1,711,467 kroner and mackerel 563,812 kroner. In the previous years the total value of the fish caught was much less, amounting to only 2,325,397 kroner, the increase being chiefly due to the long continued herring fishery, and the great increase is the yield of mackerel. The deep-sea fishing employed 97 vessels and 990 men, and the fishing in the Kattegat 104 decked boats and 608 men. The mackerel fishing with drift nets was carried on in the Kattegat and Skager Rack by 381 boats, and the line fishing in the North Sea employed 90 boats—a considerable increase on previous years. The winter fishery for herrings was prosecuted by siene-nets and set-nets, the former yielding 1,942,066 hectolitres, valued at 976,139 kroner, and the latter 240,775 hectolitres of the value of 661,705 kroner.

As in previous years strenuous efforts were made by the Swedish curers to extend and perfect the curing and preparation of herrings according to the Scotch method, and the Government gave a grant of 2000 kroner to defray the cost of instruction in this method. Enormous quantities of fresh herrings are exported from the Bohus Provinces to Germany and England to be smoked in these countries, establishments for the smoking of herrings being but slowly established in this part of Sweden, although several now exist, and have exported small quantities both of bloaters and kippers to England and Germany. It is stated that the factories for the manufacture of guano and oil from herrings have had a favourable season. The guano is for the most part exported to France and the oil

* *Royal Commission for the Chicago Exhibition*, 1893. *Official Catalogue of the British Section, London*, 1893.

† *Twentieth Annual Report of the Boston Fish Bureau*, Boston, 1895.

‡ *Berättelse öfver Göteborgs och Bohus läns hafsfisken under* 1893–94.

to Germany, France and Norway. Three new guano factories have been erected, making the total number eleven. Attempts have been made to plant out American oysters, but they have not been very successful.

Professor Otto Pettersson has recently published the results of Swedish hydrographic research in the Baltic and North Sea, which have been undertaken partly with the view of throwing light upon the movements of fish shoals. The system adopted has been to despatch a number of vessels simultaneously from different ports across that part of the sea which has to be explored. In 1890 the Kattegat and the Skager Rack were explored by means of five steamers; and more recently the Danish Government adopted the same method of simultaneous hydrographic research for the Kattegat and parts of the Western Baltic and the Danish Sounds. A very full and detailed account of the methods employed is given in the *Scottish Geographical Magazine*, as well as the principal results. Off the Swedish Coast Professor Pettersson believes he has established the relationship between the periodic changes in the physical conditions of the sea, and the migratory movements of the herring, the winter herring fishing ceasing whenever the warmer and salter bottom water, which in winter is found in the Swedish coast-channels, and on the coast-bank, was displaced by the fresher and colder waters of the Baltic current. Of late years this has, as a rule, taken place in February or March; and there seems to be a connection between the inflow and outflow of the bank-water and the herring fishery.

6. NORWAY.

The operations at the sea-fish hatchery at Flödevig, under the direction of Captain G. M. Dannevig, during the past season related chiefly to cod. The very severe winter, by reducing the temperature of the water to a very low point, proved fatal to the brood-fishes retained in the enclosures, and the work was therefore much interfered with in the early part of the year. By energetic efforts, however, Captain Dannevig succeeded in procuring a fresh supply of adult cod before the season was over, and nearly 100,000,000 of fry were successfully hatched and transferred to the adjoining fjords.

In the official reports of the various fishery inspectors for different districts, a great deal of statistical information is given respecting the fisheries along the coasts. At the great cod fishing at the Lofoten Isles, 27,415 men and 6292 boats were employed, of which 10,411 men, with 1775 boats used gill-nets and 15,274 men, with 3819 boats used lines.* The yield of the fishery amounted to 28,500,000 fish, 14,600 hectolitres of liver, 24,350 hectolitres of roe, and 12,300 hectolitres of cod-liver oil. A full account is also given of the winter fishery, of the herring fishery and of the mackerel fishery. At the Lofoten fishery, systematic temperature observations have been carried on for a number of years, together with observations on the weather, &c., and those for 1891–92 have been recently published with a chart and report.† Such observations within a fishing and spawning area so important as the Lofotens will be of permanent value. A number of interesting papers, dealing with a great variety of fishery topics, are published in the various numbers of the fishery journals.‡

* *Aarsberetning ved Kommende Norges Fiskeriers* for 1894.
† *Temperaturmaalinger i Lofoten* 1891–92, *Christiania* 1894.
‡ *Norsk Fiskeritidende Selskabet for de Norske Fiskeriers Fremme.*

7. DENMARK.

From the Official Report it appears that in the financial year 1893–94 the total value of the fish landed on the West Coast of Denmark, and caught in the North Sea and Skagerrak, was 615,756 kroner, as compared with 552,721 kroner in the previous year. Of this total, herrings yielded only 3,354 kroner, and mackerel, 16,109 kroner; plaice were valued at 116,277 kroner, soles at 689 kroner, turbot 523 and brill 322 kroner. The most important were haddock, of the value of 240,741 kroner, and cod 69,711 kroner. Lobsters were valued at 53,960 kroner. The fisheries inside the Skaw were valued at 1,622,955 kroner, of which cod yielded 376,941 kroner, mackerel 45,320 kroner, and 'flounders' no less than 1,083,103 kroner. The value of soles was 79,579 kroner, of plaice 10,977 kroner, of herrings 565,430 kroner, of eels 906,229, and of salmon 142,858 kroner. From places within the Scaw 153 cutters and 126 open boats, manned by 1146 men, carried on deep-sea fishing in the Kattegat and North Sea, their total catch comprising plaice, soles, turbot, haddock, cod, and mackerel, valued at over one million kroner. In the appendices to the report Dr C. G. Joh. Petersen gives the result of his valuable investigations on the biology of the flat-fishes of the Danish Coast, and in the decrease of the fishery for this important group. The inquiries which Dr Petersen was directed by the Government to carry on were as follows:—(1) where and to what extent, is any destruction going on of immature and especially unmarketable flat-fishes; (2) what size-limit ought to be fixed for flat-fishes that may be taken ashore; (3) whether it is desirable to formulate regulations fixing the sizes of the meshes of the various kinds of fishing gear used for the capture of flat-fishes; (4) whether it is desirable to forbid trawl-fishery for certain periods, at certain seasons and fishing places; and finally, how such regulations should be formulated. The inquiries showed that unmarketable flat-fishes are caught to a great extent in the Limfjord, and on the shores of Northern Jutland with seine-nets; that the size-limit should be for plaice not under 8 inches (to the base of the caudal fin) on the coast generally, 10 inches in the Kattegat, and about 12 inches in the Limfjord; for turbot and brill 12 inches, and for soles 10 inches. Dr Petersen gives a pretty full account of the biology of the flat-fishes found on the Coasts of Denmark, and his descriptions are illustrated by figures and tables. His observations on the spawning and sexual maturity of the various species and on their rate of growth are of special value for comparison with those obtained on this side of the North Sea. Dr Petersen also deals with the causes of the falling off in the flat-fish fisheries and the remedies that ought to be employed; and also with some of the Zoological characters applicable to the determination of young, post-larval flat-fishes. The publication of the Danish Fishery Association also contains a number of interesting papers, dealing for the most part with the fisheries in their commercial aspects.*

8. HOLLAND.

In the official report voluminous statistics are given regarding the Dutch fisheries in 1893.† The herring fishery in the North Sea yielded 25,750 barrels less than in the previous year, but the average price was a

* *Dansk Fiskeriforenings Medlemsblad Aarsberetning for* 1894.

† *Verslag van den Staat der Nederlandsche Zeevisscherijen over* 1893.

little higher; 550 vessels took part in it (as compared with 536 in 1892), of which 224 were luggers and sloops, and 312 'bomschuiten.' The earliest of the herring were in the market on 21st May, and they were forwarded from Leith to Vlaardingen by steamer, the Jagery Association for direct transport from the fishing vessels not having been formed in 1893; and they brought from 49 to 92 florins per barrel. The total quantity during the season amounted to 511,083 barrels of pickled herrings, and 46,704,250 'steurharing,' and the total value amounted to 5,048,066 florins; the export reached 337,680 barrels. Full details are also given regarding the fishing for white fish, the coast fisheries in the North Sea, and in various districts. Oysters on the Yersche and Bergsche banks were very satisfactory in the summer of 1893, both on tiles and on the natural grounds, although a great mortality in the brood occurred later. The quantities of oysters put into the home and foreign markets are estimated as follows:—home markets, 1,553,480; to Germany, 6,728,050; to Belgium and France, 2,569,970; to England, 4,942,630; making a total of 15,794,130 oysters, about three millions more than in the previous year. The value is estimated at 1,225,600 florins. The total quantity of mussels exported, or sent to home markets, was 1,563,806 kilogrammes, the estimated value being 39,100 florins. The number of boats and vessels employed in the Dutch fisheries in 1893 was 4902, of a total tonnage of 172,603, and manned by 16,700 men; showing an increase of 255 boats and 558 men over the previous year.

The report also contains the results of observations on the anchovy by Professor C. K. Hoffmann, dealing chiefly with the period when sexual maturity is attained. Hoffmann believes that it reaches maturity in the second year of its life, while Hoek is of opinion that this does not occur until the third year. A preliminary account is also given by Dr P. P. C. Hoek, the scientific adviser on fisheries, of his investigations with regard to the influence of trawl-fishing on the flat-fishes of the North Sea. These investigations are specially important in having been made at some distance from the coast, and may be referred to in some detail. The first series were carried on in a fishing-boat, provided with an auxiliary screw, between 24th August and 21st September 1893, one of the chief objects being to ascertain whether a boat of this kind was suitable for such work. It was found to be too small for the purpose, especially in bad weather, and it was impossible in many cases to examine the contents of the trawl satisfactorily.

In all seventeen hauls with the trawl were performed, two trawls, each with a different type of trawl-head, being used. The beam of both trawls measured 35 feet only, and the meshes of each net were medium-sized, from 6·5 to 7 centimetres in the main part of the net and 6 centimetres in the cod-end, or 'staart,' as it is called by Dutch fishermen. These measurements refer to the greatest dimension of the mesh when drawn tight; each side of the mesh from knot to knot would measure half. The iron trawl-heads of one were □-shaped, after the English model, while those of the other were club-shaped, of the so-called Dutch model. The advantage of a net furnished with the former over the one with the latter is, that, on reaching the bottom, it always clears itself, and falls ready for fishing; a trawl with Dutch heads sometimes reaches the bottom reversed.

The farthest point reached in 1893 was about 64 miles from the Dutch coast, the depth being 17 fathoms. Only three hauls with the trawl were made about this distance in 57–64 fathoms. Six hauls were made at a distance of from 18 to 32 miles, seven at a distance of from 6 to 14 miles, and only one in the immediate neighbourhood of the coast, at a mile and a half from the shore.

Each catch was investigated as carefully as possible, but it was difficult always to measure the specimens. Most attention was paid to the flat-fishes. They were the only fishes of value caught during the trip; a few haddocks and cod and a considerable number of whitings were also taken, but they were nearly worthless, not being in season at that time of the year. Dr Hoek's investigations were therefore confined to the flat-fishes. Of these eight species were represented in the catches of 1893, viz.:—Turbot (*Rhombus maximus*, L., Dutch, tarbot); brill (*Rhombus lævis*, Rondelet, Dutch, griet); sole (*Solea vulgaris*, Quenst., Dutch, tong); plaice (*Pleuronectes platessa*, L., Dutch, schol); common dab, (*Pleuronectes limanda*, L., Dutch, schar); flounder (*Pleuronectes flesus*, L., Dutch, bot); scald-fish or smooth-sole (*Arnoglossus laterna*, Dutch, scharretong); and little sole or solenette (*Solea lutea*, Dutch, dwergtong).

Of these the sole, the plaice and the common dab were represented in all the seventeen catches made. Only single specimens of the turbot and brill were taken in any haul; they were absent in the three catches in 17 fathoms at a greater distance (about 60 miles) from the coast. Turbot were taken eight times, and the specimens varied in length from 20 to 56 centimetres; brill were caught 7 times, their length ranging from 23 to 33 centimetres. The flounder was only three times met with, all in hauls at a very short distance from the coast. They were small specimens, probably from the Zuider Zee, which had passed out with the water through the Ymuiden-sluices.

Numerous scald-fishes were taken. They are of no commercial importance, but they were extremely abundant at depths of 15 and 16 fathoms, about 24 miles from the coast. Solenettes were obtained in nearly all the hauls. This species has until now escaped the attention of Dutch investigators, so that it was previously unknown that this little fish is to be found almost everywhere along the Dutch coast, and at greater distances also. Their size never surpasses 12 centimetres; and Dr Hoek points out that, in many of the cases in which the destruction of small or undersized soles has been complained of, it was not small specimens of *Solea vulgaris*, but full-grown specimens of *Solea lutea* that had been for the most part taken.

In 1894, a large steam-tug, the 'Hercules' from Nieuwediep, was placed at the disposal of Dr Hoek in order to continue the investigations; but it appears the quantity of coals was limited and the work somewhat handicapped.

During this excursion seventeen hauls were made with the trawl, at about the same part of the North Sea as in 1893, and, as a rule, the trawling was more successful than in the previous year. The trip lasted from July 23 to August 6, and the weather generally was rough and stormy. The trawl was a new one, the iron heads being after the English model, weighing 65 kilogrammes each; the beam was of ash, and measured about 44 feet. The meshes of the net were 9 centimetres near the mouth, and 6 centimetres near the cod-end.

The flat-fishes caught in 1894 were the same as in 1893, the only difference being that several lemon-soles were taken in the latter year. This species is called Tongschar in Dutch, and is only rarely observed in the eastern part of the North Sea, at least so far as the Dutch coast goes. *

Both in 1893 and in 1894 Dr Hoek tried to calculate the medium size of the flat-fishes at each haul. The number of specimens of turbot and brill was small, but in regard to the other three species, the plaice,

* Heincke says that it is not very rare on the plaice-grounds in the neighbourhood of Helgoland (*Wissenschaftliche Meeresuntersuchungen*, I. i. p. 103, 1894).

and the dab, the number of the measurements was large enough to allow of conclusions being drawn. The condensed results of the measurements are as follow :—

1893 (August–September).

Number of the Haul.	Depth in Fathoms.	Distance from the Coast in Miles.	Average Size of the Flat-Fishes Caught, in Centimetres.				
			Turbot.	Brill.	Sole.	Plaice.	Dab.
1	15–17	18·5	42	...	24	22	20
2	14	32	45	...	25	23·25	21
3	15–16	32	...	...	25	24·7	22·4
4	11	9	...	...	25	19	19
5	8½	6	...	26	21	15·25	14·5
6	12	7	31	25·4	25	18·9	20
7	16	11	...	27	24·7	20	19·7
8	15	22	56	...	24·7	23·7	19
9	15	18	51	...	24·5	24·9	20·5
10	16	27	42	33	25·6	24·4	20·8
11	17	57	...	...	27	28·75	17·8
12	17	64	...	...	25	30·1	18·2
13	17	60	...	...	26·6	30	21·1
14	8	6	38	...	25·8	21	21·7
15	9	8·5	...	26·5	26·6	21·5	21·3
16	7–4	1·5	20·75	28·5	24·5	16·6	17·9
17	16	14·5	14·5	25·75	26·5	18·6	18·1

1894 (July–August).

Number of the Haul.	Depth in Fathoms.	Distance from the Coast in Miles.	Turbot.	Brill.	Sole.	Plaice.	Dab.
1	6	1·5	...	...	...	14	12
*2	9	3	...	...	19·4	15·1	16·24
3	11	3·5	...	...	...	17	..
4	13	15	42·75	34	27·5	21·4	20·28
5	13	23	45	...	28·3	23·1	21·15
6	17·5	50	48·75	28·5	30·1	26·8	17·13
7	15·5	56	51·75	...	30·6	27·5	22·8
8	14	63	43	...	29·1	28	18
9	16	53	...	45	29·7	30·4	15·9
10	14	42	54	...	28·75	26·8	16·55
11	15	25	...	...	...	...	...
12	15·5	15	66	...	28·7	21·9	19·56
13	18	24	48·10	42	28·65	21·4	21·4
14	10	32	...	27·50	26·75	16·8	18
15	11	12	47·21	30·50	28·3	19·4	17·9
16	11	10	29·33	34	27·9	19·4	18·8
17	13	19	38·22	...	29·7	21·7	19·95

A very large percentage of the soles caught were measured in both years, and the uniformity of the average sizes of the soles was remarkable. It varied in 1893, with a single exception, between 24 and 27 ; in 1894, also with one exception, between 26·75 and 30·6. The exceptions were in hauls made very close to the shore.

In 1894 the soles caught were considerably larger than those of 1893, although the fishing ground was about the same in both years. This difference was, no doubt, at least partly caused by the meshes of the net being larger in 1894.

In both years, but more obviously in 1894, a slight increase in size was

* With shrimp trawl.

observed in those caught at a more considerable distance (50 miles and upwards) from the coast; the soles of hauls 11–13 of 1893 were perhaps slightly larger than the other ones; the soles of haul 6–9 of 1894 were decidedly the largest ones of that year.

This, however, was much more evident with the plaice caught at a greater distance from the shore. While the average size of all the plaice caught in 1893 was only 22·5 centimetres, the plaice of the hauls 11–13 measured 29·6 centimetres. In 1894 the medium size for all the plaice measured was only 21·6 centimetres, but those of hauls No. 6–9 (50–63 miles from shore) had an average length of 28·2 centimetres. The plaice caught in 1893 were, curiously enough, larger than those of 1894.

For the dab, such an increase could not be made out. The medium size of those measured in 1893 was 19·6, but those of the more distant hauls, No. 11–13, measured 19 centimetres only; in 1894 the length of the dabs on an average was 18·4, and exactly the same medium size characterised the specimens of the hauls No. 6–9.

In a few cases only it was possible to measure all the dabs and plaice in a haul, but a fairly representative portion was always investigated. In view, however, of the experimental character of both cruises and the relatively small number of observations made, it would be hazardous, Dr Hoek states, to base wide conclusions on these measurements; but some inferences are drawn from the results obtained:—1. Of two nets, the cod-ends of which have equal-sized meshes, but the foremost part having larger meshes in the one than in the other net, the one with the larger meshes brings up larger soles than the other. 2. The size of the plaice and of the dabs taken with nets, the meshes of the foremost part of which are different, does not show the same difference as with soles; plaice and dabs of any size once in the net appear to have no chance of escaping. 3. The difference in size of the soles taken (in July to September) with the same net, at points more or less distant from the coast, seems not to be very considerable. The soles at the greater distances were somewhat larger than those caught nearer the coast, but this may be caused by chance. 4. The difference in size of the plaice taken (in July to September) with the same net, near the coast, and at a distance of 50 miles and upwards from the coast, was found considerable in both expeditions. This difference being found both years rather large, there cannot be reasonable ground to doubt that it arose from the size of the fishes at these places being different. 5. The dabs caught at a greater distance from the coast were not found to be larger than those found at a less considerable distance.

Somewhat similar results have been found in some other parts of the North Sea, but almost nothing was previously known—in a scientific sense—of the trawl-fishing in the North Sea to the east of the fourth meridian. A large fleet of small Dutch fishing-boats is constantly working the grounds between that meridian and the west coast of Holland. When the weather is fine they go as far as the Broad Fourteens, and even farther; but for the greatest part of the year they stay eastward of the fourth meridian. Is the damage done by their fishing really so great as is believed at the west side of the North Sea; is it larger in some months of the year than in others; does it affect both round-fishes (cod, whiting, haddock, hake) and flat-fishes, or only flat-fishes, and, of the latter, some species more than others, or all of them in an equal way? Should great damage be done, the question arises whether or not it will be possible to remedy its effects—but the first thing that is necessary is to know the facts well. Such knowledge can be obtained only by the constant use, for a series of years, of a seaworthy steamer fitted up for the purpose. It appears that for several years Dr Hoek has urged upon the Dutch Government the necessity of providing such a steamer, and no serious objection has been made to the proposal; the experiments with hired ships cannot be said to have given results of consequence. As Holland is one of the countries chiefly interested in the welfare of the North Sea fisheries, from which she derives so much material advantage, it is only a question of time before such a steamer, without which scientific fishery investigations cannot be carried on satisfactorily, is provided.

The various numbers of the monthly Bulletin concerning the fisheries * contain much information, including extracts from the journals of the cruisers, statistics of fish landed, information respecting harbours, &c. The Zoological Station at Helder is to be enlarged. Last year the Dutch herring fleet numbered 550 vessels as against 536 in 1893, 228 being luggars or sloops and 322 *bomschuiten*. Professor M'Intosh's paper 'Remarks on Trawling' published in the last annual report of the Board is translated *in extenso.*

9. FRANCE.

The French Government have decided to erect a hatchery for sea-fish propagation, in connection with the Marine Laboratory at Tatihou, St Vaast La Hougue, Normandy. Dr Roche, the Chief Inspector of the Maritime Fisheries of France, visited Dunbar Hatchery some time ago, at the request of his Government, to inspect the arrangements there, and he was followed later by M. Malard, of the Tatihou Laboratory; and the French hatchery will be arranged in the same manner as the one at Dunbar, Captain Dannevig's apparatus being used. Dr Canu, of the Marine Station at Boulogne-sur-mer, also visited the Dunbar establishment, and has published a descriptive report of it.

The official statistics of French fisheries that used to be published annually have been intermitted for a year or two, pending re-organisation of the system by which they were collected. It is understood that they were found to be imperfect and in some ways misleading. In the official fishery Bulletins, published monthly by the department of the Minister of Marine, there are a number of interesting papers.† A considerable number of these deal with oyster-culture, and Professor Thoulet, of Nancy, furnishes an elaborate report of the oceanography of the Arcachon region, so famous for its oysters. Other papers deal with trawl-fishing for shrimps, the cod-fisheries at Iceland and at Newfoundland, the establishment of district schools for instruction in subjects pertaining to marine fisheries, the mackerel fishery on the coasts of Ireland, in which many French vessels participate, &c. M. Raveret-Wattel describes marine pisciculture as carried on in several countries, and Dr Canu furnishes a descriptive account of the marine hatchery at Dunbar. Dr Georges Roché, the Chief Inspector, has published a small, but very lucid and interesting work on the modern sea fisheries of France.‡ A description is given, with illustrations, of the various kinds of fishing carried on by French fishermen, both on French coasts and on the coasts of other countries; there are also chapters on the curing and preservation of fish, and on the measures which should be taken to deal with the depopulation of littoral waters.

The official journal of the Société Nationale d'Acclimatation de France also contains several papers of interest§ relating to fisheries, but most of

* *Mededeelingen over Visscherij.*

† *Ministère de la Marine. Bulletin des Pêches maritimes.*

‡ *Pêches maritimes modernes de la France*, Paris, 1894.

§ *Revue de Sciences naturelles appliquées.*

them deal with those of inland waters. Professor Thoulet, distinguished for his oceanographic researches, has published a paper dealing with the lakes of the Vosges.*

10. SPAIN.

The chief available source of information regarding the Spanish sea-fisheries is the official journal, the *Revista de Pesca Maritima*, which contains many papers and reports dealing with the subject. In Spain, during the last few years considerable attention has been devoted to the development of a cod-fishery in Iceland by Spanish fishermen, inasmuch as, although Spain is the chief country in Europe in which cured cod is used as an article of diet, they have been hitherto almost entirely dependent on importations from abroad. It appears that the Icelandic fishery is prosecuted by the fishermen of a considerable number of European States. In 1893 France had 177 vessels of a tonnage of 17,137 tons, and manned by 3375 men employed in fishing at Iceland; and the number has been increasing year by year. Most of the French vessels are large, ranging from 100 to 150 tons. The total quantity of fish caught by the French vessels in 1893 has not been given, but in 1892 it amounted to 11,493,311 kilogrammes of cod valued at 5,415,918 francs. Americans also fish to the north and north-west of the island; and the Belgian Government, following the example of the Danes, sent a steamer to Iceland last year to make an exploration of the fishing grounds.

Trawl-fishing is also a prominent question in Spain, and is dealt with in a number of articles. Lieutenant Vela, the Secretary of the Fishery Commission, while admitting that fishing with the *Bou* may affect the reproduction of fishes and frighten away certain kinds, states that further information is necessary to decide between the various opinions and interests, and he discusses the effect of the regulations by which *Bou*-fishing was prohibited within three miles from the coast and freely allowed beyond that distance. The results of this regulation may vary much at different parts of the coast, and in most places the zone of free water is practically limited to a narrow strip, because of the deep water which exists off the land in which the trawls cannot be used. It is recommended that the officers trained at the Naples Marine Station should be employed to investigate the conditions around the coast to determine—(1) the zones in which it is possible to fish with the *Bou* as regards depth and kind of bottom up to twenty miles from the shore, and the position of the various spawning-grounds and nurseries within this zone; (2) the species principally caught by the *Bou* and their condition of development; (3) the results produced on the abundance or scarcity of certain species by the uze of the *Bou* during a given period. It is also recommended that the maritime commandants should be instructed not to allow vessels to go out to fish with the *Bou*, unless they give guarantees as security, and that they should be compelled to keep a conspicuous flag flying whenever they are actually fishing. The decree which prohibited *Bou*-fishing within three miles was promulgated in 1888, but in October last year (1894) after the above article was printed, another decree was issued interdicting this method of fishing within six miles of the coast. It is stated that this measure must be regarded as temporary, and that the distance should be dependent on the nature of the coast, and subject to the decision of the various maritime authorities.

* *Contribution a l'Etude des Lacs des Vosges.*

There is also given an important paper on the *Bou*-fishing, which was submitted to the Junta de Pesca of Barcelona last December by Sig. de Borja, naturalist to the Junta, and which deals with both the scientific and the practical aspects.

There is an interesting report by Lieut. Auglada on lobster ponds, of which there are four,—at Cedeira, Ferrol, Corunna and Corcubion, in which thousands of lobsters are preserved for the market. Other papers deal with oyster-culture in Galicia, the fisheries of the Canaries, the formation of district schools of marine fishery, &c. A statement is also made regarding the zoological studies of a number of officers sent by the Government to the Marine Station at Naples to be trained to deal with fishery problems. In a separate publication Lieutenant Vela gives a statistical account of the Spanish fisheries * from which it appears that the total quantity of fish taken on the coasts of Spain during 1892 amounted to 90,587,803 kilogrammes, valued at 43,314,195 pesetas. The number of fishermen is returned as 85,117, and the number of boats 20,436.

11. EGYPT.

With the exception of unimportant sea fisheries at Portsaid, Suez, and Alexandria, the fisheries of Egypt are confined to the Nile and to certain fresh or brackish lakes, especially Menzaleh, Bouroulos and Edkou. These fisheries belong to the government, which derives a considerable revenue from them, either by letting them to tenants at a stipulated rent, or by receiving half the profits on the sale of the fish caught. The total revenue thus obtained last year amounted to about £97,000. At present there is no special fisheries department, the collection of the revenue being the only connection between the government and the fisheries, and this is under the care of the finance department. Fish is largely consumed throughout the country, chiefly salted (*fessikh*) and it is mostly eaten raw. The present method of curing is imperfect, the fish being badly preserved, and an effort is now being made to introduce better methods of cure. The most esteemed fish is the grey mullet; the Nile fish being only used by the poorer classes, and sometimes 16, each about a foot and a half long, can be purchased for one piastre, or about twopence halfpenny. The methods of fishing are by the seine-net, the casting-net, and by hooks, baited and unbaited. Professor J. C. Mitchell, of the College of Agriculture, Ghizeh, recently concluded an inquiry, at the instance of the Egyptian government, into the edible fishes of the country, and the methods of fishing and fish preserving practised at Lake Menzaleh;* and he is also engaged in an investigation of the fishes of the Nile.

12. JAPAN.

Among the Japanese fish forms the staple animal diet, and the fisheries of Japan rank among the most important of the national industries. I am indebted to Dr K. Kishinouye, of the Fisheries Bureau, Tokyo, for the greater part of the following account. The number of fishermen employed in 1891 is returned at the enormous figure of 1,943,015, and the number

* *Estadistica de Pesca, año*, 1892, Madrid, 1894.

† *Report on the Edible Fishes of Lake Menzaleh, their Capture and Preservation* Cairo, 1895.

of boats at 377,043, valued at 9,660,740 *yen*. It would appear, however, that the former figure includes all those who derive a livelihood from the fisheries. The total value of the fish, shell-fish, algæ and marine products landed in 1891 amounted to 27,567,257 *yen*, in addition to 1,464,549 *yen* yielded by the freshwater fisheries. The chief kinds and their values are as follows:—Herring, 434,956,224 *kin*,* worth 5,080,107 *yen*; sardines, 415,301,495 *kin*, valued at 2,177,354 *yen*; bonito 60,908,588 *kin*, valued at 1,481,549 *yen*; salmon 47,715,477 *kin*, of the value of 848,292 *yen*; tunny, 24,169,805 *kin*, worth 755,898 *yen*; mackerel, 35,681,998 *kin*, valued at 444,063 *yen*; oysters, 19,998,243 *kin*, valued at 71,202 *yen*, and lobsters, 80,993,745 *kin* of the value of 577,908 *yen*. Large quantities of fish are cured.

The Japanese department carry on scientific investigations in connection with their fisheries, and have recently begun an inquiry into the influence of trawl-fishing, much in the same manner as in Scotland; they are also investigating the natural history of the *Awabi* (*Haliotis gigantea*) and of an echinoderm, *Stichopus japonicus*, one of the important fishery products of Japan. Researches are also being conducted as to the spawning and spawning periods of the important food-fishes and molluscs, the food upon which they subsist, and the biological minimal sizes. The fishermen are also taught 'some foreign modes of fishing which are new to them,' and by the agency of local fishery associations papers dealing with fishery questions in foreign countries are translated and distributed.

* One *kin* is equal to $1\frac{1}{3}$ lbs.

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