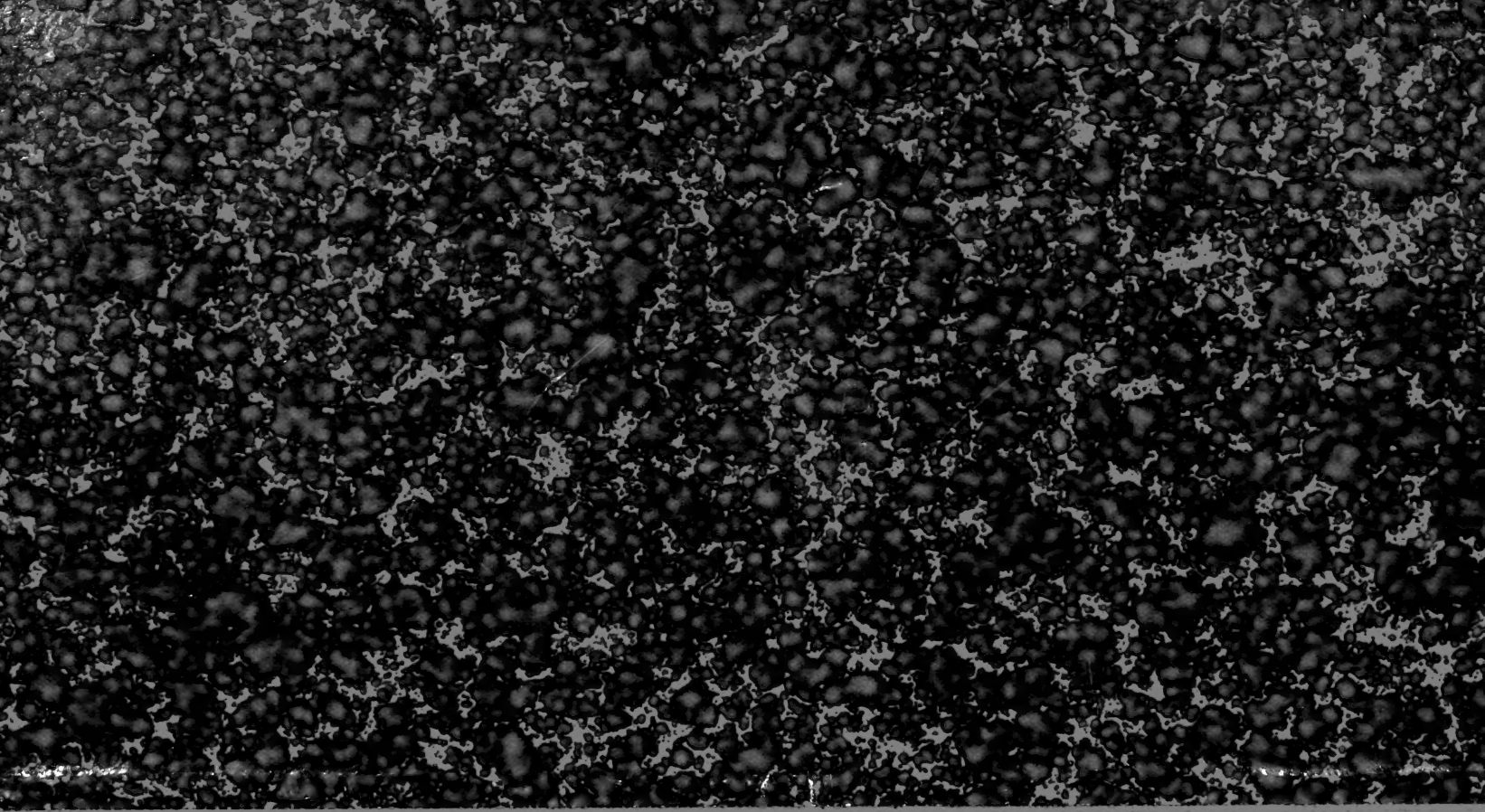

REPORT FOR 1894

ON THE

LANCASHIRE SEA-FISHERIES LABORATORY

AT

UNIVERSITY COLLEGE, LIVERPOOL.

DRAWN UP BY

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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.

Introductory.

This, the Third Annual Report of the Lancashire Sea-Fisheries Laboratory, contains an account of the work done during the past year, 1894, in endeavouring to carry out the scheme of investigations drawn up by Prof. Herdman when the Laboratory was established in 1892, and is necessarily, to a considerable extent, a continuation of what has already been published in the two former Reports. One new line of enquiry this year is the investigation, by means of "drift bottles," of the tidal and other currents in the Irish Sea, which would affect the distribution of small floating bodies, such as fish eggs and surface food (see below).

Part of the work has been carried out on board the fisheries steamer "John Fell," while making the usual periodical visits to the in-shore and off-shore fishing grounds of the district and adjacent parts of the Irish Sea. The fishery officers, under the Committee, have kept us supplied with material from their respective districts. Owing to the resignation of two fishery officers, this part of the work has been somewhat interrupted during the latter part of the year, and, consequently, the number of small fish sent in for examination has been rather less than in former years. This reduction in the number of fish is, however, counter-

balanced by a great increase in the number of shell-fish, *i.e.*, cockles and mussels, sent in, as will be observed from the statistics later on in this report.

The rest of the work, including the microscopical examination of the fish and shell-fish stomachs and eggs, has been done in the Fisheries Laboratory at University College, Liverpool. In March, 1894, Mr. Andrew Scott succeeded Mr. Corbin as Fisheries Assistant, and the detailed work during the year has been carried out by Mr. Scott, under the general direction of Prof. Herdman, as in former years.

Mr. Dawson has again kindly placed at our disposal the monthly records of observations made in the district by himself and the various fishery officers, and from these we have extracted a good deal of valuable information. Some of it is given here, while part is held over for a future report in order that further additions may be made before publication.

During the year Mr. Dawson has been continuing the interesting experiments made with an ordinary shrimp shank net fitted with a bar in order to determine whether the number of small fish usually caught in shrimping could be diminished without affecting the quantity of shrimps taken in the net, and, so far as the results go, they seem to show that the bar shank net takes on the whole fewer fish and more shrimps than either the ordinary shank or shrimp trawl nets. We give the results of some of the experiments further on.

A short account is given below of the Irish Sea as a natural fishery ground, and the subject of a sea-fish hatchery for the district is fully discussed. At the end of the Report will be found some notes on a few additions to the known fauna of the district obtained by the steamer and otherwise during the trawling investigations.

We have to thank Mr. Robert A. Dawson, the Superintendent of the Fisheries, Captain Wignall, of the fishery steamer, and the various fishery officers, for the willing assistance rendered us in carrying out the various experiments, and for supplying material for examination in the laboratory.

Examination of Food in Stomachs.

In the course of the past twelve months 3,389 stomachs of marine animals from different parts of the district have been examined for the purpose of ascertaining what forms the chief food of the animals in the area in which we are more especially interested.

The following are the sources from which the stomachs have been derived :—

Food fishes up to three inches	296
,, ,, above ,, ...	1664
Other fish	67
Cockles	529
Mussels	523
Shrimps	290
Shanks	20
	3389

The Food of Young Fishes.

From a further investigation into the food of the young fishes in order to find out what forms the chief source of nourishment after the contents of the yolk-sac have been used up, it seems pretty certain now, as was suggested in a former report, that after the larval fishes have absorbed the food supply stored up 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.

At the Scottish Fishery Board's Marine Hatchery,* Dunbar, some experiments were made last spring (1894) by Mr. Harold Dannevig, in which he endeavoured to rear young Plaice. He succeeded in keeping the newly hatched Plaice alive in filtered sea-water till they attained the age of 20 days by feeding them on material collected by tow-net in Dunbar Harbour, but owing to stormy weather, the water became loaded with fine mud, which was collected in the tow-net along with the food-material and could not be readily separated from it. This killed the young fish, and so brought the experiment to an untimely end. An examination of the tow-net material showed that it consisted chiefly of Copepoda, in various stages of development, and other young crustacea.

The following list gives the result of an examination of the stomachs of 296 young fish from various parts of the district. The list is divided up into five columns, giving the locality, date, number of fishes examined, range of size in inches, and the contents of the stomachs, the limit of size being three inches in length. The size of the smallest fish received during the year was half-an-inch, they were collected at Lytham by Mr. Ascroft, who kindly sent them to us, and an examination of the stomachs showed them to be filled with the Copepod *Eurytemora affinis*, Poppe. Later on in the year we received a few more small fish, also half-an-inch in length, from Capt. Eccles, New Brighton. These had been caught near Deposit Buoy, Horse Channel, Mersey entrance, but in this case the stomachs were empty.

* An interesting description of the hatchery at Dunbar, and an account of the very successful hatching operations carried on last spring and summer, are given in Part III of the Twelfth Annual Report of the Fishery Board for Scotland.

Young Plaice (*Pleuronectes platessa*).

Morecambe.	Dec. 4	15 fish.	$1\frac{3}{4}-3$ inch.	13 Empty, 1 Cumacea, 1 *Mysis*.
Morecambe.	Jan. 11	12 ,,	$1\frac{7}{8}-2\frac{1}{2}$,,	9 Empty, 1 Copepoda, 1 Annelida, 1 *Corophium*.
Morecambe.	Feb. 2	3 ,,	$1\frac{7}{8}-2$,,	1 Empty, 2 Animal tissue.
Lytham.	Mar. 16	28 ,,	$2-2\frac{3}{4}$,,	9 Empty, 7 An. tiss. 7 *Corophium*, 3 Amphipoda (*Bathyporeia*) 2 Larval Crustaceans.
Blackpool.	Mar. 21	5 ,,	$2-2\frac{3}{4}$,,	5 Empty.
Morecambe.	Apr. 5	1 ,,	$2\frac{1}{4}$,,	1 *Tellina*.
Off Jumbo Buoy.	Apr. 10	1 ,,	2 ,,	1 *Mactra*.
Deposit Buoy.	Apr. 18	1 ,,	$2\frac{1}{2}$,,	1 Annelida.
Blackpool.	Apr. 20	25 ,,	$2-2\frac{1}{2}$,,	5 Empty, 3 Annelida, 17 Animal tissue,
Lytham.	May 1	8 ,,	$\frac{1}{2}-\frac{7}{8}$,,	8 Copepoda (*Eurytemora affinis*).
Lytham.	May 4	7 ,,	$2\frac{1}{4}-3$,,	3 Annelida, 1 Amphipoda, 3 Animal tissue.
Lytham	May 9	5 ,,	$2\frac{1}{2}-2\frac{3}{4}$,,	2 *Crangon*, 3 Annelida.
Spencer's Spit, Mersey.	May 11	2 ,,	$2\frac{3}{4}$,,	2 Annelida.
Deposit Buoy.	May 23	2 ,,	3 ,,	2 Empty.
Lytham.	May 30	4 ,,	$2\frac{1}{2}-3$,,	3 Empty, 1 *Crangon*.
Burbo Bank.	June 21	2 ,,	3 ,,	2 Empty.
Crosby Channel.	July 23	2 ,,	$2\frac{1}{4}$,,	2 Empty.
Garston.	Oct. 16	3 ,	$2\frac{1}{2}$,,	3 Empty.
Barrow Channel.	Dec. 17	6 ,,	$1\frac{3}{4}-2\frac{3}{4}$,,	4 Empty, 1 Annelida, 1 *Crangon*.

Of the 132 young Plaice examined, 58 stomachs contained no food, and 28 contained indistinguishable animal matter, leaving 46 to be accounted for as having food.

Crustacea were found in 29 stomachs, or fully 63 %, and consisted of *Copepoda*, *Isopoda*, *Amphipoda*, *Cumacea*, and *Crangon*.

Annelida were found in 14 stomachs, or fully 30 %.

Mollusca were found in 2 stomachs, or fully 4 %.

Young Dabs (*Pleuronectes limanda*).

Morecambe	Feb. 2	1 fish.	3 inch.	1 *Pandalus*.
Lytham	Mar. 16	1 ,,	$2\frac{1}{4}$,,	1 Empty.
Blackpool.	Apr. 5	10 ,,	$1\frac{1}{8}-1\frac{3}{4}$,,	4 Empty, 2 Copepoda (*Ectinosoma curticorne*), 1 Copepoda (22 *Ectinosoma curticorne*, 1 *Longipedia*), 1 Copepoda (*Ectinosoma*, *Thalestris*, & *Canuella*), 1 Cumacea and Copepoda (*Ectinosoma*), 1 Amphipoda.
Blackpool.	Apr. 20	3 ,,	$1\frac{1}{2}$,,	2 Empty, 1 Copepoda (*Ectinosoma*).
Spencer's Spit.	May 11	1 ,,	3 ,,	1 Annelida.
Deposit Buoy.	Aug. 21	102 ,,	$\frac{1}{2}-2\frac{1}{2}$,,	86 Empty, 16 Annelida.
Ulverstone.	Oct. 23	1 ,,	2 ,,	1 Copepoda (*Jonesiella hyænæ*).
Garston.	Dec. 14	16 ,,	$2\frac{1}{4}-2\frac{3}{4}$,,	16 Empty.

Of the 135 young Dabs examined, the stomachs of 109 were found to contain no food, the remaining 26 contained food that could be recognised.

Annelida were found in 17 stomachs, or fully 65 %.

Crustacea were found in 9 stomachs, or fully 24 %, and consisted of *Copepoda*.

Sprats (*Clupea spratta*).

Lytham.	Mar. 16	3 fish.	$2\frac{3}{4}-3$ inch.	1 *Mysis*, 1 Empty, 1 *Corophium*.
Blackpool.	Mar. 21	6 ,,	$2-2\frac{3}{4}$,,	6 Empty.
Morecambe.	Mar. 22	1 ,,	3 ,,	1 Animal tissue.

Sprats (*Clupea spratta*).

Deposit Buoy.	Apr. 18	2 ,,	3 ,,	2 Empty.
Leasowe Shore, Mersey.	May 3	2 ,,	$2\frac{1}{2}$,,	2 Empty.
Lytham.	May 4	1 ,,	$2\frac{3}{4}$,,	1 Empty.
Garston.	Oct. 16	2 ,,	$2\frac{3}{4}-3$,,	2 Empty.
Barrow Channel.	Dec. 17	1 ,,	$2\frac{1}{4}$,,	1 Empty.
Garston.	Dec. 14	2 ,,	2–3 ,,	2 Empty.

Soles (*Solea vulgaris*).

Morecambe.	Mar. 22	1 fish.	3 inch.	1 Cumacea.
Ulverstone.	Oct. 23	1 ,,	$2\frac{3}{8}$,,	1 Empty.

Raia maculata.

21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	1 fish.	$2\frac{1}{2}$ inch.	1 Animal tissue.

Raia clavata.

21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	1 fish.	$2\frac{3}{4}$ inch.	1 Empty.

Flounders (*Pleuronectus flesus*).

Grange-over-Sands.	May 28	3 fish.	$2\frac{1}{2}-2\frac{3}{4}$ inch.	2 Empty, 1 *Crangon*.

Yellow Gurnard (*Trigla hirundo*).

Deposit Buoy.	Sep. 18	2 fish.	$2-2\frac{1}{2}$ inch.	2 Empty.

Food of Larger Fishes.

Since the last Annual Report was published, we have examined 1,664 food fishes, three and-a-half inches in length and upwards, with a view to determine their food, and also the condition of the reproductive organs. These fish were caught at various places both inside and beyond the limits, as the table of localities will show, thus differing from the case of the young fishes examined, which

were, with one or two exceptions, all from inside the limits, and, therefore, as may be expected, it will be found that there is a greater diversity of food in the stomachs.

Along with the food fishes, 67 other fish, not usually looked upon as being suitable for food, have also been examined, but their numbers are too small to be worthy of record until they have been supplemented by the collection of further material. These animals are of considerable interest, however, from a point of view of fish food, as they are frequently found in the stomachs of the more valuable food fishes, so that it is of some importance that we should find out what they themselves feed upon, and to what extent they compete with the food fishes feeding on the same ground.

As before, the statistics are arranged in columns showing the locality, the date, the number of fish examined, the size in inches, and the contents of the stomachs.

Plaice (*Pleuronectes platessa*).

Morecambe.	Nov. 29	2 fish.	$5\frac{7}{8}$ inch.	2 Empty.
Morecambe.	Dec. 4	18 ,,	$3\frac{1}{4}-6$,,	17 Empty, 1 *Crangon*.
Morecambe.	Jan. 11	7 ,,	$3\frac{5}{8}-6$,,	7 Empty.
Morecambe.	Jan. 24	2 ,,	$7-7\frac{1}{4}$,,	1 Empty, 1 *Cardium* (Mollusca).
Morecambe.	Feb. 2	10 ,,	$3\frac{7}{8}-9$,,	9 Empty, 1 An. tiss.
Morecambe.	Feb. 3	12 ,,	$3\frac{1}{2}-6$,,	10 Empty, 1 An. tiss. 1 remains of Crustacea,
3 miles below Lytham.	Feb. 20	14 ,,	$4\frac{1}{2}-7\frac{1}{4}$,,	11 Empty, 2 An. tiss. 1 *Idotea* and *Cardium*,
Morecambe.	Feb. 20	4 ,,	$4\frac{1}{4}-6\frac{1}{4}$,,	3 Empty, 1 An. tiss.
Morecambe.	Mar. 2	9 ,,	$4\frac{1}{2}-8$,,	7 Annelida, 2 Animal tissue.
Off Maughold Hd., Isle of Man.	Mar. 13	18 ,,	$10\frac{1}{2}-22\frac{1}{2}$,,	15 Empty, 3 *Pecten tigrinus*.

Plaice (*Pleuronectes platessa*).

The Hole.	Mar. 14	2 fish.	$6\frac{1}{2}$ inch.	2 Empty.
Lytham.	Mar. 16	15 ,,	$3\frac{1}{2}-5\frac{3}{4}$,,	4 *Corophium*, 1 *Crangon*, 1 *Crangon* & *Cardium*, 1 *Tellina*, 8 An. tiss.
Blackpool.	Mar. 21	5 ,,	$6\frac{3}{4}-8\frac{1}{4}$,,	5 Empty.
Morecambe.	Mar. 22	1 ,,	$6\frac{1}{2}$,,	1 Empty.
Morecambe.	Apr. 5	14 ,,	$4-10\frac{1}{2}$,,	6 Empty, 6 *Tellina*, 1 *Crangon*, 1 sand only.
North-West from Jumbo Buoy.	Apr. 11	2 ,,	$7-7\frac{1}{4}$,,	2 *Mactra*.
Deposit Buoy, Horse Channel.	Apr. 18	6 ,,	$3\frac{1}{2}-7\frac{1}{2}$,,	4 Empty, 2 Annelida.
Leasowe Shore.	May 3	10 ,,	$3\frac{1}{2}-9\frac{3}{4}$,,	9 Annelida, 1 Empty.
Lytham.	May 4	2 ,,	$7-8\frac{1}{2}$,,	2 *Cardium*.
Spencer's Spit, Mersey.	May 11	6 ,,	$3\frac{1}{2}-6\frac{1}{2}$,,	6 Annelida.
Station IV, off Blackpool.	May 16	4 ,,	$9-11\frac{1}{2}$,,	2 soft parts of Mollusca, 2 do. and Annelida.
Deposit Buoy, Horse Channel.	May 23	6 ,,	$3\frac{1}{4}-8$,,	3 Annelida. 3 *Donax*.
Lytham.	May 30	2 ,,	$3\frac{1}{2}$,,	2 Empty.
1 mile east from Newcome Knowl Buoy, Mersey.	June 8	6 ,,	$4\frac{3}{4}-5\frac{1}{2}$,,	6 Animal tissue.
Burbo Channel.	June 21	7 ,,	$3\frac{1}{2}-6$,,	7 Empty.
Grange-over-Sands.	July 16	3 ,,	$4-5\frac{3}{4}$,,	3 *Corophium*.
Crosby Channel.	July 23	3 ,,	$3\frac{1}{2}-7\frac{1}{2}$,,	3 Empty.
Horse Channel.	Aug. 9	29 ,,	$9-13$,,	21 *Scrobicularia*, 2 Animal tissue, 6 Empty.
Back of North Bank, near Deposit Buoy.	Aug. 21	13 ,,	4 ,,	13 *Mactra*.
Deposit Buoy.	Aug. 28	8 ,,	$5\frac{1}{2}-7$,,	1 Annelida, 7 *Mactra*.
4 miles West of Blackpool.	Aug. 31	21 ,,	$9-16\frac{1}{2}$,,	11 *Mactra*, 10 *Mactra* and *Philine*.

Plaice (*Pleuronectes platessa*).

Off Bar Ship.	Sept. 6	15 ,,	9–15 ,,	3 Empty, 1 *Nucula*, 2 Amphipoda(*Ampelisca*), 3 *Mactra* and *Nucula*, 4 *Scrobicularia*, 2 *Mactra*.
Off Blackpool.	Sept. 6	10 ,,	10–12½ ,,	10 Annelida.
Deposit Buoy.	Sept. 18	27 ,,	3½ - 7½ ,,	27 *Donax*, *Tellina*, and *Mactra*.
Burbo Bank.	Oct. 4	11 ,,	4–7½ ,,	11 *Donax*.
Garston.	Oct. 16	7 ,,	3½ - 8¼ ,,	7 Empty.
Ulverstone Chan.	Oct. 23	53 ,,	3¾ - 5¾ ,,	53 Empty.
Between Dingle and Garston.	Dec. 14	33 ,,	4–9 ,,	33 Empty.
Barrow Channel.	Dec. 17	4 ,,	4½–5½ ,,	3 Empty, 1 Annelida.

Of the 421 stomachs examined, 211 were empty and 23 contained indistinguishable animal matter, and one a little sand only, leaving 186 which contained matter that could be identified, and these are accounted for in the following notes :—

Mollusca were found in 134 stomachs, or fully 72 %, and comprised *Cardium*, *Mactra*, *Donax*, *Tellina*, *Scrobicularia*, *Nucula*, *Philine*, and *Pecten*. It will be observed from the list that the majority of the fish with Mollusca in their stomachs were taken in the Mersey district.

Annelida were found in 41 stomachs, or fully 22 %; the species were not identified owing to the mutilated condition of the specimens.

Crustacea were found in 15 stomachs, or fully 8 %, and consisted of *Crangon*, *Idotea*, *Corophium*, and *Ampelisca*.

Thus, it will be seen that Mollusca occupy a very prominent position in the food supply of the Plaice caught in the Lancashire district, Annelida being second in importance, and Crustacea third. This is almost the same result as was arrived at in last year's Report.

In the Firth of Forth, Annelida occupy the first place, Mollusca the second, and Crustacea the fourth.

Dab (*Pleuronectes limanda*).

Morecambe.	Nov. 11	6 fish.	4½–6 inch.	6 Empty.
Morecambe.	Mar. 2	1 ,,	6 ,,	1 Empty.
Off Maughold Hd., Isle of Man.	Mar. 13	12 ,,	3¾–11½ ,,	10 Empty, 1 *Ophioglypha*, 1 *Pagurus* and *Pecten*.
The Hole.	Mar. 14	6 ,,	5½–7½ ,,	6 Empty.
Lytham.	Mar. 16	1 ,,	5 ,,	1 Empty.
14 miles W.N.W. ½ W. from Morecambe Bay Lt. V.	Apr. 3	17 ,,	4½–10 ,,	8 Empty, 2 Annelida, 1 *Doris*, 2 *Ophioglypha*, 1 *Ophioglypha* & *Montacuta*, 1 *Solen*, 1 *Pagurus*, 1 Animal tissue.
21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	4 ,,	5–6¾ ,,	4 Empty.
Morecambe.	Apr. 3	2 ,,	4–7 ,,	1 Empty, 1 Amphipoda.
Morecambe.	Apr. 11	1 ,,	3¼ ,,	1 Empty.
Morecambe.	Apr. 18	1 ,,	4⅓ ,,	1 *Crangon*.
Deposit Buoy, Horse Channel.	Apr. 18	9 ,,	3½–5½ ,,	5 Empty, 4 Annelida.
Leasowe Shore.	May 3	7 ,,	4–8 ,,	2 *Crangon*, 5 Annelida.
Spencer's Spit.	May 11	6 ,,	4½–8¼ ,,	4 Annelida, 1 *Portunus*, 1 *Solen*.
12 miles W.N.W. ½ N. from Morecambe Bay Lt. V.	May 11	18 ,.	6½–10½ ,,	14 Annelida, 2 *Ophioglypha*, 1 *Pagurus*, 1 *Crangon*.
14 miles N. by W. from Liverpool N.W. Lt. V.	May 14	14 ,,	5½–11½ ,,	5 *Ophioglypha*, 1 Annelida, 2 *Pagurus*, 1 Mollusca, 1 Zoophytes, 4 Empty.
Station IV, off Blackpool.	May 16	5 ,,	9–11 ,,	2 Empty, 2 *Ophioglypha*, 1 *Philine*.
10 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	45 ,,	5½–10 ,,	7 Empty, 18 Annelida, 6 *Ophioglypha*, 2 *Pagurus*, 1 *Pagurus* and *Solen*, 4 *Ophioglypha* and *Solen*, 4 *Solen*, 3 Animal tissue.

Dab (*Pleuronectes limanda*).

Deposit Buoy.	May 23	9 ,,	3½–7¼ ,,	1 Empty, 4 *Crangon*, 2 Annelida, 1 Annelida and *Crangon*, 1 An. tiss.
1 mile E. of Newcome Knowl Buoy.	June 8	6 ,,	4½–5½ ,,	1 Empty, 5 Animal tissue.
Burbo Channel.	June 21	7 ,,	5½–9½ ,,	3 Empty, 3 *Crangon*, 1 Annelida.
Crosby Channel.	July 23	8 ,,	5–7 ,,	5 Empty, 3 Annelida.
Horse Channel.	Aug. 9	8 ,,	9½–10½ ,,	4 *Ophioglypha*, 1 *Scrobicularia* & *Mactra*, 1 *Mactra* & *Portunus*, 1 *Portunus*, 1 Annelida,
Back of N. Bank, nr. Deposit Buoy.	Aug. 21	43 ,,	3½–6 ,,	6 Empty, 1 Mollusca (soft parts), 36 Annelida.
Deposit Buoy.	Aug. 28	24 ,,	6–8 ,,	22 Empty, 1 *Crangon*, 1 *Portunus*.
4 miles W. of Blackpool.	Aug. 31	15 ,,	8–10½ ,,	6 *Ophioglypha*, 4 *Philine*, 5 *Ophioglypha* and *Philine*.
Off Bar Ship.	Sept. 6	3 ,,	8½–11 ,,	2 *Mactra*, 1 *Ophioglypha*.
Deposit Buoy.	Sept. 12	15 ,,	3½–8 ,,	9 Empty, 4 *Mactra*, 1 *Crangon*, 1 common shore Crab (*Carcinus*).
Burbo Bank.	Oct. 4	9 ,,	4–7 ,,	4 Empty, 1 *Crangon*, 4 *Donax* and *Nucula*.
Garston, Mersey.	Oct. 16	2 ,,	5¼–7 ,,	2 Empty.
Between Dingle and Garston.	Dec. 14	16 ,,	3½–8 ,,	16 Empty.

Of the 320 stomachs examined, 125 were empty, and 10 contained indistinguishable animal matter, leaving 185 to be accounted for as having matter in them that could be identified, they are as follows:—

Annelida were found in 92 stomachs, or nearly 50 %.

Echinoderms were found in 39 stomachs, or fully 21 %, and consisted chiefly of *Ophioglypha* (sand stars).

Mollusca were found in 38 stomachs, or fully 20 %, and

comprised *Donax*, *Nucula*, *Mactra*, *Philine*, *Scrobicularia*, *Solen*, *Montacuta*, and *Doris*.

Crustacea were found in 28 stomachs, or 15 %, and consisted of *Crangon*, *Portunus*, *Pagurus*, and *Amphipoda*.

Zoophytes—One stomach contained some fragments.

The above notes show that *Annelida* appear to have formed during the year a large per-centage of the food of the Dab in our district. *Echinoderms*, *Mollusca*, and *Crustacea* also form a considerable item in the food supply.

Last year's Report shows that the chief food during the period dealt with in that Report, was *Mollusca*, *Crustacea* and *Annelida* being next, but not nearly so important as the first-named.

In the Firth of Forth district, *Crustacea* form a large part of the food supply, *Echinoderms* being second, *Mollusca* third, and *Annelida* fourth.

Flounder (*Pleuronectes flesus*).

Morecambe.	Jan. 4	1 fish.	6¾ ,,	1 Empty.
Morecambe.	Jan. 24	12 ,,	4–8¼ ,,	7 Empty, 4 Annelida, 1 *Crangon*, and other Crustacea.
The Hole.	Mar. 14	2 ,,	9½–9¾ ,,	2 Empty.
14 miles N. by W. from Morecambe Bay Lt. Vessel.	Apr. 3	2 ,,	10½–16 ,,	2 Empty.
Grange-over-Sands.	May 28	2 ,,	4¾–5½ ,,	1 Empty, 1 *Crangon*.
Crosby Channel.	July 23	17 ,,	4–7 ,,	10 Empty, 7 *Crangon*.
Horse Channel.	Aug. 9	1 ,,	15 ,,	1 Annelida.
4 miles West of Blackpool.	Aug. 31	1 ,,	10 ,,	1 *Mactra*.
Ulverstone Chan.	Oct. 23	1 ,	6¼ ,,	1 Empty.

We do not give a per-centage statement of the food of this fish owing to the small number examined, but *Annelida*, *Crustacea*, and *Mollusca* appear to have been the chief food of the flounder during the year.

From last year's Report it will be seen that the order was then somewhat different, *Mollusca* being first, *Annelida* second and *Crustacea* and *Zoophytes* third.

Sole (*Solea vulgaris*).

Morecambe.	Feb. 21	2 fish.	5 – 5¼ inch.	1 Empty, 1 Annelida.
Morecambe.	Mar. 22	9 ,,	3¾ – 5 ,,	3 Empty, 2 Cumacea, 2 Amphipoda, 1 Annelida, 1 a little sand.
14 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	10 ,,	5 – 16¼ ,,	10 Empty.
14 miles W.N.W. ½ W. from Liverpool N.W. Lt.V.	Apr. 3	2 ,,	13½ – 16½ ,,	2 Empty.
16 miles W. by N. from Liverpool N.W. Lt.V.	Apr. 3	9 ,,	9 – 15 ,,	9 Empty.
Morecambe.	Apr. 5	12 ,,	3½ – 5½ ,,	9 Empty, 1 Zoea of Crab, 1 Cumacea, 1 other Crustacean remains.
Morecambe.	Apr. 11	13 ,,	3⅜ – 5 ,,	12 Empty, 1 Amphipoda.
Morecambe.	Apr. 18	5 ,,	4¾ – 6½ ,,	3 Empty, 2 Annelida.
Deposit Buoy, Horse Channel.	Apr. 18	6 ,,	3½ – 5½ ,,	6 Empty.
Spencer's Spit, Mersey.	May 5	5 ,,	4 – 4¾ ,,	1 Empty, 4 Annelida.
14 miles N. by W. from Morecambe Bay Lt.V.	May 14	18 ,,	8½ – 19 ,,	17 Empty, 1 *Solen*.
Deposit Buoy.	May 23	6 ,,	4 – 8 ,,	6 Animal tissue.
1 mile E. of Newcome Knowl Buoy.	June 8	5 ,,	4¼ – 5¼ ,,	5 Empty.
Burbo Channel.	June 21	9 ,,	4½ – 7½ ,,	9 Empty.

Sole (*Solea vulgaris*).

Crosby Channel.	July 23	13 fish.	4–5¾ inch.	11 Empty, 2 Annelida.
Back of N. Bank, nr. Deposit Buoy.	Aug. 21	10 ,,	4½–7½ ,,	4 Empty, 5 Annelida, 1 *Crangon*.
4 miles W. of Blackpool.	Aug. 31	4 ,,	11½–13 ,,	1 Empty, 3 Annelida.
Off Blackpool.	Sept. 6	12 ,,	10½–14 ,,	12 Empty.
Heysham Lake.	Oct. 15	1 ,,	7 ,,	1 *Crangon*.

Of 151 stomachs of Soles examined, 115 contained no food, 6 contained indistinguishable matter and one contained a little sand only, leaving 29 which are accounted for as follows:—

Annelida were found in 18 stomachs, or fully 62 %.

Crustacea were found in 10 stomachs, or fully 34 % and consisted of *Crangon*, *Cuma*, *Amphipoda*, etc.

Mollusca were found in one stomach only, or a little over 3%, so that *Annelida* appear to be the chief source of food for the sole, with *Crustacea* next in point of importance.

Lemon Sole (*Pleuronectes microcephala*).

14 miles W.N.W. ½ W. from Morecambe Bay Lt. V.	Apr. 3	3 fish.	7½–8¼ inch.	2 Empty, 1 Annelida
21 miles W. by N. from Morecambe Bay Lt. V.	Apr. 3	1 ,,	5½ ,,	1 Empty.
Morecambe.	Apr. 18	2 ,,	6¼–7 ,,	1 Empty, 1 Annelida.
Lytham	May 9	2 ,,	6½–11 ,,	2 Annelida.
14 miles N. by W. from Liverpool N.W. Lt. V.	May 14	2 ,,	8–11 ,,	2 Annelida.
10 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	17 ,,	5½–10 ,,	6 Empty, 11 Annelida.

The food of this fish seems to consist chiefly of *Annelida* but further data are required before we can state it definitely.

In the Firth of Forth district, *Annelida* are also the chief food, along with a few *Crustacea* and *Mollusca*.

Brill (*Rhombus lævis*).

Off Maughold Hd., Isle of Man.	Mar. 13	1 fish.	25 inch.	1 fish (Whiting).
Morecambe.	Apr. 25	1 ,,	4½ ,	1 *Crangon*.

Turbot (*Rhombus maximus*).

Morecambe.	Nov. 29	1 fish.	4 inch.	1 Empty.

Cod (*Gadus morrhua*).

Morecambe.	Nov. 29	4 fish.	4–5½ inch.	1 *Crangon*, Sprat, and *Arenicola*, 2 *Crangon* and *Gammarus*, 1 *Mysis* and *Gammarus*.
Morecambe.	Dec. 4	6 ,,	4½–6 ,,	1 Empty, 2 Amphipoda (*Gammarus*), 1 *Crangon* and Annelida. 1 fish and *Mysis*, 1 *Portunus*.
Morecambe.	Jan. 4	6 ,,	4⅜–7¼ ,,	1 *Crangon* and *Mysis*, 1 *Crangon* and Annelida, 1 *Crangon* and Shore Crab, 1 *Idotea* and *Mysis*, 1 *Gammarus*, 1 Fish.
Morecambe.	Jan. 24	11 ,,	4–6 ,,	2 Empty, 1 *Crangon*, 1 *Mysis*, 1 Cumacean, 1 Annelida, 1 Mollusca (*Tellina*), 1 *Crangon*, Fish, and Amphipoda, 1 *Crangon*, Fish, and *Mysis*, 1 *Crangon*, and *Mysis*, 1 *Mysis* and Cumacea.
The Hole.	Mar. 14	3 ,,	19¾–27 ,,	2 Empty, 1 Fish.
Blackpool Closed Ground.	Mar. 21	1 ,,	9½ ,,	1 *Crangon*.
Morecambe.	Apr. 18	2 ,,	5–6 ,,	2 *Crangon*.
Back of N. Bank, nr. Deposit Bnoy.	Aug. 21	2 ,,	4¾–5½ ,,	2 *Crangon*.
Garston, River Mersey.	Oct. 16	5 ,,	7–8½ ,,	2 *Crangon*, 3 *Pandalus*.

Cod (*Gadus morrhua*).

Ulverstone Chan.	Oct. 23	2 fish.	$3\frac{1}{2}-4\frac{1}{2}$ inch.	2 *Crangon*.
Between Dingle & Garston.	Dec. 14	1 ,,	7 ,,	1 Empty.
Barrow Channel.	Dec. 17	3 ,,	$3\frac{3}{4}-4\frac{1}{2}$,,	2 *Mysis*, 1 *Mysis* and Amphipoda.

Of the 46 stomachs examined 6 only were empty, the remaining 40 being accounted for in the following notes :—

Crustacea were found in 36 stomachs, or 90 % and consisted of *Crangon, Pandalus, Mysis, Cuma, Amphipoda, Idotea, Portunus* and *Carcinus*.

Fish were found in 5 stomachs, or fully 12 %.

Annelida were found in 4 stomachs, or fully 10 %.

Mollusca were found in one only.

On comparing the above result with that given in last year's report it will be found to be almost the same.

In the Firth of Forth district, the food of the cod appears to be very similar to that recorded for the Lancashire Sea-Fisheries District.

Whiting (*Gadus merlangus*).

Morecambe.	Nov. 29	4 fish.	$3\frac{1}{4}-3\frac{7}{8}$ inch.	1 Empty, 1 *Crangon*, 1 *Crangon* and *Mysis*, 1 Amphipoda and *Mysis*.
Morecambe.	Dec. 4	5 ,,	$3\frac{1}{4}-4\frac{1}{2}$,,	2 Empty, 2 *Mysis*, 1 Crustacean remains.
Morecambe.	Jan. 4	2 ,,	$3\frac{1}{2}-6\frac{1}{2}$,,	1 Amphipoda (*Gammarus*), 1 *Crangon* & *Mysis*.
Morecambe.	Jan. 11	1 ,,	$7\frac{1}{4}$,,	1 Empty.
Morecambe.	Feb. 2	2 ,,	$3\frac{1}{2}-6\frac{1}{4}$,,	1 Fish (Sprat),1 Empty.
Morecambe.	Feb. 11	9 ,,	4–6 ,,	2 Empty, 2 *Crangon*, 2 Fish, 1 *Crangon* and Amphipoda, 1 Annelida, 1 Animal tissue.
Off Maughold Hd., Isle of Man.	Mar. 13	4 ,,	$7-11\frac{1}{2}$,,	4 Empty.
The Hole.	Mar. 14	26 ,,	$7\frac{1}{2}-20$,,	25 Empty, 1 *Crangon*.

Whiting (*Gadus merlangus*).

Blackpool Closed Ground.	Mar. 21	3 fish.	4 – 5 inch.	1 Empty, 1 *Idotea*, 1 Fish.
Morecambe.	Mar. 22	17 ,,	3¾ - 6¼ ,,	10 Empty, 3 *Mysis*, 1 *Corophium*, 1 *Corophium* and *Mysis*, 1 Amphipoda, 1 Fish.
14 miles W.N.W. ½ W. from Morecambe Bay Lt. V.	Apr. 3	6 ,,	7 – 13¼ ,,	1 Empty, 1 *Ophioglypha*. 2 *Crangon*, 2 Fish (Sand eels).
21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	15 ,,	7½ - 11 ,,	10 Empty, 2 Annelida, 2 *Crangon*, 1 Fish.
16 miles W. & by N. from Liverpool N.W. Lt. V.	Apr. 3	19 ,,	8 - 17 ,,	17 Empty, 1 *Crangon* and *Ophioglypha*, 1 *Portunus*.
Morecambe.	Apr. 5	1 ,,	4 ,,	1 *Corophium* and *Bathyporeia*.
Morecambe.	Apr. 11	8 ,.	3½ – 5 ,,	4 Empty, 1 Fish, 1 Fish and *Crangon*, 1 *Mysis* & *Gammarus*, 1 Annelida.
Morecambe.	Apr. 18	4 ,,	4½ – 5 ,,	1 Empty, 2 *Crangon* 1 Fish (Sprat).
Lytham.	May 9	2 ,,	3¼ – 4½ ,,	2 *Crangon*
12 miles W.N.W. from Morecambe Bay Lt. Vessel.	May 11	4 ,,	7½ – 9¾ ,,	4 Empty.
14½ miles W.N.W. ½ W. from Morecambe Bay Lt. V.	May 11	26 ,,	8½ – 10½ ,,	14 Empty, 4 *Pagurus*, 3 *Crangon*, 1 Fish, 3 Amphipoda, 1 Annelida.
Spencer's Spit, Mersey.	May 11	6 ,,	4½ – 7 ,,	1 Animal tissue, 5 Fish.
14 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 14	5 ,,	8½ - 11 ,,	3 Empty, 1 *Ophioglypha*, 1 *Pagurus*.
10 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	15 ,,	9½ – 11 ,,	10 Empty, 2 Annelida, 2 Fish, 1 *Crangon*.
Deposit Buoy.	May 23	7 ,,	4½ – 6½ ,,	1 Empty, 3 *Crangon*, 2 Fish, 1 Amphipoda.
1 mile E. of Newcome Knowl Buoy.	June 8	3 ,,	4½ – 6 ,,	1 Empty, 2 *Crangon*.

Whiting (*Gadus merlangus*).

Burbo Channel.	June 21	4 fish.	6 – 10¼ inch.	2 Empty, 2 *Crangon*.
Crosby Channel.	June 23	13 ,,	4¼ – 8 ,,	13 *Crangon*.
Back of N. Bank.	Aug. 21	7 ,,	3½ – 5 ,,	6 Empty, 1 *Crangon*.
Deposit Buoy.	Sept. 18	13 ,,	4 – 6½ ,,	13 *Crangon*.
Burbo Bank.	Oct. 4	11 ,,	4½ – 5½ ,,	10 Empty, 1 Fish.
Heysham Lake.	Oct. 15	5 ,,	3½ – 4¾ ,,	3 Fish(Sprats), 2 Empty.
Ulverstone Chan.	Oct. 23	4 ,,	4 – 5 ,,	2 Fish(Sprats), 2 Empty.
Between Dingle and Garston.	Dec. 14	8 ,,	3¼ – 8 ,,	8 Empty.
Barrow Channel.	Dec. 17	2 ,,	4 – 3¼ ,,	1 Isopoda, 1 Amphipoda

Of the 761 stomachs examined 143 were empty, 2 contained matter that could not be distinguished, leaving 116 containing recognisable food; these are accounted for in the following notes :—

Crustacea were found in 85 stomachs, or fully 73 % and consisted of the following :—*Crangon, Mysis, Gammarus, Pagurus, Idotea* and *Corophium*.

Fish were found in 27 stomachs, or fully 24 %, these consisted of sprats (*Clupea spratta*) sand-eels (*Ammodytes*).

Annelida were found in 7 stomachs, or nearly 7 %.

Echinoderms were found in 3 stomachs, being fully 2 % and consisted chiefly of *Ophioglypha*.

In last year's report the same order prevails with the exception that the *Echinoderms* are replaced by *Mollusca*.

In the Firth of Forth district, the whiting appear to feed largely on *Fish, Crustacea* being next in point of importance, then *Mollusca* and *Annelida*.

Haddock (*Gadus aeglefinus*).

Off Maughold Hd., Isle of Man.	Mar. 13	4 fish.	6½ – 16 inch.	2 Empty, 2 *Ophioglypha*.
The Hole.	Mar. 14	13 ,,	6½ – 11½ ,,	10 Empty, 2 *Scrobicularia*. 1 *Solen*.

Haddock (*Gadus aeglefinus*).

14 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	4 ,,	7½–15 ,,	2 *Ophioglypha*, 1 *Portunus*, 1 Annelida.
21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	1 ,,	10 ,,	1 *Crangon*.
14½ miles W.N.W. ½ N. from Morecambe BayLt.V.	May 11	2 ,,	16–19 ,,	1 *Corystes*, 1 *Nucula* and *Echinocyamus*.
14 miles N. by W. from Liverpool N.W. Lt. Vessel.	May 14	1 ,,	14 ,,	1 *Ophioglypha* and *Pecten tigrinus*.
10 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	6 ,,	8–14 ,,	4 Empty, 1 *Portunus*, 1 *Pagurus*.
Off Bar Ship.	Sept. 6	9 ,	10–12 ,,	4 *Mactra*, 3 *Scrobicularia*, 1 Annelida, 1 Annelida and *Crangon*.
Off Blackpool.	Sept. 6	12 ,,	13–16 ,,	3 Empty, 2 Annelids, 4 *Mactra*, 1 Annelida and *Ophioglypha*, 1 *Mactra* and *Scrobicularia*, 1 *Philine*.

Of the 52 stomachs examined 19 were empty, the remaining 33 being accounted for in the following notes:—

Mollusca were found in 18 stomachs, or fully 54 %, and consisted of *Mactra*, *Scrobicularia*, *Philine*, *Pecten*, *Nucula* and *Solen*.

Echinoderms were found in 7 stomachs, or fully 21 %, and consisted chiefly of *Ophioglypha*, 1 stomach only containing *Echinocyamus pusillus*.

Annelida were found in 6 stomachs, or fully 18 %.

Crustacea were found in 6 stomachs, fully 18 %, and consisted of *Portunus*, *Corystes*, *Pagurus* and *Crangon*.

Last year's report gives the result of an examination of 37 stomachs from which it will be seen that *Mollusca*, *Crustacea*, *Annelida*, and *Echinoderms* were the chief food, in the order given.

In the Firth of Forth district, the *Crustacea* appear to be the most important food of the haddock, then *Mollusca*, *Echinoderms* and *Annelida* follow in the order named.

Herring (*Clupea harengus*).

Morecambe.	Nov. 29	1 fish.	$4\frac{5}{8}$ inch.	1 Empty.
Deposit Buoy.	Apr. 18	4 ,,	4 - 5 ,,	4 Empty.

Sprat (*Clupea spratta*).

Morecambe.	Nov. 29	2 fish.	$3\frac{1}{4} - 3\frac{3}{4}$ inch.	2 Empty.
Morecambe.	Jan. 4	9 ,,	$3\frac{1}{4} - 4\frac{1}{2}$,,	9 Empty.
Morecambe.	Feb. 21	2 ,,	$4\frac{1}{2} - 4$,,	2 Empty.
Lytham.	Mar. 16	5 ,,	$3\frac{1}{4} - 4\frac{3}{4}$,,	5 *Corophium*.
Blackpool Closed Ground.	Mar. 21	5 ,,	$3\frac{1}{2} - 4\frac{3}{4}$,,	2 Empty, 3 Animal tissue.
Morecambe.	Apr. 5	1 ,,	$3\frac{1}{2}$,,	1 Empty.
Morecambe.	Apr. 5	6 ,,	$3\frac{1}{4} - 4\frac{1}{2}$,,	6 Copepoda (*Acartia, Temora, Centropages*) & Ostracod stage of *Balanus*.
Burbo Channel.	June 21	1 ,,	$4\frac{1}{2}$,,	1 Empty.
Between Dingle & Garston.	Dec. 14	5 ,,	$3\frac{1}{2} - 3\frac{3}{4}$,,	5 Empty.
Barrow Channel.	Dec. 17	2 ,,	$3\frac{1}{2} - 3\frac{3}{4}$,,	2 Empty.

Grey Gurnard (*Trigla gurnardus*).

Off Maughold Hd, Isle of Man.	Mar. 13	5 fish.	7 - 13 inch.	5 Empty.
14 miles W.N.W. $\frac{1}{2}$ W. from Morecambe Bay Lt. V.	Apr. 3	6 ,,	$6\frac{1}{2} - 12$,,	3 Empty, 1 Fish, 2 *Crangon*.
21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	39 ,,	$7\frac{1}{2} - 17$,,	7 Empty, 25 *Crangon*, 6 *Crangon* & Fish (Sand eels), 1 Sand eels.
16 miles W. by N. from Liverpool N.W. Lt. V	Apr. 3	1 ,,	$7\frac{1}{2}$,,	1 *Crangon*.
Deposit Buoy.	Apr. 13	2 ,,	$3\frac{1}{8} - 4\frac{1}{2}$,,	2 *Crangon*.

Grey Gurnard (*Trigla gurnardus*).

Station IV., off Blackpool.	May 10	5 ,,	$9\frac{1}{2}-11\frac{1}{2}$,,	2 Fish, 2 Fish and *Crangon*, 1 *Crangon* and *Mysis*.
12 miles W.N.W. from Morecambe Bay Lt. Vessel.	May 11	9 ,,	$9-10\frac{1}{2}$,,	3 Empty, 2 *Crangon*, 2 Fish, 2 Amphipods.
$14\frac{1}{2}$ miles W.N.W. $\frac{1}{2}$ N. from Morecambe Bay Lt. V.	May 11	5 ,,	$9\frac{1}{2}-11\frac{1}{2}$,,	4 Empty, 1 Fish.
14 miles N. by W. from Liverpool N.W. Lt. V.	May 14	7 ,,	8–10 ,,	2 Empty, 3 *Crangon*, 1 Amphipoda(*Ampelisca*), 1 *Ophioglypha*.
12 miles W. $\frac{1}{2}$ N. from Morecambe Bay Lt. Vessel.	May 17	49 ,,	$6\frac{1}{2}-13$,,	31 Empty, 1 Annelida, 1 *Mysis*, 11 Fish, (Dragonet and Sand eels), 1 Amphipoda, 4 *Crangon*.
Off Bar Ship.	Sept. 6	1 ,,	10 ,,	1 *Crangon*.
Off Blackpool.	Sept. 6	1 ,,	11 ,,	1 *Crangon*.

Of the 130 stomachs examined, 55 were empty, the remaining 75 all contained recognisable food.

Crustacea were found in 55 stomachs, or fully 73 %, and comprised *Crangon*, *Mysis*, *Ampelisca*, and other Amphipods.

Fish were found in 26 stomachs, or fully 34 %.

Echinoderms were found in one stomach only, or a little over 1 %.

Annelida were also found in one stomach only.

In the Firth of Forth district, the same conclusion holds good as to the food of the Grey Gurnard.

Red Gurnard (*Trigla cuculus*).

21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	3 fish.	$12\frac{1}{2}-13\frac{1}{2}$ inch	1 Empty, 1 *Crangon*, 1 *Portunus*.
Off Lytham.	May 9	2 ,,	$13-16\frac{1}{2}$,,	1 Fish, 1 *Hyas coarctatus*.

Red Gurnard (*Trigla cuculus*).

14½ miles W.N.W. ½ N. from Morecambe Bay Lt. V.	May 11	36 fish.	8½ – 15 inch.	12 Empty, 1 *Crangon* & *Portunus*, 2 *Portunus*, 4 *Hyas coarctatus*, 3 *Pagurus*, 7 *Crangon*, 1 Amphipoda and *Hyas*, 1 Amphipoda & *Crangon*, 3 Fish, 1 *Galathea*. 1 Annelida.
14 miles N. by W. from Liverpool N.W. Lt. Vessel.	May 14	3 ,,	7½ – 10 ,,	1 Empty, 2 *Crangon*.
10 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	21 ,,	4½ – 41½ ,,	9 Empty, 1 *Portunus* and *Crangon*, 7 Fish (Dragonet & Sand eels), 1 *Portunus*, 1 *Galathea*, 1 *Galathea* & *Portunus*, 1 *Crangon*.
Off Bar Ship.	Sept. 6	2 ,,	10 ,,	2 *Crangon*.

Of the 67 stomachs examined, 23 were empty, the remaining 44 all contained recognisable food.

Crustacea were found in 32 stomachs, or fully 72 %, and consisted of *Crangon, Portunus, Pagurus, Hyas coarctatus, Galathea,* and *Amphipoda.*

Fish were found in 11 stomachs, or 25 %.

Annelida were found in 1 stomach only, or fully 2 %.

Yellow Gurnard (*Trigla hirundo*).

Spencer's Spit.	May 11	6 fish.	5 inch.	6 *Crangon*.
14 miles W. ½ N. from Morecambe Bay Lt. Vessel.	May 17	4 ,,	16½ – 24 ,,	4 Fish.
Deposit Buoy.	May 23	5 ,,	4½ – 5¾ ,,	1 Empty, 4 *Crangon*.
1 mile E. of Newcome Knowl Buoy.	June 8	3 ,,	4¾ – 6 ,,	2 Empty, 1 Fish.
Burbo Channel.	June 21	2 ,,	7 ,,	2 Empty.

Of the 20 stomachs examined, 5 were empty, the remainder 15 contained recognisable food.

Crustacea were found in 10 stomachs, or 50 %, and consisted of *Crangon* only.

Fish were found in 5 stomachs, or 25 %.

Grey Skate (*Raia batis*).

Blackpool Closed Ground.	Mar. 21	1 fish.	10 inch.	1 *Crangon*.
14 miles W.N.W. ½ W. from Morecambe Bay Lt. V.	Apr. 3	1 ,,	3½ ,,	1 Amphipoda (*Ampelisca*).
16 miles W. by N. from Liverpool N.W. Lt. V.	Apr. 3	1 ,,	14 ,,	1 Empty.
14½ miles W.N.W. ½ N. from Morecambe Bay Lt. V.	May 11	6 ,,	12–26 ,,	2 Empty, 1 Fish, 1 *Pagurus*, 1 *Portunus*, 1 Annelida.
14 miles W. by N. from Liverpool N.W. Lt. V.	May 14	1 ,,	8½ ,,	1 Amphipoda (*Ampelisca*).
Station IV, off Blackpool.	May 16	2 ,,	14 15½ ,,	2 Empty.
Deposit Buoy.	May 23	1 ,,	4 ,,	1 Empty.
1 mile E. of Newcome Knowl Buoy.	June 8	2 ,,	7–7¼ ,,	2 *Crangon*.
Burbo Channel.	June 21	1 ,,	3¼ ,,	1 *Crangon*.
Horse Channel.	Aug. 9	1 ,,	12 ,,	1 *Crangon*.
4 miles West of Blackpool.	Aug. 31	5 ,,	9½–17 ,,	5 *Crangon*.
Off Blackpool.	Sept. 6	4 ,,	11–12 ,,	4 *Crangon*.

Of the 26 stomachs examined, 6 were empty, the remainder contained recognisable food.

Crustacea were found in 18 stomachs, or 90 %, and consisted of *Crangon*, *Portunus*, *Pagurus*, and *Ampelisca*.

Fish were found in 1 stomach only, or 5 %.

Annelida were also found in 1 stomach, or 5 %.

Thornback Skate (*Raia clavata*).

Blackpool Closed Ground.	Mar. 21	2 fish.	8–9¼ inch.	2 *Crangon*.
Off Manghold Hd., Isle of Man.	Mar. 31	1 ,,	27 ,,	1 Empty.
14 miles W.N.W. ½ W. from Morecambe Bay Lt. V.	Apr. 3	1 ,,	11 ,,	1 *Crangon* and Fish (Sand eel).

Thornback Skate (*Raia clavata*).

21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	5	,,	$7\frac{1}{2}-13\frac{1}{2}$	,,	1 Empty, 1 *Galathea*, 1 *Crangon*, 2 common shore Crabs and Fish (Sand Eel).
16 miles W. by N. from Liverpool N.W. Lt. Vessel.	Apr. 3	1	,,	$7\frac{1}{2}$	,,	1 *Crangon*.
Lytham.	May 9	2	,,	$14\frac{1}{2}-17$	,,	1 Fish, 1 *Pagurus*.
Station IV, off Blackpool.	May 10	6	,,	$13-20\frac{1}{2}$	,,	1 *Crangon* and *Solen*, 5 *Portunus* and *Solen*.
$14\frac{1}{2}$ miles W.N.W. $\frac{1}{2}$ N. from Morecambe Bay Lt. V.	May 11	3	,,	$17-20$	,,	2 *Portunus*, 1 Empty.
14 miles N. by W. from Liverpool N.W. Lt. V.	May 14	3	,,	$8\frac{1}{2}-21$	,,	2 *Crangon*, 1 Fish, *Hyas* and *Pagurus*.
14 miles W. $\frac{1}{2}$ N. from Morecambe Bay Lt. Vessel.	May 17	4	,,	$6\frac{1}{2}-25$	,,	1 *Pagurus*, 1 *Nephrops*, 1 *Portunus*, 1 *Crangon*, and Amphipoda.
Deposit Buoy.	May 23	4	,,	3	,,	3 *Crangon*, 1 Empty.
1 mile E. of Newcome Knowl Buoy.	June 8	4	,,	$3\frac{1}{2}-4$	,,	4 *Crangon*.
Burbo Channel.	June 21	3	,,	$4-4\frac{3}{4}$	,,	3 *Crangon*.
Back of N. Bank.	Aug. 21	2	,,	$5\frac{1}{2}-6$	,,	2 *Crangon*.
Off Blackpool.	Sept. 6	1	,,	25	,,	1 *Portunus*, *Pagurus*, and *Crangon*.

Of the 42 stomachs examined, 4 were empty, the remaining 38 all contained recognisable food.

Crustacea were found in 36 stomachs, or fully 97 %, and consisted of *Crangon*, *Galathea*, *Portunus*, *Pagurus*, *Hyas*, *Nephrops*, *Carcinus*, and Amphipoda.

Mollusca were found in 6 stomachs, or nearly 16 %, and consisted of *Solen*.

Fish were found in 4 stomachs only, or 10 %.

Sandy Ray (*Raia maculata*).

21 miles W.N.W. from Morecambe Bay Lt. Vessel.	Apr. 3	1 fish.		$5\frac{1}{2}$	inch.	1 *Crangon*.
Burbo Bank.	Oct. 4	2	,,	$6\frac{1}{2}-7$	,,	2 *Crangon*.

Cuckoo Ray (*Raia circularis*).

14½ miles W.N.W. ½ N. from Morecambe Bay Lt. V.	May 11	5 fish.	6 – 14 inch.	2 Empty, 1 Fish, 2 Amphipods (*Ampelisca*).
1 mile E. of Newcome Knowl Buoy.	June 8	1 ,,	4½ ,,	1 *Crangon*.
Back of N. Bank.	Aug. 21	1 ,,	6 ,,	1 *Crangon* and *Mysis*.

The chief food of the various species of Skate seems to be *Crustacea* and a few fish.

In the Firth of Forth district the same order prevails.

Sand Eel (*Ammodytes lanceolatus*).

Blackpool Closed Ground.	Mar. 21	3 fish.	4¾ – 6¼ inch.	3 Empty.
Deposit Buoy.	Apr. 18	2 ,,	8 – 9½ ,,	2 Fish.
Burbo Channel.	June 21	1 ,,	9 ,,	1 Empty.

General Conclusions as to Food of Fishes.

On the whole, the results given in the above tables bear out the conclusions arrived at in last year's Report. Although we shall go on with the examination of the stomachs of fish as opportunity offers, it will probably not be necessary to publish the detailed evidence in future reports; we shall, therefore, in future give merely a summary of the results, unless some unexpected and novel facts turn up.

As to the practical application of the knowledge acquired:—

1st. It is of importance, as it enables us to ascertain the characters of feeding grounds, so that we may know whether a particular bay, bank, or tract of off-shore ground is better fitted for one fish or another.

2nd. It has a practical application in determining whether the destruction of particular classes of

invertebrates, *e.g.*, by a heavy trawl, has or has not an injurious effect upon certain fishes.

3rd. When the time comes, as it probably will, when it will be cheaper and surer to farm fish than to hunt them, when fish are bred, reared, and fed up for market, then fish food will have to be accurately ascertained and carefully cultivated, and all such statistics as those we are now accumulating will be of value and receive their proper application.

The Distribution of Immature and other Fish.

As already stated in the introduction, we have gone carefully over Mr. Dawson's statistics of the fish caught in the district during the year, and we now give some of the more important points which can be made out regarding the distribution of immature and other fish.

Owing to the steamer having been largely engaged in police work during the past year, there has not been so much opportunity for trawling over the areas for which we have given statistics in former reports, but what has been done confirms, to a great extent, the figures already given.

A continuation of the experimental trawlings on the Blackpool closed ground seems to show that the number of small fish that frequent this nursery is steadily increasing, and thus fully justifies the closing of this area against trawling, and we have no doubt whatever that if some other parts of the district were dealt with similarly the result would be equally satisfactory. Let us take, for example, the Mersey. From the middle of October till about the end of December, there are great numbers of young fish in the river between the Dingle and Garston, chiefly Plaice and Dab, $2\frac{1}{4}$ inches and upwards,

very few of them exceeding 9 or 11 inches in length, and as the ground is frequently trawled over both with shrimp and ordinary trawls, the destruction of small fish is very great. After the middle of December the fish begin to leave this part of the Mersey and come down to the banks off Crosby and Formby. These banks are then in their turn continually trawled over, so that the destruction goes on for a large part of the year. If it is not possible to apply to this part of the district the same thorough measure which has been applied to Blackpool, and entirely prohibit trawling in any form, a close time, which would take effect when the greatest number of fish are present on the respective areas, would be very useful, such as that the upper parts of the Mersey be closed against trawling from the beginning of October till the end of December, and that the lower parts be closed from January till some time in summer. There seems to be especially heavy destruction in July, August, and September around Burbo Bank and near the deposit ground. The experiment might be tried for a couple of years to ascertain what amount of beneficial effect would result from a partial closure, statistics being collected weekly or monthly. So long as no artificial hatching is done in the district, it is only by a most careful protection of the natural rearing grounds of the young fish that the quality and quantity of the larger fish on the various fishing grounds around our coasts can be maintained. As to the necessity of supplementing these restrictive measures by hatching, and so adding to the supplies in the sea, that is discussed elsewhere (see p. 33).

In the following list we give the average number of fish caught on the Blackpool closed ground during the year, and for the sake of comparison we also give the figures for the previous year from the last Report :—

1892.	December	2471	1893.	December	20889*
1893.	January	134	1894.	January	8512*
	February	1199		February	4729*
	March	638		March	3896
	April	302		April	1688*
	May	101		May	802
	June	122		June	1440
	July	385		July	1204
	August	437		August	3362*
	September	14892		September	—
	October	—		October	—
	November	2536		November	10810

The figures marked thus * are single hauls only, and in the months left blank the pressure of police work prevented any experimental hauls being taken. Taking the results of 1894 as a whole it will be seen that there is a marked increase on the number caught during the former year, and they also bear out the remarks made in last Report as to the months in which the greatest and smallest number of fish are present on this ground. It appears from the figures now before us that the number of fish on this particular part of the district reaches its maximum in December, and then gradually goes down till the month of May, after that it begins to increase, and goes on increasing till it again reaches the maximum.

As in last year's Report we again give a comparison between the numbers of fish taken on the Blackpool ground and those taken in Morecambe Bay, the estuary of the Mersey, and in the Ribble estuary, the areas included in these districts being the same as those given in the Report for 1893 at page 30.

Each column contains the *average* number of fish caught with the shrimp trawl, the figures marked * being single hauls only.

		Mersey.	Ribble.	Blackpool.	Morecambe.
1893.	December	593	—	20889*	231
1894.	January	507	1950	8512*	131

1894.	February	492	—	4729*	197
	March	871	—	3896	220*
	April	378	—	1688*	91
	May	828	—	302	186
	June	686	—	1440	57
	July	1186	—	1204	1533
	August	3149	—	3362*	2250
	September	2118	—	—	2200
	October	1331	—	—	2350
	November	—	—	10810	2150

These columns also bear out the remarks made in last year's Report as to the time when the fish seem to reach the maximum and minimum limits.

Vitality Experiments.

The following are the vitality experiments which have been made during the year by Mr. Dawson on board the steamer :—

I. December 28th, 1893. Put in tank from Blackpool closed ground—

38 Soles, 3 inches in length,
15 Plaice, from $1\frac{1}{2}$ to 7 inches in length,
4 Dabs, from $1\frac{1}{2}$ to 3 inches in length,

After being in tank $3\frac{1}{4}$ hours—

1 Plaice, $1\frac{1}{2}$ inches long, and 1 Dab, 2 inches long, were dead, the remainder were very lively.

II. March 8th, 1894. Blackpool closed ground—

2 Soles, 3 inches in length,
6 Plaice, 3 to $7\frac{1}{2}$ inches in length,
4 Dabs, $3\frac{1}{2}$ to $7\frac{1}{2}$ inches in length,

After being in tank 2 hours and 5 minutes, all the fish were alive.

III. March 19th, 1894. Blackpool closed ground—

12 Plaice, 2 to 6 inches in length,
12 Dabs, 4 to 6 inches in length,

4 Codling, 4 to 5 inches in length,

All the fish appeared lively with the exception of 2 Plaice, 2 inches in length, and 2 Codling, 4 inches in length, which appeared deadly.

After being in tank 5 hours and 10 minutes, all the fish were alive (very lively).

IV. March 23rd, 1894. Shrimping ground, near Deposit Buoy, Mersey—

13 Soles, $3\frac{1}{4}$ to 7 inches in length,
6 Plaice, $2\frac{1}{2}$ to 6 inches in length,
2 Whiting, 6 inches in length,

The fish had been lying on the deck and in the sun for 8 minutes before being put in the tank. Flat fish appeared lively and the round fish deadly. One of the Soles was left amongst the other fish and debris in the basket for 20 minutes before being put in the tank among the others.

After being in tank 2 hours, one of the Whiting was dead owing to an injury received to the air-bladder; the remainder were lively, and were returned to the sea.

V. March 23rd, 1894. Shrimping ground, near Deposit Buoy, Mersey—

12 Plaice, $2\frac{1}{2}$ to 5 inches in length,
12 Dabs, 4 to 5 inches in length,
6 Soles, $3\frac{1}{4}$ to $4\frac{1}{2}$ inches in length,

All the fish had been lying in a basket in the sun for 20 minutes before being put in the tank.

After being in the tank for $1\frac{1}{2}$ hours all the fish were lively.

VI. April 2nd, 1894. Blackpool closed ground—

12 Plaice, $2\frac{1}{2}$ to 7 inches in length,
12 Soles, 3 to $5\frac{1}{2}$ inches in length,

These fish had been left lying in a heap in a basket

amongst other fish for ½ an hour before being put in the tank and for the most part appeared deadly.

At the end of three hours all the fish with the exception of three Soles were alive, but two of these had been killed by being jammed in the discharge pipe.

VII. April 6th, 1894. Deposit ground, Mersey—
12 Plaice, 5 inches long,
12 Dabs, 5 inches long,
6 Soles, 4½ inches long,
6 Whiting, 6 inches long.

A number of the fish appeared deadly when put in the tank. After being in the tank 5 hours all the fish with the exception of 1 Whiting were very lively.

VIII. April 30th, 1894. Off Jumbo Buoy, Southport entrance—
12 Plaice, 4 to 6 inches long,
8 Dabs, 4 to 6 inches long,
1 Sole, 7 inches long,

After being in the tank 2 hours all the fish were lively.

IX. May 1st, 1894. Near Jumbo Buoy—
12 Plaice, 6 inches long,
12 Dabs, 7 inches long,

After being in the tank 2½ hours all the fish with the exception of one Dab were lively.

X. May 11th, 1894. 12½ miles W.N.W. from Morecambe Bay light vessel—

At 7 p.m. (Friday) put 4 Soles 9 to 15 inches long into the tank and another Sole from the next haul. At 12 midnight transferred the Soles from tank into a tub having a number of holes bored

in it, then put tub overboard in Douglas Harbour.

At 9.30 a.m. (Saturday morning) all the fish were alive and very lively, but at 8.30 in the evening 2 were dead and at 8 a.m. on Sunday morning only one remained alive, the others having died. During the time the tub had been in the water it had been constantly oscillating.

XI. May 14th, 1894. 10 miles W.$\frac{1}{2}$N. from Morecambe Bay light vessel—

At 9.45 a.m. put 6 Soles, 10 to 16 inches, into the tank. 9 more were added at 12.45 p m. and 3 p.m.

At 6 p.m. the circulation had to be stopped owing to the steamer going into fresh water, the soles being then all alive and very lively.

XII. May 16th, 1894. Blackpool closed ground—

12 Soles, $3\frac{1}{2}$ to 5 inches long,
5 Plaice, $2\frac{1}{2}$ to 5 inches long,
6 Dab $3\frac{1}{2}$ to 5 inches long,

After being in tank $8\frac{1}{2}$ hours all the fish were alive.

These experiments lead to the same conclusion as those we reported upon last year, viz., that under ordinary circumstances the great majority of the fish taken would survive if returned at once to the sea. Ground-frequenting fish of sedentary habits probably stand exposure best, and soles seem to be especially hardy in this respect. The practical application of these experiments is that it is well worth while taking some trouble to ensure that all undersized fish brought up in the trawl should be returned to the sea as quickly as possible.

Fish Culture and Hatching.

This northern area of the Irish Sea, in the centre of which the Isle of Man lies, and which contains our Lan-

cashire Sea-Fisheries district, is itself one large natural sea-fish area, with its own spawning grounds, nurseries, and feeding grounds, independent, so far as 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. Consequently it is most unfortunate that our national and international laws are such that the area cannot be treated as a compact whole each part of which is of importance in the interests of the fishing industries. 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.* The three mile limit whatever it may be from the point of view of national defence and international arrangement, is an absurdity from the fishery point of view, and all efforts to improve the fisheries in a district like ours are severely handicapped by the fact that the fish, their enemies, their food, and their captors can so readily pass beyond the range of all regulations. We can do a good deal, it is true, by preventing the destruction of young fishes in the shallow waters round the coast, but we cannot do nearly as much as is desirable so long as no protection can be afforded to the fish when spawning on the offshore grounds.

Excepting such a case as the Herring, a migrating fish with demersal eggs, the life history of one of our typical food fishes is probably much as follows:—During the greater part of the year the adult fish moves from place to place throughout the district, being influenced in its

wanderings chiefly by the search for food. As a general rule the Sole, for example, is feeding in winter in the deeper waters of the offshore grounds, while in spring the smaller ones at least come in again to the shallower water off the banks. At the spawning season, in the case of the Sole from May to July, the large fish go away from land and congregate on the spawning grounds which in this district (as was pointed out in last year's report) are tracts of deeper water, 20 to 25 fathoms, lying off the east of the Isle of Man, or in the central part of the Irish Sea. There the ova are extruded and fertilized, and then rise as young embryos to near the surface of the sea. They are now at the mercy of the winds and waves, they are carried in various directions (see section on surface currents, p. 51), and are exposed to the attacks of innumerable enemies, including most of the animals which live around them in the sea and even their fellow fish. Those that survive are gradually carried by tidal currents into the shallower waters round the coast, and here the young fish, which have now passed through their embryonic and larval stages, leave off their pelagic mode of existence and take to bottom feeding. It is at this stage that they make their appearance (in April, May, and onwards in the summer) in the fish nurseries round our shallow sandy coasts, and there they live and grow, with occasional wanderings determined by season and food, until they reach the adult condition. In the warmest part of summer they are frequently found moving up the estuaries (in August, September and October this year Plaice and Haddock have apparently been present in great abundance off the Ribble estuary), and then with the first cold weather they move out of the estuaries to the banks.

Consequently it is evident that the supply of the inshore nurseries depends upon the preservation of the offshore

spawning grounds. If then, it is impossible at present to take any steps for the protection of the old fish when spawning, can anything be done to ensure a more abundant supply of larval fishes to stock our bays? The only help, in addition to protection, that can be given by man to the fish-population of an area is by artificial fish culture and hatching. On account of the enormous numbers of ova which food fish produce it is possible for man, by stepping in and saving even a minute fractional per-centage from the destruction which normally takes place, to increase very largely the number of young in a given area of the coast waters.

These considerations shew the importance of sea-fish hatching, and in an area like the Irish Sea there ought to be, and one can scarcely doubt but that there will soon be, a central fish hatching and rearing establishment in some convenient spot where the water is the purest obtainable and as free as possible from all suspended matters. Such a hatchery should not be for the benefit of Lancashire alone, nor of Cheshire, nor of the Isle of Man. The locality ought to be chosen on the merits of its physical conditions alone, apart from any ideas of County boundaries and limits of jurisdiction of local authorities. In a previous report, Port Erin at the S.W. corner of the Isle of Man was recommended for this purpose, solely because of the known purity and clearness of the sea water on that rocky coast, because of the proximity to the spawning grounds of the most esteemed fish, and because of the presence of the Biological Station at Port Erin from which assistance and advice might readily be obtained in regard to many of the difficulties which would probably turn up during the first few years of working. Spawning fish could be obtained in the season either from the trawlers at Port Erin or from the

"John Fell," and the fry when hatched could be conveyed to any selected spots on the coasts of Lancashire, Cheshire, or North Wales and set free on suitable ground.

Port Erin is probably not the only suitable spot for a hatchery in the district, but it is the one where the physical conditions are best known. There may be other places on the coast of the Isle of Man, or in North Wales, possibly even in Cumberland, which are equally suitable for the establishment of a hatchery, but they have still to be investigated. Port Erin and its water, the temperatures and specific gravities, the fauna and flora, and all the surrounding conditions are pretty well known to us. In regard to the other coasts of our district, Cheshire and Lancashire, the shallow waters around them although apparently admirably suited as nurseries for fish in somewhat older stages, are so exceedingly muddy that it would be a very difficult and probably expensive matter to render them sufficiently free from all suspended particles as to be fit for hatching purposes. The elaborate precautions that have to be taken even at Dunbar in order that the water may be sufficiently filtered bring forcibly before one the inestimable advantage of having a pure supply of water to begin with.

We have paid some attention lately to the water around Piel Island, in the Barrow Channel, as that spot has been proposed as the site of a hatchery for Lancashire. On two special visits, along with Mr. Dawson and others, in the Fisheries Steamer, the specific gravity, temperature, and living contents of the water were examined, and since then some samples of water taken by the bailiff at Piel have been sent to the Laboratory for examination. On June 5th, 1894, the specific gravity in different parts of the Channel from Barrow to Piel Island varied from 1·026 to 1·027, the temperature of the bottom water was 54° F.,

and the tow-nets showed plenty of ordinary surface forms, both diatoms and animals, medusoids being especially abundant. All this is satisfactory enough, and the water sent to the laboratory by the bailiff has been of good quality, although the sp. gr. has been only about 1·022. In looking at the sea off Piel Island however the water is seen to contain much fine suspended matter, this is especially the case when one examines it close to shore from a small boat, and when wading along the edge at low tide. No doubt it would be *possible* to filter such water, but the process would, judging from what has been done at Dunbar, be troublesome and expensive and any temporary breakdown in the filtering arrangements would be fatal. It is giving the experiment—for the first year of working of a sea-fish hatchery in a new district must be more or less experimental—a poorer chance of success to handicap it with water which is not the cleanest obtainable in the Irish Sea.

Although at the time when the specific gravity was taken, off Piel Island, on June 5th, the salinity of the water was perfectly satisfactory, still it was much lower when tested in November and December and there is some reason to doubt—judging from the great variations in the specific gravity observed in places off the Lancashire coast (*e.g.*, in Crosby Channel our statistics range from 1·018 to 1·026)—whether it would remain sufficiently constant for hatching purposes. In one of his earlier reports on sea-fish hatching in Norway, Captain Dannevig complains of the large proportion of deaths due to variations in the specific gravity, and furthermore we notice that during the remarkably successful first season's work at Dunbar last year, when about 27 millions of young plaice and half-a-million of young cod were hatched out and set free on the Scottish fishing grounds, with a loss

of only 4·4 per cent, the water supplied to the hatchery was almost invariably at the normal specific gravity 1·0270, only once sinking to 1·0264.

In the event of the salinity at Piel remaining fairly constant, and provided that the water can be successfully filtered, a hatchery placed there would in all probability be a success, and the same might be said of Hoylake which has also been suggested as a site for a hatchery, but in both cases the initial difficulty, the muddiness of the water, has still to be overcome. Hence we are led to the conclusion that in place of a hatchery for Lancashire being established at Piel Island and one for Cheshire at Hoylake it would be much better if the various County Councils and Fishery Boards* having jurisdiction over the territorial waters of the Irish sea could see their way to unite in promoting a fish hatchery at Port Erin for the benefit of the entire area.

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: viz., 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-Fishery 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.

* A measure has passed the House of Keys and has lately been promulgated conferring powers to make fishery bye-laws and other regulations upon a Committee in the Isle of Man.

SHELL-FISH.

I. Mussels.

During the year 523 mussels (*Mytilus edulis*) have been examined with the view of finding out the time of spawning and also the food of this important shell-fish. So far the result of this examination seems to show that the food of the mussel consists of Diatoms, Spores of Algæ, Vegetable debris, Foraminifera, and remains of Copepoda, all of which are no doubt brought within reach of the mussel's ciliary currents by the motion of the surrounding sea water; the variety in the food will therefore depend to a very large extent upon what is the general fauna of the mussel bed. As the food is, however, comparatively well known now, our attention was more especially directed to the determination of the spawning period, and as far as the year's results go they appear to show that the mussel reaches maturity about the middle of May, and that the spawning period lasts to the middle of July. There seem to be a few exceptional cases, but the majority of the mussels on the Lancashire coast have probably finished spawning by the time stated.

In a report in 1886 by Mr. John Wilson, B.Sc., on the development of the common mussel, published in the appendix to the Fourth Annual Report of the Fishery Board for Scotland, p. 218, it is stated that "Professor M'Intosh found that in general the mussels reached full reproductive maturity in April; thereafter the ova and spermatozoa gradually disappeared from the mantle, until in July those he examined were spent."

The following list gives the results of the examination of the samples sent to us.

Morecambe.	Jan. 24	11 fish.	2 – 2¼ inch.	3 female, 8 male } nearly ripe.	4 Empty, 7 Spores, Diatoms and Vegetable debris.

Fleetwood.	Jan. 27	13 ,,	$2\frac{1}{2}-2\frac{7}{8}$,	9 female, 4 male } almost ripe.	4 Empty, 9 Spores, Diatoms and Vegetable debris.
St. Anne's, lower Scar.	Feb. 1	2 ,,	$3\frac{1}{8}-3\frac{1}{4}$,,	1 female, 1 male } almost ripe.	2 Spores, Diatoms and Vegetable debris.
St. Anne's, Lighthouse Scar.	Feb. 1	12 ,,	$1\frac{5}{8}-2$,,	4 female, 8 male } almost ripe.	12 Spores, Diatoms and Vegetable debris.
Lytham, Church Scar.	Feb. 1	16 ,,	$1\frac{1}{8}-2\frac{3}{8}$,,	8 female, 8 male } almost ripe.	16 Spores, Diatoms and Vegetable debris.
Morecambe.	Feb. 2	8 ,,	$2-2\frac{1}{4}$,,	3 female, 5 male } nearly ripe.	8 Empty.
Morecambe.	Mar. 22	14 ,,	$2-2\frac{3}{4}$,,	6 female, 8 male } immature.	14 A little mud.
Grange over Sands Humphrey Head.	Apr. 10	12 ,,	$2\frac{1}{2}-3\frac{1}{8}$,,	12 male, immature.	6 Empty, 6 Spores, Diatoms and Vegetable debris.
Lytham; 1 mile below St. Anne's.	Apr. 10	7 ,,	$3-8\frac{1}{2}$,,	4 female, 3 male } about $\frac{1}{2}$ mature.	7 Spores.
Morecambe.	Apr. 11	12 ,,	$2-2\frac{3}{8}$,,	6 female, 6 male } immature.	7 Empty, 5 sand and Vegetable debris.
Morecambe, Heysham Scars.	Apr. 11	11 ,,	$2-2\frac{1}{2}$,,	7 female, 4 male } immature.	11 Empty.
Lytham St. Anne's.	Apr. 18	6 ,,	$3\frac{1}{4}$,,	5 female, 1 male } about $\frac{1}{2}$ mature.	6 Spores and Vegetable debris.
Lytham, near Pier.	Apr. 18	10 ,,	$2-2\frac{1}{2}$,,	5 female, ova ·07 m. 5 male sperms moving.	10 Spores and Vegetable debris.
Roe Island.	May 1	12 ,,	$1\frac{7}{8}-2\frac{1}{2}$,,	5 female ova ·06-07m. 7 male, sperms not moving.	7 Empty, 5 Spores, Diatoms and Vegetable debris.
Lytham. 2 yrs. old from St. Anne's beds.	May 3	12 ,,	$2\frac{1}{4}-2\frac{1}{8}$,,	10 female, ova ·07 m. 2 male sperms moving.	2 Empty, 10 Spores and Vegetable debris.
Lytham, Church Scar.	May 10	8 ,,	$2-2\frac{1}{2}$,,	2 female, ova ·07 m. 6 male, sperms not moving.	8 Mud and Diatoms.
Lytham, Formby Scar.	May 22	7 ,,	$2\frac{1}{4}-2\frac{1}{2}$,,	3 female, ova ·09 m. 4 male, sperms not moving.	3 Empty, 4 a little mud.
Roe Island.	May 24	12 ,,	$2\frac{1}{8}-2\frac{3}{8}$,,	7 female, ova ·09 5 male sperms moving.	11 Empty, 1 sand and Vegetable debris.

Grange over Sands	May 21	12	,,	1 - $1\frac{1}{8}$	,,	4 female, ova ·1 m. 8 male, sperms not moving.	12 Empty.
Grange over Sands Humphrey Head.	May 28	12	,,	2 - $2\frac{3}{4}$	,,	9 female, ova ·07-·1m. 3 male, sperms not moving.	7 Empty, 5 Spores and Vegetable debris.
Lytham.	May 30	12	,,	$2\frac{1}{8}$ - $2\frac{1}{4}$	,,	5 female, ova ·09 m. 7 male, sperms not moving.	12 Empty.
Lytham, Horse Bank.	June 6	14	,,	$1\frac{1}{4}$ - $1\frac{3}{8}$	,,	5 female, ova ·09 m. 9 male, sperms not moving.	14 Empty.
Grange over Sands Waded Scar.	June 11	12	fish.	$1\frac{3}{4}$ - 2	,,	4 female, ova ·09 m. 8 male, sperms not moving.	12 Empty.
Duddon Channel.	June 21	8	,,	2 - $2\frac{1}{2}$	,,	4 female, ova ·1 m. 4 male, sperms not moving.	8 Empty.
Roe Island, Rusebeck Scars.	June 21	12	,,	2	,,	12 male, sperms not moving.	12 Empty.
Lytham, St. Anne's Mussel beds.	July 5	12	,,	$2\frac{3}{4}$ - 3	,,	12 ? spent.	12 Empty.
Barrow Channel.	July 18	12	,,	2	,,	12 male sperms moving	12 Empty.
Lytham, St. Anne's beds.	July 19	16	,,	$2\frac{1}{2}$ - $3\frac{1}{4}$	,,	16 ? spent.	16 Empty.
Grange over Sands Humphrey Head.	July 23	7	,,	$1\frac{3}{4}$ - $2\frac{1}{4}$	,,	7 ? spent.	7 Empty.
Lytham, St. Anne's beds.	July 24	10	,,	$2\frac{1}{2}$ - $2\frac{5}{8}$	,,	10 ? spent.	10 Empty.
Duddon Channel	July 31	10	,,	2 - $2\frac{1}{2}$	,,	3 female, ova ·07 m. 7 male, sperms not moving.	10 Empty.
Roe Island, Rusebeck outer Scar.	Aug. 6	10	,,	2 - $2\frac{1}{2}$	,,	10 ? spent.	10 Empty.
Grange over Sands Ulverstone Bridge	Aug. 7	8	,,	$1\frac{1}{4}$ - $1\frac{5}{8}$	,,	4 female, ova ·12 m. 4 male ?	8 Empty.
Lytham, St. Anne's beds.	Aug. 7	12	,,	$2\frac{1}{4}$ - $2\frac{1}{2}$	,,	12 spent.	12 Empty.
Grange over Sands Humphrey Head.	Aug. 13	12	,,	2 - $2\frac{1}{2}$	,,	12 spent.	1 Empty, 11 Vegetable debris & sand
Roe Island, Ruesbeck Scar.	Aug. 28	12	,,	2 - $2\frac{1}{2}$	,,	12 spent.	12 Sand, Diatoms and mud.

Duddon Sands.	Sept. 18	10 ,,	$2\frac{3}{4}-2\frac{1}{2}$,,	10 spent.	10 Empty.
Roe Island, Waded Scar.	Sept. 19	7 ,,	$2\frac{1}{4}$,,	7 spent.	1 A little mud. 6 Empty.
Baicliff, West Hollow.	Sept. 25	9 ,,	$2\frac{1}{4}$ $2\frac{5}{8}$,,	9 spent.	1 Empty, 8 Sand and spores.
Grange over Sands Humphrey Head.	Oct. 2	11 ,,	$2-2\frac{1}{4}$,,	11 spent.	9 Empty, 2 Vegetable debris.
Ulverstone Channel, West Hollow.	Oct. 11	12 ,,	$2\frac{1}{2}-2\frac{3}{4}$,,	12 spent.	7 Empty, 5 Vegetable debris.
Barrow Channel.	Oct. 15	7 ,,	$2\frac{1}{4}-2\frac{1}{2}$,,	7 immature.	7 Empty.
Grange over Sands	Oct. 16	12 ,	$2\frac{1}{8}-2\frac{5}{8}$,,	3 female, 1 male } very immature.	12 Empty.
Grange over Sands Humphrey Head.	Oct. 30	12 ,,	$1\frac{1}{2}-2\frac{1}{4}$,,	1 female, ova ·12 m. 11 immature.	10 Empty, 2 Vegetable debris.
Roe Island, Rusebuck Scar.	Oct. 30	10 ,.	$2\frac{1}{8}-2\frac{7}{8}$,,	3 female, ova ·1 m. 7 immature.	4 Empty, 6 Vegetable debris.
Grange over Sands Waded Scar.	Nov. 5	12 ,,	$2-2\frac{1}{2}$,,	4 female, ova ·1 m. 8 immature.	10 Empty, 2 Vegetable debris.
Morecambe Channel, deep water.	Nov. 13	12 ,,	$1\frac{1}{2}-2\frac{1}{2}$,,	9 female, ova ·1 m. 3 immature.	11 Empty, 1 Vegetable debris.
Barrow Docks.	Nov. 20	8 ,,	$2\frac{1}{4}-3$,,	2 female, 1 male, 5 ? } all immature.	8 Empty.
Humphrey Head.	Dec. 4	13 ,,	$1\frac{1}{2}-2\frac{1}{2}$,,	8 female, 5 male } immature.	Sand, mud and Vegetable debris.

Our mussel fisheries, valuable as they are, might, we have no doubt, be made still more valuable by the introduction of some artificial cultivation. Our coast waters are well supplied at present with mussel seed (the free-swiming embryos), they are found year after year settling down on all sorts of suitable and unsuitable submerged objects, and many millions of them every year perish miserably for want of a little looking after. As was recommended in last year's report, simple stakes (bouchots without wattling) should be erected in likely spots, not for the purpose of taking the place of the beds—which are probably better suited on the whole to our local conditions than the

complete bouchot system would be—but to aid them, to rescue from destruction the minute mussel fry in order that they may be later on stripped off and bedded out.

The number of our mussel beds might so be largely increased, and it ought to be remembered that these mussel beds are not valuable merely because of the mussels they produce, but also because of the effect which they have upon other fisheries by enriching the waters with numerous larval and other minute forms of life. Mussel beds become centres of attraction to numerous other invertebrates producing swarms of living things which are most valuable as food for young fishes, as well as for the mussels on the bed.

II. Cockles.

529 cockles (*Cardium edule*) have been examined in the Laboratory during the past year in order to find out the food and times of spawning of this important shell-fish.

As was stated in the first report, (1892) the stomachs of a very large proportion of the individuals are always empty, and this seems to be the case throughout the year. It is difficult to give an opinion as to the reason for this, as it can scarcely be due to digestion after capture, seeing that mussels collected at the same time and sent to the Laboratory along with the cockles frequently contain food. Possibly a further examination of the cockles made at the moment of collecting may throw some light on the matter; it will be kept in view during the ensuing year.

In regard to the spawning time of the cockle it is difficult to give a definite period as we find them sexually mature nearly all the year round. Towards the latter part of the year measurements were made of the ovarian ova; and the inside of the shell and mantle cavity were carefully washed out before opening the animal so as to

find out whether or not there were any ova free in the cavity between the mantle and the body. The sizes of the ova are given in the accompanying lists; we usually found a few of the ova free in the mantle cavity when the specimen under examination was a female and when the ovarian ova were at or about maturity.

Grange over Sands	Feb. 7	12 fish.	1 – 1⅛ ,,	6 female, nearly ripe. 6 male, nearly ripe.	12 Empty.
Grange over Sands Grange Banks.	Apr. 10	12 ,,	1⅛ – 1¼ ,,	10 female 2 male } immature	12 Empty.
LythamNorth side of Horse Bank.	Apr. 10	11 ,,	⅞ – 1 ,,	7 female 4 male } about ½ mature.	11 Spores, etc.
Morecambe.	Apr. 11	10 ,,	1¼ – 1½ ,,	4 female 6 male } immature.	10 Vegetable debris.
Baicliff Sands.	Apr. 17	23 ,,	1 – 1⅜ ,,	13 female 10 male } about ½ mature.	23 Empty.
Morecambe.	Apr. 18	12 ,,	1⅛ – 1¼ ,,	8 female 4 male } about ½ mature.	12 Empty.
Lytham, Horse Bank.	Apr. 18	8 ,,	⅞ – 1 ,,	5 female 3 male } about ½ mature.	8 Vegetable debris
Lytham.	Apr. 25	12 ,,	1 – 1⅛ ,,	8 female ova ·07-·12m. 4 male sperms moving.	12 Sand and Vegetable debris.
Leasowe Shore.	May 3	13 ,,	1 – 1⅜ ,,	7 female, ova ·1-·12m. 6 male sperms moving.	8 Empty, 4 Sand and Vegetable debris.
Duddon Sands.	May 7	14 ,,	1⅛ – 1⅜ ,,	8 female, ova ·1 m. 6 male, sperms not moving.	14 Empty.
Lytham, Horse Bank.	May 9	15 ,,	1 ,,	10 female, ova ·1 m. 5 male, sperms not moving.	15 Empty.
Lytham, Horse Bank.	May 23	12 ,,	1 ,,	7 female, ova ·09-1m. 5 male, sperms not moving.	12 Vegetable debris.
Lytham, Salthouse Bank.	May 23	12 ,,	1¼ ,,	7 female, ova ·1 m. 5 male, sperms not moving.	12 Vegetable debris.
Grange over Sands	May 21	12 ,,	1 – 1⅓ ,	4 female, ova ·1 m. 8 male, sperms not moving.	12 Sand only.

Rusebeck Sands.	May 28	12 ,,	1 – 1⅛ ,,	6 female ova ·1-·14 m. 6 male, sperms not moving.	12 Empty.
Grange over Sands Humphrey Head.	May 28	10 ,,	1 – 1⅛ ,,	4 female, ova ·14 m. 6 male sperms moving.	10 Empty.
Lytham.	May 30	12 ,,	1⅛ – 1¼ ,,	8 female ova ·15-·17m. 4 male, sperms not moving.	12 Empty.
Baicliff Cockle Beds.	June 6	12 ,,	1¼ ,,	5 female, ova ·15 m. 7 male, sperms not moving.	12 Empty.
Grange over Sands Bardsea Bank.	June 11	12 ,,	1⅛ ,,	4 female, ova ·14 m. 8 male, syerms not moving.	12 Empty.
Lytham, S. Shore Cockle Beds.	July 4	12 ,,	1⅛ ,,	2 female, ova ·14 m. 10 male, sperms not moving.	12 Empty.
Grange over Sands Kent's Bank.	July 10	12 ,,	1 – 1⅛ ,	6 female, mature. 6 male, sperms lively.	12 Empty.
Lytham, Salthouse Bank.	July 19	32 ,,	¾ - 1⅜ ,,	1 female, ova ·12 m. 7 male sperms moving 11 male, sperms not moving. 13 ? immature.	32 Empty.
Crosby Channel.	July 23	12 ,,	1⅛ – 1¼ ,,	12 spent.	12 Empty.
Lytham, South Shore.	July 25	9 ,,	1 – 1¼ ,,	9 spent.	9 Empty.
Lytham, Horse Bank.	July 25	12 ,,	1 – 1¼ ,,	1 ripe. 11 spent.	12 Empty.
Baicliff Cockle Beds.	July 26	12 ,,	1¼ – 1⅜ ,,	6 female, ova ·1·-14m. 6 male sperms moving.	12 Empty.
Grange over Sands Humphrey Head.	July 31	12 ,,	1⅛ – 1¼ ,,	10 female, ova·14-·2m 2 spent.	12 Empty.
Grange over Sands Grange Banks.	Aug. 7	12 ,,	1⅛ – 1¼ ,,	9 female, ova ·15m 3 male sperms moving.	12 Empty.
Duddon Cockle Beds.	Aug. 14	12 ,,	1 – 1¼ ,,	9 female, ova ·15m. 3 male sperms moving.	12 Empty.
Grange Banks.	Sept. 13	12 ,,	1 - 1¼ ,,	3 female, ova ·15m. 9 spent.	12 Empty.
Grange over Sands Kent's Bank.	Sept. 24	12 ,,	1 – 1¼ ,,	2 female, ova ·14 m. 10 spent.	12 Empty.

Grange over Sands	Oct. 8	12 ,,	$1\frac{1}{8}-1\frac{1}{4}$,,	4 female, ova ·15 m. 8 spent.	12 Empty.
Grange over Sands Kent's Bank.	Oct. 16	12 ,,	$1-1\frac{1}{8}$,,	3 female, ova ·14 m. 9 spent.	10 Empty.
Grange over Sands	Oct. 22	12 ,,	$1-1\frac{1}{4}$,,	4 female, ova ·165 m. 8 male, sperms not moving.	12 Empty.
Grange over Sands	Oct. 29	12 ,,	$1-1\frac{1}{8}$,,	12 spent.	12 Empty.
Grange over Sands Waded Scar.	Nov. 5	12 ,,	$1-1\frac{1}{4}$,,	2 female, ova ·15-·18m 10 spent.	12 Empty.
Duddon Sands.	Nov. 6	12 ,,	$1-1\frac{1}{8}$,,	2 females, ova ·14 m. 4 male. sperms moving 6 spent.	12 Empty.
Grange Banks.	Dec. 1	12 ,,	$1\frac{1}{8}-1\frac{1}{4}$,,	12 males, immature.	12 Empty.
Kent's Bank, Cockle Beds.	Dec. 4	14 ,,	$1-1\frac{1}{8}$,,	1 female, ova ·14 m. 13 male, immature.	14 Empty.
Duddon Sands.	Dec. 11	10 ,,	$1-1\frac{3}{8}$,,	2 female, ova ·14 m. 5 male, sperms moving 3 male, immature.	10 Empty.
Grange Banks.	Dec. 11	12 ,,	$1\frac{1}{8}$,,	11 male, sperms moving. 11 male, immature.	12 Empty.
Grange Banks.	Dec. 19	12 ,,	$1-1\frac{1}{4}$,,	3 female ova ·12-·15m. 9 male, immature.	12 Empty.

In addition to the great value of cockles for their own sake, we desire to point out that they are probably of great economic importance in connection with the nourishment of young true fish. The inter-dependence of different forms of life in the sea is a very marked thing, the presence of one species frequently attracts another, and sands that contain cockles seem usually to have other burrowing mollusca and many amphipods and other invertebrates and so no doubt form an attractive feeding ground for fish.

Shrimps and Shanks.

During the year 290 shrimps (*Crangon vulgaris*) have been examined in order to ascertain further particulars in regard to the food and times of spawning.

The examination of the food confirms what has already been stated in previous reports, that *Mollusca*, *Crustacea*, *Annelida*, etc., are used as food by the shrimp. In the stomach of one specimen examined in October, 1894, which was one of twenty-four collected on Burbo Bank, a perfect specimen of a young *Donax* was found which measured 1·3 millimeters, both valves being intact. The other shrimps in this gathering had also been feeding on the young of *Donax*, but the shells were all more or less damaged.

In regard to the spawning periods we have as yet nothing further to add to what has already been stated in the first Report, p. 34, viz., that there seem to be two chief periods in the year, the one about November and the other in April and May, although many are found spawning between these periods, as the following statistics show :—

In December most of the Shrimps examined had spawn.

In February most of the Shrimps examined had spawn.

In March 60 % of the Shrimps examined had spawn.

In April 70 to 85 % of the Shrimps examined had spawn.

In May 60 to 80 % of the Shrimps examined had spawn.

Only 20 Shanks (*Pandalus annulicornis*) were examined during the year so that we have nothing further to add on that head to what is contained in last year's Report.

Shrimping and the Destruction of Young Fish.

We desire, however, before leaving the subject of shrimps to bring once more prominently before the Committee, and to recommend for careful consideration, a matter we have discussed in a former report, (Rep. I. p. 23) viz., the appalling destruction of young food fishes which is caused by shrimping as practised in this neighbourhood.

In the Report for 1893 the subject was drawn attention to, the numbers taken in particular hauls were given, and

suggestions were made as to remedial measures. The destruction by shrimping was again referred to in last year's report where a full description was given of the "casier" or shrimp trap and its method of use at Le Croisic on the Brittany coast. This instrument has not yet had a satisfactory trial in our estuaries, and it is a question whether even if it were shown to work as well here as it does in France our men could be induced to make use of it.

The statistics of hauls taken during the past year from the steamer show once more, if any showing is still needed, that that destructive engine the shrimp trawl brings up along with a miserably small number of shrimps, an astonishingly large number of young food fishes. On November 2nd, off the Ribble estuary, with 5 quarts of shrimps were taken over 5,000 undersized food fishes. On the same date, off Blackpool with $1\frac{1}{4}$ quarts of shrimps were 10,000 fish; on October 24th, in Heysham Lake with 2 quarts of shrimps were 4,000 plaice about 4 inches long; and so on. Of course it is satisfactory to know that there are so many young fish on the ground, but it is deplorable that for the sake of a quart or two of shrimps several thousands of young fish should run some risk of being sacrificed.

Bar Shank Net Experiments.

These experiments were carried out by Mr. Dawson for the purpose of determining whether the destruction of small fish caught while shrimping could be decreased without affecting the number of shrimps taken. In carrying out the experiments an ordinary shank net and a shrimp trawl were worked over the same ground, along with a modified shank net having a bar fixed to the frame about 3 inches off the bottom, to which bar the lower part of

the net is attached, the three being worked simultaneously so that the experiments might have a fair trial. As stated in the introduction these experiments have, so far, supported Mr. Dawson's idea as to the fish caught in this net being fewer in number than those caught either by the ordinary shank net or the shrimp trawl, but it would perhaps be better that the experiments should be carried on for a further period before any definite opinion is expressed on this matter.

Although the results have already been given in part in one of Mr. Dawson's Quarterly Reports (January, 1894) to the Committee, we consider that their importance renders it desirable that they should have if possible a more extended circulation and so we state them here more fully taking the more striking examples for the various months.

(1) In December, 1893, an experiment was made on the Blackpool closed ground with a Bar Shank net, an ordinary shank net, and a shrimp trawl, the three being worked simultaneously, with the following result:—

The Bar Shank net caught 3708 fish and 11 quarts of Shrimps.

The Ordinary Shank net caught 5221 fish and $10\frac{1}{2}$ quarts of shrimps.

The Ordinary Shrimp trawl caught 20889 fish and $22\frac{1}{2}$ quarts of shrimps.

(2) In January, 1894 another experiment was made on the same ground and under the same conditions with the following results:—

Bar Shank net, 2011 fish and $14\frac{1}{2}$ qts. shrimps.

Ordinary Shank net, 2027 fish and $8\frac{1}{4}$ qts. shrimps.

Ordinary Shrimp trawl, 8512 fish and 6 qts. shrimps.

(3) An experiment in the Ribble carried out under the same conditions in January gave the following:—

Bar Shank net caught 746 fish and $11\frac{1}{4}$ qts. of shrimps.

Ordinary Shank net, 561 fish and $8\frac{1}{4}$ qts. shrimps.

Ordinary Shrimp trawl, 1950 fish and 6 qts. shrimps.

(4) Another experiment was made on the Blackpool ground with the three nets in the month of March and the following is the result :—

Bar Shank net, 38 fish and $1\frac{1}{2}$ qts. shrimps.

Ordinary shank net, 865 fish and 9 qts. shrimps.

Ordinary Shrimp trawl, 3076 fish and $2\frac{1}{2}$ qts. shrimps.

(5) In the same month (March) an experiment was made in the Mersey with the three nets with a result as follows :—

Bar Shank net caught 536 fish and 12 qts. shrimps.

Ordinary shank net, 365 fish and $6\frac{1}{2}$ qts. shrimps.

Ordinary Shrimp trawl, 1177 fish and 13 qts. shrimps.

(6) In August another experiment was made on the Blackpool closed ground with the following result :—

Bar Shank net caught 502 fish and 2 qts. $\frac{3}{4}$ gill shrimps.

Ordinary Shank net, 330 fish and 2 qts. shrimps.

Ordinary Shrimp trawl, 3362 fish and 2 qts. shrimps.

"Drift Bottles and Surface Currents."

In connection with the investigation of the surface life, in discussing the appearance and disappearance of swarms of certain Copepoda and Medusæ, and in considering the possible influence of the movements of such food matters upon the migrations of fishes, and also in connection with the movements of the fish ova and floating embryos, it occurred to us, that it would be worth while to try to ascertain the set of the chief currents, tidal* or otherwise

* The tidal currents of the district are already to some extent known, and are marked in the charts and given in books of sailing directions, as Admiral Beechy's "Tidal Streams of the Irish Sea;" but we desire to ascertain the resultant currents from all influences which would affect the drift of small floating bodies.

such as the movement of surface waters caused by prevalent winds. The Prince of Monaco started a few years ago the system of distributing over the North Atlantic large numbers of small floating copper vessels, with the object of finding out where they drifted to. This plan we have adopted, with slight modifications, and in September we started the distribution of what may be called "drift bottles" over the Irish Sea. A small, strong, buoyant bottle, measuring 7·5 cm. by 1·8 cm., which seemed well suited for the purpose, and which costs only 7s. per gross was selected. A notice was drawn up, as follows, to go in the bottles, and a large number of copies were printed and numbered consecutively.

> Any one who finds this is earnestly requested to write the place, and date when found, in the space (on the other side) for the purpose, place the paper in an envelope, and post it to
>
> PROFESSOR HERDMAN,
> University College,
> LIVERPOOL.
>
> No.....
> Postage need not be prepaid.
>
> Turn over.
>
> [OTHER SIDE.]
>
> Please write distinctly, and give full particulars.
> LOCALITY, where found.....
> .....
> .....
> DATE, when found.....
> Name and address of sender.
> .....
> .....

A paper was then placed in each bottle, so folded that the number could be readily seen through the glass, the

cork was well pressed down, and dipped in melted paraffin. Over a hundred of these bottles have, since September 30th, been dropped into the sea in various parts of our area, a record being kept of the locality and time when each was set free. Several dozen were let off from the Isle of Man steamer in crossing to Douglas and back, at intervals of quarter of an hour, and from our trawler when dredging between Port Erin and Ireland. Several dozen have been let off from Mr. Alfred Holt's steamers in going round to Holyhead and in coming down from Greenock. Mr. Dawson on the fishery steamer "John Fell" has distributed a number along the coast in the northern part of the district, and others have been set free at stated intervals during the rise and fall of the tide from the Morecambe Bay Light Vessel, and Lieutenant Sweny has kindly arranged to have a similar periodic distribution from the Liverpool North West Light Vessel. Altogether, over 33 per cent., or about one in three of the papers distributed have been subsequently picked up on the shore and returned duly filled in and signed. They come from various parts of the coast of the Irish Sea—Scotland, England, Wales, Isle of Man, and Ireland. Some of the bottles have gone quite a short distance, having evidently been taken straight ashore by the rising tide. Others have been carried an unexpected length, *e.g.*, one (No. 35), set free near the Crosby Light Vessel, off Liverpool, at 12.30 p.m., on October 1st, was picked up at Saltcoats in Ayrshire, on November 7th, having travelled a distance of at least 180 miles* in 37 days; another (H. 20) was set free near the Skerries, Anglesey, on October 6th, and was picked up one mile N. of Ardrossan, on November 7th, having travelled 150 miles in 31 days; and bottle No. 1, set free

* More probably, very much further, as during that time it would certainly be carried backwards and forwards by the tide.

at the Liverpool Bar, on September 30th, was picked up at Shiskin, Arran, about 165 miles off, on November 12th. On the other hand, a bottle (J. F. 34), set free on November 7th, at the Ribble Estuary, was picked up on November 12th, at St. Anne's, having gone only 4 miles.

It would be premature as yet—until many more dozens or hundreds have been distributed and returned—to draw any very definite conclusions. It is only by the evidence of large numbers that the vitiating effect of exceptional circumstances, such as an unusual gale, can be eliminated. Prevailing winds, on the other hand, such as would usually affect the drift of surface organisms are amongst the normally acting causes which we are trying to ascertain. We may, however, state for what they are worth, the following results obtained so far:—(1) Nearly 50 per cent. of the bottles found have been carried across to Ireland, and they are chiefly ones that had been set free in the southern part of the district (between Liverpool and Holyhead) and off the Isle of Man; (2) the bottles set free along the Lancashire coast and in Morecambe Bay seem chiefly to have been carried to the South and West—to about Mostyn and Douglas; (3) it is apparently only a few that have been carried out of the district through the North Channel. Perhaps, the most interesting point so far is that so many of the bottles have been stranded on the Irish coast, although they were sent off for the most part much nearer to the English and Welsh coasts, showing probably the influence on the tidal currents of the spell of Easterly winds in October. It is interesting to learn that the Fishery Board for Scotland has also commenced a similar inquiry to ours by the distribution of floating bottles in the Scottish territorial waters. No account of their experiment has yet appeared, but it will be of some importance to compare results with them, say at the end of the first year's work.

Faunistic Investigations.

Besides carrying out the work of examining the fish caught in the net while on board the steamer a sharp look-out is kept upon the debris brought up along with the fish so that we may know as much as possible of the nature of the food at the bottom, and so that any rare vertebrates or invertebrates that may happen to be among the refuse may not escape notice. It is only by having a thorough knowledge of the fauna of the district that we can expect to be able to make out accurately the food of the various fishes, for without such a detailed knowledge of the species one would often be puzzled to tell what the fish really are feeding upon, the contents of the stomachs get so much altered during the process of digestion.

As a result of the untiring zeal of the various members of the Liverpool Marine Biology Committee and other workers it is now no easy matter to make many additions to the fauna of the district, the records during the past year being only 1 Fish, 1 species of Cumacean, 5 species of Copepoda, 1 Ostracod and 1 Sponge.

The following are the names of the various species referred to, with a note to each of some particulars which may be of interest.

Fish.

Zeugopterus unimaculatus, (Risso).

1880–84, Day, Brit. Fish., v. II., p. 17, pl. xcix., fig. 1.

1885, Brook, Appendix to Fourth Ann. Rept. Fish. Board for Scotland, p. 225, pl. ix.

Four specimens of this rare and pretty little fish were captured by the trawl-net of the Fisheries Steamer "John Fell," while trawling on the off-shore grounds 10 to 12 miles west from Morecambe Bay Light Vessel during the month of May, 1894.

Depth 23 fathoms, *bottom* sand, shells, and stones.

The specimens agree in all points with the figure and description given by the late George Brook in the Scottish Fishery Board's Fourth Annual Report. The figure given in Day's British Fishes does not seem to be very characteristic.

One of the fish was a mature female and measured $5\frac{1}{2}$ inches in length, the unfertilised ova measured 1·078 millimeters and the oil globule ·1848 millimeter.

Cumacea.

Petalosarsia declivis (G. O. Sars).

Petalomera declivis, T. Scott, Eleventh Annual Rep., Fishery Board for Scot., Pt. III., p. 215, pl. v., fig. 43.

A few specimens of this Cumacean were obtained among bottom tow-net material collected 14 miles N. by W. from Liverpool N.W. Light Vessel. The tow-net had touched the bottom and brought up a small quantity of sandy mud which was carefully washed through a muslin sieve and on examining the contents of the sieve this species was found, and also a copepod which is referred to later on. This species had not previously been recorded for the west coast of Britain.

Copepoda.

Longipedia minor, T. and A. Scott.

Longipedia coronata, var. *minor*, T. and A. Scott. Eleventh Annual Report, Fishery Board for Scotland, Part III, p. 200, pl. ii., figs. 14—20.

In rock-pools on Hilbre Island, collected by hand net, not common. This is one of the copepods we sometimes find in the stomachs of young fish from the district.

Bradya minor, T. and A. Scott.

Several specimens of this new *Bradya* were obtained in the same gathering with the last.

Ectinosoma normani, T. and A. Scott.

Amongst material collected in Barrow Channel by Professor Herdman while surveying the ground for the proposed establishment of Mussel Beds, &c., in the vicinity of Piel and Roe Islands.

Pseudanthessius sauvagei, Canu.

Pseudanthessius sauvagei, T. Scott, Twelfth Annual Report, Fishery Board for Scotland, p. 260.

Washed from the Echinoderms, *Spatangus purpureus* which were brought up in the trawl net of the steamer while working on the off-shore grounds during the year. It has also been found on *Echinocardium cordatum*, see Canu's monograph "Les Copepodes du Boulonnais."

Lichomolgus agilis (Leydig).

Lichomolgus concinnus, T. Scott, Tenth Annual Report, Fishery Board for Scotland, Part III, p. 261, pl. xi., figs. 25—33.

A few specimens were found amongst the bottom material from which *Petalosarsia* were obtained.

This is not the *Lichomolgus agilis* of T. and A. Scott referred to in the First Report as having been found in the cockles. The latter species is identical with *Hermanella rostrata*, Canu, a species which was described and published a short time before the figures and description by T. and A. Scott appeared in the Annals and Magazine of Natural History for September, 1892.

Ostracoda.

Cytheropteron pyramidale, G. O. Sars.

Among the mud brought up in the tow-net gathering in which *Petalosarsia* was found.

Sponge.

Leiosella (*Spongionella*) *pulchella*, Sowerby.

Amongst trawl refuse, which had been collected 14 miles N. by W. from Liverpool N.W. Light Vessel in the same haul from which *Petalosarsia* was got in the tow-net. This sponge had not been taken before on the west coast of Britain, and we are indebted to Dr. Hanitsch for the name.

Note. It may be of interest to record here the occurrence of the Calanid *Candace pectinata*, Brady, in the Irish Sea. It was found among some surface tow-net material collected by Mr. R. L. Ascroft off Lambay Island on the Irish coast, about 10 miles N.E. of Dublin, while on board a trawler working there in November, 1894. Mr. Ascroft also kindly sent to the Fishery Laboratory for examination some material which he obtained when trawling off Galley Head, Co. Cork. This has been examined by Mr. A. O. Walker who reports the following interesting and rare Amphipods and other higher Crustacea, viz. :—*Hemilamprops assimilis*, *Diastylis* (? n. sp.), *Cirolana borealis*, *Parathemisto oblivia*, *Callisoma crenata*, *Hippomedon denticulatus*, *Orchomenella ciliata*, *Typhosites longipes*, *Lepidepecreum carinatum*, *Ampelisca spinipes*, *Monoculodes carinatus*, *Epimeria cornigera*, and *Paratylus vedlomensis*.

Summary and Conclusions.

In concluding this Third Report on the work of the Fishery Laboratory we desire to point out that there are several matters to which we have drawn attention in this and in former reports and which seem to us still to be pressing for attention and to be well worthy of serious consideration. These are :—

1° In regard to Shrimping :—A fair trial of the Croisic trap (see Report II., p. 74) and a trial of artificial Shrimp culture in enclosed areas (Report I., p. 35) with the view

of providing some substitute for the present destructive method of fishing.

2° The erection of some plain Mussel bouchots so as to catch spat (Report II., p. 79) with the view of forming fresh Mussel beds or re-stocking old ones.

3° The establishment of a Sea-fish hatchery (this Rep., p. 33) with the object of doing all that is possible to add to the population of the sea.

Other points which we have raised in these reports, such as the determination of the spawning grounds, feeding grounds and nurseries, the question of the "vitality" of fish caught in trawls, the distribution of immature fish, the size at maturity and the benefit of the imposition of a "size limit," have all now been more or less completely determined and settled. There still remain, however, unsolved or only partially solved problems, and new ones are arising as a result of the discussion of our statistics, both these collected in the laboratory and also those taken at sea by the steamer in carrying out the scheme of investigation recommended in our first Report.

We propose in the coming year, in addition to the usual statistics on the food, maturity, growth, &c., of fishes, and any questions that may arise therefrom, to investigate more closely the shell-fish on the beds, and to pay special attention to the spawning of fish and to the larval and other immature stages.