

IX.—OBSERVATIONS ON THE FOOD OF FISHES.

By THOMAS SCOTT, F.L.S., Mem. Soc. Zool. de France.

The observations contained in the present paper refer chiefly to the food of small or immature fishes, but reference to a few large gadoids, congers, and others are also included. It may be explained that during the past two or three years my attention has, to some extent, been devoted to the investigation of the ecto- and ento-parasites of fishes, and in connection with this it was generally found necessary that an examination should be made of the stomachs as well as of the other parts of the fishes which had been handed over to me for that purpose, and frequently while a search was being made for Entozoa separate notes of the food observed in the stomachs were also taken. In this way, as well as by the examination of fishes set apart for the special purposes of this paper, a considerable number of notes on the food of fishes have been collected.

The number of fishes dealt with in this paper reaches to considerably over two thousand, and includes representatives of fifty-six species and thirty-seven genera.* Their names are as follow.

The names of the fishes whose food is described in the following pages:—

<i>Sebastes norvegicus</i> (Ascan.).	The Norway Haddock.
<i>Cottus scorpius</i> , Lin.	The Sea Scorpion.
<i>Trigla pini</i> , Bloch.	The Red Gurnard.
„ <i>lucerna</i> , Lin.	The Sapphirine Gurnard.
„ <i>gurnardus</i> , Lin.	The Grey Gurnard.
<i>Agonus cataphractus</i> , Lin.	The Pogge.
<i>Lophius piscatorius</i> , Lin.	The Angler-fish.
<i>Trachinus vipera</i> , Cuv.	The Lesser Weaver.
<i>Scomber scombrus</i> , Lin.	The Mackerel.
<i>Caranx trachurus</i> , Lin.	The Horse-mackerel.
<i>Gobius minutus</i> , Gmel.	The Speckled Goby.
<i>Callionymus lyra</i> , Lin.	The Common Dragonet.
„ <i>maculatus</i> (Bonapart).	The Spotted Dragonet.
<i>Cyclopterus lumpus</i> , Lin.	The Lump-sucker.
<i>Anarrhichas lupus</i> , Lin.	The Cat-fish.
<i>Pholis gunnellus</i> , Lin.	The Butter-fish.
<i>Macrurus laevis</i> , Lowe.	
<i>Enchelyopus</i> (<i>Zoarces</i>) <i>viviparus</i> , L.	The Viviparous Blenny.
<i>Lumpenus lampretiformis</i> (Walb.).	The Sharp-tailed Lumpenus.
<i>Atherina presbyter</i> , Cuv.	The Sand Smelt.
<i>Mugil chelo</i> , Cuv.	The Grey Mullet.
<i>Gasterosteus aculeatus</i> , Lin.	The Three-spined Stickleback.
<i>Gastræa spinachia</i> (Lin.).	The Fifteen-spined Stickleback.
<i>Gadus callarius</i> , Lin.	The Cod-fish.
„ <i>æglefinus</i> , Lin.	The Haddock.
„ <i>luscus</i> , Lin.	The Whiting Pout or Brassie.
„ <i>esmarkii</i> , Nilsson.	The Norway Pout.
„ <i>merlangus</i> , Lin.	The Whiting.

* Besides the fishes dealt with here, a large number of others were examined, but have been excluded because their stomachs were either empty or contained matter that could not be identified.

<i>Gadus virens</i> , Lin.	The Saithe or Coal-fish.
„ <i>pollachius</i> , Lin.	The Pollack or Lythe.
<i>Molva molva</i> , Lin.	The Ling.
<i>Onos mustela</i> , Lin.	The Five-bearded Rockling.
<i>Ammodytes lanceolatus</i> , Le Sauvage.	The Greater Sand Eel.
<i>Drepanopsetta plattessoides</i> (Fabr.).	The Long Rough Dab.
<i>Lepidorhombus whiff</i> (Walb.).	The Sail-Fluke or Whiff.
<i>Platophrys laterna</i> (Walb.).	The Scald-fish.
<i>Pleuronectes platessa</i> , Lin.	The Plaice.
„ <i>microcephalus</i> , Dono- van.	The Lemon Sole.
„ <i>limanda</i> , Lin.	The Common Dab.
„ <i>flesus</i> , Lin.	The Flounder.
<i>Solea vulgaris</i> , Quensel.	The Black Sole.
<i>Argentina sphyreana</i> , Lin.	The Hebridean Smelt.
<i>Clupea harengus</i> , Lin.	The Herring.
„ <i>sprattus</i> , Lin.	The Sprat.
„ <i>alosa</i> , Lin.	The Allis Shad.
„ <i>finta</i> , Cuv.	The Twait Shad.
<i>Anguilla vulgaris</i> , Cuv.	The Common Eel.
<i>Conger niger</i> (Risso).	The Conger.
<i>Syngnathus acus</i> (Lin.).	The Great Pipe-fish.
<i>Nerophis aquoreus</i> (Lin.).	The Straight-nosed Pipe-fish.
<i>Raia batis</i> , Lin.	The Grey Skate.
„ <i>fullonica</i> , Lin.	The Shagreen or Fuller's-ray.
„ <i>clavata</i> , Rond.	The Thornback-ray.
„ <i>radiata</i> , Donovan.	The Starry-ray.
„ <i>circularis</i> , Couch.	The Sandy-ray.
<i>Lamna cornubica</i> , Cuv.	The Porbeagle Shark.

When the food present in the stomachs of fishes has been subjected for a time to the strong solvent action of the gastric fluid it is often difficult, if not impossible, especially in the case of annelids and other soft-bodied animals, to determine with anything like precision the species or even the genus to which the organisms belong. Sometimes the food may consist partly or wholly of small fishes, and if the digestive processes have not been too long at work it may be possible, by an examination of what remains of the bony skeleton or of the ear-stones, if any be available, to ascertain with some degree of certainty whether the food observed consists of flat or round fishes, and in certain cases it may even be possible from an examination of the ear-stones to arrive at a more definite knowledge of the kind of fish which had been appropriated as an article of food. In the Whiting, for example, the ear-stones are of such a characteristic form that the observer may distinguish by these alone the kind of fish the remains belong to. The ear-stones of the Whiting are narrow and elongated, at one end they taper gradually to a sharp point, but the opposite end is somewhat obliquely rounded; they are also slightly curved laterally, so that when placed on any plane surface they do not lie flat. The young Pollack has ear-stones shaped somewhat like those of the Whiting, but they are not so elongated, nor do the narrow ends taper so much. The ear-stones of the Haddock do not taper so much at the narrow end as do those of the Whiting, and they are also proportionally shorter, stouter, and more crenulated; those of the Cod are of a massive structure, and are broadly sub-cylindrical in shape, and have the margins and concave surface usually more or less strongly rugose, while on the convex side the surface is smooth or nearly so. The ear-stones of large Pollack, Saithe, and Ling are also of a massive structure,

and somewhat resemble those of the Cod in shape, except that they are rather more elongated; they do not show the same amount of crenulation on the edges nor is the concave surface corrugated—at least not so distinctly as in those of the Cod.

In the so-called flat-fishes, *i.e.*, Turbot, Plaice, Witch-soles, and others, the ear-stones are usually flat, moderately thin, and more or less rounded in shape. The ear-stones of the Witch-sole, *Pleuronectes cynoglossus*, are nearly circular in outline, and have the surfaces slightly rugose; those of the Plaice, *Pleuronectes platessa*, are broadly oblong, their inner surface is slightly irregular, and one edge is more evenly rounded than the other; the ear-stones of a Plaice 24 inches long were 12 millimetres long by 7 broad.

There is sometimes a considerable difference in the proportional size of the ear-stones of different fishes; those, for example, of a Lump-sucker 15½ inches long measured about 1½ by 1¼ mm., they were nearly round, but had a small tooth-like process at one end; those of a Lemon Sole 12 inches in length were sub-rhomboid in shape, and measured 3½ by 2 mm., while those of a Long Rough Dab 10 inches in length, which were sub-rotundate, measured 6 by 4½ mm. The ear-stones of the Hake appear to be comparatively large; those of a specimen of moderate size, but the exact length of which I am unable to give, measured 24 mm. in length by 9 mm. at the broadest part, in form they are broadly dagger-shaped, one edge is nearly even and gently curved, but the opposite margin is almost pectinate. A Cat-fish 27 inches in length had ear-stones broad at one end and pointed at the other, and measured 4 mm. by about 2½ mm. at the broad end. The ear-stones of some of the smaller fishes, such as the Worm Pipe-fish, require the aid of a hand-lens to see them properly.

The shells of the smaller species of Mollusca are sometimes fairly perfect, and when that is the case it is not difficult to distinguish the more common forms, but molluscan shells, even if not smashed by the teeth of the fish, soon become corroded by the gastric fluid, and should the sculpture be, as it often is, a specific characteristic, their identification is made difficult and frequently uncertain.

The Crustacea are on the whole more easily determined than most of the other groups; the test of the smaller forms is usually moderately tough and flexible, so that they frequently occur in the stomachs of fishes more or less entire, and even when there are only fragments available the genus, if not the species, to which the animal they are part of belongs, may be made out. In many of the species of the Amphipoda, for example, there are certain appendages so characteristic that it is possible by an examination of these to indentify with a fair amount of certainty the species which they belong to; and in proof of this, reference may be made to the following from among other species. The first and second gnathopods of *Amphilocheus manudens* are characteristic of that species; the second gnathopods of *Stenothoe marina* and *Metopa pollexiana* are also well-marked appendages. By the structure of the seventh pereopods, together with the form of the third epimeral plates of the metasome, several species of *Ampelisca*, such as *A. brevicornis*, *A. macrocephala*, and *A. assimilis*, may be satisfactorily determined. The males of the three British species of *Cheirocrates*, of *Protomedea fasciata*, and others may be distinguished by the form and armature of the second gnathopods, and I have frequently detected the presence of *Dulichia porrecta* and *falcata* by the second gnathopods alone.

The most of the Annelida appear to be readily acted upon by the gastric fluid, for if they are even for a comparatively short time in a fish's stomach the only evidence we have of their presence is a quantity of mucus mixed up with which are fascicles of bristles, and perhaps some of

the internal muscular structure; *Aphrodita*, *Arenicola*, and a few others do not, however, appear to be so readily acted upon as some others.

The Starfish remains observed in the stomachs of fishes are usually very fragmentary; they consist of the disks and pieces of the arms, while sometimes plates and spines are the only evidence that Starfishes have been taken by the fish.

An interesting fact, brought out by the examination of the fishes mentioned in the sequel, is that *Sagitta* and the tadpole-like Ascidian, *Oikopleura*, sometimes form a considerable portion of the food of certain kinds of fishes; and it is also shown that the smaller Cœlenterata, *Pleurobrachia* and others, are at times moderately abundant in the stomachs of the common Lumpsucker.

Before passing on to describe the food observed in the stomachs of the fishes belonging to each of the particular species mentioned in the list, I would remark, although it is hardly necessary to do so, that to obtain a fairly accurate knowledge of the food of the smaller and immature fishes which feed largely on the minute Crustacea requires careful and patient research—it is work which cannot be done in a hurry. It frequently happens that minute organisms are so covered with mucus that they must be cleaned ere they can be identified, and sometimes they can only be identified by dissection.

The food of the various kinds of fishes will be described in the order in which their names are given in the list. The measurements are in centimetres (cm.) unless otherwise stated.

THE NORWAY HADDOCK. *Sebastes norvegicus* (Ascan.).

Nine specimens were examined, their measurements being—one at 10 cm., one at 11 cm., one at $12\frac{1}{5}$ cm., one at $12\frac{1}{2}$ cm., one at 14 cm., three at 20 cm., and one at 34 cm. They were captured to the east of Fair Island, October 16th, 1900. The stomach of one was empty, or contained matter so much digested as to be almost indistinguishable, while the food contained in the others consisted entirely of Crustacea, chiefly *Pandalus montagui* and *Crangon* (?) *allmanni*. The *Crangon* remains were too disintegrated to be satisfactorily identified.

SEA SCORPION. *Cottus scorpius*, L.

In the stomachs of seven specimens, all from the Bay of Nigg, near Aberdeen, the food observed consisted altogether of Crustacea, and included larval Decapods, the fragments of a Hermit Crab (*Eupagurus*), *Porcellanea longicornis*, *Idothea baltica*, the Cypris stage of *Balanus* sp., and some fragments which could not be satisfactorily assigned to any particular genus or species. Van Beneden states that he has observed a young Gurnard, *Trigla gurnardus*, in the stomach of *Cottus scorpius*, but otherwise the food recorded by him consisted entirely of Crustaceans, and such as usually frequent shallow inshore water. The size of the fish ranged from about four to seven inches (10 to 18 cm.).

RED GURNARD. *Trigla pini*, Bloch, and

SAPPHIRINE GURNARD. *Trigla lucerna*, L.

One specimen of the former measuring about $24\frac{1}{2}$ cm. in length, and two of the latter measuring $32\frac{1}{2}$ cm. and 34 cm. respectively, were examined. In the stomach of the first, two small *Portunus* sp. were observed, while the only food observed in the stomachs of the other two consisted of fragments of *Portunus* (?) *holsatus*. The Red Gurnard was

captured in Sinclair Bay, Caithness-shire, and the Sapphirine Gurnards in the Moray Firth, June 29th, 1901.

GREY GURNARD. *Trigla gurnardus*, L.

Of the seventy-nine Grey Gurnards examined, five of them, which were from Annan (Solway), collected in May, 1900, and measuring about $14\frac{1}{2}$ to $15\frac{1}{2}$ cm., had their stomachs filled almost entirely with the fragments of Crustacea—*Crangon vulgaris* being the most common. Some specimens of Mysidæ and of *Calanus finmarchicus* were observed, and also a single specimen of *Monoculodes carinatus*.

In the stomachs of ten specimens from the Clyde, collected on October 4th, 1901, and which measured from $14\frac{1}{2}$ to $19\frac{1}{2}$ cm., *Crangon* was again the prevailing kind of food observed; the species observed was *Crangon allmanni*, and it occurred in eight out of the ten stomachs examined. *Pandalus montagui* was observed in two stomachs, *Schistomysis ornatus* in one, and *Halimedes parvimanus* (an Amphipod species) in two. A small round fish was observed in one of the stomachs, and was the only organism other than Crustacea obtained.

In twenty-four stomachs of Gurnards from the Moray Firth, seven of which were examined in June, 1900, and the others in June of the present year (1901), *Crangon* formed a smaller proportion of the food observed than in those just referred to, especially in the specimens examined this year. The stomachs examined last year were not in very good preservation, and only one contained food that could be identified, and which consisted of the remains of *Crangon* sp.; the examination of further specimens belonging to this sample was therefore discontinued. In the stomachs of those examined this year small Decapods were found in four (*Nika edulis* in one and *Crangon* sp. in three); *Erythropis elegans* occurred in one, *Schistomysis* sp. in one, and *Pseudocuma cercaria* in one; several Amphipods were also observed, but no Copepods or other minute forms. One stomach contained only the remains of Annelids, while similar remains, along with those of Crustaceans, were found in another. These Moray Firth Gurnards ranged from about $10\frac{1}{2}$ to 30 cm. in length, and it was in the stomachs of the smaller specimens—from $10\frac{1}{2}$ to 20 cm.—that the most of the Crustacean species were obtained; the food in the stomachs of the larger specimens was for the most part indistinguishable.

Seven specimens collected in Aberdeen Bay on June 10th, 1901, and fourteen captured off Collieston on July 5th, had all, without a single exception, been living to a greater or less extent on *Schistomysis spiritus* (Norm.); some other things, including a small *Crangon*, a few young *Pandalus*, a few Amphipods, the ear-stones of a small flat-fish, and the remains of other small fishes and fragments of Annelids, were also noticed, but the *Schistomysis spiritus* appeared to be the favourite food of these fishes at this time. These two samples of *Trigla gurnardus* ranged from 11 cm. to 20 cm. in length. It may also be stated that, besides the fourteen specimens from Collieston specially noticed here, a considerable number of others from the same locality were examined, though perhaps not so carefully, and all were found to have been feeding largely on the same kind of Schizopod. This Schizopod, which is sometimes abundant off the Aberdeenshire coast, is almost transparent; there is a faint tinge of red on parts of its body, and its eyes are intensely black, so that to one looking into the water from above the creature would be invisible were it not for its prominent and intensely black eyes.

Nineteen specimens of Gurnards from the Firth of Forth, captured in April and May, 1901, were also examined; those captured in April

ranged in length from 19 cm. to 35 cm., and were not in very good preservation when examined, but it was found that, with the exception of two, the contents of whose stomachs were too imperfect for identification, they had been living entirely on *Crangon allmanni*. Those captured in May—seven in number—were smaller than the others, and though with these *Crangon* still formed a considerable part of their food, there were other things that appeared to be even more highly relished, especially by the smaller Gurnards; the species which, next to *Crangon*, appeared to be most in demand was the skeleton-like Amphipod *Dulichia falcata*; the food in two of the stomachs examined consisted very largely of this *Dulichia*, both males and females being obtained; several other species of Amphipods were observed, such as *Amphilochus*, *Amphilochoides*, *Paramphithoë*, *Ampelisca*, *Protomedeia*, but these were all more or less rare.

A common Gurnard, fully 5 cm. in length, from Smith Bank, collected in November, 1901, had in its stomach the heads and other parts of ten *Erythropus elegans*, besides a number of other fragments; probably in this case the beautiful eyes of the *Erythropus* had proved their destruction.

The following is a full list of the species of Crustacea, etc., observed in the stomachs of *Trigla gurnardus* referred to in the preceding notes:—

CRUSTACEA.	OTHER THINGS.
<i>Crangon allmanni</i> , Kinahan.	Small round fish.
<i>Crangon vulgaris</i> (Linne).	Small flat fish (ear-stones).
<i>Nika edulis</i> , Risso.	Annelid remains.
<i>Pandalus montagui</i> , Leach.	
<i>Schistomysis ornatus</i> , G. O. Sars.	
<i>Schistomysis spiritus</i> , Norman.	
<i>Schistomysis</i> , sp.	
<i>Erythropus elegans</i> , G. O. Sars.	
<i>Erythropus</i> sp.	
<i>Diastylis</i> sp.	
<i>Pseudocuma cercaria</i> (v. Beneden).	
<i>Bathyporeia</i> sp.	
<i>Harpinia crenulata</i> , G. O. Sars.	
<i>Ampelisca brevicornis</i> (A. Costa).	
<i>Ampelisca</i> sp.	
<i>Amphilochus tenuimanus</i> . Boeck.	
<i>Amphilochoides</i> sp.	
<i>Metopa</i> sp.	
<i>Leucothoë lilljeborgii</i> , Boeck.	
<i>Monoculodes carinatus</i> , Spence Bate.	
<i>Perioculodes longimanus</i> (Spence Bate).	
<i>Synchelidium brevicarpum</i> (Spence Bate).	
<i>Pontocrates altamarinus</i> (Spence Bate).	
<i>Halimedes parvimanus</i> (Spence Bate).	
<i>Apherusa borealis</i> .	
<i>Paramphithoë monocuspis</i> , G. O. Sars.	
<i>Megaluropus agilis</i> , Norman.	
<i>Protomedeia fasciata</i> .	
<i>Dulichia falcata</i> .	
<i>Dulichia</i> sp.	
<i>Calanus finmarchicus</i> (Gunner).	

THE POGGE. *Agonus cataphractus*, L.

Eighty Pogges have been examined for this paper, and with the exception of eleven they are all from Annan, Solway Firth. Fifty of those from Annan were collected at the end of April and the beginning of May, 1900, and fifteen in September; ten were from the Firth of Forth, and were collected on May 13th, 1901, while the others were part of a sample of fish sent from the Clyde in the beginning of October last. The food in the stomachs examined consisted almost entirely of Crustacea, and included representatives of the *Macrura* (*Crangon vulgaris*, jun.), the Schizopoda (*Praunus flexuosus*), the Stomapoda (*Lamprops fasciata*), the Isopoda (*Idothea linearis*), the Amphipoda (*Gammarus locusta*, *Cheirocratus intermedius*, *Corophium grossipes*, *Dulichia*, etc.), the Copepoda (*Longipedia*, *Ectinosoma*), the Ostracoda (*Paradoxostoma variabile*), and the Cirripedia (*Balanus* sp., cypris stage). Starfish remains occurred in one or two of the stomachs, and Annelid remains in one. Nearly all the Pogges taken in April and May were infested with what looked like encysted worms; they occurred in the walls of the body cavity, sometimes on one side only, but more frequently on both sides, and in some cases they were present in large numbers. The specimens of *Agonus* examined ranged in length from $6\frac{3}{10}$ cm. to $12\frac{1}{2}$ cm., but it was only in the smaller specimens measuring from $6\frac{3}{10}$ cm. to $8\frac{3}{10}$ cm. that the Copepoda, Ostracoda, and larval Balani were observed, while *Crangon*, *Praunus*, and others of the "higher Crustacea" were only found in the stomachs of the larger specimens.

The following is a list of the species of Crustacea found in the stomach of the Pogges:—

CRUSTACEA.	OTHER THINGS.
<i>Crangon vulgaris</i> (Lin.). <i>Praunus flexuosus</i> (O. F. Müller). <i>Praunus</i> sp. <i>Lamprops fasciata</i> , G. O. Sars. <i>Idothea linearis</i> (Pennant). <i>Bathyporeia</i> sp. <i>Metopa</i> sp. <i>Pontocrates altamarinus</i> (Spence Bate). <i>Paratylus swammerdami</i> (M. Edwards). <i>Gammarus locusta</i> (Lin.). <i>Cheirocrates intermedius</i> , G. O. Sars. <i>Corophium grossipes</i> (Lin.). <i>Dulichia porrecta</i> , Spence Bate. <i>Dulichia falcata</i> . <i>Proto pedata</i> . <i>Longipedia coronata</i> , Claus. <i>Ectinosoma melaniceps</i> , Boeck. <i>Paradoxostoma variabile</i> (Baird). <i>Balanus</i> (cypris stage).	Annelid remains. Starfish remains. The most of the fish caught on April 30th, 1900, were infested more or less with parasitic worms, which were encysted on the walls of the body cavity, sometimes on both sides.

ANGLER FISH. *Lophius piscatorius*, L.

Several small *Lophius* captured off Aberdeen in September, 1900, and measuring from 19 to about 30 cm., were examined, but the only food observed consisted of the remains of small fish—both flat fish and round fish. Professor M'Intosh has found a *Cottus bubalis* about a foot in

length in the stomach of a *Lophius*, while the stomach of the *Cottus* itself was distended by two *Carcinus mænas*.*

LESSER WEAVER. *Trachinus vipera*, Cuv.

Of the forty-three specimens of *Trachinus vipera* examined, thirty-four were sent from Annan (Solway), and nine were taken off Collieston, Aberdeenshire. The specimens from Annan were for the most part collected in April, May, and June, 1900, but seven of them were captured early in January of the present year. In the stomachs of those collected in April, 1900, very little food was observed, and only four out of the fourteen examined contained matter that could be identified; this consisted chiefly of the remains of *Praunus inermis*, *Gammarus locusta*, some remains of Annelids and of two or three small fishes (Clupeoids). The specimens of *Trachinus* in this sample measured from 8 to 11½ cm. In the stomachs of ten specimens examined in May the contents consisted chiefly of *Schistomysis* sp.; an Isopod—*Eurydice achata*—was also found in one, and in another the remains of a small Clupeoid. The specimens taken in September and January contained nothing that could be distinguished.

The nine specimens from Collieston collected on July 5th, 1900, had apparently been feeding largely on Schizopods, all of which appeared to belong to the one species, *Schistomysis spiritus*; the only other food observed consisted of the remains of a small fish, probably a young Clupeoid or Sand-eel. These Collieston specimens ranged from 11 cm. to 13½ cm. in length. A considerable number of these specimens were examined besides the nine specially referred to here, but they all appeared to have been feeding on the same species of Schizopod.

The following is a tabulated list of the organisms observed:—

ORGANISMS FOUND IN THE STOMACHS OF LESSER WEAVERS.

CRUSTACEA.	OTHER THINGS.
<i>Praunus inermis</i> (Rathke). <i>Schistomysis</i> sp. <i>Schistomysis spiritus</i> , Norman. <i>Eurydice achata</i> (Slabber). <i>Gammarus locusta</i> (Lin.). Copepods (gen. et sp. ?)	Small fishes? (Clupeoids or Sand-eels).

MACKEREL. *Scomber scombrus*, L.

The stomachs of over thirty Mackerel from the Clyde, examined in June, 1899, were found to be all more or less filled with Copepods, the prevailing form being *Calanus finmarchicus*; Euphausidæ (*Nyctiphanes* and *Rhoda*, or *Boreophausia*) were also observed in several, but the specimens were scarcely perfect enough for identification.

Another three dozen Mackerel, chiefly from Barra, Outer Hebrides, were also examined, and the food of these, as in the case of the Loch Fyne specimens, was found to consist largely of Copepods, but there was a greater variety of species; besides *Calanus finmarchicus*, which was well represented, the following other forms were also observed:—*Pseudocalanus*

* *Micros. Journ.*, vol. v,

elongatus, *Temora longicornis*, *Centropages typicus*, and *Metridia* sp. Fragments of Schizopods were noticed in some of the stomachs, but were too much broken for certain identification. No remains of fish were observed in these stomachs from the West Coast, but in the stomachs of a few specimens captured off Aberdeen the remains of small fish, probably young Clupeoids or Sand-eels, were observed, in addition to the usual pelagic Copepods. A quantity of Mackerel stomachs were sent to me some years ago from Stornoway, and the food in these was found to consist almost exclusively of young fishes. They appeared to be for the most part the fry of herrings or sprats, but in some cases they consisted of the young of their own kind; so extensively do they at times feed on small or young fish that Yarrel, referring to the food of the Mackerel, remarks:—"Their principal food is probably the fry of other fishes."* Professor P.-J. van Beneden, who devoted considerable attention to the subject of fish food, had evidently a somewhat different experience, for he states that the food of the Mackerel consisted of *Cetochilus septentrionalis* (? *Calanus finmarchicus*), and adds:—"Ce poisson est très-vorace, mais son estomac est généralement vide."†

The following is a tabulated list of the organisms observed in the stomachs examined:—

ORGANISMS OBSERVED IN THE STOMACHS OF MACKEREL.

CRUSTACEA.	OTHER THINGS.
<i>Nyctiphanes</i> sp. <i>Rhoda</i> sp. <i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i> , Boeck. <i>Centropages typicus</i> , Kröyer. <i>Temora longicornis</i> (O. F. Müller). Copepods (gen. et sp. ?)	Fish remains (Herring or Sprats).

HORSE MACKEREL. *Caranx trachurus* (L.).

A specimen of *Caranx trachurus*, 18 cm, in length, captured in Aberdeen Bay, July 30th, 1901, had its stomach filled with Copepods, and, so far as could be made out, they all belonged to the one species—*Temora longicornis*. This fact is not without interest, as it seems to suggest that the *Caranx* had either fallen in with a shoal of *Temora* and had thus no choice but to feed upon them, or, being able to discriminate between one kind and another, it chose this particular form in preference to others.

SPECKLED GOBY. *Gobius minutus*, Gmelin.

A considerable number of Speckled Gobies have been examined, but those specially referred to here number fifty-one, and include samples from Annan (Solway), the Firth of Forth, and the Moray Firth. In the stomachs of a sample of fourteen Speckled Gobies sent from Annan in May, 1900, the food consisted largely of Copepods, all of which belonged to the genus *Eurytemora*, the species which was not satisfactorily made out appeared to be *Eurytemora velox*. These Copepods were fairly numerous in some of the stomachs examined. Mysidæ were

* *British Fishes*, vol. i., p. 140.

† *Les Poissons des Cotes de Belgique*, p. 136.

observed in four stomachs, *Lamprops fasciata* was found in one and *Bathyporeia* sp. in four, while *Gammarus* (?) *locusta*, the only other Amphipod identified, occurred in one. Only Crustaceans or Crustacean remains were observed. The fishes in this sample measured from $4\frac{1}{2}$ to $7\frac{1}{2}$ centimetres in length. In the stomachs of two specimens forming part of a sample sent from Annan in July, 1900, the food consisted entirely of Mysidæ and *Corophium grossipes*, while in a sample collected on November 28th, 1900, only two out of five contained matter that could be even doubtfully recognised, and it consisted of the remains of (?) Amphipods in the one and of *Crangon* sp. in the other; these Gobies ranged from $7\frac{1}{2}$ to $8\frac{3}{10}$ centimetres. Twelve specimens were sent from Annan in January, 1901, but the stomachs of seven of them were empty or contained matter that could not be identified; while the food observed in the other five consisted entirely of fragments of Amphipods, the genus and species of which could not be made out.

The stomachs of the Moray Firth specimens, collected in June, 1900, contained numerous Amphipods and the remains of Mysidæ. The two Amphipods identified were *Bathyporeia* sp. and *Corophium grossipes*.

The stomachs of fifteen specimens sent from the Firth of Forth were those of fishes collected at Station III. on July 13th, 1901. The constituents of the food in these stomachs exhibited rather more variety than that of those previously referred to. Copepods, consisting chiefly of *Longipedia coronata*, occurred in eight of these stomachs; Amphipods, comprising *Metopa*, *Harpinia*, and *Dulichia*, were present in four and Annelids in three; Crustaceans representing the cypris stage of *Balanus* were also observed in two of these stomachs, but Echinoderm or fish remains were not obtained in any of them.

The following Table contains a complete list of the various organisms observed in the stomachs examined:—

SPECIMENS FOUND IN STOMACHS OF *Gobius minutus*.

CRUSTACEA.	OTHER THINGS.
<i>Crangon</i> sp. (jun.) Mysidæ. <i>Lamprops fasciata</i> , G. O. Sars. <i>Bathyporeia</i> sp. <i>Harpinia</i> sp. <i>Metopa</i> sp. <i>Gammarus</i> (?) <i>locusta</i> (Lin.). <i>Corophium grossipes</i> (Lin.). <i>Dulichia falcata</i> . Amphipod remains (gen. et sp. ?) <i>Eurytemora</i> (?) <i>velox</i> (Lilljeborg). <i>Longipedia coronata</i> , Claus. <i>Jonesiella spinulosa</i> (Brady and Robertson). <i>Balanus</i> (cypris stage).	Annelids.

COMMON DRAGONET. *Callionymus lyra*, L.

Over fifty specimens of common Dragonets captured off Aberdeen in July, 1900, were examined, and fully sixty per cent. of these were males. Only the stomachs of eleven of these specimens contained matter that could be identified, which consisted almost entirely of Mysidæ; *Leucothoë* sp. was the only other organism observed.

The stomachs of five specimens from the Moray Firth contained a variety of organisms comprising Mollusca, Crustacea, Annelid and Starfish remains. The stomach of one specimen $12\frac{3}{10}$ cm. in length contained the remains of two *Anapagurus hyndmanni* and an *Ampelisca* sp.; one $13\frac{2}{5}$ cm. in length contained fragments of lamellibranch shells (*Tellina* sp.), young *Crangon* sp., *Cheirocrates intermedius*, *Erichthonius* sp., *Longipedia coronata*, and the remains of Annelids and brittle Starfishes; while the others contained the remains of lamellibranch shells and *Ampelisca* sp.

Seventeen specimens from the Clyde, collected on October 4th, 1901, had all without exception been feeding more or less on small Mollusca, chiefly lamellibranchs; Crustaceans were also well represented, their remains being found in fourteen of the stomachs examined; fragments of brittle Starfishes were not uncommon, and one stomach contained fragments of a young *Amphidotus* sp. The shell-fish included a *Natica alderi* and a fragment of a *Turritella* (each with a small Hermit Crab enclosed), a young *Pecten varius*, young *Solen*, *Montacuta bidentata*, and young *Saxicava rugosa*. The length of these Clyde Dragonets ranged from $13\frac{3}{10}$ to 19 centimetres. There was no appreciable difference in the food observed in the smaller specimens from that contained in the stomachs of the larger.

The names of the various organisms observed in the stomachs of these Dragonets are given in the Table annexed.

CRUSTACEA.	OTHER THINGS.
<i>Portunus</i> sp. (small).	<i>Natica alderi</i> .
<i>Anapagurus hyndmanni</i> (Thomp.).	<i>Turritella</i> (fragments).
Small hermits (sp. ?)	<i>Pecten varius</i> (small).
<i>Crangon</i> sp. (small).	<i>Montacuta bidentata</i> .
Decapod remains (small).	<i>Tellina</i> sp.
Mysidæ.	<i>Solen</i> sp. (small).
<i>Harpinia</i> sp.	<i>Saxicava rugosa</i> .
<i>Ampelisca</i> sp.	Annelids.
<i>Ampelisca spinipes</i> , Böeck.	Starfish remains.
<i>Leucothoë</i> sp.	<i>Amphidotus</i> , sp.
<i>Cheirocrates intermedius</i> , G. O. Sars.	(fragments of test).
<i>Erichthonius</i> sp.	<i>Lagena</i> sp.
<i>Longipedia coronata</i> , Claus.	

SPOTTED DRAGONET. *Callionymus maculatus* (Bonap.).

The number of Spotted Dragonets examined was twenty-eight; they included two from Annan (Solway Firth), collected on April 30th, 1900; six collected about fifty miles to the eastward of Fair Island on October 19th, 1900; and twenty from the Clyde, collected on October 4th, 1901.

The two specimens from Annan measured $10\frac{9}{10}$ cm. and $12\frac{1}{2}$ cm. respectively; in one of these stomachs there was nothing that could be identified, and the only thing observed in the other was a single specimen of *Acartia* sp.

The stomachs of all the six specimens from the eastward of Fair Island contained matter that could be identified. *Diastylis* sp. was observed in one and *Astacilla* sp. in two stomachs; Amphipods comprising *Ascidostoma obesum*, *Harpinia* sp., *Metopella nasuta*, *Gammaropsis* sp., and *Dulichia* sp. were observed in five, Copepoda were observed in one, and Ostracoda in two. The remains of Annelids were observed in

four stomachs, and the remains of Starfishes (*Amphiura* sp.) in one. One or two specimens of Foraminifera were also obtained in three of these stomachs. The length of the fish in this sample ranged from 9 to 12 centimetres.

The lengths of the twenty specimens from the Clyde ranged from $9\frac{1}{5}$ to $11\frac{1}{2}$ cm., and it was evident from the contents of their stomachs that small Mollusca, Crustacea, and brittle Starfishes had been specially sought after for food. Small Mollusca, usually more or less fragmentary, were found in nineteen of these stomachs examined; *Montacuta bidentata* was of frequent occurrence, and was the only Molluscan species satisfactorily identified. The rare Isopod *Arcturella dilatata* was obtained in one of these stomachs—one specimen was fairly complete and there were fragments of other two. Amphipoda, which were not very common, were observed in five stomachs. No Copepods were observed, but Ostracoda—chiefly *Bythocythere turgida*—were found in eight. Fragments of Echinoderms (chiefly brittle Starfishes) were found in all the stomachs except two, and the remains of Annelids in sixteen—these Annelid remains were sometimes distinguishable only by the bristles which were left after the soft parts had been more or less dissolved by the gastric fluid. A few Foraminifera, such as *Miliolina siminulum* and *Rotalia beccari*, were noticed in one or two of the stomachs.

It may be remarked that most of the organisms which, judging from the samples of fish examined, constitute the chief part of the food of Spotted Dragonets, are such as have their habitat upon or near the bottom of the water, and this would indicate that the habitat of the fish is also usually near the bottom.

In the following Table will be found a list of the organisms observed in the various stomachs examined:—

LIST OF SPECIES FOUND IN THE STOMACHS OF SPOTTED DRAGONETS.

CRUSTACEA.	OTHER THINGS.
<i>Eupagurus</i> sp. (remains).	<i>Natica</i> sp.
<i>Diastylis</i> sp.	Small Pecten.
<i>Artacilla</i> sp.	Small <i>Tellina</i> sp.
<i>Arcturella dilatata</i> , G. O. Sars (one nearly whole and fragments of other two).	<i>Montacuta bidentata</i>
<i>Ascidostoma obesum</i> (Spence Bate).	<i>Solen</i> sp. (jun.)
<i>Harpinia neglecta</i> , G. O. Sars.	Remains of <i>Terebella</i> sp.
<i>Harpinia</i> sp.	Remains of Annelids.
<i>Ampelisca</i> sp.	Remains of Starfishes
<i>Metopa</i> sp.	<i>Amphidotus</i> sp. (fragments).
<i>Metopella nasuta</i> (Boeck).	<i>Miliolina siminulum</i> .
<i>Gammaropsis</i> sp. (jun.)	<i>Rotalia beccari</i> .
<i>Dulichia</i> sp.	
<i>Cythere antiquata</i> , Baird.	
<i>Cytheridea papillosa</i> , Bosquet.	
<i>Bythocythere turgida</i> , G. O. Sars.	
<i>Cytheropteron latissimum</i> (Norman).	
<i>Machaerina tenuissima</i> (Norman).	
<i>Asterope marica</i> (Baird).	
<i>Acartia</i> sp.	
<i>Longipedia coronata</i> , Claus.	

LUMPSUCKER. *Cyclopterus lumpus*, L.

Considerably over three hundred specimens of Lumpsuckers were examined during the past two years, but the stomachs of a large propor-

tion of them were either empty or filled with a watery fluid of about the same specific gravity as ordinary sea water. The fact that the stomachs of these fishes are found so frequently containing more or less of this watery fluid, and having sometimes mixed up with it a comminuted and whitish-coloured matter, has given rise to curious conjectures concerning the food supply of these fishes. P.-J. van Beneden in his work on *Animal Parasites* remarks that "Fishermen affirm, and the examination of the animal's stomach confirms their assertion, that the *Cyclopterus lumpus* feeds on nothing but the excreta of other fishes."* It is probably for this reason that he calls the Lump-suckers "crotophagous fishes."† Occasionally I have found the stomachs of Lump-suckers well filled with small Cœlenterates, such as *Pleurobrachia* or *Beroë*, and perhaps the occurrence of the comminuted bodies of such organisms may, partly at least, account for this opinion.

The Lump-suckers referred to here were all, with the exception of two small specimens from Annan, captured in the Bay of Nigg, near Aberdeen, in the nets of the salmon fishers. It would appear that the Lump-suckers come into the Bay to spawn, and the specimens captured in the salmon-nets, and which I examined, were therefore for the most part adult forms. The length of the two small specimens sent from Annan (Solway Firth), and which were collected on April 30th, 1900, measured 4.2 and 4.5 centimetres respectively; the only food found in the stomachs of these specimens consisted entirely of remains of *Gammarus locusta*. The Lump-suckers from the Bay of Nigg, which numbered one hundred and forty-four, were all, with the exception of eleven, collected during the present year (1901). The eleven referred to were captured between the 16th and 18th of May, 1900, and are included here because the stomachs of a few of them contained a considerable number of Copepoda, chiefly *Temora longicornis*, whilst among other things observed were *Centropages hamatus*, *Gammarus locusta*, and *Idothea baltica*. In the stomachs of five specimens collected in the salmon-nets in February no solid food was found nor anything that could be identified; but in the stomachs and intestines of four of the specimens a considerable quantity of watery fluid was observed; young cestoid parasites were frequent, especially in their intestines, but the fish were apparently in a healthy condition. Forty Lump-suckers were examined during March; the stomachs of seven, taken on the 9th of the month, were all more or less filled with watery fluid, nothing that could be identified being noticed. The stomachs of two captured on the 13th contained a quantity of matter closely resembling *Pleurobrachia* or some similar Cœlenterate, but was not sufficiently perfect for identification. Five captured between the 14th and 15th had their stomachs more or less full of fluid. On the 19th thirteen specimens, comprising ten males and three females, were captured; and in the stomachs of four of the males were found the remains of Amphipods and Isopods, the following species being distinguished, viz.:—*Hyperia galba*, *Calliopius leviusculus*, *Gammarus locusta*, and *Idothea emarginata*; the contents of the other stomachs consisted only of a little semi-fluid matter. Seven specimens were captured between the 21st and 22nd, but only in the stomachs of two was there anything that could be identified. One of these contained the remains of *Pandalus montagui*, and the other the remains of *Gammarus locusta*; the other stomachs contained the usual watery fluid. Of the five specimens captured on the 27th, two contained watery fluid, two were empty and greatly distended with air, while in one the remains of a chætopod Annelid and a specimen of *Hyperia galba* were observed.

* *Animal Parasites*, The International Scientific Series, vol. xx., p. 79 (1876).

† *Les Poissons des Côtés de Belgique*.

Forty-five Lump-suckers were examined in April. In the stomach of one captured on the 11th a single Amphipod (*Amathilla* sp., jun.) was observed. In the stomach of one captured on the 13th one *Pandalus montagui*, a number of *Calanus finmarchicus*, and one or two Hyperids (gen. et sp. ?), were obtained as well as the remains of Annelides, and a considerable quantity of whitish semi-fluid matter, consisting partly at least of Cœlenterata. In the stomach of a male Lump-sucker captured on the 16th the following organisms were noticed—fragments of several *Pandalus montagui*, one young *Amathilla* (sp. ?), a few specimens of *Temora longicornis*, and the remains of several Annelids; in the stomach of another captured at the same time there was a quantity of matter consisting apparently of small Cœlenterates. In the stomach of a specimen captured on the 18th I obtained *Amathilla homari* and the remains of some Annelids, while fragments of *Pandalus montagui* were obtained in the stomachs of two collected on the 29th. Small Cœlenterates occurred in the stomachs of two of the five Lump-suckers collected on the 30th of April; the Cœlenterates were numerous in one of the stomachs referred to along with the remains of Annelids, but only a few Cœlenterates were observed in the other.

Thirty-three Lump-suckers were captured in May. Seven specimens were collected on May 1st, but only two of them contained food, which consisted of a considerable quantity of small Cœlenterates; and in the stomach of another collected on the 2nd, fragments of a moderately large *Idothea* (?) *baltica* were observed; *Temora longicornis*, the remains of at least four Annelids, and a few larval *Balani* (cypris stage) were also obtained. Five Lump-suckers were captured on May 3rd, and the stomach of one of them was well filled with what looked like small Cœlenterates, and mixed up with them were a number of *Temora longicornis*, apparently only recently swallowed, one or two *Calanus finmarchicus*, larval *Balani* (cypris stage), and the remains of one or two Annelids. On the fins of this specimen several small tumours were observed, which, when opened, were found to contain numerous but extremely minute living Psorosphæræ; some were of a globular form and filled with granular matter, but the greater number were pear-shaped and furnished with two flagella at the narrow end. The gall-bladders of some of these fishes were also infested with larval Cestoids, and similar organisms were of frequent occurrence in the intestines. One *Idothea pelagica* and a number of *Temora longicornis* were mixed up amongst a quantity of whitish semi-fluid matter in the stomach of one of four Lump-suckers collected on the 9th, and numerous specimens of *Temora*, mixed up with similar whitish matter, occurred in the stomach of another; both of these stomachs were those of male fishes. Ten Lump-suckers were captured between the 13th and 16th of the month, and the stomachs of three or four of them contained small Cœlenterates and remains of Annelids. *Temora longicornis* and larval *Balani* were also frequent. Seven Lump-suckers were captured in the month of June and three in July, but after the 18th of the latter month no more were obtained, and they appear to have left the Bay about that time. The stomachs of two of those obtained in June contained small Cœlenterates and *Temora longicornis*, and one of those captured in July was also filled with Cœlenterates consisting for the most part of *Pleurobrachia*. It may be of interest to note the fact that the stomachs containing food which could be most easily identified were usually those of male fishes; the great majority of the stomachs of female fishes examined were either empty or contained a thin fluid differing little, if at all, from sea water. The apparent absence of food in the majority of adult Lump-suckers has been taken special notice of

by Professor van Beneden, who remarks that "On trouve rarement des traces de pâture dans les poissons adults,"* while the only food observed by him that could be identified consisted of small Mysidæ and *Crangon*, and these occurred not in the stomachs of adults but of young specimens measuring from 1 to 3½ centimetres in length.†

The following is a list of species obtained in the stomachs of the Lumpsuckers examined:—

LIST OF SPECIES FOUND IN STOMACHS OF LUMPSUCKERS.

CRUSTACEA.	OTHER THINGS.
<i>Pandalus montagui</i> , Leach (remains). <i>Idothea emarginata</i> (Fabr.). ,, <i>pelagica</i> , Leach. <i>Hyperia galba</i> (Mont.). <i>Calliopius laeviusculus</i> (Krøyer). <i>Amathilla homari</i> (Fabr.) <i>Gammarus locusta</i> (Linné). <i>Calanus finmarchicus</i> (Gunner). <i>Temora longicornis</i> (O. F. Müller). <i>Balanus</i> (cypris stage).	Annelid remains. Small Coelenterates. <i>Berœe</i> , etc. <i>Pleurobrachia</i> .

CAT OR WOLF-FISH. *Anarrhichus lupus*, L.

Only one or two stomachs of Cat-fishes have been examined; they were collected in the Moray Firth, and the food observed consisted chiefly of lamellibranch shells (*Cardium echinatum*, etc.) in a very fragmentary condition and of Crustacea. The only Crustacean that could be identified was *Atelecyclus septemdentatus*, and only the claws of this were available for identification.

BUTTER-FISH. *Pholis gunnellus*, L.

The stomachs of fourteen specimens of *Pholis gunnellus*, sent from Annan (Solway Firth) in April and May, 1900, were examined, but the food they contained, besides being small in quantity, was not in very good preservation. Three of the stomachs contained Mussel fry; eleven contained small or young Crustacea, comprising young *Idothea*, *Gammarus locusta* (and perhaps one or two other Amphipods), and Ostracods belonging to the two species *Cythere viridis* and *Cytherura similis*. Four contained specimens of marine Acarides, while in another a few insect larvæ were observed. These Annan Butter-fishes ranged from 7½ to 15 centimetres in length, but though there was a considerable difference in size between the smallest and largest, there was no appreciable difference in the nature of their food.*

The stomachs of seven specimens from the Moray Firth, which were collected on May 18th, 1901, and measured from 10 to 16 centimetres in length, contained very little food, and so far as it could be identified it consisted almost entirely of small Crustaceans (Amphipods chiefly). In the stomach of one of the smaller fishes several insect larvæ were observed.

The food observed in the stomachs of nine Butter-fishes collected in the Firth of Forth on May 13th, 1901, comprised a much greater

* *Les Poissons des Cotes de Belgique*, p. 51.

† *Op. cit.*, p.

variety of organisms than was observed in the other two samples. The food of this sample of fishes, like that of the other two, consisted almost entirely of Crustaceans, and included such forms as *Pandalus montagui* (jun.), *Pandalina brevirostris*, Mysidæ, *Erichthonius deformis*, *Dulichia porrecta*, and the cypris stage of *Balanus* sp. The remains of a young fish were also observed in one of the stomachs from the Forth. One of the more interesting things observed was *Phryxus abdominalis*, female and male; probably this parasite had been adhering to the *Pandalus* or *Pandalina* when swallowed by the fish and had afterwards become detached.

The following is a tabulated list of the various species obtained in the stomachs of the Butter-fishes examined:—

SPECIES IN STOMACHS OF BUTTER-FISH.

CRUSTACEA.	OTHER THINGS.
<i>Pandalus montagui</i> , Leach.	Remains of young fish.
<i>Pandalina brevirostris</i> (Rathke).	
Mysidæ (gen. et sp. ?)	Small Mussels.
<i>Idothea</i> sp.	Insect larvæ.
<i>Phryxus abdominalis</i> (Krøyer).	
<i>Metopa</i> sp.	
<i>Paramphithoë monocuspis</i> , G. O. Sars.	
<i>Gammarus</i> sp.	
<i>Melita</i> (?) <i>obtusata</i> (Mont.).	
<i>Photis tenuicornis</i> , G. O. Sars.	
<i>Podoceropris excavata</i> (Spence Bate).	
<i>Erichthonius deformis</i> , M. Edwards.	
„ <i>hunteri</i> (Spence Bate).	
<i>Dulichia porrecta</i> , Spence Bate.	
„ <i>falcata</i> , Spence Bate.	
<i>Protella phasma</i> (Mont.).	
<i>Cytherura similis</i> , G. O. Sars.	
<i>Lichomolgus hirsutipes</i> , T. Scott.	
<i>Balanus</i> (cypris stage).	

Macrurus lævis, Lowe.

Through the kindness of Dr. Fulton I am able to add a note on the food of this rather rare species of fish. The stomachs of five specimens which had been captured off St. Kilda by an Aberdeen trawler in September last, and which measured approximately 29, 31, 31, 33, and 42 centimetres respectively, were found to contain Crustacea and small fishes, but they were for the most part fragmentary. One contained a small *Galathea* sp. and a small stone; fragments of *Crangon allmanni* were observed in two; an Amphipod, the species of which could not be determined, was found in one, and the remains of small fishes (? Clupeoids) in three. It is apparent that, from the nature of the food, these specimens of *Macrurus* had been feeding near or at the bottom.

VIVIPAROUS BLENNY. *Enchelyopus* (*Zoarces*) *viviparus*, L.

Ten stomachs of *Zoarces* have been examined. One was from Annan (Solway Firth), but the food in the stomach of this one was so much decomposed as to be indistinguishable.

Nine were captured by Dr. Williamson in the Bay of Nigg in crab creels; the stomachs of six of these were empty, two contained small

Crustacea which could not be determined, and one contained small Molluscs and Amphipods (*Podocerus falcatus* chiefly), the Mollusca comprised young *Mytilis edulis* and Gastropods. The specimens of *Zoarces* examined ranged from about 23 to 28 centimetres in length.

SHARP-TAILED LUMPENUS. *Lumpenus lampretiformis* (Walb.).

Twenty-five specimens of Lumpenus have been examined; they comprised twenty-two from the Firth of Forth, collected in May and July of the present year (1901), and three from the Clyde, collected in 1897 but not examined till January 17th, 1901. The stomachs of all the specimens contained food, and in some cases in considerable quantity, but the organisms of which it was composed were generally small. A considerable proportion of the food consisted of Copepods and Ostracods, but several other groups of Crustaceans were also represented. Mollusca, Annelida, and brittle Starfishes also contributed to the Lumpenus' "bill of fare." The three Clyde specimens measured $15\frac{4}{5}$, $16\frac{3}{5}$, and $22\frac{2}{5}$ centimetres respectively; the stomach of one of these contained a few specimens of Ostracods (*Krithe bartonensis* and *Cytheridea* sp.) and Annelids. In the stomach of another *Cytheridea papillosa* and remains of Annelids were observed, while the stomach of the third contained the following among other organisms—young *Cardium* sp., *Nucula* sp. and *Cylichna* sp., *Eudorella truncatula*, and *Leptognathia breviremis*; *Cythere porcellanea*, *Krithe bartonensis*, *Cytheridea papillosa* and other Ostracods; *Longipedia coronata*, *Ectinosoma* sp., and other Copepods not determined.

The food observed in the stomachs of ten specimens captured at Station V., Firth of Forth, on May 13th, 1901, was composed of a great variety of organisms, and all the stomachs were well filled. Mollusca were found in two of the stomachs, and comprised small specimens of *Nucula tenuis*, *Corbula gibba*, *Tellina* sp., and *Montacuta substriata*. Crustacea formed the principal part of the food in the stomachs of almost all the fishes in this sample. Sympoda (Cumacea) occurred in five stomachs, but the only forms observed were *Leucon nasica* and *Diastylis* sp.; *Leptognathia breviremis*—one of the Isopoda chelifera—was found in one. Amphipods, comprising *Leucothoë lilljeborgii*, *Ampelisca* sp., *Protomedeia fasciata*, *Dulichia falcata* and other species were observed in four, Ostracoda were present in eight stomachs, and included the following amongst other species—*Cythere concinna* and *dunelmensis*, *Krithe bartonensis*, *Bythocythere simplex*, and *Philomedes interpuncta*. The Copepoda were represented by several species, but the following two were the most common, viz., *Longipedia coronata*, which was moderately abundant in several of the stomachs, and *Robertsonia tenuis*, which was also "frequent" or "common" in several, and usually in company with the *Longipedia*. Larval *Balani* (cypris stage) were present in a few, while marine Acarides and Foraminifera, the remains of Annelids, and the fragments of brittle Starfishes were also occasionally observed. The specimens of Lumpenus in this sample ranged from 28 to a little over 34 centimetres in length.

The second sample of Lumpenus from the Firth of Forth comprised twelve specimens, which were collected at Station III. on July 13th, 1901. The stomachs of all these specimens contained food which for the most part could be easily identified, and the organisms which appeared to be most in favour with the fish were *Longipedia*, these Copepods being present in eleven out of the twelve stomachs examined. There appeared to be less variety in the food of this sample than in that of the last, and a few organisms were observed which did not appear to be present in the last sample. The Sympoda were represented by *Leucon nasica*, *Eudorella*

truncatula, and *Pseudocuma cercaria*. No Isopods were observed. The Amphipods comprised such forms as *Ampelisca* (?) *assimilis*, *Halimедon parvimanus*, and *Harpinia neglecta*. The only Ostracod noticed was *Cythere emaciata*. The Copepods, as already remarked, formed the principal part of the food of this sample. *Longipedia* (chiefly *L. coronata*) was abundant in three of the stomachs, frequent in other three, and few or moderately rare in five; *Robertsonia tenuis* was observed in four stomachs, and *Ectinosoma sarsi* in four; *Jonesiella spinulosa* was moderately rare in three, and *Ameira reflexa* in one. Young Mollusca were abundant in one of the stomachs examined, while in six the remains of Annelids were found. It may be noted in passing that *Pseudocalanus elongatus* and *Temora longicornis* were the only "pelagic" forms observed in all the stomachs examined, and these two forms were very rare; it would thus appear that the Lumpenus collects its food chiefly from amongst bottom fauna, and that the smaller Crustacea are the organisms that are most in favour with the fish.

The following tabulated list contains the names of all the species observed in the stomachs examined.

SPECIES FOUND IN THE STOMACHS OF LUMPENUS.

CRUSTACEA.	OTHER THINGS.
<i>Leucon nasica</i> , Kröyer.	Annelids (small).
<i>Eudorella truncatula</i> (Spence Bate).	<i>Natica</i> sp. (jun.)
<i>Diastylis</i> sp.	<i>Tellina</i> sp.
<i>Pseudocuma cercaria</i> (v. Beneden).	<i>Montacuta substriata</i> .
<i>Leptognathia breviremis</i> (Lilljeborg).	<i>Beloculina</i> sp.
<i>Harpinia neglecta</i> , G. O. Sars.	<i>Nucula tenuis</i> .
<i>Ampelisca</i> sp. (? <i>assimilis</i>)	<i>Corbula gibba</i> .
<i>Leucothoë lilljeborgii</i> , Boeck.	<i>Rotalia beccari</i> .
<i>Periocolodes longimanus</i> (Spence Bate).	<i>Cylichna</i> sp.
<i>Halimедon parvimanus</i> (Spence Bate).	<i>Cardium</i> sp. (jun.).
<i>Autonoë longipes</i> (Lilljeborg).	
<i>Protomedeia fasciata</i> , Kröyer.	
<i>Dulichia falcata</i> , Spence Bate.	
„ sp.	
<i>Cythere porcellanea</i> , Brady.	
„ <i>concinna</i> , Jones.	
„ <i>emaciata</i> , T. R. Jones.	
„ <i>tuberculata</i> (G. O. Sars).	
„ (?) <i>finmarchica</i> (G. O. Sars).	
„ <i>dunelmensis</i> (Norman).	
<i>Cytheridea papillosa</i> , Bosquet.	
„ <i>punctillata</i> , Brady.	
<i>Krithe bartonensis</i> , T. R. Jones.	
<i>Bythocythere simplex</i> (Norman).	
<i>Cytherideis subulata</i> , Brady.	
<i>Machaerina tenuissima</i> (Norman).	
<i>Philomedes interpuncta</i> (Baird).	
<i>Pseudocalanus elongatus</i> , Boeck.	
<i>Temora longicornis</i> (O. F. Müller).	
<i>Longipedia coronata</i> , Claus.	
„ <i>minor</i> , T. and A. Scott.	
<i>Bradya typica</i> , Boeck.	
<i>Ectinosoma sarsi</i> , Boeck.	
<i>Robertsonia tenuis</i> (Brady and Robertson).	
<i>Ameira reflexa</i> , T. Scott.	
<i>Jonesiella spinulosa</i> , Brady.	
<i>Cletodes</i> (?) <i>longicaudata</i> , Brady and Robertson.	
<i>Balanus</i> (cypris stage).	

SAND SMELT. *Atherina presbyter*, Cuv.

Twelve Sand Smelts, part of a small lot captured in Inverneil Bay on October 31st, 1899, were recently examined. The length of the specimens ranged from $5\frac{1}{2}$ to $8\frac{2}{5}$ centimetres, and the stomachs of every one of the twelve examined contained Copepods in considerable abundance. One stomach was fairly well filled with *Oithona* sp.; one contained *Oithona* sp. and fragments of an insect; but in the other ten the food consisted of nearly equal numbers of *Oithona* and *Acartia*. In one of these ten there were also the remains of a few larval decapod Crustacea, and in another a young *Calanus finmarchicus*. The *Oithonas* contained in these stomachs appeared to be the one known as *O. spinifrons* (or *O. helgolandica*); the *Acartia* was *A. clausi*.

GREY MULLET. *Mugil chelo*, Cuv.

In the summer of 1900 three Grey Mulletts were captured in the salmon fishers' nets in the Bay of Nigg, near Aberdeen; two were taken on June 20th and one on July 4th, but only one stomach (one of the two captured in June) contained food, and this consisted almost entirely of *Rhizoselenia*; there was a considerable quantity of these organisms in this stomach, and mixed up with them were a few common Copepods—*Calanoids*.

THREE-SPINED STICKLEBACK. *Gasterosteus aculeatus*, L.

Twenty-nine specimens of these Sticklebacks have been examined, one from the Bay of Nigg, two from the Moray Firth, and twenty-six from Loch of Loirston—within three or four miles from Aberdeen. The food observed in the stomach of the specimen from the Bay of Nigg consisted entirely of marine Copepods belonging to the Harpacticidæ, and they included *Ectinosoma* sp., *Stenhelia* sp., *Dactylopus tisboides*, and *Harpacticus* sp. (probably *H. fulvus*); this Stickleback measured $6\frac{7}{10}$ centimetres in length.

The stomachs of the two specimens from the Moray Firth contained small flat-fishes partly digested, and young Mysidæ. A number of Copepods, chiefly *Ectinosoma*, were also observed in one of them, as well as a few larval *Balani* (cypris stage). These two specimens of *Gasterosteus* measured $6\frac{3}{10}$ and $6\frac{1}{2}$ centimetres in length respectively.

The twenty-six specimens from Loch of Loirston ranged from about $3\frac{1}{2}$ to 5 centimetres in length, but the length of most of them did not exceed $4\frac{1}{2}$ centimetres. The stomachs of all the specimens, with only one or two exceptions, contained Entomostraca in fewer or larger numbers. *Cyclops serrulatus* and *Bosmina longirostris* were the two species most frequently noticed; the names of the others will be found in the tabulated list. Insect larvæ were observed in a number of the stomachs, and every one of these fishes was infested with cestoid parasites (*Schistocephalus*), the body cavity of the fish being in some instances crammed with them; eight comparatively large *Schistocephali* were taken from the body cavity of a Stickleback scarcely 5 centimetres in length.

LIST OF SPECIES FROM THREE-SPINED STICKLEBACKS.

CRUSTACEA.	OTHER THINGS.
Mysidæ (gen. et sp. ?)	Small flat fish (remains). Insect larvæ.
<i>Cypria ophthalmica</i> (Jurine).	
<i>Cyclops viridis</i> (Jurine).	
„ <i>albidus</i> (Jurine).	
„ <i>serrulatus</i> , Fischer.	
„ <i>fimbriatus</i> , Fischer.	
<i>Ectinosoma</i> sp.	
<i>Canthocamptus staphylinus</i> (Jurine).	
„ <i>minutus</i> , Claus.	
„ <i>crassus</i> , G. O. Sars.	
„ <i>zschokkei</i> .	
<i>Stenhelia</i> sp.	
<i>Dactylopus</i> sp.	
<i>Harpacticus</i> (?) <i>chelifer</i> (O. F. Müller).	
<i>Bosmina longirostris</i> (O. F. Müller).	
<i>Alona quadrangularis</i> (O. F. Müller).	
<i>Harporhyncus falcatus</i> , G. O. Sars.	
<i>Chydorus sphaericus</i> , O. F. Müller.	
„ (?) <i>cœlatus</i> , Schoedler.	
„ <i>barbatus</i> (G. S. Brady).	
<i>Balanus</i> (cypris stage).	

FIFTEEN-SPINED STICKLEBACK. *Gastræa spinachia* (L.).

Five Fifteen-spined Sticklebacks were examined, but their stomachs contained very little food that could be identified. In the stomach of one from the Bay of Nigg, $12\frac{3}{10}$ centimetres in length, a few partially digested Amphipods, too imperfect to be determined, were found; and as for the other four, which were from Annan (Solway Firth), the stomach of one was empty, the stomach of another contained Crustacean remains which could not be distinguished; a partially digested Isopod (*Idothea baltica*) was obtained in the third, while the food contained in the fourth comprised *Idothea* sp. (probably *I. baltica*), *Gammarus locusta*, and *Jæra* sp. The lengths of the Annan specimens ranged from $10\frac{1}{2}$ to $14\frac{7}{10}$ centimetres.

COD-FISH. *Gadus callarius*, L.

The stomachs of the Cod-fishes referred to here have been examined at different times, and they have been obtained at different places, including the Firth of Forth, Aberdeen Bay, the Bay of Nigg near Aberdeen, the Moray Firth, and the estuary of the Annan (Solway Firth). One or two of the samples consisted of very small fishes, and these are considered separately.

A sample of eighteen collected at Annan on June 26th, 1900, ranged in length from 5 to 8 centimetres; the stomachs of all these contained food, the principal part of which consisted of Schizopods, and the specimens that were sufficiently perfect for identification belonged chiefly to *Neomysis vulgaris* (J. V. Thomp.), but a few of them appeared to be the common *Praunus* (*Mysis*) *flexuosus*. Small specimens of *Crangon vulgaris* were observed in two of the stomachs, and *Gammarus locusta* was obtained in four; one or two other Amphipods such as *Bathyporeia* sp. and *Corophium grossipes* were also noticed. *Eurytemora* (?) *velox* was

frequently met with in these stomachs, and even spermatophores which had become detached from the females were obtained. The organisms obtained in the stomachs of these Annan specimens were all more or less estuarine and littoral forms.

A small sample of specimens, ranging from $8\frac{6}{10}$ to 11 centimetres in length, and collected in the vicinity of Aberdeen in October, 1900, had, like the Annan specimens, their stomachs moderately full of Schizopods, but in this case the species was *Schistomysis spiritus*; these organisms were absent from only one of the seven stomachs examined. Fragments of *Crangon* sp. and of a few Amphipods occurred in one or two stomachs, but no Copepods or other minute forms were observed. A small specimen about $47\frac{1}{2}$ millimetres in length, captured in the Moray Firth off Golspie, had its stomach filled with *Calanus finmarchicus*, *Thalestris* sp., and other Copepoda; larval *Balanus* (cypris stage) were also present. The food in this example is more characteristic of the open sea than is the case with the other two, but its only significance is that the young Cod seem to have a special liking for small Crustaceans, though not for particular species.

Four specimens from the Firth of Forth, of a somewhat larger size than those already referred to, and collected on May 13th, 1901, had their stomachs partly filled with *Portunus holsatus*; but these Crustaceans having been subjected for a while to the action of the gastric fluid were not in very good preservation. The length of these small Cod ranged from $19\frac{3}{10}$ to 23 centimetres. The stomach of another specimen from the Firth of Forth, collected also in May, and measuring $20\frac{1}{2}$ centimetres, contained *Portunus pusillus* and *Eupagurus pubescens*.

A small Cod, $18\frac{1}{2}$ centimetres in length, taken off Collieston, Aberdeenshire, had also fragments of *Eupagurus* sp. in its stomach. Evidently Crustaceans were more in favour with these small Cod as food than any other kind of organism.

The following examples were all larger than those already mentioned, but their exact sizes could not always be obtained; they would probably, however, range between 50 and 75 centimetres in length, except in the case of some extra large specimens, the measurements of which are given.

The stomachs of nine Codlings captured in the salmon nets at the Bay of Nigg in April and May, 1900, contained *Portunus holsatus*, *Crangon vulgaris*, *Galathea rugosa*, *Idothea baltica*, and *Caprella septentrionalis*; Crustaceans only were observed in these stomachs. In the stomach of a large Cod from the same place, taken on July 27th, 1900, only partially digested fishes were found; the food in this example was too much decomposed for identification. The heads and viscera of two Codlings obtained from the salmon fishers at the Bay of Nigg on February 19th, 1901, were examined, but the only food observed in the stomachs consisted of fragments of *Galathea* (?) *rugosa* and the remains of some other Crustacea. The stomach of a moderately large Cod, captured in the salmon nets on May 18th, 1901, contained two female shore crabs, *Carcinus maenas* (with eggs nearly ripe), one common Dab about $12\frac{1}{2}$ centimetres long, one *Parajassa pelagica*, and a large number of *Caprella septentrionalis*. A small Cod, taken on July 20th, had in its stomach the remains of small flat fishes, two or three *Portunus holsatus*, and of an Amphipod—*Jassa falcata*; while another, about $77\frac{1}{2}$ centimetres in length, captured on the 19th of August, had in its stomach the remains of *Portunus* sp. and fishes. (Over one hundred specimens of the Copepod species *Bomolochus soleæ* were removed from the nostrils of this Cod.) In the stomach of a Cod from the Aberdeen Fish Market, examined at the Laboratory in October, and the length of which was 103

centimetres, a Long Rough Dab, *Drepanopsetta platessoides* (Fabr.), measuring 19 centimetres in length, was obtained; while in the stomach of the Dab portions of several young *Portunus* sp. were found. Several specimens of a cestoid parasite (*Abothrium*) were obtained in the intestines of this Cod, but each parasite had its head inserted into one of the cæcal tubes. The stomach of another cod from the Fish Market, measuring 89½ centimetres, and examined on November 6th, contained three adult Norway Lobsters (*Nephrops norvegicus*), a small *Lucina* (?) *spinifera*, and a fragment of a *Cardium*, while the stomach of another specimen about 82½ centimetres, captured in Aberdeen Bay on November 29th, 1901, contained one Haddock about 16½ centimetres in length, the remains of some other fishes, and a considerable portion of the body of a large *Buccinum undatum* with the operculum attached.

The following is a tabulated list of species which the Cod, referred to in the preceding notes, had captured in the way of food.

SPECIES OBSERVED IN THE STOMACHS OF COD.

CRUSTACEA.	OTHER THINGS.
<i>Carcinus maenas</i> (Pennant).	Haddock.
<i>Portunus holsatus</i> , Fabricius.	Long Rough Dab (19 centimetres).
„ <i>pusillus</i> , Leach.	Common Dab.
<i>Eupagurus pubescens</i> (Kröyer).	Fish remains (sp. ?)
„ sp. (remains).	<i>Cardium</i> sp.
<i>Galathea</i> ? <i>strigosa</i> , Fabricius.	<i>Lucina spinifera</i> .
<i>Nephrops norvegicus</i> (Lin.).	<i>Buccinum undatum</i> .
<i>Crangon vulgaris</i> (Lin.).	Starfish remains
„ sp.	(<i>Ophiura</i>).
Small brachyura (gen. et sp. ?)	
<i>Praunus</i> ? <i>flexuosus</i> (O. F. Müller).	
<i>Schistomysis spiritus</i> , Norman.	
<i>Apherusa</i> sp.	
<i>Gammarus locusta</i> (Lin.).	
<i>Parajassa pelagica</i> (Leach).	
<i>Corophium grossipes</i> (Lin.).	
<i>Caprella septentrionalis</i> (Kröyer).	
<i>Calanus finmarchicus</i> (Gunner).	
<i>Eurytemora velox</i> (Lilljeborg).	
<i>Ectinosoma</i> sp.	
<i>Thalestris</i> sp.	
Copepods (gen. et sp. ?)	
<i>Balanus</i> (cypris stage).	

HADDOCK. *Gadus aeglefinus*, L.

The stomachs of one hundred and twenty Haddocks have been examined for the purposes of this paper; fully 78 per cent. of these specimens were collected south-eastward of the Shetland and Fair Islands, about 17½ per cent. are from deep water—58 to 65 fathoms—about 10 miles off Aberdeen; of the other specimens, two are from the Clyde and two from the Moray Firth.

Fifty-five of the Haddocks from the Shetland district were collected 65 miles south-east of Sumburgh Head, on September 4th, 1900; thirty-one of them ranged from 8 to 11 centimetres (3½ to scarcely 4½ inches) in length, but the other twenty-four were of average size. The stomachs of the thirty-one small specimens contained food which consisted for the most part of small Crustacea; the remains of Annelids were observed in

a number of the stomachs, while small Molluscan shells and fragments of Starfishes and Foraminifera were obtained in only one or two. The Crustacea included representatives of nearly all the important groups, except the Brachyura and the Schizopoda; young *Crangon* sp. (probably *C. allmanni*) occurred in a few of the stomachs, but the Sympoda (*Hemilamprops rosea* and others) were rarely noticed. On the other hand, Amphipods, Ostracods, and Copepods were of frequent occurrence. Amongst the Amphipods *Dulichia monacantha* and *porrecta* were the forms most frequently met with, but *Metopella nasuta* and *Gammaropsis nanus* were also occasionally observed as well as one or two of the more common species. *Bythocythere simplex* and *Krithe bartonensis* were the two Ostracod species most frequently obtained, while the Copepoda most commonly met with were *Ectinosoma sarsi* and *Idya furcata*. *Leptognathia breviremis*, one of the Isopoda-chelifera, was also found in one or two stomachs. No trace of fish remains was observed in the stomachs of any of this sample of small Haddocks. The stomachs of the larger Haddocks, captured at the same place and on the same date as the smaller specimens just referred to, contained food which was largely composed of Crustacea, though not so exclusively as in the previous sample, the grouping of the species was also somewhat different. The Sympoda were more frequently represented, and the species belonging to this group were more varied; small shell-fish were more frequent, and the remains of young fishes were also on one or two occasions obtained. Decapods (*Eupagurus* sp., and *Crangon allmanni*) were only observed in three of the twenty-four stomachs examined. Schizopods (*Erythropis serrata*) occurred in three. Sympoda, comprising *Hemilamprops rosea*, *Leucon nasica*, *Eudorella truncatula*, *Diastylis cornuta*, *Diastylodes biplicata*, *Campylaspis* sp., etc., were obtained in at least sixteen stomachs. Amphipoda, including amongst them the somewhat rare *Metopella nasuta* and *Aceros phyllonyx*, were even of more frequent occurrence. No Isopods were observed in the stomachs of this sample. The only Ostracod observed was *Philomedes interpuncta*, which occurred once. Copepods were also rarely met with, *Robertsonia tenuis* being the only species identified. Fully 75 per cent. of the stomachs contained partially digested Annelids (Chætopods), which in some cases were only identified by the presence of their bristles. The Mollusca comprised both Lamellibranchs and Gasteropods, but chiefly the former, and were represented by such forms as *Scrobicularia* sp., young *Solen* sp., and *Philine*. The fish remains observed were chiefly those of young flat-fishes—a small Long Rough Dab being one of those identified.

Two samples of Haddocks—one consisting of twenty-five small specimens ranging from 11 to $14\frac{2}{5}$ centimetres, and one of ten specimens of average size, and collected about fifty miles south-eastward of Fair Island—were also examined; but as the contents of the stomachs of these two samples resembled very closely those already described, both as to the quantity and the variety of the organisms observed, it is not necessary that a detailed description of them should be given; a full list of the organisms observed will be found in the annexed Table.

Two Haddocks which were captured in the Clyde at Station IV. (Kilbrennan Sound) in 18 to 20 fathoms on October 4th, 1899, gave the following results:—One which measured $26\frac{1}{2}$ centimetres in length had in its stomach eighty specimens of *Nyctiphanes norvegicus* of an average length of about 33 millimetres; the stomach of the other, which was a smaller fish and measured 22 centimetres long, contained one hundred and eighty *Nyctiphanes*, the length of the majority of which was about 20 millimetres.

In the stomach of a Haddock—one of a sample from Smith Bank,

Moray Firth—captured on June 5th, 1901, a quantity of food was obtained consisting chiefly of *Oikopleura* (*Appendicularia*), and young *Echinocardium*.

A sample of twelve Haddocks captured in 65 fathoms off Aberdeen on May 17th, 1901, and measuring from 17 to $21\frac{3}{10}$ centimetres in length, had all apparently been recently feeding, but they had evidently from choice or necessity limited their efforts to the selecting of small shell-fishes (young *Corbula gibba*, *Cylichina alba*, and *Philine scabra*), small Crustacea of various kinds, small Annelids, and brittle Starfishes. Foraminifera comprising *Biloculina* sp., *Miliolina* sp., *Rotalia beccari*, and others were also not infrequent, but whether these were introduced into their stomachs from adhering to or forming the food of the other organisms captured or intentionally selected by the fish, is a question which in some cases at least would be difficult to answer satisfactorily. Crustacea, as usual, formed a large part of the food found in the stomachs of these fishes, and the following are a few of the rarer forms observed:—*Hemilamprops rosea* was observed in seven stomachs, *Eudorellopsis deformis* in one, and *Campylaspis affinis* in one; *Metopa rubrovittata* was observed in one stomach, and *Metopella nasuta* in seven; *Phoxocephalus holbolii* occurred in at least one stomach, and *Amphilochoides intermedius* in one, while *Unciola planipes* was found in four. A few Ostracods, of which *Bythocythere turgida* was the more frequent, and the Copepod species *Longipedia coronata*, were also occasionally observed. In none of these stomachs were any fish remains found. Another sample of Haddocks from the deep water (about 58 fathoms) ten miles off Aberdeen, and collected on September 3rd, 1901, was also examined; the specimens in this sample, which were smaller than the last, ranged from $11\frac{3}{10}$ to $14\frac{3}{10}$ centimetres in length; all their stomachs contained food which as usual consisted largely of small Crustacea, chiefly Sympoda, Amphipoda, and Copepoda (*Longipedia coronata*). Fragments of a small slender Starfish (? *Amphiura*) were occasionally noticed, and also very small *Echinocyamus* (or young *Echinocardium* sp.), but no remains of Annelids or fishes were observed. The following are some Crustacean species observed in the stomachs of this sample but which were not noticed in those of the previous one, viz.:—*Petalosarsia declivis*, *Bodotria scorpioides* (Montague), and *Diastylis rugosa* belonging to the Sympoda; *Megaluropus agilis*, *Paramphithoë monocuspis*, *Gammaropsis erythrophthalmus*, and *Phtysica marina* belonging to the Amphipoda; *Asterope marice*—one of the Ostracoda—and *Temora longicornis* belonging to the Copepoda. Twelve specimens—part of another sample of small Haddocks from the deep water off Aberdeen—collected on November 28th, and ranging in length from about 16 to $18\frac{1}{2}$ centimetres, had apparently been all feeding just before they were captured, as the contents of their stomachs were in a fairly fresh condition when examined. The food observed consisted for the most part of Crustacea (young *Portunus*, *Crangon*, *Spirontocaris securifrons*, *Ampelisca macrocephala*, *Pontocrates altamarinus* and other Amphipods) and Echinoderms (chiefly *Amphiura* sp., and *Echinocyamus pusillus*—*Echinocyamus* occurred more or less frequently in every stomach examined, and in one no fewer than eighty-three specimens of this small Echinoderm were obtained); some Annelid remains and one or two small Molluscs (*Philine scabra*, etc.) were also noticed.

It is evident from an examination of the food of these Haddocks that, for a short time before they were captured, they had been feeding almost solely on bottom organisms; it may be that a scarcity of pelagic forms had caused them to seek their food from amongst the bottom fauna, but it is probable that they prefer such organisms instead of those whose habitat is more pelagic.

The following tabulated list will show the very varied character of the food of Haddocks:—

SPECIES FOUND IN THE STOMACHS OF HADDOCKS.

CRUSTACEA.	OTHER THINGS.
<i>Inachus</i> (?) <i>leptochirus</i> , Leach.	<i>Gobius</i> sp. (jun.).
<i>Eupagurus</i> sp. (small).	<i>Scrobicularia prismatica</i> .
<i>Anapagurus</i> (?) <i>chiroacanthus</i> (Lilljeborg).	<i>Scrobicularia</i> sp.
<i>Crangon allmanni</i> , Kinahan.	<i>Cardium</i> sp.
<i>Nyctiphanes norvegica</i> (M. Sars).	<i>Modiolaria discors</i> .
<i>Gastrosaccus spinifer</i> (Goës).	<i>Nucula</i> sp.
<i>Erythropros serratus</i> , G. O. Sars.	<i>Tellina tenuis</i> .
„ sp.	<i>Corbula gibba</i> .
<i>Bodotria scorpioides</i> (Montague).	<i>Solen</i> sp. (jun.).
<i>Iphinoë serrata</i> , Norman.	Lamellibranchia
<i>Lamprops fasciata</i> , G. O. Sars.	(sp.?)
<i>Hemilamprops rosea</i> (Norman).	<i>Philine scabra</i> .
<i>Leucon nasica</i> , Krøyer.	<i>Cylichna alba</i> .
<i>Eudorella truncatula</i> (Spence Bate).	<i>Cylichna</i> sp.
<i>Eudorella</i> sp.	<i>Eulima</i> sp.
<i>Eudorellopsis deformis</i> (Krøyer).	<i>Utriculus obtusus</i> .
<i>Diastylis cornutus</i> (Boeck).	<i>Scalaria</i> sp.
„ <i>rugosa</i> , G. O. Sars.	<i>Amphidotus cordatus</i> .
<i>Diastylodes biplicata</i> , G. O. Sars.	<i>Echinocyamus</i>
<i>Pseudocuma cercaria</i> (v. Beneden).	<i>pusillus</i> .
<i>Petalosarsia declivis</i> (G. O. Sars).	Starfish remains.
<i>Campylaspis rubicunda</i> (Lilljeborg).	<i>Oikopleura</i> .
<i>Leptognathia breviremis</i> (Lilljeborg)	<i>Biloculina oblonga</i> ,
<i>Gnathia maxillaris</i> (Montague).	<i>Biloculina depressa</i> .
<i>Paramunna bilobata</i> (G. O. Sars).	„ <i>subrotunda</i> .
<i>Acidostoma obesum</i> (Spence Bate).	<i>Spiroloculina</i> sp.
<i>Urothoë</i> sp.	<i>Globigerina</i> sp.
<i>Phoxocephalus</i> (?) <i>holbölli</i> (Krøyer).	<i>Bulimina</i> sp.
<i>Harpinia neglecta</i> , G. O. Sars.	<i>Rotalia beccari</i> .
<i>Harpinia</i> sp.	<i>Nonionina</i> sp.
<i>Ampelisca macrocephala</i> (Lilljeborg).	<i>Polymorphina</i> sp.
<i>Ampelisca</i> (?) <i>assimilis</i> , Boeck.	<i>Miliolina seminulum</i> .
<i>Ampelisca tenuicornis</i> , Lilljeborg.	<i>Orbiculina universa</i> .
<i>Ampelisca</i> sp.	
<i>Stegoplax brevirostris</i> (T. and A. Scott.)	
<i>Metopa bruzelii</i> , Goës.	
<i>Metopa rubrovittata</i> , G. O. Sars.	
<i>Metopella nasuta</i> (Boeck).	
<i>Amphilocheus manudens</i> , Spence Bate.	
<i>Amphilocheoides odontonyx</i> (Boeck).	
<i>Amphilocheoides intermedius</i> , T. Scott.	
<i>Amphilocheoides</i> sp.	
<i>Synchelidium brevicarpum</i> (Spence Bate).	
<i>Monoculodes</i> sp.	
<i>Halimedeson parvimanus</i> (Spence Bate).	
<i>Pontocrates altamarinus</i> (Spence Bate).	
<i>Paramphithoë monocuspis</i> , G. O. Sars.	
<i>Paratylus swammerdami</i> (M. Edwards).	
<i>Aceros phyllonyx</i> (M. Sars).	
<i>Dexamine</i> sp.	
<i>Melita obtusata</i> (Montague).	
<i>Megaluropus agilis</i> , Norman.	
<i>Gammaropsis maculata</i> , Johnstone.	
<i>Gammaropsis nanus</i> , G. O. Sars.	
<i>Photis tenuicornis</i> , G. O. Sars.	

SPECIES FOUND IN THE STOMACHS OF HADDOCKS—*continued.*

CRUSTACEA.	OTHER THINGS.
<p><i>Photis longicaudatus</i> (Spence Bate). <i>Unciola planipes</i>, Norman. <i>Siphonocæstus colletti</i>, Boeck. <i>Corophium affine</i>, Bruzelius. <i>Dulichia porrecta</i>, Spence Bate. <i>Dulichia falcata</i>, Spence Bate. <i>Dulichia monocantha</i>, Metzger. <i>Dulichia</i> sp. <i>Phytisica marina</i>, Slabber. <i>Cythere tuberculata</i> (G. O. Sars). <i>Cythere dunelmensis</i> (Norman). <i>Krithe Bartonensis</i> (T. R. Jones). <i>Cytheropteron latissimum</i> (Norman). <i>Bythocythere turgida</i>, G. O. Sars. <i>Bythocythere simplex</i> (Norman). <i>Paradoxostoma variabile</i> (Baird). <i>Asterope marie</i> (Baird). <i>Philomedes interpuncta</i> (Baird). <i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i>, Boeck. (?) <i>Scolecithrix</i> sp. <i>Temora longicornis</i> (O. F. Müller). <i>Metridia</i> (?) <i>lucens</i>, Boeck. <i>Cyclopina</i> sp. <i>Longipedia coronata</i>, Claus. <i>Ectinosoma sarsi</i>, Boeck. <i>Idya</i> (?) <i>furcata</i> (Baird). <i>Balanus</i> (cypris stage).</p>	

WHITING POUT OR BRASSIE. *Gadus luscus*, L.

The stomachs of two specimens of *Gadus luscus*, captured in the deep water off Aberdeen (58 fathoms) on September 3rd, 1901, and measuring 20½ and 24 centimetres respectively, contained food which consisted entirely of Crustacea, but the specimens in the stomach of the smaller fish could not be identified; the remains in the stomach of the other consisted of fragments of *Eupagurus* sp., *Epimeria cornigera*, and of some other forms which were doubtful. Professor P.-J. van Beneden gives the following species which he has found in the stomach of Whiting Pout:—*Portunus holsatus*, *Orangon vulgaris*, *Eupagurus bernhardus*, *Eolis coronata*, Forbes, and *Buccinum undatum*.*

NORWAY POUT. *Gadus esmarkii*, Nils.

Fifty-nine specimens of *Gadus esmarkii* were specially examined; they included six from the Firth of Clyde, collected in March, 1900; nineteen captured about sixty-five miles to the eastward of Sumburgh Head, Shetland, on September 4th, 1900; twenty from the Moray Firth, collected on October 11th and 12th, 1900; and ten collected in the deep water (58 fathoms) off Aberdeen, on September 3rd, 1901.

The stomachs of only three of those sent from the Clyde contained food that could in some measure be identified; Echinoderms (brittle Starfishes) were found in one, Schizopods (gen. et sp. ?) in another, while

* *Les Poissons des Côtes de Belgique*, p. 58.

in the third a few Copepods were found which could not be satisfactorily determined; the fishes in this sample ranged from $14\frac{3}{10}$ to $18\frac{1}{2}$ centimetres in length.

The stomachs of all the nineteen specimens from the Shetland district contained food which consisted almost entirely of the remains of Crustacea, but they were so much decomposed that it was with difficulty the following organisms could be recognised: *Hemilamprops rosea* and a few Mysidæ were found in two stomachs; *Crangon allmanni*, *Halimedes parvimanus*, and one or two other Amphipods—the genus and species of which were doubtful—were found in two. Copepods, including *Calanus finmarchicus*, *Temora longicornis*, and *Metridia lucens* occurred in at least nine of the stomachs, and the remains of small fishes in one. The viscera of these fishes was very oily, more so than those of any of the others examined.

The food observed in the Moray Firth specimens was largely composed of young Crustacea belonging to the Macrura; they occurred in the stomachs of every one of the twenty specimens examined; *Calanus finmarchicus* was also obtained in all these stomachs, but it was not so numerously represented as were the young forms I have mentioned. Other Copepods, such as *Temora longicornis*, *Metridia lucens*, and *Centropagus typicus*, were occasionally noticed, as also were *Eupagurus* sp., *Crangon* sp., *Hyperia galba*, and *Parathemisto oblivia*. It will be observed that the organisms which constituted the chief part of the food of these Norway Pouts from the Moray Firth were more truly pelagic in their habits than the organisms which constituted the food of the Haddock, but whether this difference is the result of necessity or choice it would at this stage be difficult to say.

The food observed in the stomachs of the sample collected in the deep water off Aberdeen consisted chiefly of *Sagitta* and *Calanus finmarchicus*; *Temora* occurred in eight of the ten stomachs examined, and *Pseudocalanus elongatus* in one; *Argissa hamatipes* was found in two, while *Gastrosaccus spinifer* and *Pseudocuma* (?) *cercaria* were each observed in one. One stomach contained matter too imperfect for identification. No young fishes, Mollusca, nor Starfishes were found in any of the stomachs of this sample; but the organisms of which the food was composed, though differing somewhat markedly from those composing the food of the Moray Firth sample, were forms which, like them, were more or less distinctly pelagic. It will be understood that in these remarks on the differences observed in the food of the different samples the reference is not so much to individuals, but rather to the group of species composing the food. Thus the food of the Moray Firth specimens consisted chiefly of young Macrura and *Calanus*, to which were added a few other forms, such as *Metridia lucens* and *Temora longicornis*, the former being the more frequent of the two. In the food of the Aberdeen sample, on the other hand, the young Macrura are replaced by *Sagitta*, and *Temora* is about equal to *Calanus* in frequency and quantity, but *Metridia* is altogether absent; moreover, in place of *Crangon* and the *Hyperoidæ* we have *Gastrosaccus*, *Pseudocuma*, and *Argissa*, yet the organisms composing the food in both samples are mainly pelagic forms.

The following list contains the names of all the species observed so far as they could be identified:—

LIST OF SPECIES FOUND IN THE STOMACHS OF *Gadus esmarkii*.

CRUSTACEA.	OTHER THINGS.
<i>Crangon allmanni</i> , Kinahan. <i>Eupagurus</i> sp. Larval Decapods. Young <i>Macrura</i> (Abundant). <i>Gastrosaccus spinifer</i> (Goës). <i>Erythropus</i> sp. <i>Hemilamprops rosea</i> (Norman). <i>Pseudocuma</i> (?) <i>cercaria</i> (van Beneden). <i>Hyperia galba</i> (Montague). <i>Parathemisto oblivia</i> (Kröyer). <i>Halimedon parvimanus</i> (Spence Bate). <i>Argissa hamatipes</i> (Norman). Amphipod remains (sp. et gen. ?) <i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i> , Boeck. <i>Temora longicornis</i> (O. F. Müller). <i>Metridia lucens</i> , Boeck. <i>Centropages typicus</i> , Kröyer.	Fish remains (rare). <i>Oikopleura</i> . <i>Sagitta</i> (more or less abundant). Echinoderm remains.

WHITING. *Gadus merlangus*, L.

About two hundred and thirty-five specimens of Whittings have been specially examined. A sample consisting of eight Whittings measuring from 9 to 11½ centimetres, collected 65 miles south-east of Sumburgh Head, had in their stomachs nothing that could be distinguished except a small *Crangon allmanni*; a number of others from the same locality were also examined, but with no better result.

The stomachs of twenty-eight specimens ranging from 8½ to 14½ centimetres in length and captured in the vicinity of Aberdeen on September 20th, 1900, nearly all contained food which consisted to a large extent of small Crustacea; a considerable proportion of these belonged to the Amphipoda, and included such well-known forms as *Hippomedon denticulatus*, *Bathyporeia* sp., *Pontocrates arenarius*, *Paratylus swammerdami*, and others. Remains of small Schizopods (Mysidæ) occurred in several of the stomachs. *Pseudocuma cercaria* was also of frequent occurrence, but the only species observed belonging to the Copepoda was *Temora longicornis*, and it was only obtained in the stomachs of the smaller fishes. The remains of Annelids occurred in several stomachs, but Starfish remains were rare. Another sample of five specimens from near the same locality as the last, but collected five days later, had nearly the same kind of food in their stomachs.

A number of Whittings—about forty-one in all—collected off Aberdeen, between the 17th and 19th December, 1900, were also examined. The lengths of these specimens ranged from 12 to 17½ centimetres, and nearly all of them had food in their stomachs; the food, so far as it could be identified, consisted mainly of Crustacea and Annelids. *Crangon allmanni* was moderately frequent, *Pandalina brevirostris* was observed once, *Gastrosaccus spinifer* and the remains of other Mysidæ were obtained in several stomachs, and specimens of *Parathemisto* were also not uncommon. A small *Sepiolo* occurred in one stomach, a small Long Rough Dab about 3⅞ centimetres long was found in another, and the remains of a small flat-fish (sp. ?) in a third.

A sample collected off Aberdeen in 65 fathoms on May 17th, 1900, is

noticed here because in the stomach of one of them, about $26\frac{1}{2}$ centimetres in length, I found a specimen of *Conchæcia elegans*, an Ostracod only hitherto observed in Loch Etive on the West Coast, and very rarely in the extreme North of Scotland.

Schistomysis spiritus was frequent in the stomachs of twelve specimens collected off Aberdeen on June 10th, 1901; *Crangon allmanni*, *Apherusa borealis*, and *Gammarus locusta* were very rarely observed, while the only species belonging to the Copepoda obtained was *Pseudocalanus elongatus*. *Oikopleura* was observed in four of the stomachs and was moderately common in three of them, while Annelid remains occurred in five.

A sample of Whittings, collected about ten miles off Aberdeen on September 3rd, 1901, measured from $10\frac{1}{2}$ to 19 centimetres in length. One of these had nothing in its stomach that could be distinguished, but the stomachs of four contained the following among other Crustacea:—*Pandalus montagui*, *Pseudocuma cercaria*, *Callisoma crenata*, *Argissa hamatipes*, *Megamphopus cornutus*, *Calanus finmarchicus*, *Pseudocalanus elongatus*, *Temora longicornis*, and *Metridia lucens*; *Sagitta*, and some other Annelids were also observed.

Thirteen specimens from Aberdeen Bay, collected November 6th, 1901, and measuring from 15 to $24\frac{3}{10}$ centimetres, had very little food in their stomachs; *Crangon vulgaris*, jun., was observed in two; so also were *Schistomysis inermis*, *Hyperia galba*, and *Gammarus* sp. (jun.). Remains of Annelids were also observed in one or two of the stomachs, but any food that was present was not very easily identified. The stomach of one specimen, $7\frac{1}{2}$ centimetres, had a young flat-fish in its stomach, while in the stomach of the flat-fish itself, *Calanus* and fragments of *Bathyporeia* sp. were obtained. The stomach of another specimen, 7 centimetres long, contained *Hyperia galba*, *Pseudocalanus elongatus*, and a few very young Decapoda.

Fourteen specimens ranging in length from 9 to 14 centimetres, besides two at $15\frac{1}{2}$ c.m. and one at 17 c.m., were captured in 68 fathoms about 9 or 10 miles off Aberdeen, in November, 1901, and the examination of these gave the following results; the smaller specimens were found to have been feeding chiefly on *Parathemisto obliqua*—nearly every one of them having some of these Crustaceans in their stomach—the specimens were somewhat immature, but they all probably belonged to the species named; a few other species such as *Crangon allmanni*, *Paratylus* sp., *Temora longicornis*, and *Metridia lucens* were also noticed. The stomachs of two of the larger specimens were empty, but the other contained fragments of two *Spirontocaris securifrons*.

Other twelve Whittings ranging from about 14 to 20 c.m., collected in Aberdeen Bay on November 29th, had scarcely anything in their stomachs that could be identified; but so far as the contents could be made out, the fish appeared to have been feeding chiefly on Annelids; but a few fragments of species of Mysidæ were also observed.

Schistomysis spiritus was the most common species in the stomachs of some Whittings captured off Collieston on July 5th, 1901; *Pseudocuma cercaria* occurred in four of these stomachs and was abundant in one of them; *Bathyporeia norvegica* was present in one and *Oikopleura* in six. A few other common forms were also observed.

Six specimens from Smith Bank, Moray Firth, measuring $20\frac{1}{2}$ to 27 centimetres, and collected June 5th, 1901, had very little in their stomachs that could be distinguished. A female of *Ampelisca assimilis* was about the only thing that could be satisfactorily determined; while the remains of small fishes, Annelids, and what seemed to be fragments of a *Crangon* appeared also to form part of the food contained in these stomachs—all being considerably decomposed.

Ninety-seven specimens of Whitings from the Firth of Forth collected during April and May of the present year (1901) included the following:—A sample of twenty of medium size, measuring on an average about 25 centimetres (or 10 inches) in length, and collected in April, had comparatively little food in their stomachs, and what was of it was much decomposed; but so far as it could be identified it was found to consist for the most part of *Crangon allmanni*, with occasionally the remains of *Pandalus montagui* and small fishes. Two small *Nephrops*, $4\frac{7}{10}$ centimetres in length (measuring to the end of the claws), were found in one of these stomachs. A sample of smaller Whitings—sixty-two in number—collected in April, and ranging from 12 to 15 centimetres in length, appear to have been feeding largely on small Crustacea at the time they were captured; every stomach was found to contain food, and some stomachs were well filled; *Crangon* was, as usual, one of the organisms most frequently observed, and specimens sufficiently perfect to be identified were found to belong to *Crangon allmanni*; *Pandalus montagui* was also occasionally noticed. The Schizopoda were represented by *Erythroops goesii*, which was the only species observed, and it was one which occurred very often amongst the contents of the various stomachs. The Sympoda was represented by several species, such as *Leucon nasica*, *Eudorella truncatula*, *Diastylis rostratus*, and others; the *Leucon* was, however, the most common form. The Isopoda were apparently rare, only one—*Astacilla* sp.—being obtained. The Amphipoda were represented by a number of forms, the following being the most frequent:—*Ampelisca assimilis*, *spinipes*, and *macrocephala*, *Protomedeia fasciata*, *Dulichia porrecta*, and others. The most common species of the Copepoda observed was *Temora longicornis*; but *Calanus finmarchicus*, *Pseudocalanus elongatus*, *Longipedia coronata*, and *Robertsonia tenuis* were also noticed. The parasitic Copepod—*Caligus rapax*—was found mixed up with the other things in one or two of the stomachs. I do not remember having previously observed *Caligus* amongst the food of fishes, but perhaps these specimens had been conveyed into the stomachs in which they occurred from adhering to some object which the fish had captured. Larval *Balani* (cypris stage) were not uncommon, and the Ascidian—*Oikopleura*—was also found in nearly all the stomachs; Annelids, on the other hand, were rarely obtained. I give the following as examples of the contents of some of the stomachs, in order to show the variety of organisms sometimes found in them:—

(1) *Crangon allmanni*, *Erythroops goesii*, *Leucon nasica*, *Diastylis* (? *lucifera*), *Diastylis rostrata*, *Ampelisca* sp., *Periocolodes longimanus*, *Melita* sp., *Protomedeia fasciata* (male and female), *Temora longicornis*, *Longipedia coronata*, and *Robertsonia tenuis*.

(2) *Crangon allmanni*, *Leucon*, *Diastylis*, *Ampelisca* sp. (? *spinipes*), *Calanus*, *Temora* (male), *Oikopleura*.

(3) *Erythroops goesii*, *Leucon*, *Diastylis*, *Eudorella emarginata*, *Ampelisca*, *Dulichia falcata*, *Pseudocalanus*, and *Longipedia coronata*.

A considerable difference, when compared with the sample just referred to, was observed in the food of some Whitings from the Firth of Forth, collected on May 13th, 1901; the average length of these specimens was about seven inches ($17\frac{1}{2}$ centimetres). The food of this sample consisted largely of Schizopods (*Schistomysis spiritus* and *ornatus*), and *Oikopleura* was also abundant in several of the stomachs. A specimen of *Gobius minutus* was found in one stomach, and a young *Eupagurus* sp. and a specimen of *Metopa alderi* in another, but otherwise the food, so far as it could be identified, consisted almost entirely, if not altogether, of Schizopods and *Oikopleura*. From the occasional frequency and even abundance of

these small tadpole-like Ascidians in the stomachs of fishes, it is evident that, though minute, they are by no means unimportant as fish food, and especially when it is found that even comparatively large fishes feed upon them. It is also interesting to note that the *Sagittæ*, which seem undoubtedly to prey on the smaller larval and post-larval fishes, are themselves devoured, sometimes in quantity, by fishes of larger size.

The annexed Table contains the names of the various organisms which have been found to constitute the food of Whittings:—

CRUSTACEA.	OTHER THINGS.
<p><i>Eupagurus bernhardus</i> (Lin). <i>Anapagurus lævis</i> (Thompson). <i>Eupagurus</i> sp. <i>Nephrops norvegicus</i> (Lin.), (one 47½ mm. to end of claws). <i>Crangon allmanni</i>, Kinahan. <i>Spirontocaris securifrons</i> (Norman). <i>Pandalus montagui</i>, Leach. <i>Pandalina brevirostris</i> (Rathke). <i>Gastrosaccus spinifer</i> (Goës). <i>Erythropus goesii</i>, G. O. Sars. <i>Praunus</i> (?) <i>inermis</i> (Rathke). <i>Schistomysis spiritus</i>, Norman. ,, (?) <i>ornatus</i>, G. O. Sars. <i>Leucon nasica</i>, Kröyer. <i>Eudorella emarginata</i> (Kröyer). ,, <i>truncatula</i> (Spence Bate). <i>Diastylis rostrata</i> (Goodsir). ,, <i>lucifera</i> (Kröyer). <i>Diastylis</i> sp. <i>Pseudocuma cercaria</i> (v. Beneden). <i>Gnathia maxillaris</i> (Mont.), (jun.). <i>Astacilla</i> sp. <i>Parathemisto oblivia</i> (Kröyer). <i>Callisoma hopei</i> (A. Costa). <i>Hippomedon denticulatus</i> (Spence Bate). <i>Orchominella nana</i> (Kröyer). <i>Bathyporeia norvegica</i>, G. O. Sars. <i>Bathyporeia</i> sp. <i>Argissa hamatipes</i> (Norman). <i>Harpinia neglecta</i>, G. O. Sars. <i>Ampelisca assimilis</i>, Boeck. ,, <i>macrocephala</i>, Lilljeborg. ,, <i>spinipes</i>, Boeck. <i>Ampelisca</i> sp. (fragments). <i>Amphilocheus tenuimanus</i>, Boeck. <i>Stenothoë marina</i>, Spence Bate. <i>Metopa alderi</i> (Spence Bate). ,, <i>pusilla</i>, G. O. Sars. <i>Leucothoë lilljeborgii</i>, Boeck. <i>Perioculodes longimanus</i> (Spence Bate). <i>Pontocrates arenarius</i> (Spence Bate). <i>Synchelidium brevicarpum</i> (Spence Bate). <i>Epimeria cornigera</i> (Fabricius). <i>Apherusa bispinosa</i> (Spence Bate). ,, <i>borealis</i> (Boeck). <i>Paratylus swammerdami</i> (M. Edwards). <i>Gammarus locusta</i> (Lin.). <i>Melita</i> sp. <i>Mæra loveni</i> (Bruzelius).</p>	<p><i>Gobius minutus</i>. Long Rough Dab (young). Remains of flat-fishes. Remains of other young fishes. <i>Sepiola</i> sp. <i>Oikopleura</i> (common). <i>Sagitta bipunctata</i>. Annelid remains. Remains of Starfishes.</p>

THE FOOD OF WHITINGS—continued.

CRUSTACEA.	OTHER THINGS.
<p><i>Cheirocrates</i> sp. <i>Megamphopus cornutus</i>, Norman. <i>Microprotopus maculatus</i>, Norman. <i>Protomedeia fasciata</i>, Kröyer. <i>Dulichia porrecta</i>, Spence Bate. ,, <i>falcata</i>, Spence Bate. ,, <i>monocantha</i>, Metzger. <i>Cythere porcellanea</i>, G. S. Brady. ,, <i>tuberculata</i>, G. O. Sars. <i>Cytheropteron humile</i>, G. S. Brady and Norman. <i>Asterope maria</i> (Baird). <i>Philomedes interpuncta</i> (Baird). <i>Conchæcia elegans</i>, G. O. Sars. <i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i>, Boeck. <i>Temora longicornis</i> (O. F. Müller). <i>Metridia lucens</i>, Boeck. <i>Candacia pectinata</i>, G. S. Brady. <i>Longipedia coronata</i>, Claus. <i>Bradya typica</i>, Boeck. <i>Robertsonia tenuis</i> (Brady and Robertson). <i>Caligus</i> sp. <i>Balanus</i> (cypris stage). Megalops and other young forms of Crustacea.</p>	

SAITHE OR GREEN COD. *Gadus virens*, L.

The stomachs of four moderately large specimens, kindly handed over to me by Dr. H. C. Williamson, were examined, and gave the following results:—

(1) The stomach of a Saithe, 90 centimetres (36 inches) in length, contained one Haddock $28\frac{1}{10}$ centimetres ($11\frac{1}{4}$ inches) long, one Whiting $24\frac{1}{2}$ centimetres ($9\frac{3}{4}$ inches) long, two other round fishes (? Whitings) which measured about 20 and $26\frac{9}{10}$ centimetres (8 inches and $10\frac{3}{4}$ inches) respectively, and the backbone of another round fish of moderate size.

(2) A Saithe, obtained in the Fish Market at Aberdeen, and which was slightly larger than the last, had in its stomach a Long Rough Dab $18\frac{3}{10}$ centimetres ($7\frac{1}{2}$ inches) in length.

(3) The stomach of another specimen from the Fish Market, and which measured 88 centimetres in length, contained the remains of fishes, but they were too much decomposed for identification.

(4) The fourth specimen, which was a male, and was also obtained at the Aberdeen Fish Market, appears to have been specially voracious; eight fishes were removed from its stomach, the dimensions of which were as follows:—One Common Dab 18 centimetres ($7\frac{1}{5}$ inches) in length, and seven Whitings; two of the Whitings measured each 25 c.m. (10 in.) in length, one measured 27 c.m. ($10\frac{4}{5}$ in.), one 19 c.m. ($7\frac{3}{5}$ in.), one $14\frac{1}{2}$ c.m. ($5\frac{4}{5}$ in.), one 12 c.m. ($4\frac{4}{5}$ in.), and one 11 c.m. ($4\frac{2}{5}$ in.) in length respectively.

LYTHE OR POLLACK. *Gadus pollachius*, L.

A considerable number of Pollacks have been examined—about ninety-two altogether—but the food contained in the stomachs of a number of them

was too imperfect for satisfactory identification. In the stomach of a Pollack captured in the Bay of Nigg in the nets of the salmon fishers on February 19th, 1900, the remains of several small fishes and Schizopods (*Schistomysis spiritus*) were observed. The following Crustacea were obtained in the stomach of another Pollack received from the salmon fishers on April 2nd, 1900, viz. :—*Idothea emarginata*, *Idothea baltica*, *Idothea pelagica*, and *Idothea linearis*; *Amathilla homari*, *Parajassa pelagica*, *Caprella septentrionalis*, and fragments of some other species. There was also a post-larval Eel in this stomach. Two stomachs obtained from the salmon fishers—one on April 16th and one on the 17th—contained the following organisms :—*Idothea pelagica*, *Idothea emarginata*, and *Idothea linearis*; *Amathilla homari*, *Hyale nilssoni*, *Caprella septentrionalis*, and remains of other Amphipods. A young Pollack about $47\frac{1}{2}$ centimetres ($19\frac{3}{10}$ inches) in length was received from the salmon fishers on April 18th, and in its stomach the following Crustacea were obtained :—*Schistomysis spiritus*, *Idothea baltica*, *Idothea pelagica*, *Idothea emarginata*, and *Caprella septentrionalis*, as well as the remains of some Annelids. In the intestines of this fish over two hundred specimens of the cestoid parasite—*Echinorhynchus acus*—were obtained, as well as a few nematodes. Another stomach received on April 19th contained an immense number of *Caprella septentrionalis*, as well as the remains of other Crustaceans and of Sand-eels. In a stomach received from the salmon fishers on June 6th the remains of Amphipods, the genus and species of which were doubtful, was the only food observed.

In the stomach of a Pollack received from the salmon fishers in July of this year (1901) *Caprella septentrionalis* was again common. The frequent appearance of this *Caprella* in the stomachs of these fishes seems to indicate that it must be more or less abundant somewhere in the vicinity of the Bay, and that it is a favourite kind of food with the Pollack.

A Pollack about 27 centimetres in length, taken in 60 fathoms off Aberdeen on October 3rd, 1901, had the following organisms in its stomach :—A small round fish too imperfect for identification (its length would be about 9 centimetres), three or four *Pandalus montagui*, a few small Decapods (sp. ?), *Hyperia galba*, and a few Schizopods belonging to Mysidæ.

The following organisms were obtained in the stomachs of four Pollack taken in St. Andrews Bay in the salmon fishers' nets during May, 1901. These specimens measured about 43, 50, 51, and 62 centimetres in length respectively. The stomach of the first contained the remains of fish, one or two small Cephalopods and Crustacean and Annelid remains, but not sufficiently perfect for satisfactory identification. The second contained a large Sand-eel, *Ammodytes* sp. The third contained a specimen of *Onos* sp. (*Motella*) about 12 centimetres long; but in the fourth there was nothing that could be identified.

A sample consisting of six specimens which were sent from Girvan, Firth of Clyde, in May, 1901, had scarcely any food in their stomachs that could be satisfactorily identified. The specimens measured from 27 to 28 centimetres in length, and the stomach of one of them contained a small *Labrus*, very imperfect; while the remains of Crustacea (probably of *Crangon* sp.) were observed in three. The contents of the other two stomachs were very much decomposed. Three specimens were sent from Girvan on October 15th, 1901, the length of which measured $23\frac{1}{2}$ c.m., 33 c.m. and 43 c.m. respectively. The food contained in the stomachs of this sample consisted entirely of the remains of small Herrings or Sprats about 3 inches (75 mm.) long.

The annexed Table contains the names of various organisms observed in the stomachs of the various Pollacks examined :—

ORGANISMS OBSERVED IN THE STOMACHS OF POLLACKS.

CRUSTACEA.	OTHER THINGS.
<i>Crangon vulgaris</i> (Lin.). <i>Crangon</i> sp. <i>Pandalus montagui</i> , Leach. Decapod remains. <i>Schistomysis spiritus</i> , Norman. <i>Schistomysis</i> sp. <i>Idothea baltica</i> (Pallas). ,, <i>pelagica</i> , Leach. ,, <i>emarginata</i> (Fabricius). ,, <i>linearis</i> (Pennant). <i>Hyperia galba</i> (Montague). <i>Hyale nilssoni</i> (Rathke). <i>Ampelisca spinipes</i> , Boeck. <i>Paratylus swammerdami</i> (M. Edwards). <i>Amathilla homari</i> (Fabricius). <i>Parajassa pelagica</i> (Leach). <i>Dulichia</i> sp. <i>Caprella septentrionalis</i> (Kröyer).	<i>Labrus</i> sp. (7 c.m.). <i>Onos</i> sp. (12 c.m.). Sand-eels (remains). Herrings or Sprats, about 3 inches. Young Eel. Fish remains. Small Cephalopods.

LING. *Molva molva*, L.

Several specimens of small Ling were examined, but the only food observed in their stomachs consisted of the remains of Crustacea belonging to the Decapoda and Sympoda, but they were too imperfect for identification. A partly-digested Eel (*Anguilla vulgaris*) was found in the stomach of a small Ling captured in the Bay of Nigg on June 30th, 1900.

FIVE-BEARDED ROCKLING. *Onos mustela*, L.

The stomach of a specimen about 10 centimetres in length, sent from Annan on July 30th, 1900, contained a number of Amphipoda and other Crustacea, but they were too imperfect for identification. A Five-bearded Rockling taken in the Bay of Nigg, which measured about 12 cm. in length, had a number of Isopods and Amphipods (including *Hyale lubbockiana*) in its stomach, but the specimens were imperfect.

Ten Rocklings from the Firth of Forth, collected on May 13th, 1901, measured from 13 cm. to 23½ cm. in length; the stomachs of all these specimens contained food which consisted chiefly of small Crustaceans. *Crangon allmanni* was observed in eight stomachs, *Pandalus montagui* in two, and *Erythropis goesii* in one; only one species (a *Diastylis*) belonging to the Sympoda (Cumacea) was observed in these stomachs, but no Isopods were obtained. The Amphipoda, on the other hand, were represented by a number of species, comprising *Ampelisca macrocephala*, *Mæra loveni*, *Protomedeia fasciata*, *Unciola planipes*, and *Dulichia falcata*. No Copepods were observed in any of the stomachs, but several Ostracods, such as *Bythocythere turgida*, *Bythocythere simplex*, *Loxoconcha impressa*, and *Machærina tenuissima*, were noticed. The remains of small Ascidiæ and Annelids occurred in one or two of these stomachs, and also some young *Balani* (cypris stage). It may be mentioned that sixty-

five specimens of a *Bomolochus* taken from the gills and gill-covers of one of these Rocklings, appear to belong to a new species.*

The annexed list contains the names of all the organisms observed:—

LIST OF SPECIES IN THE STOMACHS OF FIVE-BEARDED ROCKLINGS.

CRUSTACEA.	OTHER THINGS.
<i>Crangon allmanni</i> , Kinahan. <i>Crangon</i> sp. <i>Pandalus montagui</i> , Leach. <i>Erythropis goesii</i> , G. O. Sars. <i>Diastylis</i> sp. Small Isopods. <i>Ampelisca macrocephala</i> , Lilljeborg. <i>Ampelisca</i> sp. <i>Gammarus locusta</i> (Lin.). <i>Mæra loveni</i> (Bruzelius). <i>Gammaropsis nana</i> , G. O. Sars. <i>Protomedeia fasciata</i> , Kröyer. <i>Unciola planipes</i> (Norman). <i>Dulichia falcata</i> , Spence Bate <i>Dulichia</i> sp. <i>Cythere lutea</i> (O. F. Müller). <i>Loxococoncha impressa</i> , Baird. <i>Bythocythere simplex</i> (Norman). <i>Bythocythere turgida</i> , G. O. Sars. <i>Machærina tenuissima</i> (Norman). <i>Thalestris</i> sp. <i>Balanus</i> (cypris stage).	Insect larva. Small (?) Ascidians. Annelids. Starfish remains.

GREATER SAND-EEL. *Ammodytes lanceolatus*, Le Sauvage.

Six Sand-eels from the Moray Firth, measuring $12\frac{1}{2}$ cm. to $16\frac{1}{2}$ cm. in length, and collected in June, 1900, were found to have been feeding largely on Copepods, and the following species were recognised:— *Pseudocalanus elongatus*, *Temora longicornis*, *Ectinosoma* sp. (? *sarsi*), *Stenhelia* sp., and *Lichomolgus* sp. Larval *Balani* (cypris stage) were also of frequent occurrence. A sample comprising four specimens which were sent from Annan in April, 1900, had nothing in their stomachs that could be identified.

In the stomach of a specimen from the Moray Firth (Smith Bank), collected on June 5th, 1901, many pelagic Copepods were observed, and they belonged for the most part to two species—*Calanus finmarchicus* and *Pseudocalanus elongatus*; in this stomach no organisms other than the Copepods were noticed. I have notes of a sample of ten specimens collected on December 26th, 1900, but the locality where they are from is uncertain. The length of these specimens ranged from $15\frac{1}{2}$ cm. to $17\frac{1}{2}$ cm., and the stomachs of all of them contained food. The food in three was not sufficiently perfect for identification, but the contents of the others consisted almost entirely of pelagic Copepods, the prevailing species being *Temora longicornis*. *Calanus finmarchicus* was observed in one, and a number of specimens of *Centropages typicus* were obtained in another stomach; a young *Mytilis* (?) *edulis* occurred in one, and larval *Balani* (cypris stage) in one.†

* This *Bomolochus* is described at p. 289 of the present Report, under the name of *Bomolochus onosi*.

† Van Beneden states (*Les Poissons des Cotes de Belgique*, p. 64) that the food of the closely-allied species, *Ammodytes tobianus* consists also of microscopic Crustacea.

The annexed list contains the names of all the organisms observed :—

LIST OF ORGANISMS FROM THE STOMACHS OF GREATER SAND-EELS.

CRUSTACEA.	OTHER THINGS.
<i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i> , Boeck. <i>Temora longicornis</i> (O. F. Müller). <i>Centropages typicus</i> , Kröyer. <i>Ectinosoma</i> sp. <i>Stenhelia</i> sp. <i>Lichomolgus</i> sp. <i>Balanus</i> (cypris stage).	Young <i>Mytilis</i> .

LONG ROUGH DAB. *Drepanopsetta platessoides* (Fabr.).

The stomachs of one hundred and five Long Rough Dabs, chiefly small specimens, have been specially examined; twenty-eight from the Shetland district were collected on September 4th, 1900, and other five on May 17th, 1901; sixty specimens from the Firth of Forth were collected in May, 1901, and other six on July 13th. Six specimens from deep water about ten miles off Aberdeen were collected on September 3rd, 1901.

The food observed in the stomachs of the specimens from Shetland, which were collected sixty-five miles south-east of Sumburgh Head on September 4th, 1900, was in some cases largely composed of the remains of Annelids, while in others it consisted chiefly of Starfish remains. The length of the specimens ranged from $4\frac{3}{10}$ cm. to 16 cm., but fully 57 per cent. were under 10 cm., and it was the food of the larger specimens that was composed chiefly of Annelids, while that of the smaller consisted for the most part of small Starfishes (Ophiurids). Small Crustacea were also moderately frequent in the stomachs of both the larger and smaller fishes, but Mollusca were rarely obtained. The Crustacea included examples of several groups. The Decapoda were represented by small Hermits, the species of which could not be clearly made out; *Erythropis serrata* represented the Schizopoda, and *Hemilamprops rosea* and *Diastylis* sp. the Sympoda. The Amphipoda comprised several species, such as *Hippomedon denticulatus*, *Halimmedon parvimanus*, *Ampelisca macrocephala*, the rare *Dulichia monacantha*, and others. *Cythere dunelmensis* and *Bythocythere simplex* represented the Ostracoda, but the only Copepoda observed were *Calanus finmarchicus* and *Temora longicornis*. The second sample from Shetland was from 85 fathoms and collected on May 17th, 1901; the specimens of this sample measured $7\frac{1}{4}$, $10\frac{1}{4}$, $12\frac{1}{2}$, $14\frac{1}{4}$, and $18\frac{1}{4}$ centimetres respectively. In the stomach of the first two, specimens of *Leucon nasica* and some other Crustacean remains were observed; in the stomach of the second there were two small specimens of *Natica* and of two other small univalves (imperfect), all of them containing Hermit Crabs; the stomach of the third contained two *Naticas* and a few very young *Fusus* sp., all with Hermits; the fourth had in its stomach several small *Naticas*, one specimen of the somewhat rare *Adeorbis subcarinatus* and a *Trophon* (or *Diffrancia*) sp., all of which had small Hermits located in them; in the stomach of the fifth, a specimen of *Anapagurus levis* was found occupying the shell of a small *Natica*, and there were also one or two small *Fusus* containing hermits, even the shell of a *Ditrupa* was observed which had been utilised by a tiny Hermit; this last was the only

stomach of the present sample in which the remains of Starfishes were observed.

Of the sixty specimens from the Firth of Forth collected during May, 1901, thirty-four measured from $7\frac{1}{4}$ to $9\frac{1}{4}$ centimetres and twenty-six from $10\frac{1}{4}$ to $19\frac{1}{2}$ centimetres in length. Crustacea formed the principal part of the food of all the specimens, the only difference was that Ostracoda and Copepoda, which were frequent in the stomachs of the smaller fishes, were seldom observed in those of the larger. The remains of Annelids were not very common, and Starfish remains were rarely noticed. The shells of small univalve Molluscs containing Hermits were met with in one or two of the stomachs. The variety of the Crustacean species was considerable, but none of the larger Decapods were obtained, *Crangon* (?) *allmanni*, which was not observed very often and was usually in a more or less fragmentary condition, was the largest of the Crustacea noticed. *Erythropros goesii*, *Schistomysis ornata*, and *Leucon nasica* occurred very frequently; *Pseudocuma cercaria*, *Diastylis lucifera*, and one or two other species of Sympoda were also observed. No Isopod species was obtained in the stomachs of this sample. The Amphipoda were represented by a number of species, some of them being rare forms; their names are all entered in the tabulated list, but a few may be given here:—*Ampelisca macrocephala*, *Ampelisca brevicornis*, *Haploops tubicola*, *Amphilochus tenuimanus*, *Cheirocrates sundewalli*, *Protomedeia fasciata*, *Dulichia monacantha* (not previously noticed in the Firth of Forth), and others. *Bythocythere simplex* and *Cythere dunelmensis*, belonging to the Ostracoda, were occasionally noticed, so also were the two species of Copepoda—*Longipedia coronata* and *Robertsonia tenuis*. Other things observed included larval *Balani* (cypris stage) and several Anemones. The sample of Long Rough Dabs from the Firth of Forth collected at Station V. on July 13th, which were all under 10 centimetres in length, did not have very much food in their stomachs, and what was of it consisted chiefly of Crustacea. *Ampelisca assimilis* and *Erichthonius deformis* were observed in these stomachs and were the only species satisfactorily identified.

Six specimens from the deep water off Aberdeen collected on September 3rd, 1901, had an average length of about 13 centimetres. The food contained in their stomachs was very similar to that observed in the specimens from the Firth of Forth.

The following list contains the names of the various organisms referred to in the preceding notes:—

LIST OF SPECIES FOUND IN THE STOMACHS OF LONG ROUGH DABS.

CRUSTACEA.	OTHER THINGS.
<i>Eupagurus</i> (?) <i>cuanensis</i> (Thomp.)	Young fish (Herring or Sand-eel, 37 mm. long).
<i>Anapagurus laevis</i> (Thomp.).	<i>Tellina</i> (?) <i>tenuis</i> .
<i>Eupagurus</i> sp. (small).	<i>Natica</i> sp. (small).
<i>Crangon allmanni</i> , Kinahan.	<i>Turritella terebra</i> .
„ <i>nanus</i> (Kröyer).	<i>Adeorbis subcarinatus</i> .
Young <i>Carida</i> (? <i>Pandalus</i>).	<i>Fusus</i> sp. (jun.).
<i>Erythropros goesii</i> , G. O. Sars.	<i>Pleurotoma septangularis</i> .
<i>Schistomysis ornata</i> (G. O. Sars).	<i>Pleurotomatrevelyana</i> .
<i>Hemilamprops rosea</i> (Norman).	„ <i>turricola</i> .
<i>Leucon nasica</i> , Kröyer.	
<i>Eudorella</i> sp.	
<i>Diastylis rathkii</i> (Kröyer).	

LIST OF SPECIES FOUND IN THE STOMACHS OF LONG ROUGH DABS—*continued*.

CRUSTACEA.	OTHER THINGS.
<p><i>Diastylis lucifera</i> (Kröyer). <i>Pseudocuma cercaria</i> (P.-J. v. Beneden). <i>Hippomedon denticulatus</i> (Spence Bate). <i>Tryphosella höringii</i> (Boeck). <i>Harpinia neglecta</i>, G. O. Sars. <i>Ampelisca typica</i> (Spence Bate). ,, <i>brevicornis</i> (A. Costa). ,, <i>macrocephala</i>, Lilljeborg. ,, <i>assimilis</i>, Boeck. <i>Haploops tubicola</i>, Lilljeborg. <i>Amphilochus tenuimanus</i>, Boeck. <i>Metopa</i> sp. <i>Leucothoë lilljeborgii</i>, Boeck. <i>Perioculodes longimanus</i> (Spence Bate). <i>Pontocrates arenarius</i> (Spence Bate). <i>Halimedes parvimanus</i> (Spence Bate). <i>Cheirocratus sundewalli</i> (Rathke). <i>Aora gracilis</i> (Spence Bate). <i>Protomedeia fasciata</i>, Kröyer. <i>Photis longicaudata</i> (Spence Bate). <i>Erichthonius deformis</i>, M. Edwards. <i>Dulichia porrecta</i>, Spence Bate. ,, <i>falcata</i>, Spence Bate. ,, <i>monacantha</i>, Metzger. <i>Phtisica marina</i>, Slabber. <i>Cythere concinna</i>, T. R. Jones. ,, <i>limicola</i>, Norman. ,, <i>dunelmensis</i> (Norman). <i>Loxococoncha tamarindus</i> (T. R. Jones). <i>Bythocythere simplex</i> (Norman). <i>Calanus finmarchicus</i> (Gunner). <i>Temora longicornis</i>, O. F. Müller. <i>Longipedia coronata</i>, Claus. <i>Ectinosoma</i> sp. <i>Robertsonia tenuis</i> (Brady and Robertson). <i>Balanus</i> (cypris stage).</p>	<p><i>Trophon</i> (or <i>Defrancia</i>) sp. <i>Defrancia</i> sp. Annelids (Chaetopoda). <i>Ditrupa</i> sp. Starfish (Ophiura) remains.</p>

WHIFF OR SAIL FLUKE. *Lepidorhombus whiff* (Walb).

The Sail Flukes examined were collected, for the most part, from deep water (85 fathoms) north of Shetland on May 17th, 1901. The number of specimens was thirty-one, and they measured $11\frac{1}{2}$ to 20 centimetres in length. The food observed in their stomachs consisted almost entirely of Crustacea, but it was in most cases very fragmentary. The Euphausiidae were most in evidence as an article of food, but the genus or species could not be satisfactorily determined; these Schizopods occurred in the stomachs of fully half the number of the fishes examined. *Erythroops serratus* was also frequently observed. *Crangon* (?) *allmanni* was found in three stomachs and *Nika edulis* in one; *Ampelisca brevicornis* was obtained in three, and the remains of Annelids in one, but these organisms were comparatively few in number.

In the stomach of a moderate-sized Sail Fluke captured off Aberdeen on July 7th, 1900, a *Sepioloa* sp. (?) and the remains of *Crangon* sp. were found.

The names of the various organisms are given in the tabulated list annexed :—

SPECIES FOUND IN STOMACHS OF SAIL FLUKES.

CRUSTACEA.	OTHER THINGS.
Remains of Decapods. <i>Eupagurus</i> sp. <i>Nika edulis</i> , Risso. <i>Crangon</i> (?) <i>allmanni</i> , Kinahan. Remains of Euphausiidæ sp. <i>Erythrops serratus</i> , G. O. Sars. <i>Ampelisca brevicornis</i> (A. Costa).	<i>Sepiola</i> sp. Remains of Annelids.

SCALD-FISH. *Platophrys laterna* (Walb.).

A single specimen from the Clyde was captured between Rhoad Point and Ailsa Craig in 22 to 25 fathoms on October 4th, 1901, and measured about 12½ centimetres. A few fragments of *Crangon allmanni* was the only food observed in the stomach of this specimen.

PLAICE. *Pleuronectes platessa*, L.

Two hundred and twenty-six Plaice, most of them small, have been examined.

Eighteen specimens from the Moray Firth, collected on May 18th, 1900, and measuring from 7½ to 20 centimetres, appeared to have been feeding for the most part on Lugworms, *Arenicola* sp., as the food contained in their stomachs, as far as it could be distinguished, consisted of the remains of these Annelids.

One hundred and thirty-five specimens were from Annan (Solway Firth), and were collected on April 30th, 1900; eighty-two of these specimens were under 10 centimetres in length, while the other fifty-three ranged from 10 to 19 centimetres. The stomachs of nearly all these fishes contained food, but it was in many instances too imperfect for satisfactory determination. The organism which composed the principal part of the food of the smaller specimens was *Eurytemora velox*, one of the Copepoda. *Corophium grossipes*, remains of Schizopods (Mysidæ), larval *Balani*, fragments of lamellibranch shells and of polychæte worms were also occasionally observed. The food of the larger Plaice, on the other hand, consisted for the most part of small lamellibranchs, such as *Tellina* (chiefly *T. baltica*), *Cardium* sp. (probably young *C. edule* and *C. fasciatum*). Copepods were rarely observed in the stomachs of the larger Plaice. Another sample from Annan consisting of twenty-four small specimens, ranging from 3¾ to 4¼ centimetres in length and collected on June 26th, exhibited, as regards their food, a somewhat remarkable contrast to those previously examined which were collected in April. The food in the stomachs of the present sample consisted entirely of the Copepod *Jonesiella spinulosa*, one of the Harpacticidæ; this species occurred in considerable numbers in almost all the stomachs in this sample. In the stomachs of another sample from the same place and collected at the same time, but ranging from 7 to 7½ centimetres in length, *Jonesiella* was again of frequent occurrence, but a second Harpactid—*Canuella perplexa*—was also moderately common; specimens

of *Cythere* (?) *pellucida* were occasionally noticed, as well as a few Foraminifera and fragments of *Crangon vulgaris*. A further sample of seven fishes, which measured from 10 to 15 centimetres, had Annelids in the stomachs of five of them; *Amphidotus* sp. was observed in one, but the contents of the others could not be distinguished. Eighteen specimens, also from Annan, and collected on July 30th, 1900, had very little in their stomachs, the only organisms identified being small lamellibranchs (*Cardium* sp.), Gasteropods (*Rissoa* sp.), *Canuella perplexa*, the remains of one or two Amphipoda and small Annelids.

In the stomach of a moderate-sized Plaice obtained from the fishermen at the Bay of Nigg on March 29th, 1900, the following species were obtained:—*Amathilla homari*, *Gammarus locusta*, *Idothea baltica* and *Idothea emarginata*; while in the stomachs of a few Plaice, also of moderate size, taken in the Bay of Nigg on April 11th, 1901, only the remains of Annelids were observed.

The names of the organisms from the stomachs of the Plaice referred to in the preceding notes will be found in the annexed Table:—

SPECIES FOUND IN THE STOMACHS OF PLAICE.

CRUSTACEA.	OTHER THINGS.
<i>Crangon</i> sp. (small).	<i>Mytilus</i> (?) <i>edulis</i> .
<i>Praunus</i> (?) <i>inermis</i> (Rathke).	<i>Cardium</i> sp. (small).
<i>Pseudocuma cercaria</i> (P.-J. van Beneden).	<i>Tellina</i> (?) <i>tenuis</i> .
<i>Idothea baltica</i> (Pallas).	<i>Tellina</i> (?) <i>baltica</i> (in nearly all the stomachs).
" <i>emarginata</i> (Fabricius).	<i>Donax</i> sp.
<i>Bathyporeia</i> sp.	<i>Hydrobia ulvæ</i> .
<i>Pontocrates arenarius</i> (Spence Bate).	<i>Rissoa</i> sp.
<i>Amathilla homari</i> (Fabricius).	Annelids (Polychæta sp.)
<i>Gammarus locusta</i> (Lin.).	Annelids (Lugworms chiefly).
<i>Corophium grossipes</i> (Lin.).	<i>Amphidotus</i> sp.
<i>Cythere</i> (?) <i>pellucida</i> , Baird.	<i>Polystomella striatopunctata</i> .
<i>Eurytemora velox</i> (Lilljeborg).	
<i>Canuella perplexa</i> , T. and A. Scott.	
<i>Jonesiella spinulosa</i> (Brady and Robertson).	
<i>Balanus</i> (cypris stage).	

LEMON SOLE. *Pleuronectes microcephalus*, Donovan.

Several Lemon Soles were examined, but the remains of Annelids formed, as usual, nearly the whole of their food; the only other thing worth recording here is an example of *Acidicola rosea*, Thorell, found in the stomach of a specimen from the Moray Firth; this Copepod lives within the branchial sac of an Ascidian, and probably the Lemon Sole had swallowed one of these Ascidians, and the *Acidicola* had then somehow parted company with its host.

It has been pointed out in former reports on the food of Lemon Soles* that Annelids constitute by far the largest proportion of it, but it has also been shown that a considerable number of the stomachs that have been examined have been empty. With reference to the frequent appar-

* See papers by Dr. Ramsay Smith in Part III. of the 7th, 8th, 9th, and 10th Annual Reports of the Fishery Board for Scotland. I will refer later and more particularly to some of the results given in these papers, but the following figures may be noted here. Out of 821 stomachs of Lemon Soles examined, 333 were empty or contained matter that was not distinguishable and 383 contained Annelids, so that only 105 (or scarcely 11½ per cent.) of those stomachs contained other than Annelid food.

ent absence of food in the stomachs of Lemon Soles, it is interesting to note in the work by Professor P. J. van Beneden on the Fishes of the Coasts of Belgium, already alluded to, that the author in speaking of these fishes remarks:—"Nous ne connaissons donc ne leur pâture ni les vers qui les hautent," and again—"Nous avons eu, au mois de juin, l'occasion d'en étudier deux examplaires provenant de la côte de Norwége, tous les deux très-frais; ils ne contenaient riens dans leur estomac, ni aucun parasite sur les branchies et dans les intestines."*

COMMON DAB. *Pleuronectes limanda*, L.

Sixty-eight specimens of Common Dabs have been examined, forty-one from Aberdeen Bay, seven from the Firth of Forth, and twenty from Annan.

Two from a sample collected in Aberdeen Bay in September, 1900, had some Amphipods and the remains of Starfishes in their stomachs, but they were not sufficiently perfect for identification. The stomachs of eighteen specimens captured in the vicinity of Aberdeen on September 20th and 25th, 1900, and ranging from 10 to 30 centimetres in length, were all found to contain food, and there was no appreciable difference in the food of the smaller from that of the larger specimens, which, in all of them, consisted principally of brittle Starfishes in a very fragmentary condition. In some cases the food consisted entirely of Starfish remains, but in a number of the stomachs of a few other things were also observed. In one a young hermit was obtained, and *Apherusa borealis* in another. *Pariambus typicus* was noticed in several, and the remains of other Crustacea not perfect enough for identification; young Molluscs—such as *Cardium echinatum*—and Annelid remains were also occasionally observed. *Paratylus falcatus*, a somewhat rare Amphipod, was obtained in the stomach of a specimen about 13 centimetres in length. The food contained in the stomachs of another sample from Aberdeen Bay, collected on June 10th, 1901, exhibited a greater variety in the organisms of which it was composed. The number of fishes in this sample was twenty-one, and they were mostly of small size; none of them reached six inches in length, while the smallest measured about three inches (or from $7\frac{3}{10}$ cm. to about $14\frac{1}{2}$ cm.). Annelids and brittle Starfishes formed the principal part of their food, but there were also a considerable number of other things observed, as shown by the following examples:—A Dab, $14\frac{1}{4}$ cm. in length, had in its stomach *Montacuta ferruginosa*, *Venus fasciata* (jun.), *Mya arenaria* (jun.), *Chiton* sp., *Philine scabra*, *Pariambus typicus* (and some other Amphipods—the fragments only remaining), several *Cythere* (?) *confusa*, *Ophiura albida* (there were fragments of this and probably also of another species), and a few specimens of *Miliolina seminulum*. In the stomach of another were found the remains of Starfishes (Ophiuroids) and Annelids; *Metopa rubrovittata*, *Apherusa borealis*, *Cythere confusa*, and other Crustaceans. *Apherusa borealis* occurred in several stomachs; *Leucothoë lilljeborgii*, *Argissa hamatipes*, *Microprotopus maculatus*, *Dulichia* sp., and a few other Amphipods were also obtained, but they were all more or less damaged. Young Mysidæ were observed in some of the stomachs, but no Isopods were met with. In view of the difference between the food observed in the stomachs of these Dabs and that obtained in the stomachs of previous samples, the question may be asked:—Was the difference due to a greater variety of suitable organisms on the ground where these Dabs were feeding, or was the difference the result of more or less deliberate choice—the fishes being more inclined to feed on certain

* *Les Poissons des Côtés de Belgique*, p. 77.

organisms at one time, while at another time they preferred different forms? Probably the food present on the ground determines, to some extent, the kind of organisms that are to be found in the stomachs of such fishes as are at least partly or wholly omnivorous.

A sample of twenty small Dabs—some of them being under two inches in length—were sent from Anuan on April 30th, 1900. The food of this sample consisted of small lamellibranchs and other Molluscs; Amphipods such as *Bathyporeia* sp., *Corophium grossipes*, and *Gammarus*; and a few Copepods, chiefly *Eurytemora*, were also observed, besides fragments of Annelids, Zoophytes, etc., but nothing very particular was noticed.

The stomachs of seven specimens from the Firth of Forth, collected on May 13th, 1901, contained several small *Eupagurus* (? *cuanensis*), several *Ampelisca* sp., *Stenothoë marina*, *Paramphithoë monocuspis*, *Cheirocrates intermedius*, and *Dulichia falcata*, and also some remains of Annelids. The names of all the species will be found in the list annexed:—

LIST OF ORGANISMS FOUND IN THE STOMACHS OF COMMON DABS.

CRUSTACEA.	OTHER THINGS.
<i>Eupagurus cuanensis</i> (Thomp.).	Remains of small fish.
<i>Eupagurus</i> sp.	<i>Mya arenaria</i> (jun.).
<i>Crangon</i> sp. (jun.).	<i>Cyprina</i> (jun.).
Young Mysidæ.	<i>Cardium echinatum</i> (jun.).
<i>Idothea baltica</i> (Pallas).	<i>Mactra</i> sp.
<i>Idothea</i> sp. (jun.).	<i>Venus fasciata</i> (jun.).
<i>Bathyporeia</i> sp.	<i>Montacuta ferruginosa</i> .
<i>Argissa hamatipes</i> (Norman).	<i>Chiton</i> sp.
<i>Ampelisca</i> sp. (fragments).	<i>Philine scabra</i> .
<i>Stenothoë marina</i> , Spence Bate.	Annelid remains.
<i>Metopa alderi</i> (Spence Bate).	<i>Echinocyamus pusillus</i> .
<i>Metopa</i> (?) <i>rubrovittata</i> , G. O. Sars.	<i>Ophiura albida</i> .
<i>Metopa</i> sp.	Starfish remains.
<i>Leucothoë lilljeborgii</i> , Boeck.	<i>Hydrozoa</i> .
<i>Paramphithoë monocuspis</i> , G. O. Sars.	<i>Miliolina siminulum</i> .
<i>Apherusa borealis</i> (Boeck).	
<i>Paratylus falcatus</i> (Metzger).	
<i>Gammarus locusta</i> (Linn.).	
<i>Cheirocrates intermedius</i> , G. O. Sars.	
<i>Photis</i> sp.	
<i>Microprotopus maculatus</i> , Norman.	
<i>Corophium grossipes</i> (Lin.).	
<i>Dulichia falcata</i> , Spence Bate.	
<i>Pariambus typicus</i> (Krøyer).	
<i>Cythere confusa</i> , Brady and Norman.	
<i>Eurytemora velox</i> (Lilljeborg).	
<i>Longipedia coronata</i> , Claus.	
<i>Ectinosoma</i> sp.	

FLOUNDER. *Pleuronectes flessus*, L.

A considerable number of Flounders obtained from the salmon fishers at the Bay of Nigg have been examined, but the stomachs of most of them contained only the remains of Annelids, which were usually too much decomposed for identification, the only form recognised being the common Lugworm (*Arenicola*). Of seven specimens obtained on March 19th, 1901, the stomachs of six did not contain anything that could be identified, but the following organisms were obtained in the other one,

viz.:—*Idothea baltica*, *pelagica*, and *emarginata*, and also *Gammarus locusta*. The stomachs of eleven specimens were obtained on the 23rd, and five of these contained only a little digested matter; one was full of small Annelids, with the addition of a *Crangon vulgaris*, while the food contained in the other five was composed of Annelids and Amphipods (*Gammarus* (?) *locusta* chiefly).

A small Flounder from Annan, collected on April 30th, 1900, and measuring slightly over 13 centimetres, had its stomach and intestines filled with *Corophium grossipes*. Two other specimens, somewhat larger (about 17 to 19¼ cm.), from the same place, and collected at the same time as the last, had numerous fragments of *Tellina baltica* and a few small *Cardium* sp. in their stomachs.

In the stomachs of several of the Flounders obtained at various times from the salmon fishers at the Bay of Nigg, small *Portunus* (*P. holsatus*, jun.), *Idothea emarginata*, *Idothea pelagica*, *Paratylus swammerdami*, and *Amathilla homari* were observed. The names of the different species are given in the Table:—

SPECIES FOUND IN THE STOMACHS OF FLOUNDERS.

CRUSTACEA.	OTHER THINGS.
<i>Portunus</i> sp. (small). <i>Crangon vulgaris</i> (Lin.). <i>Idothea baltica</i> (Pallas). ,, <i>pelagica</i> , Leach. ,, <i>emarginata</i> (Fabricius). <i>Paratylus swammerdami</i> (M. Edwards). <i>Amathilla homari</i> (Fabricius). <i>Gammarus locusta</i> (Lin.). <i>Corophium grossipes</i> (Lin.).	<i>Cardium</i> sp. <i>Tellina baltica</i> . <i>Hydrobia ulva</i> . Annelids (<i>Arenicola</i> and others).

BLACK SOLE. *Solea vulgaris*, Quen.

The following are notes of the contents of twenty-five stomachs of *Solea vulgaris* examined at different times; all the specimens, with the exception of four from the Clyde, were from Annan. The Annan specimens were of small size, ranging from 6½ to 18 centimetres in length; the four from the Clyde were larger, and measured 24½ to 32 centimetres. The food in the stomachs of the Clyde specimens, so far as it could be identified, consisted of Annelids and lammellibranch Mollusca. The food of the Annan specimens was similarly composed of Annelids, but there were also a few Crustaceans observed, such as *Corophium grossipes*, a specimen of *Hyperia* (?) *galba*, a few Copepoda (*gen. et sp.?*), and a few Ostracoda (*Cythere* sp.), but the specimens were not in very good preservation.

HEBRIDEAN SMELT. *Argentina sphyraena*, L.

Twenty-four specimens of the Hebridean Smelt (or Argentine), collected fifty miles to the eastward of Fair Island on October 19th, 1900, were examined on the 26th of the same month. The lengths of the specimens ranged from 15 to 21 centimetres. Annelids appeared to form the principal part of the food of these specimens, but the smaller Crustacea were also fairly well represented, and the following Molluscan species were observed:—*Tellina prismatica* (once), *Philine scabra* (in

two stomachs), and *Dendronotus* sp. (once). *Tomopteris* (one of the Annelida) was obtained in three stomachs, and in one of them a considerable number of this curious species was found, the tube of a species of *Pectinaria* was also noticed. The Crustacea comprised the following amongst other species:—*Crangon allmanni*, which was obtained in six stomachs, and a young *Portunus* in one; *Ampelisca macrocephala* occurred in one, and *Stenothoë marina* in six. *Proto pedata* was observed in five stomachs, many specimens being found in one or two of them; *Dulichia* sp. and a few other Amphipods which could not be satisfactorily determined were also observed. The only Copepod noticed was *Longipedia coronata*, and it occurred in only one of the stomachs examined. In only one stomach were the remains of Starfishes observed. All the stomachs contained food, and the names of the organisms observed in them are given in the annexed Table:—

SPECIES OBSERVED IN STOMACHS OF HEBRIDEAN SMELT.

CRUSTACEA.	OTHER THINGS.
<i>Portunus</i> sp. (jun.). <i>Crangon allmanni</i> , Kinahan. <i>Ampelisca macrocephala</i> , Lilljeborg. <i>Stenothoë marina</i> , Spence Bate. <i>Pontocrates altamarinus</i> (Spence Bate). <i>Dulichia</i> sp. <i>Pariambus typicus</i> (Kröyer). Amphipod remains. <i>Longipedia coronata</i> , Claus.	<i>Tellina prismatica</i> . <i>Philine scabra</i> . <i>Dendronotus</i> sp. <i>Pectenaria</i> , <i>Tomopteris</i> , and other Annelids. Starfish remains.

HERRING. *Clupea harengus*, L.

The stomachs of two hundred and fifty-seven Herrings have been examined; they are from the following places:—A sample from Annan, collected on July 30th, 1900, and one from Ballantrae, Firth of Clyde, collected on March 15th, 1901; a sample of twenty-three from the Firth of Forth, collected in May, 1901; another of fifteen from the Bay of Nigg, collected on June 19th, 1900, and of sixty from Aberdeen Bay (six being collected on August 14th, five on November 9th, and thirty-one on December 17th, 1900, and eighteen on June 6th, 1901). There was also a sample of Herrings collected off Collieston on July 5th, 1901, but with the exception of the specimens from the Clyde all those examined were of small size.

The sample from Annan, collected in July, measured from 6 to 9½ centimetres in length; all their stomachs contained Schizopods, which appeared to belong chiefly to one species, *Neomysis vulgaris*; the only other organisms noticed were one or two specimens of *Macropsis slabberi*, which occurred in the stomach of one of the smallest Herrings. Some Copepods were obtained in a few of the stomachs, but the only species identified was *Ectinosoma atlanticum*. A small *Mytilus* was also observed.

In the stomach of a Herring from Annan, collected in May, 1900, and measuring about 10¼ centimetres in length, numerous Copepods were observed, all belonging to *Eurytemora velox*; there were also fragments of *Mysidæ* and a small Amphipod.

The specimens from Ballantrae were collected by Mr. Dannevig, who kindly permitted me to examine them; they ranged from 21¼ to 30¼

centimetres in length. The only food observed in the stomachs of this sample consisted of larval Crustaceans.

The Herrings from the Firth of Forth measured from four to nearly five inches (10 to 14½ cm.) in length; the stomachs of all the specimens contained food which for the most part consisted of pelagic Copepods and larval *Balanus* (cypris stage). *Oikopleura* were moderately common in at least eight of these stomachs. The Copepods most frequently observed were *Pseudocalanus elongatus*, *Temora longicornis*, and *Centropages hamatus*; *Podon leuckartii* (G. O. Sars), one of the Cladocera, was also of frequent occurrence. A few other organisms were occasionally noticed; but those mentioned above formed the chief constituents of the food of this sample of Herrings.

In June, 1900, a shoal of young Herrings came into the Bay of Nigg; fifteen of them, collected on the 19th, and measuring from 5½ to 6½ centimetres, were examined, and the food contained in their stomachs was found to consist entirely of Copepods, some of which were pelagic, while others were demersal forms. The species identified were *Temora longicornis*, *Idya furcata*, and *Dactylopus tisboides*.

A small lot of average-sized Herrings, collected off Aberdeen on August 14th, had apparently, like those from the Bay of Nigg, been living entirely (or largely) on Copepods—no other organisms being observed in their stomachs—but the specimens were scarcely perfect enough for identification.

A sample of Herrings from Aberdeen Bay, collected on November 11th, 1900, and measuring from 13 to 14½ centimetres in length, had nothing in their stomachs that could be identified. Another lot, also from Aberdeen Bay, and comprising thirty-one specimens, measuring from 12¼ to 15¼ centimetres, were collected on December 17th, 1900. The stomachs of all these specimens contained a considerable amount of food, which consisted very largely of *Parathemisto oblivia* and *Sagitta*; *Calanus finmarchicus* occurred also sparingly in nearly all the stomachs; but this species, except in a very few examples, formed but a small proportion of the food. *Temora longicornis*, *Metridia lucens*, *Candacia pectinata*, and fragments of a Schizopod ("Euphausida") were occasionally observed, but, as already stated, the principal constituents of the food of these Herrings were *Parathemisto* and *Sagitta*. It will be observed that the food of this sample of Herrings is in marked contrast to that found in the stomachs of those previously described. I do not remember having formerly observed *Sagitta* so plentiful in the stomachs of fishes as a constituent of their food. Many observations have been made on the food of fishes, but they were frequently made under conditions that did not admit of exact microscopical examination, and the presence of *Sagitta* may have thus at times been overlooked. It has also to be remembered that the *Sagitta*, like other creatures not protected by a chitinous or calcareous test, are readily acted upon by the gastric fluid and soon become unrecognisable, so that unless the fish had been feeding on these organisms shortly before or about the time it was captured they may become so much decomposed as to be indistinguishable.

In order to indicate more clearly the peculiar character of the food found in the stomachs of these Herrings I subjoin a short extract from the records made when the fish were examined:—

SIZE OF FISH.	KIND OF FOOD.					
13.0 cm.	<i>Sagitta</i> , few ;	<i>Parathemisto</i> , none ;	<i>Calanus</i> , frequent ;	<i>Metridia</i> , very rare.		
12.7 "	" numerous ;	" frequent ;	" few.			
14.4 "	" numerous ;	" frequent ;	" rare ;	<i>Temora</i> , rare.		
14.7 "	" frequent ;	" few ;	" few.			
14.7 "	" frequent ;	" common ;	" few.			
14.5 "	" numerous ;	" frequent ;	" few ;	<i>Temora</i> , rare.		

The records for the whole thirty-one stomachs are very much a repetition of the part here given, and the peculiarity of the food contents will be more noticeable when compared with the food of the next sample of Herrings, which are also from Aberdeen Bay, but which were collected on June 10th of the present year (1901). In this sample there were eighteen Herrings, the lengths of which ranged from 13 to 16½ centimetres, and their food consisted very largely of pelagic Copepods, the most common form being *Temora longicornis*, a species which in the last sample held a very subordinate place as a constituent of their food. *Pseudocalanus elongatus* was moderately frequent, but larval *Balani* (cypris stage), though found in a considerable number of the stomachs, were not very numerous ; on the other hand, *Schistomysis spiritus*, which only occurred in a few stomachs, was common or abundant in one or two of them. *Oikopleura*, which were common in the stomachs of some of the Herring from the Firth of Forth, were also moderately frequent in the stomachs of this lot. Subjoined is part of the notes made when this sample of Herrings was examined, as it will show more clearly the contrast between their food and the food of the previous sample :—

SIZE OF FISH.	KIND OF FOOD.					
15.8 cm.	Copepods, frequent (<i>Temora</i> and <i>Pseudocalanus</i>); young <i>Balani</i> , few; <i>Oikopleura</i> , many.					
14.8 "	" common (	" (chiefly),	");	" "	few ;	" many.
14.0 "	" frequent (	" and	");	" "	none ;	" none.
15.2 "	" abundant (	" (chiefly),	" ?);	<i>Schistomysis spiritus</i> ,	common.	
13.0 "	" abundant (	" (chiefly),	none);	" "	abundant.	
16.5 "	" few (	" and <i>Pseudocalanus</i>);	young "	<i>Balani</i> ,	few.	

Four specimens captured off Collieston on July 5th, 1901, measured 14, 14, 14 $\frac{3}{10}$, and 15½ centimetres respectively, and the food observed in their stomachs was as follows :—

- (1) Copepods, frequent (*Acartia* sp.); *Podon* sp., very rare; young *Balani*, very few.
- (2) Copepods, frequent (they appear to be mostly *Acartia* sp. and *Pseudocalanus elongatus*); remains of a Schizopod; *Podon* sp., very rare; a minute Gasteropod; and a few young *Balani*.
- (3) Schizopods, numerous (chiefly *Schistomysis spiritus*); *Pseudocuma cercaria*, rare; *Pseudocalanus elongatus*, few; *Acartia* sp., frequent; young *Balani*, rare.
- (4) Copepods, frequent (they appear to belong mostly to *Acartia*); young *Balani*, very few.

The names of all the species observed in the stomachs of the Herrings examined are given in the annexed list :—

SPECIES FOUND IN THE STOMACHS OF HERRINGS.

CRUSTACEA.	OTHER THINGS.
Young Decapods. <i>Schistomysis spiritus</i> , Norman. <i>Neomysis vulgaris</i> (J. van Thompson). <i>Macropsis slabberi</i> (P.-J. van Beneden). <i>Pseudocuma cercaria</i> , P.-J. van Beneden. <i>Parathemisto</i> sp. (jun.). <i>Calanus finmarchicus</i> (Gunner). <i>Pseudocalanus elongatus</i> , Boeck. <i>Temora longicornis</i> (O. F. Müller). <i>Eurytemora velox</i> (Lilljeborg). <i>Centropages hamatus</i> (Lilljeborg). <i>Centropages</i> sp. <i>Metridia</i> sp. (? <i>lucens</i> , Boeck). <i>Ætidius</i> sp. <i>Candacia pectinata</i> , G. S. Brady. <i>Acartia</i> sp. <i>Ectinosoma atlanticum</i> (Brady and Robertson). <i>Dactylopus</i> (?) <i>tisboides</i> , Claus. <i>Idya</i> sp. <i>Evadne nordmanni</i> , Loven. <i>Podon leuckartii</i> . <i>Balanus</i> (cypris stage).	<i>Mytilus edulis</i> . Minute Gasteropods. <i>Oikopleura</i> . <i>Sagitta</i> .

SPRAT. *Clupea sprattus*, L.

Thirty-three specimens have been examined, twenty being from the Moray Firth and thirteen from the Firth of Forth. The Moray Firth specimens were collected on December 25th, 1900, and measured about 9 to 13¼ centimetres in length; only nine of them contained food that could be identified, and it consisted for the most part of Copepods. The following are the species which have been satisfactorily determined:—*Calanus finmarchicus*, observed in one stomach; *Pseudocalanus elongatus*, observed in one; *Temora longicornis*, in six; *Acartia* sp., in two; and *Oithona* (?) *helgolandica*, in two.

The specimens from the Firth of Forth were collected in May of the present year (1901), and with the exception of one specimen they were all under four inches in length (about 8 to 9 cm.); the largest one measured about 13¼ cm. The stomachs of all the thirteen specimens were fairly well filled, but their food consisted almost entirely of pelagic Copepoda. The most common species were *Pseudocalanus elongatus*, *Temora longicornis*, and *Centropages hamatus*; *Calanus finmarchicus* was also present in most of the stomachs, but was usually represented by only a few specimens; *Podon leuckartii*, *Evadne nordmanni*, larval Decapods, and larval *Balani* (both nauplius and cypris stages) were occasionally observed.

The names of the various organisms noticed are arranged in the annexed list:—

SPECIES FOUND IN THE STOMACHS OF SPRATS.

CRUSTACEA.	OTHER THINGS.
Larval Decapods. <i>Cumacea</i> sp. (young). <i>Calanus finmarchicus</i> . <i>Pseudocalanus elongatus</i> . <i>Temora longicornis</i> (Gunner). <i>Centropages hamatus</i> (Lilljeborg). <i>Acartia</i> sp. <i>Oithona</i> sp. (? <i>helgolandica</i> or <i>similis</i>). <i>Podon leuckartii</i> . <i>Evadne nordmanni</i> , Lov. <i>Balani</i> (nauplius and cypris stages).	

ALLIS SHAD. *Clupea alosa*, Lin.

A specimen of *Clupea alosa* was obtained from the salmon fishers at the Bay of Nigg on August 18th, 1900; it had been captured in their nets during the preceding tide. The specimen measured twenty inches (about 50 cm.) in length, and weighed 2 lbs. 6¼ oz. The food contained in its stomach, which appeared to consist entirely of *Temora longicornis*, filled a 4-oz. bottle.

TWAIT SHAD. *Clupea finta*, Cuv.

A specimen of the Twait Shad measuring 20¾ inches, or nearly 51 centimetres, in length, which was captured about eight miles east-north-east of Aberdeen on January 6th of this year (1902), had in its stomach two Sprats about 7½ centimetres in length, and also several Amphipods belonging apparently to *Parathemisto oblivia* (Kröyer).

COMMON EEL. *Anguilla vulgaris*, Leach.

Nineteen specimens of the Common Eel have been examined, seven of which were captured at the mouth of the River Dee at Aberdeen, one in Loch Fyne, and eleven in Loch of Loirston—a few miles distant from the Laboratory—and for these I am indebted to Dr. Williamson. The specimen from Loch Fyne was captured near Inveraray in 1897, but it was only examined on January 27th, 1901. The stomach of this specimen contained three dozen examples of *Idothea pelagica*, Leach. Some of the female specimens carrying ova measured scarcely 5 millimetres in length. The fragments of a few *Gammarus locusta* were observed in the intestines of this fish.

Two specimens of average size captured near the mouth of the River Dee, the one in July and the other in August, 1900, had in their stomachs partly digested Crustacea and Annelids. Five which were captured near the mouth of the River Dee on July 8th, 1901, and measured from 37½ to 60 centimetres in length, were examined, and in the stomach of the largest one a small shore Crab, *Carcinus mænas*, and the partly digested remains of a Hermit Crab were obtained; the stomach of another, 39½ centimetres, contained a small Gunnel, *Pholis gunnellus*, the length of which was about 10 cm.; but the other three stomachs contained nothing that could be identified.

The specimens from Loch of Loirston were collected early in June, 1901, five being collected on the 4th and six on the 5th; nothing

was observed in the stomachs of those collected last that could be identified, but the stomachs of the other five contained partly digested Sticklebacks, *Gasterosteus aculeatus*; several of these little fishes were observed in the stomach of the largest Eel, which was about $90\frac{1}{2}$ centimetres in length.*

CONGER EEL. *Conger niger* (Risso).

The following are records of the food observed in the stomachs of five specimens of *Conger niger*. Several others have been examined but as no food was observed in their stomachs they are not mentioned here. A specimen from Loch Fyne weighing 26 lbs., and captured in September, 1900, had in its stomach a partly digested *Cottus* sp. and several Gobies. The stomach of another, but smaller, specimen, captured at the same time as the last, contained three *Cottus* sp. and the remains of a shore Crab, *Carcinus mænas*, and of a Hermit Crab, *Eupagurus* sp.

The stomach of a specimen obtained from the salmon fishers at the Bay of Nigg on July 23rd, 1900, and measuring $48\frac{1}{2}$ inches (fully 112 cm.), contained an *Octopus vulgaris*, which was about $13\frac{1}{2}$ inches (nearly 24 cm.) in length, measuring from the posterior end to the extremity of the tentacles.† A specimen was obtained from the salmon fishers on August 16th, 1900, which measured $57\frac{1}{2}$ inches (about 144 cm.) in length and weighed 18 lbs., and in its stomach was found a partly digested Mackerel and the remains of Decapod Crustacea, too imperfect to be identified. In the stomach of another specimen which was also obtained from the salmon fishers, and which measured 61 inches long and weighed 32 lbs., the remains of fish and fragments of *Cancer pagurus* were obtained. On the outside surface of the stomach of this specimen were fascicles of minute globules resembling *Myxosporidium congri* (a Sporozoon).‡

GREAT PIPE-FISH. *Syngnathus acus*, L.

Twenty-four specimens from Annan, collected in April and May, 1900, and measuring from 13 to $16\frac{1}{2}$ centimetres, have been examined, and in the stomach of one of them a number of young Mysidæ were observed, but the food of all the others consisted entirely of Copepods, *Eurytemora velox* being the only species observed.

STRAIGHT-NOSED PIPE-FISH. *Nerophis aquoreus* (L.).

The stomach of a specimen 14 inches long, sent from Annan, collected April 30th, 1900, contained numerous specimens of young Mysidæ, but they were too young and too much decomposed for more particular identification.

* Van Beneden, referring to the presence of Eels in the reservoirs that had been prepared for Lobster culture, states that they are dangerous enemies of these Crustaceans, and, speaking generally of the food of Eels, he remarks:—"On peut dire que tout ce que a vie est dévoré par ce poisson. Il n'y en a pas de plus vorace. Les Crustacés mêmes, les Ecrevisses et les Homards deviennent leur proie."—(*Les Poissons des Côtés de Belgique*, p. 82.)

† Prof. P.-J. van Beneden also records *Octopus vulgaris* in the stomach of a Conger, and adds:—"Nous en avons trouvé, au mois de Janvier, un Poulpe complet, remplissant tout la cavité de l'estomac."—(*Les Poissons des Cotes de Belgique*, p. 82.)

‡ *Myxosporidium congri*, Perugia, Boll. Sci., Pavia, vol. xiii., pp. 24, 25, figs. 15-20; see also Dr. Gurley's Memoir on Psorosperms of Fishes in the *Report of the United States Commission of Fish and Fisheries*, 1892 (pub. 1894), p. 182, pl. 6, figs. 3-8.

§ Van Beneden, *op. cit.*, p. 89, states that the food of *Syngnathus acus* is *Crangon vulgaris*, and that the same Crustacean forms also the principal food of the next species (*Nerophis aquoreus*), but he adds that he had obtained, in addition to the *Crangon*, a dozen young fishes which he had not been able to determine.

GREY OR BLUE SKATE. *Raia batis*, L.

The examination of the stomachs of nine specimens of *Raia batis* gave the following results—three stomachs of moderate-sized fish obtained at the Fish Market, Aberdeen, on March 21st, 1901, contained partly digested *Pandalus montagui* and the remains of other Crustaceans, but they were too imperfect for identification. The stomachs of two of average size were obtained at the Fish Market on April 9th, 1901; one of them contained the remains of flat-fishes, Whittings, *Crangon vulgaris*, and *Nika edulis*, the other contained one Common Gurnard, two flat-fishes, and the remains of two *Portunus holsatus*, but they were all very imperfect.

Three stomachs which were obtained at the Fish Market on April 11th, 1901, contained the remains of fishes (Whittings and others), but too imperfect for identification.

The stomach of a Grey Skate measuring 15 inches across the pectoral fins, collected in the deep water (65 fathoms) off Aberdeen, contained the remains of *Crangon allmanni* and *Pandalus montagui*.

Van Beneden, referring to the food of *Raia batis*, remarks that "Ce poisson dévore tout," and gives the following list of fishes that he had found in their stomachs:—*Callionymus lyra*; *Gadus morrhua*, jun., *Gadus aeglefinus*, *Gadus merlangus*, and *Pleuronectes platessa*, L. *Portunus holsatus*, *Loligo vulgaris*, and *Solen ensis* were also among the organisms obtained by him.* Day also refers to the voracity of the Grey Skate, and states on the authority of Mr. Dunn of Mevagissey that a stone of nearly a pound weight was taken from the stomach of one of these fishes.†

SHAGREEN OR FULLER'S RAY. *Raia fullonica*, L.

The stomachs of three specimens of Fuller's Ray, obtained at the Fish Market, Aberdeen, contained a *Portunus holsatus* (with a sacculine parasite attached to its abdomen), *Spirontocaris securifrons*, *Nika edulis*, *Pandalus montagui* and a fragment of *Scalaria* sp., which had within it a partly decomposed Hermit Crab. The stomachs of other four specimens were obtained at the Fish Market on April 9th; and one of them contained a Sand-eel 14 centimetres in length and also the remains of another small fish; one contained three Sand-eels fairly perfect as well as the remains of a few others, and a *Crangon allmanni*; a third stomach contained fish remains (probably of small Haddocks) and a Schizopod, *Gastrosaccus spinifer*; while in the fourth a male *Callionymus lyra* 12 inches (30 cm.) in length was obtained. Another stomach, received on April 11th, contained the remains of fish, but they were too imperfect for identification.

THORNBACK SKATE. *Raia clavata*, L.

Two young specimens of *Raia clavata* captured in Aberdeen Bay on July 3rd, 1900, had some food in their stomachs which consisted chiefly of Amphipoda, but the only species identified were *Hippomedon denticulatus* and *Bathyporeia norvegica*.

The stomachs of two Thornback Skates obtained at the Fish Market, Aberdeen, on April 11th contained *Eupagurus bernhardus* and the remains of some fishes not perfect enough for identification.

Three small Thornbacks captured in the Firth of Clyde on October 4th, 1901, and measuring respectively 18½, 22, and 23 cm. across the

* *Op. cit.*, p. 16.

† *Brit. Fishes*, vol. II., p. 337.

pectoral fins, had each a small quantity of food in their stomachs which consisted entirely of Annelids and small Crustacea (apparently *Crangon*), but the food was too imperfect to be satisfactorily determined.

P.-J. van Beneden remarks (*op. cit.*, p. 18) that he has, in the month of April, found the stomachs of young *Raia clavata* about the size of the palm of the hand full of *Pseudocuma cercaria*, *Gammarus locusta* and *Calanus finmarchicus*. Mr. Dunn of Mevagissey states that he has known of quantities of Thornback Rays captured in the winter that were glutted with Horse-Mackerel, and he also states that this Skate "is very partial to Herrings and Sand-eels."

STARRY RAY. *Raia radiata*, Donovan.

A considerable number of Starry Rays were captured about 180 miles north-east of Buchan Ness on May 22nd, 1901, but the stomachs of most of them were empty, and any food observed consisted entirely of Crustaceans, which appeared to consist for the most part of young Decapods and Macruræ, but they were not perfect enough to be identified.

Five Starry Rays captured 10 miles off Aberdeen on August 21st, 1901, had all of them more or less food in their stomachs, and this, like that of the Starry Rays previously noticed, consisted wholly of Crustacea; these fishes measured from 22 to 27½ centimetres across the pectoral fins. The food contained in the stomach of the smallest of these specimens was not sufficiently perfect for identification; the food in another was also a good deal broken up, but the remains of a *Hyas* and *Astacilla* were observed; other two stomachs contained *Crangon allmanni* and what looked like the remains of *Hyas*, while the stomach of the other, which was the largest of this sample of Starry Rays, contained *Ebalia tuberosa*, *Portunus pusillus*, young *Hyas coarctatus*, and *Crangon allmanni*. A considerable number of specimens of what appears to be a new species of *Eudactylina* were obtained on the gills of these Starry Rays, and several specimens of *Callicotyle kroyerii*, a Trematode not previously recorded from Scottish waters, occurred on the ventral surface of several of these Rays.

Eight specimens of *Raia radiata* captured in Aberdeen Bay on November 29th and 30th were examined; their sizes ranged from 5¾ to 11¾ inches across the pectoral fins. The food found in their stomachs consisted of various organisms, amongst which the remains of small fishes were more or less frequent; they included a small *Cyclopterus lumpus* and some small Clupeoids, Whittings, and Common Dabs; a small *Rossia* was found in one stomach, *Crangon vulgaris* in six, and *Schistomysis ornatus* in two or three. There did not appear to be any material difference between the food observed in the stomach of the larger from that of the smaller specimens.

SANDY OR CUCKOO RAY. *Raia circularis*, Couch.

In the stomachs of two specimens of *Raia circularis* obtained in the Fish Market, Aberdeen, on April 9th, 1901, the only food observed consisted of the remains of a few Sand-eels. Fish remains constituted the only food found in the stomachs of several other specimens received from the same place on April 11th.

Five specimens captured in the Clyde on October 4th, 1901, and measuring 12¾, 13, 18, 18, and 19 centimetres across the pectoral fins, were also examined. The stomach of one, 18 cm. in width, had nothing in it that could be identified, but the others contained food which consisted almost entirely of Crustacea and Annelids; a few Foraminifera were also observed.

The names of the various forms obtained are given in the annexed Table:—

SPECIES OBSERVED IN STOMACHS OF *Raia circularis*.

CRUSTACEA.	OTHER THINGS.
<i>Portunus holsatus</i> (with <i>sacculina</i>).	Sand-eels.
<i>Eupagurus</i> sp.	Fish remains (sp.?)
<i>Nika edulis</i> , Risso.	<i>Scalaria</i> (fragments).
<i>Spirontocaris securifrons</i> (Norman).	Annelid remains.
<i>Crangon</i> sp.	<i>Biloculina depressa</i> .
<i>Pandalus montagui</i> , Leach.	
<i>Erythropis</i> sp.	
Remains of Mysidæ (sp.?)	
<i>Ampelisca</i> sp.	
<i>Cythere jonesi</i> , Baird.	
Remains of small Crustacea (gen. et sp.?)	

PORBEAGLE SHARK. *Lamna cornubica*, Cuv.

A Porbeagle Shark sent from the Fish Market at Aberdeen on December 3rd, and measuring about 3 feet 9½ inches in length to the fork of the tail, was examined at the Laboratory, and in its stomach were found the remains of ten partly digested Whittings, the lengths of which was probably from eight to ten inches; the only other organism observed was a *Crangon*, but it might have been derived from the stomach of one of the Whittings.

Another specimen of a Portbeagle Shark obtained at the Fish Market on December 5th, and measuring 3 feet 4 inches to the fork of the tail, contained in its stomach one Common Dab about six inches long, the earstones of four Whittings, probably 8 or 9 inches in length, a small *Loligo* (or *Ommatostrephes*) about 6 or 8 inches long, but not perfect enough to be identified, and also a small Crustacean, *Inachus dorsettensis*.

CONCLUDING REMARKS.

It may be pointed out by way of conclusion that the observations contained in the preceding pages concerning the food of fishes, especially of the larger and more adult forms, agree generally with the results given in Part III. of the Tenth Annual Report of the Fishery Board for Scotland,* of the examination of 10,461 specimens. These specimens comprised Common Gurnards, Cod, Haddock, Whittings, Long Rough Dabs, Plaice, Lemon Soles, Common Dabs, and Witch Soles. The total numbers of the respective kinds examined, including those from the Firth of Forth and St. Andrews Bay, were:—

Common Gurnards, - - - 1,113	Plaice, - - - - - 1,931
Cod, - - - - - 727	Lemon Soles, - - - - 821
Haddocks, - - - - 1,006	Witch Soles, - - - - 217
Whittings, - - - - 1,187	Common Dabs, - - - - 1,778
Long Rough Dabs, - - - 1,606	Flounders, - - - - - 75

About one hundred other stomachs, comprising those of Skate, Cat-fish, and Angler-fish, were also examined.

The general results brought out by the examination of these fishes serve to show that Crustacea formed the principal part of the food of the

* *On the Food of Fishes*, by W. Ramsay Smith, M.B., C.M., B.Sc., pp. 211-231.

Common Gurnard, the Cod, and to some extent also of the Haddock they also formed a considerable proportion of the food of the Long Rough Dab and the Common Dab. On the other hand fishes were seen to form the most important part of the food of the Whiting, while Annelids entered largely into the food of the Plaice, the Lemon Soles, and the Witch Soles.

Although in the present paper the results stated above are generally corroborated as regards the larger and adult fishes, it is shown that in the food of young and immature fishes, and even of those which in the adult stage live to a large extent on Annelids, the smaller Crustacea—Schizopods, Amphipods, and Copepods—form a very important part. If, for example, we compare the food of the Plaice, as given in the Tenth Annual Report already referred to, with the observations on the food of immature and small specimens contained in this paper, we find that, as recorded in the Tenth Annual Report, 1931 Plaice were examined, 1392 of the stomachs contained food which could be identified, and of this number only about 9 per cent. contained Crustacea, while fully 54 per cent. contained Annelids, and 45 per cent. Mollusca. In the present paper it is shown that, in marked contrast to the above, the food of the two hundred and twenty-six small specimens examined consisted almost entirely of minute Crustacea, and that it was in the stomachs of only a few of the larger of the specimens where Annelids were observed.

In a number of cases only a few stomachs have been examined, but it is likely that further observations will be made on the species noticed here as well as on others I have not yet had an opportunity to examine.

In former papers on the food of fishes it has usually been the larger organisms observed that have been recorded; the conditions under which these records were made were frequently unfavourable for the identification of minute forms; but in the preparation of the present paper these smaller forms have been specially studied, and this has permitted me to give a more detailed account of the food of the various fishes referred to.