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IV.—NOTES ON SOME PARASITES OF FISHES.

By Thomas Scott, F.L.S. (Plates VII.–VIII.)

CONTENTS.

GENERAL REMARKS.

In Part III. of the Eighteenth Annual Report of the Fishery Board for Scotland, I published some notes on the Parasites of Fishes that had been observed for the most part during the preceding year.

In that paper my observations were limited entirely to parasites belonging to the Crustacea. In the present paper I continue my observations on Crustacean parasites, but I also record a number of other forms belonging to the Hirudinea, or leeches, and the Trematoda. These, which form the subject of a separate section of this paper, have for the most part been observed on the skin and gills of fishes captured off the coast of Scotland by the "Garland"; some interesting forms have also been obtained on fishes received from the people in charge of the salmon fishings in the vicinity of the Fishery Board's Laboratory at Bay of Nigg.

But in addition to the study of the various creatures referred to above, my attention has also been directed, as opportunities occurred, to the study of the Entozoa of fishes. This has been done for the purpose of acquiring some knowledge of the more characteristic forms belonging to that group; and with reference to these organisms, it is almost superfluous to say that from their peculiar habits of life, and the remarkable transformations which many of them undergo, their study, though one of the most interesting, is also one of the most difficult that can engage the attention of the zoologist. These forms are still being studied, and I hope to be able to prepare some notes about them later on. Meantime I have to state that the records and observations which follow here are divided into two parts. The first part refers exclusively to Crustacean parasites belonging to the Copepoda; while the second part will include only such organisms as belong to the Hirudinea and the ecto-parasitic Trematoda.

It has been necessary, for the elucidation of some of the species recorded in both parts, to give drawings of several of them showing their characteristic forms as well as of some of their appendages; these drawings

have, as before, been done by my son, Mr. Andrew Scott, assisted by Mrs. Scott.

Mr. Peter Jamieson has also, as formerly, been of much assistance to me by the collection of specimens.

PART I.—COPEPODA PARASITA.

The Copepoda mentioned in the sequel include several species recorded in my former paper, but concerning which I am now able to give some additional information. A few are also recorded which have not previously been observed in Scottish waters.

Fam. Ergasilidæ.

Genus *Bomolochus*, Nordmann (1832).

Bomolochus soleæ, Claus.

1864. *Bomolochus soleæ*, Claus, Zeitschrift für Wissenschaft. Zool., vol. xiv., p. 374, Pl. XXXI.

In my previous note on this species I stated that it had been obtained on specimens of the common Sole, *Solea vulgaris*, captured in the Firths of Forth and Clyde as well as in the Humber near Grimsby. I have now to report the occurrence of what appears to be undoubtedly the same species in the nostrils of a number of different kinds of fishes, captured in the vicinity of Aberdeen and the Moray Firth. As many as twenty-nine specimens of this Copepod have been obtained in the nostrils of a single large cod caught in the Moray Firth by the "Garland," and sent to the Laboratory at the Bay of Nigg. The following is a list of the fishes in the nostrils of which the *Bomolochus* referred to has been obtained.*

Cyclopterus lumpus, L., the Lumpsucker, Bay of Nigg; Copepods not common in nostrils.

†*Gadus callarius*, L., the Cod, Moray Firth and vicinity of Aberdeen; Copepods frequent in nostrils.

Gadus æglefinus, L., the Haddock, Moray Firth; Copepods not common in nostrils.

Gadus merlangus, L., the Whiting, Moray Firth; Copepods not common in nostrils.

Gadus pollachius, L., the Pollack or Lythe, Bay of Nigg; Copepods frequent, but scarcely so much so as in the nostrils of the cod.

Pleuronectes platessa, L., the Plaice, Moray Firth; Copepods not common in nostrils.

Pleuronectes flesus, L., the Flounder, Bay of Nigg; Copepods not very rare in nostrils.

Solea vulgaris, Quen., the Common or Black Sole, Copepods found occasionally adhering to the skin.

The *Bomolochus* has been found much more frequently in the nostrils of the Cod than in those of any other fish which I have investigated; indeed there are few codfishes of moderate size which I examined that were not found to harbour *Bomolochus* in their nostrils. Frequently, not only

* See also *Ann. Scot. Nat. Hist.* (July, 1900), p. 153.

† My son, Mr. Andrew Scott, has found the same *Bomolochus* in the nostrils of codfish caught in Barrow Channel, near Barrow-in-Furness, Lancashire (*14th Ann. Rept., L.M.B.C.*, Dec., 1900, p. 12).

adult males and females (the latter commonly with ovisacs) are observed, but also young ones in all stages of development, clearly indicating that the Copepodes are quite "at home" in this curious domicile. This habit on the part of *Bomolochus solew* is the more interesting when it is remembered that it is a "free living" species, and that there appears to be nothing to hinder it from leaving the nostrils of the fish, for it can move freely about amongst the mucus with which the nostrils are usually well supplied, and if the Copepods are removed and placed in clean sea water they may be seen swimming, or running about the sides of the vessel, with nearly as much agility as a "free-swimming" species. Judging from the number of adult and young specimens found in the nostrils of a single cod it is evident that the *Bomolochus* not only lives and propagates in this strange abode, but finds the conditions of life, amid such surroundings, fairly satisfactory, even though the accommodation be somewhat limited; one point in the Copepod's favour is that it has plenty of food, and is well sheltered from its enemies.

Quite recently, and after this paper had been sent to the printer, I obtained the heads of a number of Ling, *Molua molva* (L.), from the Fish Market at Aberdeen, and in the nostrils of several of them specimens of a *Bomolochus* not unlike those found in the nostrils of the fishes mentioned above, but somewhat larger, were observed. This adds another species to the list of fishes in the nostrils of which Copepods are found to live. I have, moreover, to record the occurrence of *Bomolochus* sp. on the gills of a Four-bearded Rockling, *Onos cimbrius* (L.), from the Firth of Forth, collected as far back as 1892, and also specimens of a *Bomolochus* sp., which were obtained on the back of a small *Zeugopterus punctatus* (Bl.), captured by the "Garland" near the mouth of the Clyde estuary in September 1897. At present I am unable to say whether all these *Bomolochus* belong to the one species or not, that will be determined later; meantime, it is interesting to observe how extensively *Bomolochus* is associated in one way or another with the fishes of our seas.

Genus *Thersites*, Pagenstecher (1860).

Thersites gasterosteus, Pagenstecher.

1861. *Thersites gasterosteus*, Pagenstecher, Arch. f. Naturg., vol xvii., p. 118, Pl. VI., figs. 1–9.

In my paper on the Parasites of Fishes published in the Eighteenth Annual Report, Part III., I stated that *Thersites gasterosteus* had been obtained on the inside of the gill-covers of *Gasterosteus aculeatus*, from Barra, Outer Hebrides, and in the Forth near Alloa; and that it had also been observed on *Gastræa* (*Gasterosteus*) *spinachia*, from Loch Etive. I have now to record its occurrence on *Gasterosteus aculeatus* captured in the brackish pools on the Aberdeen links, between the mouth of the River Don and the golf-course, on September 11th, 1900. *Thersites* appeared to be a comparatively common species here, as it was observed on nearly every one of the specimens of *Gasterosteus* captured. Both males and females were observed, and many of the latter were carrying ovisacs.

Genus *Ergasilus*, Nordmann (1832).

Ergasilus nanus, E. van Beneden. (Pl. VII., figs. 1–8.)

1870 *Ergasilus nanus*, P. J. v. Beneden, *Les Poissons des côtes de Belgique, leurs parasites et leurs commensaux*, p. 27, Pl. I., fig. 6 (recorded and figured but not described in this work).

Description of the female.—The body, which is elongated, is moderately stout anteriorly, but tapers gradually to the narrow posterior extremity. Its length from the broadly rounded forehead to the end of the caudal furca is 1·2 mm. (about $\frac{1}{21}$ of an inch). The cephalothoracic segment is large, and when seen from above is somewhat pear-shaped in its general outline; the widest part of the segment, which is equal to fully half its length, is about one-third of its length from the anterior end; while at about one-third of its length from the posterior end there is a distinct though not very deep contraction, which seems to indicate that an articulation has here become obsolete, and that this segment is really composed of two coalescent segments. The remaining thoracic segments are small, as shown by the full-sized drawing (fig. 1).

The antennules and antennæ.—The antennules are short, apparently only five-jointed, and moderately setiferous (fig. 2); the first joint is proportionally larger than any of the others; the proportional lengths of the joints are indicated approximately by the annexed formula :—

Numbers of the joints,	1 . 2 . 3 . 4 . 5
Proportional lengths of the joints,	26 . 12 . 10 . 9 . 11

The antennæ are large and strong, and are apparently used as powerful grasping organs; they are each three-jointed, and the second and third joints, which are elongated, are fully twice the length of the basal joint; each antenna is armed with a strong slightly curved terminal claw, nearly half as long as the joint to which it is articulated (fig 3).

Oral appendages.—The oral appendages in *Ergasilus nanus* are apparently more or less obsolete or rudimentary.

Thoracic feet.—The first four pairs of thoracic feet which are all well developed, are each of them two-branched; in the first three pairs the branches are each three-jointed, but in the fourth pair, while the inner branches, like the branches of the other three pairs, are three-jointed, the outer branches are only two-jointed (figs. 4-6). In the fifth pair, each foot consists of a single uniarticulate branch, subcylindrical in outline, and with the apex somewhat truncated and furnished with about three setæ (fig. 7).

The abdomen.—This portion of the animal is comparatively short, while the caudal furca are scarcely equal in length to the last abdominal segment. The specimen was provided with two large ovisacs of a light-bluish colour, and contained numerous ova (fig. 8).

Habitat.—Found adhering to the gills of a Thick-lipped Grey Mullet, *Mugil chelo*, Cuv., caught in the salmon-nets at Bay of Nigg, near Aberdeen, July 30th, 1900. It seems to be a rare species, for, though several mullets were examined, only one specimen of *Ergasilus* was observed.

Remarks.—One of the characters by which the *Ergasilus* may be readily distinguished from either *Bomolochus* or *Thersites*, is the great disproportion between the long and powerful antennæ and the short antennules, when compared with the same appendages in the other two genera named. This character is not peculiar to *Ergasilus nanus*, but appears to be common more or less to all the members of the genus. These long antennæ, armed as they are with strong terminal claws, enable the parasite to grasp securely the gill filaments of the fish to which it attaches itself. In *Thersites*, on the other hand, the antennæ, though moderately stout and armed with terminal claws, are short, even more so than the antennules. The *pear-like* form of the cephalothoracic segment does not appear to be peculiar to *Ergasilus nanus*, though it is perhaps more obvious in that species; but it is interesting to note that the drawing of the parasite given by Prof. P. J. v. Beneden in his work on

the fishes of the coast of Belgium, shows the cephalothoracic segment to have practically the same outline as that represented here.

Ergasilus sieboldii, Nordmann, found on the Pike, *Esox lucius*, and one or two other fresh-water fishes is, as figured by Prof. C. Claus,* somewhat similar to *Ergasilus nanus* in its general outline, and in one or two details of structure; it will be observed, however, that in the original description of this Copepod by Nordmann,† the cephalothorax is more rotund, the abdomen is proportionally rather shorter and more distinctly differentiated from the thorax, and the six-jointed antennules are shown to be rather more elongated and slender.

Distribution.—Found on *Mugil chelo*, Cuv., caught at Ostend and on the coast of Brittany (P. J. v. Ben., *Poiss. d. côtes d. Belg.*, p. 27). On *Mugil chelo*, Cuv., caught "dans les environs de Saint-Vaast, Côtes de La Manche" (A. E. Malard, *Bull. Soc. Philom. de Paris* (8), t. ii., No. 2, p. 30—separate reprint). On *Mugil chelo*, Cuv., caught in the Gulf of Trieste (Ed. Graeffe, *Arbeit. d. Zool. Inst. z. Wien*, t. xiii.,—Heft 1, p. 41, 1900).

Fam. Caligidæ.

Genus *Caligus*, Müller (1785).

Only one species belonging to the genus *Caligus* falls to be noticed at this time, viz. :—

Caligus scombri, Basset-Smith. (Pl. VII., figs. 9, 10.)

1898. *Caligus scombri*, Basset-Smith, Ann. and Mag. Nat. Hist., (7) vol. ~~ii~~ XI., p. 11, p. 83., Pl. ~~VI~~ III., fig. 2. This reference is for C. platytarsi and not for C. scombri.

A single specimen of a *Caligus*, apparently belonging to this species, was found adhering to the inside of one of the gill-covers of a Mackerel, *Scomber scombrus*, Lin., caught in the vicinity of Aberdeen, August 17th, 1900. The specimen was a female, no male was obtained.

It will be observed from the drawing of this specimen (fig. 9) that the cephalic segment does not greatly exceed the thorax in length, and that the abdomen is nearly as long as the cephalic shield; the body is thus divided into three nearly equal portions.

The *sternal fork* (fig. 10) resembles that of *Lepeophtheirus thompsoni*, Baird, while the fourth pair of feet are somewhat like those of *Caligus diaphanus*, Nordm. In general appearance *Caligus scombri* is not very unlike *Lepeophtheirus thompsoni*, and, but for the fact that it possesses frontal *lunulæ*, might be mistaken for that species.

There does not appear to be any previous record of this *Caligus* for Scotland. It is a comparatively small species; the specimen represented by the drawing measures scarcely 5·5 mm. in length, from the forehead to the end of the caudal furca.

Genus *Dinematura*, Latreille (1827).

Dinematura producta (O. F. Müller).

1785. *Caligus productus*, O. F. Müller, Entomostraca, p. 132, Pl. XXI., fig. 3.

The examples of *Dinematura producta*, recorded in my paper published

* Prof. C. Claus, 'Parasitische Copepoden (Zeitschrift fur wiss. Zool., Bd. xxv., 4), separate copy. p. 15, Pl. XXIII., fig. 12 (1875).

† Prof. A. Nordmann, Mikrogr. Beiträge z. Naturg. d. Wirbel. Thiere, Zweites Heft, p. 15, Taf. II. (1832).

last year, were obtained from one or two young specimens of Porbeagle Sharks landed at Aberdeen Fish Market, but the localities where these sharks had been captured could not be given with certainty. In the present paper I am able to record *Dinematura producta* from sharks captured at two different places close to the shores of Scotland. On November 16th, 1900, a Porbeagle Shark was caught off Dunrobin Castle, on the north side of the Moray Firth, during some investigations that were being carried on there on behalf of the Fishery Board; several fine specimens of the *Dinematura* were obtained on this shark. These specimens, which are finer and more perfect than those from which the drawings for my previous papers were prepared, are now in the collection at the Laboratory at Bay of Nigg. But besides these specimens from the Moray Firth, I have, through the kindness of Prof. D'Arcy W. Thompson, Dundee, had the privilege of examining a few fine examples of the same parasite taken from a Thrasher Shark, *Alopias vulpes* (Gmel.), captured near Buddon, Firth of Tay, on July 30th, 1889; these specimens are in the Museum of University College, Dundee; they are specially interesting from having been obtained on a Thrasher Shark; the shark they are most frequently found upon appears to be the Porbeagle.

The specimens recorded by Dr. Baird (Brit. Entom., p. 286) were obtained by Dr. Johnston from a Porbeagle Shark captured in Berwick Bay in September 1834.

Dinematura serrata, Kröyer.

1863. *Dinemqura serrata*, Kr., Bidrag til Kundskab om Snyltekrebsene (1863), p. 176, Pl. VIII., fig. 4.

Habitat.—Taken on a Short Sunfish, *Orthagoriscus mola* (L.), at Banff in 1862 by the late Thomas Edward.

The Rev. A. M. Norman informs me that he has specimens of this species in his collection sent to him by Mr. Edward. The species when discovered by Edward was new to science, and the Rev. A. M. Norman, in his M.S. notes, gave it the name of *Monm fimbriata*. Unfortunately no description of the parasite was published till Kröyer did so in 1863 under the name which it now bears. The species will be found recorded under Dr. Norman's M.S. name *Monima fimbriata*, in the Appendix to Samuel Smiles's Life of Thomas Edward, p. 437 (1877), as one of the many creatures which that keen-sighted naturalist added to the fauna of Scotland.

Genus *Echthrogaleus*, Steenstrup and Lütken (1861).

Echthrogaleus coleoptratus (Guérin).

1817. *Dinematura coleoptrata*, Guérin, Icon. d. règne animal, vol. iii., Pl. XXXV., fig. 6.

A specimen of this somewhat rare species was taken from the fin of a Dogfish, caught to the east of Fair Island (between Orkney and Shetland), on October 18th, 1900. The species to which the fish belonged is somewhat uncertain, as the fish was not preserved and no note of it was taken at the time it was captured, but probably it was a young Porbeagle Shark, *Lamna cornubica*. The specimens of *Echthrogaleus* recorded in my previous paper were taken from the fins of a Porbeagle Shark landed at the Fish Market at Aberdeen; and according to Dr. Baird (Brit. Entom., p. 285), the same species of *Echthrogaleus* was obtained by the late Dr. Johnston, Berwick-on-Tweed, also from a Porbeagle Shark, captured in

Berwick Bay in 1834. Dr. Basset-Smith also gives *Lamna cornubica* as the host of the *Echthrogaleus*. It would appear from Dr. Johnston's remarks on the habits of this parasite that his specimens were not obtained on the fins, but were found adhering to the "sides of the branchial covers" of the Porbeagle; and he also adds that it "appears to be parasitical on several species of fish." He does not, however, give the names of any other species of fish on which *Echthrogaleus* was found, nor the name of anyone who had found this parasite on other fishes.

Genus *Cecrops*, Leach (1816).

Cecrops latreillii, Leach.

1816. *Cecrops latreillii*, Leach, Ency. Brit. Suppl., vol. i., p. 20, figs. 1–5.

A large number of specimens of *Cecrops* were obtained on the gills of a Short Sunfish sent from Mallaig, West Coast of Scotland, to the Laboratory at Bay of Nigg in April, 1900; the specimens comprised both males and females.

A correspondent (William Evans, Edinburgh) has kindly forwarded to me the following interesting extract from the M.S. minutes of a meeting of the Royal Physical Society held in Edinburgh on January 15th, 1851:—"Specimens of *Cecrops latreille*, a singular parasitic animal, were exhibited by John Stewart, Esq., taken from the gills of a Short Sunfish captured in Glenluce Bay." This bay is part of Solway Firth district.

Fam. Dichelestidæ.

Genus *Clavella*, Oken (1815).

Clavella hippoglossi, Kröyer. (Pl. VII., fig. 11.)

1838. *Clavella hippoglossi*, Kr., Naturh. Tidsskrift, R. i., vol. i., p. 196, Pl. II., fig. 3.

In my paper in Part III. of the Eighteenth Annual Report I gave a short description and some figures of the female of this species, and added that no males had been observed. In the present paper I am able to record the discovery of a single male specimen of *Clavella hippoglossi*, which occurred amongst a considerable number of females taken from a Halibut in the Fish Market at Aberdeen during the past summer.

This male, which is represented by the drawing on Plate VII. (fig. 11), measures only about 1·5 mm. (about $\frac{1}{17}$ of an inch) in length. The antennules, like those of the female, are five-jointed. The antennæ resemble those of the female, but are much more strongly hooked. The head is proportionally larger, the thorax more distinctly segmented, and the genital segment considerably shorter than in the female. The abdominal appendages are more prominent and elongated, as shown by the drawing.

The males of *Clavella hippoglossi* are apparently very rare; the one now recorded is the only one I have seen, though many specimens of females have been examined, and I do not find any records of males in any of the works on fish parasites to which I have access. Perhaps one of the reasons why the males have escaped notice hitherto may be because they are so small, but, whatever the reason, it is evident that males are not so common in proportion to the females as they are found to be in some other species, *e.g.*, in *Chondracanthus* and *Brachiella*.

Clavella labracis, van Beneden.

1870. *Clavella labracis*, v. Ben., Les Poiss. d. côtes d. Belg., pp. 45–46, Pl. I, fig. 4. (The species, though recorded and figured, is not described in this work.)

A number of specimens of this *Clavella* were obtained on the gills of specimens of the Striped Wrasse, *Labrus mixtus*, captured in the Clyde near Ayr, January 30th, 1900. The species is a small one, ova-bearing specimens being scarcely a millemetre in length, but though the copepod itself is small, it carries comparatively large eggs; these, however, are few in number, and are arranged in a single series. Prof. v. Beneden has found *Clavella labracis* "in abundance" on the gills of *Labrus maculatus*, Bloch (*L. berggylta* Asc.); he also records it from the gills of *Labrus trimaculatus*, Gmel. (*L. mixtus*, L.—the same species of fish as that on which I also found the *Clavella*). *C. labracis* appears to be an addition to our fauna.

Genus *Cycnus*, M.-Edwards (1840).

Cycnus pallidus (P. J. van Beneden).

1854. *Congericola pallida*, P. J. van Ben., Acad. Roy. Belg, t. xxi., pt. 2, p. 583.

This parasite is found on the gills of the Conger Eel, *Conger niger* (Risso), (*C. vulgaris*, Cuv.), and is recorded in my former paper as having been taken from the gills of a conger captured in the Firth of Clyde. I have now to record the occurrence of the same parasite on the gills of one or two Conger Eels captured in the salmon-nets at the Bay of Nigg in July and August 1900. A few *Cycnus* were obtained on the gills of a conger caught on the 21st July, on another caught on the 23rd, and also on one caught on the 25th. Several other specimens were taken from the gills of a conger captured by the salmon fishermen on August 4th, while on one caught on August 16th no fewer than twenty *Cycnus* were observed. All these examples of conger were of moderate size; two of those captured in July measured fully four feet in length, while the one caught on August 16th was over four feet nine inches long. As all the large congers examined hitherto have been found to harbour *Cycnus* in fewer or larger numbers, it would seem that the parasite is not at all a rare form. Of course, its occurrence in any quantity may be limited to certain areas; but that it has a wide distribution is apparent from the fact that it has been on obtained on the gills of conger at Plymouth by Dr. Basset-Smith, and by my son, Mr. Andrew Scott, at Piel, Barrow-in-Furness. It has also been recorded by P. J. v. Beneden from the gills of conger captured on the coast of Belgium,* and by Dr. Graeffe from the same species, taken in the Gulf of Trieste, in the Adriatic.

Fam. Lernæidæ.

Genus *Lernæenicus*, Lesueur.

Lernæenicus sprattæ (Sowerby).

1806. *Lernæa sprattæ*, Sow., British Miscellany, ii., p 17, Pl. LXVIII.

In my previous paper on Fish Parasites I recorded this species as having

* This author does not appear to have found the parasite very common, for he says—"Il n'est pas abondant: on en trouve rarement une demi-douzaine dans le même poisson" (Les Poiss. d. côtes d. Belg., p. 82, footnote).

been observed on the eye of a Clupeoid at Leith, Firth of Forth, and I have now to record its occurrence on the eyes of sprats captured in the Solway Firth near Annan. One of the specimens of *Lernæenicus* was observed on the eye of a sprat captured on the 24th of May, and two on sprats captured on November 27th, 1900. The specimens were observed by Dr. Fulton, our Superintendent, who kindly handed them over to me. This is the first time *Lernæenicus sprattæ* has been recorded for the West of Scotland.

Genus *Lernæa*, Linné (1767).

Lernæa minuta, T. Scott.

1900. *Lernæa minuta*, T. Scott, Eighteenth Annual Report of the Fishery Board for Scotland, Pt. III., p. 161, Pl. VII., fig. 13.

This small *Lernæa* was described and figured in Part III. of the Eighteenth Annual Report of the Fishery Board for Scotland, from specimens obtained on *Gobius minutus* sent to the Laboratory from Annan (Solway Firth). Several additional specimens of this *Lernæa* have been obtained on examples of the same species of Goby captured at Annan on October 31st, 1900, and forwarded to the Laboratory. Annan is still the only locality where this species has been obtained. No males have yet been observed.

Lernæa lumpi, T. Scott. (n. sp.) (Pl. VII., fig 12.)

The somewhat curious parasite which I record here under the name of *Lernæa lumpi* was obtained on the gills of a moderately large adult female Lumpsucker, *Cyclopterus lumpus*, Lin., captured in the salmon-nets at the Bay of Nigg, near Aberdeen, March 29th, 1900.

The parasite is about two inches in length (50 mm.). It is moderately slender, and a portion of the posterior end is bent round so as to assume a hook-like form,—this part of the body is not sigmoid as in *Lernæa branchialis*. The cephalic appendages are not so greatly developed as in that species; the neck is long and slender and gradually merges into the somewhat stouter posterior part of the body. There is a distinct constriction between the genital segment where the ovisacs are attached and the caudal portion of the body, and as I have, so far, only seen one specimen of the parasite, I am unable to say whether the constriction is normal or accidental. The ovisacs are small, and, as is usual in *Lernæa*, they are also more or less twisted.

The head, and a portion of the neck measuring about three-quarters of an inch, were buried amongst the tissues of one of the gill-arches of the *Cyclopterus*.

Only the one specimen of the *Lernæa* was observed, notwithstanding that nearly two hundred Lumpsuckers were examined; it would appear from this to be a moderately rare species. *Lernæa lumpi* is the largest member of the genus I have yet observed.

Fam. Chondracanthidæ.

Genus *Sphyrion*, Cuvier (1830).

Sphyrion lumpi (Kröyer). (Pl. VII., fig. 13.)

1845. *Lestes lumpi*, Kr., Danmarks Fiske, vol. ii., p. 217.
1863. *Lesteira lumpi*, Kr., Bidrag til Kundskab om Snyltekrebsene, p. 325, Pl. XVIII., fig. 5.
1899. *Sphyrion lumpi*, Basset-Smith, Proc. Zool. Soc. (April 1899), p. 489.

A damaged specimen of this curious species was obtained on a Lump-sucker, *Cyclopterus lumpus*, L., captured in the salmon-nets at Bay of Nigg on April 23rd, 1900. When observed, the specimen was minus the head, owing probably to the fish having been roughly handled. The specimen also appeared to be somewhat immature, but there can be no doubt as to its identity with the species to which it is ascribed. The drawing on Plate II. gives a fairly accurate representation of the specimen, which measures 13.2 mm. or fully half an inch in length, exclusive of the caudal appendages.

Sphyrion lumpi seems to be a rare species; the only British locality where it is said to have been found is Dungenesss, and even that is doubtful; while on the Continent it does not appear to have been observed anywhere but in Denmark. The Rev. T. R. R. Stebbing records a closely allied species (*Sphyrion lævigatum*, Guérin-Méneville), from Mossel Bay, Cape of Good Hope, taken from the abdomen of a "Ling," *Genypterus blacodes* (*Report of the Marine Biologist* (1898), published by the Department of Agriculture, 1899, p. 198); and G. M. Thomson records the same parasite (also from *Genypterus blacodes*) from New Zealand (Trans. N.Z. Inst., vol. xxii. (1889), p. 370, Pl. XXVIII., fig. 4).

Genus *Chondracanthus*, De la Roche (1811).

Chondracanthus ornatus, T. Scott. (Pl. VII., fig. 14.)

1900. *Chondracanthus ornatus*, T. Scott, Eighteenth Annual Report of the Fishery Board for Scotland, Part III., p. 168.

This species, which was described in Part III. of the Annual Report referred to, was obtained on the gills of Spotted Dragonets, *Callionymus maculatus* Raf., captured in the Firth of Clyde and the Moray Firth. I have now to record the occurrence of the same *Chondracanthus* from the gills of a *Callionymus* captured about 50 miles to the east of Fair Island (between Orkney and Shetland), on the 19th October, 1900. This record extends the distribution of *C. ornatus* very considerably.

When preparing a description of the species for my previous paper, want of time prevented me from adding any drawings to illustrate its form or structure, and I take this opportunity to present a full-sized figure of the species prepared from a fairly typical specimen; this figure shows the animal as seen from above. In the description of the species the following statement occurs:—"This Copepod viewed from above has a general outline closely similar to that of an equilateral triangle, the bluntly rounded head forming the apex and the truncate posterior end the base. The front of the head is indistinctly trilobed, one lobe being in the centre and projecting slightly in front of the two lateral lobes, which, like the central one, are bluntly rounded. The neck connecting the head with the thorax is very short. Along each side of the thorax (forming the sides of the triangle) there are three or four more or less distinct tubercles, and a series of three similar tubercles extends along the middle of the dorsum. The posterior tubercle of the middle series stands well up, but each of the other two stands at a slightly lower elevation than the one immediately behind. The abdomen is exceedingly small and inconspicuous. The ovisacs are of moderate length and stoutness, like those of *Chondracanthus limandæ*." The arrangement and position of the lateral tubercles seem to vary slightly in different specimens. No males have yet been observed.

Though *C. ornatus* is of comparatively moderate size, being about 5 mm. in length, and as much in width at the posterior end, it is so well concealed by the gill-covers that it easily escapes notice, and it is only by turning back the gill-covers that one can make sure whether the *Chondracanthus* is present or not.

Fam. LERNÆOPODIDÆ.

Genus *Charopinus*, Kröyer (1863).

Charopinus dalmanni (Retzius). (Pl. VII., fig. 16.)

1831. *Lernæa dalmannii*, Retzius, Froriep's Notizen, xxix., p. 617, Pl. VI., fig. 5.

1863. *Charopinus dalmannii*, Kr. Bidr. til Kundsk. om Snyltekr., p. 280, Pl. XIV., fig. 6.

This species was obtained in the nasal fossæ of a Grey Skate, *Raia batis*, captured in the Moray Firth, November 16th, 1900. This, I think, is a new station for the species in Scotland. The drawing (fig. 16) shows a side view of the modified extremities of the second maxillipedes, by means of which it is anchored securely to its host. The form which this modification assumes becomes one of the chief characters for distinguishing this species of *Charopinus* from the others. The importance of this character is also referred to in the description of the next species—*C. ramosus*, Kröyer.

Charopinus ramosus, Kröyer. (Pl. VII., figs. 17–23.)

1863. *Charopinus ramosus*, Kr., Naturh. Tidsskr., R. iii., p. 284, Pl. XIV., figs. 5, a–i.

Charopinus ramosus, Kr., is a comparatively small species; the specimen represented by the drawing (fig. 17) measures from the forehead to the extremity of the posterior appendages only nine millimeters, whereas *C. dubius* is about twice, and *C. dalmanni* four times that length. The most important and characteristic difference, however, is in the form assumed by the extremities of the second maxillipedes. These appendages are united near their distal ends by their inner surfaces, but instead of forming at their junction a chitonous plate like *C. dubius*, each maxilliped terminates in a lateral biramose process which penetrates the tissues of the host.

In the few specimens of *Charopinus ramosus* I have seen, the terminal rami of the second maxillipedes are more divaricate than they are shown to be in Kröyer's figure, but this difference, which seems to be unimportant, may be due to the position in which the parasites were attached to the fish.

Charopinus ramosus was obtained on the gills and gill-arches, both of *Raia clavata* and *Raia maculata* landed at the Fish Market at Aberdeen on June 27th, 1900, but it appeared to be somewhat rare.

Charopinus dubius (T. Scott). (Pl. VII., fig. 15.)

1900. *Charopinus dubius*, T. Scott, Eighteenth Annual Report of the Fishery Board for Scotland, Pt. III., p. 170.

A few more specimens of *Charopinus dubius* have been obtained on the gills and gill-arches of some specimens of *Raia circularis* landed during the past year at the Fish Market at Aberdeen.

This species is intermediate in size between *Charopinus dalmanni* and

Ch. ramosus, and like the latter it has only hitherto been obtained attached to the gills or gill-arches of its host and not in the nasal fossæ. It appears to be a more common species than *Ch. ramosus*, being found with moderate frequency on the specimens of *Raia circularis* which have so far been examined. The most distinctive specific character of *Ch. dubius*, as stated in the description of the species published in my former paper on the Parasites of Fishes, is the form assumed by the extremities of the second maxillipedes, which are modified so as to enable the parasite to anchor itself to the fish. In this species the maxillipedes unite at their extremities and form a single horny or chitonous enlargement, which differs in form from that of the same appendages in *Ch. dalmanni* and *Ch. ramosus*.

In my previous paper on Fish Parasites, it was pointed out that, according to Kröyer, the more important characters by which *Charopinus dalmanni* (Retz.) and *Ch. ramosus* are distinguished are taken chiefly from the form assumed by the apices of the second maxillipedes, and therefore in the present paper I give figures of the apical portions of the second maxillipedes of all the three species mentioned in the foregoing notes; these figures are placed in juxtaposition that they may show more clearly the differences that exist between these three *Charopini*.

In *Charopinus dalmanni* the apices of the second maxillipedes, though placed closely side by side, as shown in Plate VIII., fig. 6, of my previous paper,* are not adherent to each other, and if they be viewed from the side they are seen to have each a semilunate form (see fig. 17, Pl. VII. of the present paper), they are thus enabled to grasp a portion of the tissue into which they have been inserted, and which has in some way through contact with them become modified and hardened, and as the apices themselves have become considerably enlarged they are able to obtain a firm and secure hold of that part of the host to which the parasite has in this way attached itself. In *Charopinus ramosus*, on the other hand, the second maxillipedes, as already stated, become coalescent near the distal end and there send out on each side a moderately large biramose appendage, the rami of which, though in some cases as figured by Kröyer, not much separated, are in other examples considerably divergent (fig. 17, Pl. VII.). In *Charopinus dubius* the second maxillipedes become coalescent at the apex and develop a moderately large horizontal appendage, which is of a brownish colour and a hard structure; when perfect, this appendage is in general appearance somewhat boat-shaped, and having the ends slightly turned up (fig. 15, Pl. VII.). On the under side of the appendage there is what appears to be a disk, of an oval, or in some cases of a nearly circular form, probably caused by a fold of the under surface, and it sometimes happens that, if one is not very careful in dissecting out an appendage from the tissues in which it is embedded, the ends of it may get broken off and only the disk-like central portion is left. The second maxillipedes of the specimen from which the species was described appear to have been injured in the way I have indicated, and hence the remark that "The second maxillipedes . . . are joined to each other at the apex by small horn-coloured plugs which unite to form a thin circular horny disk, hollow in the middle, with the margins slightly reflexed."† If the differences in the form of the anchoring arrangement assumed by the second maxillipedes of *Charopinus*, such as have been described, be more or less of a permanent character, and there seems to be little doubt that they are so, the three species mentioned here must be held as sufficiently distinct, the one from the other.

**Eighteenth Annual Report*, Part III. (1900).

†*Op. cit.*, Part III., p. 170.

Genus *Actheres*, Nordmann (1832).

Actheres percarum (Nordmann).

1832. *Actheres percarum*, Nordm., Mikrog. Beiträge, p. 63, Pl. I.

Habitat.—On the gills of the common Trout, Moray district (T. Edward, Banff). Nordmann records this species as found on the gills of the common Perch, *Perca fluviatilis*, L., and the Pike-Perch, *Stizostethium lucioperca* (L.).

The Rev. A. M. Norman informs me that this species of Copepod was sent to him by Thomas Edward, who obtained it somewhere in the neighbourhood of Banff, and that it is now in his collection. *Actheres percarum* is recorded in the Appendix to Samuel Smiles's Life of Edward (p. 437) as *Basanistes salmonea*. It appears that Edward obtained the *Actheres* on the gills of Salmon as well as on the gills of the common Trout.

Genus *Lernæopoda*, Kröyer (1837).

Lernæopoda elongata (Grant).

1827. *Lernæa elongata*, Grant, Brewster's Edin. Journ. Sci., vol. vii., p. 147, Pl. II., fig. 5.

A specimen of this Lernæopod was taken by Mr. Dannevig from the eye of a Shark caught to the eastward of Fair Island (between Orkney and Shetland) by the steam trawler "St. Andrew," October 19th, 1900. This specimen, which is now in the collection in the Fishery Board's Laboratory at Bay of Nigg, gives the following measurements:—Length of body, exclusive of the second maxillipedes, fully 15 mm. ($\frac{3}{5}$ inch). Length of the second maxillipedes, fully 15 mm. (or as long as the body).

The species of the shark from the eye of which Mr. Dannevig removed the Copepod was not definitely ascertained, but it was probably a Porbeagle shark, *Lamna cornubica*.

Mr. Ingram, the Fishery Officer at Aberdeen, brought me recently another specimen which he had removed from the eye of a shark about six feet in length—which, from his description, appeared to be a Greenland shark,—landed at the Aberdeen Fish Market. This specimen measured about 40 mm. ($1\frac{3}{5}$ inches) from the extremity of the second maxillipedes to the posterior end of the body.

The specimen recorded in my previous paper* was taken from the eye of a Porbeagle Shark, but the locality was not clearly ascertained. The only British specimen which Dr. Baird records† was taken by Mr. Yarrel from the eye of a shark caught on the English coast and brought to London in the winter of 1848, but the species to which this shark belonged is not stated.

Genus *Brachiella*, Cuvier.

Brachiella bispinosa, Nordmann.

1832. *Brachiella bispinosa*, Nordm., Mikrog. Beiträge, p. 94, Pl. VIII., fig. 4.

Habitat.—On the gills of *Trigla sp.*, Moray Firth, 1863 (T. Edward).

**Eighteenth Annual Report*, Pt. III., p. 171, Pl. VIII., figs. 11–15 (1900).
†Brit. Entom., p. 333, Pl. XXXV., fig. 5 (1850).

The Rev. A. M. Norman has kindly directed my attention to the fact that this Copepod was obtained by the late Thomas Edward of Banff on the gills of Gurnards caught in the Moray Firth, and specimens sent to him by Edward are in his collection. The species is recorded in the Appendix to Samuel Smiles's life of the Banff naturalist (p. 438), 1877. This is the only Scottish record of *Brachiella bispinosa* known to me.

Brachiella (?) *triglæ*, Claus. (Pl. VII., figs. 24–29.)

1860. *Brachiella triglæ*, Claus, Zur Morph. der Copep., Pl. I., fig. 6.

1896. *Brachiella triglæ*, Basset-Smith, Journ. M.B. Assoc., Plymouth, p. 163.

A few specimens of a Copepod apparently belonging to this species were obtained on the gills of a specimen of *Trigla lineata*, Gmel., captured in the Clyde in the vicinity of Ailsa Craig in 1897, but only now recorded.

The species is a small one; the specimen figured measures only 4·5 mm. (about $\frac{2}{11}$ of an inch), but is comparatively moderately stout; the head and neck are scarcely so elongated as the posterior thoracic part of the body; the second maxillipedes, which are very short, appear to be free except at the point of attachment to the gills of the fish. The genital segment is considerably dilated and somewhat irregular in outline, and emarginate in the posterior end; the abdomen is very rudimentary; and the two posterior appendages do not extend much beyond the general contour of the body (fig. 24).

The antennules are short and apparently four-jointed, the end joints being slender (fig. 25). The antennæ are moderately stout, and somewhat like those of *Lernæopoda galei* (fig. 26), while the mandibles, maxillæ, and first maxillipedes are more or less similar to the same appendages in *Thysanote impudica*, Nordm. (figs. 27–29).

Brachiella triglæ, Claus, appears to be extensively distribnted; it has been obtained at Plymouth, by Dr. Basset-Smith from "*Trigla cuculus*, *gurnardus*, and *hirundo*, but was not very common."* Dr. Claus (*op. cit.*) and Dr. W. Kurz† have also recorded the occurrence of this Copepod on the gills of *Trigla*; Dr. Ed. Graeffe gives *Anchorella triglæ*, Kurz (*Brachiella triglæ*, Cls.) in his *Uebersicht der Fauna der Golfes von Triest*,‡ and states that, according to Kurz, it has been found living attached to the gill-arches of *Trigla lineata*—the same species of Gurnard on which I also obtained it.

Brachiella ovalis (Kröyer). (Pl. VII., figs. 30–35.)

1837. *Anchorella ovalis*, Kr., Naturh. Tidsskr., R. i., p. 289, Pl. III., fig. 6.

1870. *Anchorella ovalis*, P. J. v. Ben., Poiss. d. côtes de Belg., p. 31, Pl. II., fig. 8.

Brachiella ovalis has the cephalothorax rather more elongated than the genital segment. The second maxillipedes are short and separated from each other except at the extremity where they are attached to the gill-raker. The genital segment is considerably dilated; the posterior end of this segment has the sides moderately straight, and, converging slightly

* *Journ. M.B. Assoc., Plymouth* (Feb. 1896), p. 163.

† *Zeitsch. f. Wiss. Zool.* (1877), p. 404, Pl. XXV., figs. 13–15.

‡ *Arbeiten der Zoolog. Institute zu Wien*, T. XIII., Heft I. (1900).

backwards, they form an obtuse angle at the point where they meet ; the abdomen is very rudimentary; there are two small posterior appendages—one on each side of the abdomen—but they are so much obscured by the short but considerably dilated ovisacs as to be easily overlooked ; this is probably the reason they are not shown in the figure of the species in Prof. v. Beneden's work referred to above. *Brachiella ovalis* is very small; the specimen represented in the drawing (fig. 30) measures little more than 2 mm. in length.

In this species the antennules appear to be four-jointed, the first joint is much dilated, but the others are small ; the third joint is very short, being scarcely half the length of the end joint (fig. 31); the antennules of *Brachiella ovalis* resemble somewhat those of *Lernæopoda galei* ; the antennæ have also a close resemblance to those of that species (fig. 32). The mandibles are moderately stout, and are furnished with a series of small irregular teeth at the distal end of the inner margin (fig, 33); while the maxillæ are somewhat like those of *Anchorella emarginata*, Kr. (fig. 34). The first maxillipedes are moderately stout, the terminal joint, which is hinged to the second one, is armed with a short but moderately strong claw (fig. 35).

Habitat.—Found attached to the gill-rakers of the common Gurnard, *Trigla gurnardus*, caught in the Moray Firth and forwarded to the Fishery Board's Laboratory at Bay of Nigg, from the "Garland," during April and May, 1900. The parasites were more frequently seen on the gills of half-grown specimens of the fish than on the adults. Both Kröyer and P. J. v. Beneden record *Brachiella* (or *Anchorella*) *ovalis* from the common Gurnard.

There cannot, I think, be any doubt that the species recorded above is the "*Anchorella ovalis*" of Klöyer as figured by P. J. v. Beneden in his work on the fishes of the coasts of Belgium (Pl. II., fig. 8). The only apparent discrepancy between his figure and the above description is that he does not show any appendages on the posterior end of the genital segment, but these appendages are so small that they may have been concealed by the dilated ovisacs ; sometimes it is almost impossible to see these appendages till the ovisacs are removed.

In this species the arms (second maxillipedes), though short, are distinctly separate along their whole length, and their structure shows a closer affinity with *Brachiella* than with *Anchorella*; I have therefore ascribed it to that genus. I have, so far, seen no males of this species, and till these are described the question as to the genus to which the species really belongs may remain a doubtful one.

Genus *Anchorella*, Cuvier (1817).

Anchorella stellata, Kröyer. (Pl. VIII., figs. 1–2.)

1838–39. *Anchorella stellata*, Kr., Naturh, Tidsskr, R. i., vol. ii., p. 142, Pl. III., fig. 5.

1900. *Anchorella stellata*, T. Scott, Eighteenth Ann. Rept. of the Fishery Board for Scotland, Pt. III., p. 178.

In Part III. of the Eighteenth Annual Report, I gave a moderately full description of *Anchorella stellata*, Kr., but want of time prevented me from illustrating the description with drawings of the more important characters referred to, and I therefore take this opportunity to submit one or two figures showing the more characteristic points by which the species is distinguished. Figure 1 gives a side view of an *Anchorella stellata* attached to a scale of the Hake, *Merlucius merluccius* (L.), by a

chitinous plug which penetrates the substance of the scale. Figure 2 represents a front view of the plug after removal from the scale in which it was embedded. This plug, after penetrating the scale of the fish, expands between its outer and inner surfaces into a thin roundish disk; the parasite thus obtains a secure hold and can only be detached by the falling off or removal of the scale to which it has fixed itself, or by the attachment being severed at the point where it penetrates the scale. An interesting feature of the disk is that it possesses a number of openings (or pellucid markings) just inside its circumference, which have a regular stellate arrangement as shown by the figure, and from which the name of the species is derived. How these markings are produced, or what purpose they serve, are questions that may not be easy to explain, but the solution would no doubt be interesting.

The species has been found parasitic on Hake captured in the Clyde by the "Garland," but does not appear to be very common.

Anchorella scombri, Kurz. (Pl. VIII., fig. 3.)

1877. *Anchorella scombri*, Kurz, Zeitschrift f. wissenschaftl. Zool., B. xxix., p. 403, Pl. XXV., fig. 12.

This curious species was found on the gills of a Mackerel, *Scomber scombrus*, Lin., captured in the vicinity of Aberdeen, August 17th, 1900.

In this *Anchorella* the thorax is extremely elongated and moderately stout; the genital segment is nearly globular and small in comparison to the thorax. The second maxillipedes are very short, and appear to be entirely coalescent. The abdomen is rudimentary or obsolete, and the genital segment is apparently unprovided with posterior appendages. The ovisacs of the specimen represented by the drawing, and which is the only one I have yet seen, are small (fig. 3).

This species has at first sight a somewhat close resemblance to *Anchorella emarginata*, Kr., but a closer examination reveals several more or less important differences, one or two of which may be noted here.

(1) The second maxillipedes are not only entirely coalescent instead of being slightly separated, but they are also more rudimentary than those of *Anchorella emarginata*.

(2) The cephalothoracic portion of the body is proportionally considerably more elongated, being equal to nearly three times the length of the genital part, whereas in *A. emarginata* the cephalothorax is little more than twice the length of the genital segment.

(3) There does not appear to be even a rudimentary abdomen as there is in *A. emarginata*.

The length of the genital segment of the specimen represented by the drawing is about 2·5 mm. ($\frac{1}{10}$ of an inch), which is similar to the size given for *A. emarginata*.

Anchorella scombri, Kurz, appears to have a moderately wide distribution, but is probably not very common; though I have examined a number of Mackerel, only the one specimen of *A. scombri* has been observed. I do not at present know of any other British record for this Copepod, but Dr. Ed. Graeffe records it for the Gulf of Trieste, and states that, according to Kurz, it is found on the gill-arches of *Scomber scombrus*.*

Anchorella (?) *brevicollis*, M.-Edw. (Pl. VIII., figs. 11–16.)

1840. *Anchorella brevicollis*, M.-Edw., Hist. Nat. Crust., vol. iii., p. 418, Ann. Sci. Nat. (3), t. xvi., Pl. VI., figs. 1–3.

This *Anchorella* was found on a Haddock, *Gadus æglefinus*, Lin.

* Arbeiten der Zoolog. Institute zu Wien, Tom. xiii., Heft. 1, p. 17 (1900). (Separate reprint.)

captured in the Firth of Forth, January 30th, 1896, but only now recorded. It was found adhering, not to the gills, but close to the vent of the fish, and it was the peculiar position it occupied that induced me to take notice of it. It was at first considered to be merely a form of *Anchorella uncinata* (O. F. Müll.), but the further examination of it has revealed one or two differences both in its form and structure which can hardly be reconciled with the characters of that species. The conformation of the body of this specimen of *Anchorella* differs considerably from that of *A. uncinata* in the following particulars:—(1) The neck is comparatively much shorter and stouter, and is more distinctly a continuation of the posterior portion of the body; in *Anchorella uncinata*, on the other hand, the neck is comparatively long and slender, and is more or less distinctly separated by a constriction from the posterior segment. (2) The posterior maxillipedes are distinctly lateral, whereas in *A. uncinata*, as shown in Dr. Baird's figure,* as well as in Pl. VIII., fig. 43, in my paper last year,† the position of these maxillipedes is such that they have the appearance of being a continuation of the genital segment.

The antennules are very small, and two-jointed, but the first is considerably larger than the other, and there are a few minute spines at the apex of the terminal joint (fig. 12). The antennæ are simple and rudimentary; they each consist of a short and stout and apparently uniarticulate appendage (fig. 13). The mandibles are small, and their armature resembles that of the mandibles of *Lernæopoda* rather than of *Anchorella* (fig. 14). The maxillæ are moderately stout; they are each armed with two subapical processes bearing short terminal spines; there are also two minute lateral spines on the same side as the processes referred to, and at a small distance from them (fig. 15). The anterior maxillipedes are comparatively large, the first and second joints are considerably dilated, but the third is narrow, furnished with a stout terminal claw, in addition to two small spines (fig. 16). The abdomen is small, but distinct (fig. 11).

In 1840 M.-Edwards described (op. cit.) an *Anchorella* from the Haddock under the name of *Anchorella brevicollis*; the same species was also obtained on the Haddock by van Beneden‡; and it is to this species that I have provisionally ascribed the specimen mentioned above.

Incerta sedis.

(?) *Lernæopoda* sp. ♂. (Pl. VIII., figs. 4-10.)

A few male specimens of what appears to be a species of *Lernæopoda* were obtained on the gills of an Opah or Kingfish, *Lampris pelagicus* (Gunn.) = (*Lampris luna*, Gmel.), forwarded from Shetland to the Fishery Board's Laboratory at Bay of Nigg, October 10th, 1900; no females were observed. The species is a moderately large one, for the male represented by the drawing measures 4·3 mm. (about $\frac{1}{6}$ of an inch) in length. If in this species the proportional size of the females to the males be similar to that which we find in such species as *Charopinus dalmanni* or *Lernæopoda galei*, the females of this species should reach to about 16–18 mm. in length.

The body of this parasite of the Kingfish is comparatively slender; it tapers more or less gradually towards the posterior end. The antennules are small-and four-jointed, the penultimate joint being shorter than the others (fig. 5). The antennæ are moderately robust, except the last two joints, which are small, and the end-joint is very feebly clawed. The

* Brit. Entom., Pl. XXXV., fig. 9.

† *Eighteenth Annual Report*, Part III.

‡ Les Poissons des Cotes de Belgique, p. 57.

mandibles are small, but somewhat similar in form and armature to those of *Charopinus dalmanni* (fig. 7). The maxillæ are also somewhat similar to those of that species, except that the ends are furnished with two instead of three spiniform appendages (fig. 8). The first and second maxillipedes are very robust, and armed with short but powerful hooked terminal claws (figs. 9 and 10).

The form of the various appendages shows a close relationship with the Lernæopodidæ, closer perhaps with *Charopinus* than with *Lernæopoda*. I am inclined, however, for the present to ascribe the specimens to the latter genus, and to distinguish them from kindred species by the name of *Lernæopoda lampri*.

PART II.—HIRUDINEA AND TREMATODA.

The vermes recorded in the following notes belong to the two great Classes Annelida* and Platyhelmintha. The first includes animals which, for the most part, are free-living, but some are parasitic or predatory. The animals which belong to the second class are, on the other hand, mostly parasitic and live within the bodies of other animals (Entozoa), but some take up their abode on the skin and gills of fishes (Ectozoa), while some others of them are free-living. The Hirudinea comes under the first and the Trematoda under the second of these two classes, and I have grouped my notes to agree with this arrangement.

(A.) The Hirudinea.

The work by which I have chiefly been guided in the preparation of my notes on Hirudines parasitic on fishes is Prof. Léon Vaillant's *Histoire naturelle des Annelés marins et d'eau douce*, vol. iii. (second part), (1890). M. Vaillant divides the Hirudines into the two sub-orders, Bdellariæa and Histriobdellariæa; the first he sub-divides into five families, but the other contains only one. The Hirudines parasitic on fishes belong for the most part to the family Ichthyobdellidæ, one of the five comprised in the first sub-order, and it is only to species belonging to this family that the following notes refer.

Fam. Ichthyobdellidæ.

The leeches included in this family form two more or less distinct groups, both of which are represented by the species recorded here. The leeches contained in the first group (sub-family Branchellionæ) have the body usually divided into two portions more or less obvious by a depression or constriction; the anterior portion, or neck, which is terminated by the head, is less robust than the other; the posterior portion, besides being more robust, is usually furnished with lateral processes which are ramified, lamelliform, or in the form of rounded vesicular tubercles; these processes are non-contractile, and are "destined in every case for branchial respiration"—they do not extend to the anterior portion. One of the most remarkable species belonging to this sub-family is the *Branchellion rhombi* (v. Ben. and Hesse), found living on the Turbot, *Bothus maximus*, at Brest and the Channel, and which may possibly also occur on the same fish in our seas. *Branchellion rhombi* is comparatively a moderately large species, reaching from two to nearly two and a half inches in

* In the Cambridge Natural History, vol. ii. (1896), the Hirudines occupy a position in the classification apparently equal in importance to that of the Platyhelminthes, while the term "Annelida" as the name of a class is set aside.

length; the lateral processes are large foliaceous appendages which extend nearly straight out from the body and impart a singular appearance to the animal. There are several other species of *Branchellion*, but the one mentioned is the only species likely to occur in our seas. The species I now record belongs to another genus of the same sub-family, viz. :—

Genus *Trachelobdella*, R. Blanchard (1894).
[= *Calliobdella*, van Beneden and Hesse (1863).]

Trachelobdella lophii (van Beneden and Hesse).

1863. *Calliobdella lophii*, v. Ben. and Hesse, *Recherches sur les Bdellodes*, p. 36, Pl. II., figs. 11–16.

In this species the body is elongated and rounded, but more so on the dorsal aspect than ventrally. There is, at about a fourth or fifth part of the length of the body from the anterior end, a slight compression, sometimes not very evident in specimens preserved in alcohol, that divides the body into two unequal portions; the posterior portion is furnished with a row of vesicles, along each side, in the form of sphærical tubercles—there are usually twelve to fifteen tubercles in each row; the anterior portion is without tubercles, and forms a kind of simple neck. There is a sucker at each end of the body, that at the anterior end is of an oval form and comparatively small, but the posterior sucker is large and rounded and of a simple structure. No eyes have been observed. The length of this species is stated by van Beneden and Hesse to be about five to six centimeters (from 2 to nearly $2\frac{1}{2}$ inches); probably these measurements were taken from living specimens; our specimens preserved in alcohol scarcely extend beyond three centimeters.

Habitat.—In the gill-pouches of the Angler-fish, *Lophius piscatorius*, captured in the Firth of Forth (1894), and in the Moray Firth (1899). *Trachelobdella lophii* does not appear to be very rare on the Angler-fish. The eggs are very small, and, in general appearance, resemble somewhat the cocoon of a *Bombyx*.

Van Beneden and Hesse record in their *Recherches* one or two other species of *Trachelobdella* which, though I have not yet observed them, may in passing be mentioned here, as they live on the bodies of fishes that are fairly well known and moderately common on our shores.

Trachelobdella punctata (van Beneden and Hesse).

Habitat.—On the body of the Sea Scorpion or Long-spined Cottus, *Cottus scorpius*, *L.* This is a small species, being scarcely two centimeters (about $\frac{4}{5}$ of an inch) in length. It has four eyes, arranged in pairs, and each pair is situated on a little conical prominence. There are from fourteen to fifteen round, almost transparent, tubercles along each side of the posterior portion of the body, and by this last character *C. punctata* may be readily distinguished from *Piscicola scorpii*, which lives on the same kind of fish.

Trachelobdella striata (van Beneden and Hesse).

Habitat.—On the body of the common or Black Goby, *Gobius niger*. This species has two eyes, one on each side and near the base of the head; they form little conical eminences, and at a small distance in front of and in line with each eye there is one (? or two) ocular marks which appear to be quite distinct in living specimens. The number of

lateral tubercles in this species is twelve or thirteen on each side. The posterior sucker is ornamented with striæ and white points. This, like the last, appears to be a small species.

The following other species recorded by the authors of the *Recherches* may also be referred to for the reason that it is said to be found commonly in large numbers on the Black Sole, *Solea vulgaris*, viz. :—

Platybdella soleæ (van Beneden and Hesse).

This leech differs from those already mentioned by the possession of only a single pair of respiratory tubercles, one of which is situated on each side of the constriction that separates the two portions of the body. The species is a very small one, being only about 5 mm. ($\frac{1}{5}$ of an inch) in length. The authors quoted state that these leeches not only occur in considerable numbers on the back of the Black Sole, but hold on with such tenacity to the skin that often their bodies are ruptured when removing them from the fish. They are found on Black Soles captured on the coast of France and Denmark, but I do not yet know of any record of their occurrence on Soles captured in our seas.

Sub-Family Pontobdellinæ.

There are, according to M. Vaillant, nine genera in this group of the *Ichthyobdellæ*, but only three of them fall to be noticed here, viz. :—*Piscicola*, *Ichthyobdella*, and *Pontobdella*.

Genus *Piscicola*, Blainville (1827).

In leeches belonging to this genus the body is smooth, usually rounded, and becomes in some species gradually, and to a small extent, enlarged posteriorly, while in others it is of nearly equal thickness throughout. The anterior and posterior suckers are both distinct and equally flattened. The eyes are distinct; their number varies in different species, but is usually four, six, or eight. There are no lateral contractile organs as in species belonging to the Branchellionæ.

The number of species is considerable; several live on marine fishes, but the majority of them appear to be found on fishes that live more or less entirely in fresh water. The *Piscicolæ*, which have a wide distribution in space, are usually separated into three groups, according to the number of their eyes.

Piscicola geometra, Lin., the earliest known species, is found on the Pike, *Esox lucius*, Lin., and other fresh-water species. This species is furnished with eight eyes.

The *Piscicolæ* usually found on marine fishes are provided with six eyes, while those that have four eyes appear, for the most part, to be limited to fresh-water fishes, such as the Perch, Carp, Burbot, and others. Two species,—*Piscicola maculata*, Grube, and *P. quadrioculata*, Malm., —both with four eyes, have been recorded, however, from the Ballan Wrasse, *Labrus berggylta*, the first from the Mediterranean, the other from Norway and Denmark.

Piscicola scorpii, Fabricius.

This species, which belongs to the group provided with six eyes, has occasionally been obtained on specimens of the Sea Scorpion, *Cottus scorpius*, captured by Mr. Williamson in the Bay of Nigg, near the Laboratory, during the past autumn, and to whom I am indebted for the specimens; the same leech was also obtained on a specimen of the Sea

Scorpion captured in the Firth of Forth. One of the largest specimens, preserved in alcohol, measured fully 12 mm. (about ½ an inch) in length.

When living *P. scorpii* is of a reddish or carmine colour, but immersion in alcohol removes the colouring matter from the body, and apparently also from the eyes as well.

Piscicola sexoculata, Malm., has been found on the Cod, but I have not yet observed this species.

Genus *Ichthyobdella*, Blainville (1827).

The species which have been ascribed to *Ichthyobdella* resemble the *Piscicolæ* very closely in their general conformation and structure, so that it is almost necessary for their correct identification that the specimens when examined should be living or but recently dead; it is difficult to correctly identify specimens that have been for a considerable time immersed in alcohol.

The *Ichthyobdellæ* have usually no distinct eyes, and are of a pale colour. The following species have been observed :—

Ichthyobdella sanguinea, Örsted.

1844. *Ichthyobdella sanguinea*, Örsted, *De Region. Mar.*, Elementa topographiæ historico-naturalis Freti Æresund (Dissert. inaug.), p. 80.

1859. *Ichthyobdella anarrhichæ*, Diesing, *Revision der Myzhelminthen.* Abtheilung. Bdell., p. 15.

1863. *Ichthyobdella anarrhichæ*, v. Ben. and Hesse, *Rech. sur Bdell.*, p. 26, Pl. I., figs. 9–13.

1890. *Ichthyobdella sanguinea*, Vaill., *Hist. Nat. des Annelés*, vol. iii., p. 530.

This species is moderately common on the Wolf or Cat Fish, *Anarrhichus lupus*, L. They are found adhering to the gills and inside the mouth as well as on the outside of the body. The specimens I have examined range in length from about 25 to 30 mm., but the authors of the *Recherches* give 30 to 40 mm. as the usual length of the species; a good deal, however, depends on the state of preservation of the specimens.

I. sanguinea has been observed on Catfish captured in the Firth of Forth, the Firth of Clyde, and in the Moray Firth.

Ichthyobdella hippoglossi, Gervais and v. Beneden.

1859. *Ichthyobdella hippoglossi*, Gerv. and v. Ben., *Zoologie médicale*, vol. ii., p. 170.

1863. *Ichthyobdella hippoglossi*, v. Ben. and Hesse, *Rech. sur Bdellodes*, p. 28, Pl. I., figs. 14–17.

A specimen of *Ichthyobdella hippoglossi* was obtained on a Halibut landed at the Fish Market at Aberdeen in June, 1899. The leech was adhering to the inside of the throat of the fish. This is a larger species than the last; the authors of the *Recherches* state that this worm is from five to six centimeters in length, while the specimen I obtained measured about 6·5 cm.

Ichthyobdella marina, Johnston.

1846. *Ichthyobdella marina*, Johnst., Ann. and Mag. Nat. Hist., vol. xvi. (Suppl.), p. 441, Pl. XV.

This species, which has been recorded by Dr. George Johnston from the

Pogge, *Agonus cataphractus*, I have not yet observed. It appears to be a small species, and on that account may have escaped notice.

Other small species of *Ichthyobdellæ—i.e.*, *I. rhombi*, van Beneden and Hesse—found on the Brill, and *I. luscæ*, van Beneden and Hesse, found on the Brassy, *Gadus luscus*, have been recorded by Continental students of the parasites of fishes, and these may probably also occur on the same kinds of fishes in our seas.

Genus *Pontobdella*, Leach (1815).

This genus contains the well-known "Skate Leech," *Pontobdella muricata*, Lin., found on different species of Skates and Rays, as *Raia batis*, *R. clavata*, *R. circularis*, and others; and which occasionally occurs on specimens captured by the "Garland." These leeches are readily distinguished from any of the preceding forms by their greater size and corrugated, warty skin.

Several other species of *Pontobdella* are recorded, but the *P. muricata* is the only one known to me as occurring in Scottish waters. But besides the leeches recorded in the foregoing notes, others have been observed on the Lumpsucker, the Ling, and the Plaice; the identification of these, however, is not certain, and consideration of them is delayed meantime.

(B.) The Trematoda.

The Trematoda which I record in the following notes are all ecto-parasites of fishes. A few of them are, in general appearance, not unlike some of the forms referred to under Hirudinea, but the difference between the two groups (A.) and (B.) is usually more or less apparent. These parasites are found living upon the gills and also upon the skin of fishes, and, as will be observed from the records which follow, some of them are apparently not very rare. But though that is so, and though the study of the group opens up an interesting field for practical research, it is worthy of note that very little appears yet to be known regarding the ecto-parasitic Trematodes of the Scottish seas.

The Trematoda have been sub-divided in different ways by different authors; discoveries, real or fancied, bearing on the development and structure of different members of the group have led to modifications in the arranging and classifying of them; but the discussion of such matters being outside the scope of the present paper it is not necessary to dwell upon them; the purpose for which this paper has been prepared is merely to record the various species that have come under the notice of the writer.

In recording the species that fall to be noticed here, I have followed generally the arrangement of MM. van Beneden and Hesse's *Recherches sur les Trématodes Marins*, published in the "Memoirs of the Royal Academy of Belgium," vol. 26 (1863). In this work the Trematoda are divided into the following five families—Tristomidæ, Polystomidæ, Octocotylidæ, Udonellidæ, and Gyrodactylidæ; and the species to be recorded here include representatives of at least four of them. The classification employed by van Beneden and Hesse is here slightly modified so as to be in line with that of vol. ii. of the Cambridge Natural History series; in that work the family Udonellidæ becomes a sub-family (Udonellinæ) of the Tristomatidæ, and the family Octocotylidæ a sub-family (Octocotylinæ) of the Polystomatidæ.

Fam. TRISTOMATIDÆ.

Sub-Fam. TRISTOMATINÆ.

Genus *Epibdella*, Blainville (1827).

Epibdella hippoglossi (O. F. Müller).

1776. *Hirudo hippoglosssi*, O. F. Müller, *Zoolog. Dan.*, II., p. 138, Pl. LIV., figs. 1–4.

1858. *Epibdella hippoglossi*, v. Ben., *Mem. sur les vers intestin.* (Suppl. des Comptes Rendus, t. ii.), p. 21, Pl. II. and III.

This Trematode is sometimes very common on Halibut landed from the steam line-fishing boats at the Fish Market at Aberdeen. In this species the body is thin and flat and of an oval form. There are two small suckers in front, one on each side of the head, and a single large posterior sucker; the suckers are situated on the ventral aspect. The one at the posterior end is armed on the under side with several small hooks; they are arranged in two series, with three in each series, the hooks in each series being partly connected with each other end to end, and arranged in a longitudinal line a little to the right and left of the middle of the sucker; each series or line extends from the posterior margin of the sucker inwards towards the centre; the middle hook of each series is the largest, but the posterior one is very small, and can scarcely be made out except under the microscope. The under surface of the sucker, and especially the posterior half of it, is covered with small tubercles, some of which have a bifid apex; they are arranged in lines extending from the centre towards the circumference. A thin, delicate fringe extends around the edge of the sucker, which enables the sucker to be fitted perfectly to any part of the surface of the skin of the fish.

It is interesting to note that Job Baster appears so long ago as 1759 to have described and figured this same Trematode under the name of *Tertia pediculorum species.**

Genus *Phyllonella*, van Beneden and Hesse (1863).

Phyllonella soleæ, van Beneden and Hesse. (Pl. VIII., fig. 17.)

1863. *Phyllonella soleæ*, v. Ben. and Hesse, *Recherches sur les Trématodes*, p. 70, Pl. V., fig. 1–8.

Specimens of this Trematode have been found on Black Soles, *Solea vulgaris*, captured in the Clyde in May, 1897, and again in November, 1899. The specimen represented by the figure (fig. 17) measures about 6·7 mm. (fully ¼-inch) in length. The body is of an oval form, thin and flat. At the anterior end there are two small suckers, one on each side and a little in front of the head; the edges of these suckers are slightly crenulated; the posterior sucker is large, somewhat variable in form, but usually more or less circular, and is surrounded with a very thin flexible border, which permits the sucker to be accurately applied to slight irregularities on the skin of the fish. The sucker is also armed with hooks, as shown in the figure. The surface of the body is covered with minute papillæ, and the colour usually corresponds with that of the fish on which the Trematode lives. This *Phyllonella* is also provided with four distinct eyes; these are only faintly shown in the figure, which represents the ventral aspect.

* J. Baster, *Opuscula subsceciva: observationes miscellaneæ de Animalculi et Plantis aibusdam marinis*, II., p. 138, Pl. VIII., fig. 11 a, A. (1759)

This pretty species does not appear to be very common, and the Clyde is the only part of the Scottish coast from which I have obtained specimens, but my son informs me that he has obtained specimens on *Solea vulgaris* captured off the coast of Lancashire.

Genus *Trochopus*, Diesing (1838).

Trochopus lineatus (sp. nov.). (Pl. VIII., fig. 18.)

A few specimens of this species were obtained in the gill-cavities of a Streaked Gurnard, *Trigla lineata*, captured in the Clyde. It is a small species; the specimen represented by the figure (fig. 18) measures scarcely 3 mm. ($\frac{1}{8}$ of an inch) in length. The body is thin, flat, comparatively smooth, and of a somewhat broadly oval shape. The anterior end is broadly rounded and furnished with two distinct suckers having slightly crenulated margins. The posterior sucker is large and circular; on the under side of it twelve distinct rays are seen, extending at nearly regular intervals from the margin towards the centre; ten of the rays are, at their inner ends, joined to a central and nearly circular ring, which is incomplete only towards its posterior aspect. The two posterior rays have their inner ends apparently free, as the central ring is interrupted at the place where the inner ends of these two rays terminate. A small hook or tooth is situated near the inner end of the ray next in order to and on each side of the two posterior rays just referred to, as shown in the figure. The twelve rays do not reach entirely to the outer edge of the margin of the sucker, but stop short a little way from it, while extending all round the margin is a very thin crenulated fringe, as shown in the drawing.

This Trematode is provided with four distinct eyes, which may be seen even from the under side. The drawing (fig. 18) represents the ventral aspect of the specimen.

Trochopus is closely allied to *Placunella*, one species of which (*Placunella pini*) has been obtained on the Red Gurnard (*Trigla pini*, Bloch, = *T. cuculus*, of Day's British Fishes), and I at one time thought that our specimens might belong to that genus; but *Placunella* appears to differ from *Trochopus* in one or two important points. Not only is the position of the two anterior suckers and the armature of the posterior sucker different, but the posterior sucker in *Placunella* shows a tendency to divide itself into three portions—two lateral sub-circular portions and a middle one; this tendency is more clearly shown in *Placunella rhombi*, which lives upon the Turbot, than in *Placunella pini*, though here also the same tendency may be perceived. In *Trochopus*, on the other hand, the posterior sucker is circular, and without any indication of a tri-partite structure.

Trochopus lineatus resembles somewhat closely the *Trochopus tubiporus* of Diesing, found parasitic on the gills of the Sapphirine Gurnard, *Trigla hirundo*, but in that species the number of rays of the posterior sucker is only nine, whereas in the one I am describing there are distinctly twelve rays, as shown in the figure, and the armature of this sucker appears also to be somewhat different.

One other difficulty encountered in assigning our Trematode to *Trochopus* is that the *nine rays* of the posterior sucker of *Trochopus tubiporus* are made an important generic character. It must be borne in mind, however, that at the time the genus was instituted there was but the one species of *Trochopus* known—viz., the one with the nine-rayed posterior sucker; the number *nine* can, therefore, hardly be considered of more than temporary generic value, and good enough only till another species

possessing a posterior sucker having fewer or more rays should be discovered.

Genus *Tristoma*, Cuvier (1829).

Tristoma molæ, Blanchard. (Pl. VIII., fig. 19.)

Tristoma molæ, Blanchard, Ann. des Sci. Nat., 3 ser., vol. viii., p. 326; *Voy. sur les côtes de Sicile*, p. 129, Pl. II., fig. 2, 2 a.

1863. *Tristoma molæ*, van Ben. and Hesse, *Recherches sur les Trématodes*, p. 77.

A few specimens of this Tristome were taken from a Short Sunfish *Orthagoriscus mola*, sent to the Laboratory, Bay of Nigg, and which had been captured near Mallaig, West Coast of Scotland, in April, 1900. The same Tristome was also taken from a specimen of the Short Sunfish, captured in the Firth of Forth in 1890.

The body of this Tristome is nearly circular, very thin and flat, and the margin is provided with a thin crenulate fringe that extends almost entirely round it.

The specimen represented by the figure measures about 18 mm. (about $\frac{3}{4}$ of an inch) in its longest diameter, but some specimens are slightly longer than that. The posterior sucker is very large, round, sessile, unarmed, and divided into seven compartments by an equal number of rays; the rays scarcely reach to the centre of the disk. The two rays which bound the sides of the compartment at the base of the sucker are joined together by a cross-bar; there is also a central space formed by faint lines joining the inner ends of the seven rays, as shown in the figure (fig. 18).

Tristoma coccineum, Cuv., has been recorded from the Short Sunfish by Couch and referred to by Yarrel,* but this is probably an error, as that Tristome is really a parasite of the Swordfish, *Xiphias gladius*, found in the Mediterranean, and which sometimes wanders to our seas. Van Beneden suggests that the Tristome recorded by Couch may be the *T. papillosa* of Diesing.

Sub-Family Udonellinæ.

Genus *Udonella*, Johnston.

Udonella caligorum, Johnston.

Udonella caligorum, Johnston, Loudon's Mag. Nat. Hist., vol. viii., p. 497.

1858. *Udonella caligorum*, P. J. van Beneden, *Mem. sur les vers intestin.*, p. 13, Pl. I.

Habitat.—Usually attached to the ovisacs and posterior part of the body of *Caligus curtus* found living on the Cod and other Gadoids. This is a very common species on *Caligus curtus*. Van Beneden and Hesse described several other species of *Udonella*, but *U. caligarum* is the only one I have, so far, observed.

* Yarrel, British Fishes, vol ii., p. 438. Yarrel gives two figures showing a dorsal and a ventral view of the Tristome. The ventral view shows the sucker to be seven-rayed like *T. molæ*, but the two posterior rays are not connected by a cross-bar as in that species.

Fam. Polystomatidæ.

Sub-Fam. Octobothrinæ (Octocotylinæ).*

The Trematodes in this group are characterised for the most part by having at the posterior end of the body eight cupules or "suckers," differently arranged in different genera; these cupules are also either sessile (or nearly so), or are situated at the ends of short or moderately long pedicles.

Genus *Octobothrium*, Leuckart (1828).

Octobothrium alosæ (Hermann). (Pl. VIII., fig. 21.)

1728. *Mazocræs alosæ*, Hermann, *Naturforscher*, 17 st., p. 182, t. iv., fig. 13–14.

1828. *Octobothrium alosæ*, Leuckart, *Brev. anim. descript.*, 1828.

1841. *Octobothrium lanceolatum*, Dujardin, *Helminth.*, p. 313.

1858. *Octobothrium lanceolatum*, P. J. van Beneden, *Mem. vers intestin.*, p. 45, Pl. V.

This Trematode lives on the gills of the Allis and Twaite Shads, *Clupea alosa* and *Clupea finta*, and is found sometimes in abundance. The body is elongated and flattened, and of a narrow-lingulate form; it becomes narrower towards the anterior end, which is pointed or rounded; towards the posterior end the width of the middle region of the body becomes slightly less and forms a kind of neck between that region and the part bearing the posterior "suckers"; this part, which, next the neck, is of moderate width, narrows quickly to the posterior extremity, and has a more or less triangular outline; four "suckers" are situated on each of the two margins of this part, while at the apex there are four small hooks, two of which are much larger than the others. At the anterior end there are two small suckers situated to the right and left of the mouth.

As pointed out by van Beneden, the so-called suckers at the posterior end are somewhat different in their structure from true suckers, but are rather of the nature of claws or pincers (his words are "Ce ne sont pas de ventouses, mais plutôt des pinces. Dans chacun de ces organes, on voit deux lèvres mobiles articulées entre elles comme la mâchoire des poissons plagiostomes."‡ Van Beneden gives the length of this species as from 10 to 12 mm.; my specimens do not reach that length, owing probably to their having been immersed for a considerable time in alcohol.

Octobothrium harengi, van Beneden and Hesse.

1863. *Octocotyle harengi*, v. Ben. and Hesse, *Recher. sur les Trém.*, p. 98, Pl. IX., fig. 1–10.

This species lives on the gills of the Herring, *Clupea harengus*. It is of an oblong lanceolate form; the head is at the end of a long, narrow neck; the posterior part, where the eight suckers are situated, is elongate-oval, and the suckers are arranged along the lateral margins, four on each

* As the generic name *Octocotyle* has been set aside in favour of *Octobothrium*, the name of the sub-family requires to be modified to correspond with that adopted for this genus, which is the oldest genus among those arranged in this sub-family.

‡ Vers intestinaux p. 47.

margin, while at the apex four small hooks, two of which are very minute, are observed. The length of this species is somewhat similar to that of the last.

I have only seen one or two damaged specimens of *Octobothrium harengi*; they were obtained on the gills of a herring sent from Annan, Solway Firth, July 30th, 1900.

Octobothrium scombri (Kuhn). (Pl. VIII., fig. 20.)

1830. *Octostoma scombri*, Kuhn, *Mém. Mus. d'Hist. Nat.*, vol. xviii.

1832. *Octobothrium scombri*, Nordmann, *Mikrog. Beiträge*, t. i., p. 77.

1850. *Octocotyle truncata*, Diesing, *Syst. helminth.*, vol. i., p. 422.

1863. *Octocotyle scombri*, v. Ben. and Hesse, *Rech. sur les Trém.*, p. 97.

Habitat.—On the gills of the common Mackerel, *Scomber scombrus*, captured in the vicinity of Aberdeen, August 14th, 1900. *Octobothrium scombri* is a smaller species than the last one, the specimen represented by the figure is only about 5·5 mm. in length,—van Beneden gives 6 mm. as the average length.

The body is linear-lanceolate, very flat and thin ; the head is described as being pointed and carried on a neck of the same size, but the worm possesses sufficient mobility to enable it to some extent to change its form. The posterior suckers are arranged in two nearly parallel lines, and they are carried on very short retractile stalks, and there are also at the extremity of the posterior end two comparatively large and two very small hooks, somewhat similar to those observed in the other species of *Octobothrium*. The portion of the body at the posterior end occupied by the eight suckers is more or less distinctly marked off from the middle portion by a narrowing or constriction immediately in front of that portion; and it seems that by this arrangement the two sides of this portion, each with its four suckers, can be folded so as to clasp the gill-filament to which the animal may be adhering.

Prof. P. J. van Beneden states that *Octobothrium scombri* is not common, and that he rarely found more than one or two specimens at one time.* It has been obtained on the gills of the common Mackerel captured on the coast of Belgium and La Manche; my son has also obtained it on Mackerel caught off the Lancashire coast.†

Octobothrium merlangi (Kuhn).

1830. *Octostoma merlangi*, Kuhn, *Mém. du Museum d'Hist. Nat.*, vol. xviii.

1832. *Octobothrium merlangi*, Nordmann, *Mikrog. Beitr.*, vol. i., p. 78, Pl. VII., fig. 1–5.

1895. *Octobothrium merlangi*, T. Scott, Thirteenth Annual Report of the Fishery Board for Scotland, Part III., p. 172, Pl. IV., figs. 23, 24.

Habitat.—On the gills of the Whiting, *Gadus merlangus*, Lin., sometimes not unfrequent, especially on half-grown specimens of the fish. The length of this Trematode is usually about 10 mm., but specimens smaller and others slightly larger are occasionally observed.

* P. J. van Beneden, *Les Poissons des Côtes de Belgique*, p. 37.

† Fourteenth Ann. Rept. of the Liverpool Marine Biology Committee, p. 12 (1900).

The mouth-opening is very near the anterior end of the body, on the under side. This end is very narrow, but the body, which is flat and thin, rapidly expands in width from the anterior end backwards for a short distance, whence the width gradually diminishes to the posterior end, so that the general outline of the body partakes of a leaf-like form.

Towards the posterior end of the body the gradually converging margins send out on each side, and at short intervals, four narrow prolongations which carry little suckers or cupules at their extremities; the prolongations on the one side can be, by the animal, folded over towards those on the other side, so as partly to surround and securely clasp the gill-filament of the fish which for the time forms its host.

I find it to be frequently the case that the form of different specimens of the same species tends to vary more or less, because of their soft and mobile bodies; this is specially observed in specimens preserved in alcohol or removed from the gills of fishes which have been for some time so preserved.

Octobothrium (?) *esmarkii* (sp. nov.). (Pl. VIII., fig. 22.)

Habitat.—On the gills of a specimen of *Gadus esmarkii*, Nilss., captured about sixty miles to the south-eastward of Sumburgh Head, Shetland, in September, 1900. Although a considerable number of specimens of this *Gadus* were examined, only the one *Octobothrium esmarkii* was observed. This appears to be a small species; the specimen represented by the figure scarcely reaches 4 mm. in length and about 2 mm. at the widest part.

The body is thin and flat and is of a broadly ovate form. The anterior end is somewhat wedge-shaped, and separated from the rest of the body by a slight constriction on each side. The posterior end is somewhat truncate; the suckers or cupules are arranged in two rows, with four in each row, along the margins, and towards the posterior end of the body, as shown in the figures; the margins are slightly lobate on that part where the cupules are situated, while the cupules themselves are sessile or nearly so; in front of the anterior cupule on each side the body is slightly constricted. The cupules seen under a moderately high magnification exhibit a somewhat complicated structure, which the artist has tried to show in the figure, but of which it is difficult to give a correct representation; the structure somewhat resembles that observed in the cupules of *Pleurocotyle scombri* (Grube).

I have been unable to find any published description of this species, and I have given to it the name of the fish on which it was observed.

Genus *Phyllocotyle*, van Benneden and Hesse (1863).

Phyllocotyle gurnardi, van Beneden and Hesse. (Pl. VIII., fig. 23.)

1863. *Phyllocotyle gurnardi*, v. Ben. and Hesse, *Rech. sur les Trém.*, p. 103, Pl.

Habitat.—On the gills of the common Gurnard, *Trigla gurnardus*. The body is narrow-oblong, flat and thin; the head is small, and, in the living animal, is carried on an elongated narrow neck, but in all the specimens preserved in alcohol which I have examined, the head is contracted so as to assume the form represented by the figure (fig. 23). Near the posterior end there are six sessile suckers disposed in two slightly converging marginal lines, three in each line; they are of medium size, and have a very complicated structure. The posterior end of the body is produced into a narrow elongated process, very thin, and apparently retractile, or capable of being folded under the body; I have only seen

this proboscis-like appendage extended in living or recently dead specimens, but have failed to find it in an extended position in specimens preserved in alcohol.* The form which preserved specimens assume is well shown in the figure already referred to. There is at the extremity of the proboscis-like appendage a small cupule or sucker, in which are arranged four hooks—two of moderate size and two very small.

The specimen represented by the drawing, and which had been for some time preserved in alcohol, measures scarcely 2 mm. in length and about ·6 mm. in breadth.

Genus *Anthocotyle*, van Beneden and Hesse (1863).

Anthocotyle merluccii, van Beneden and Hesse. (Pl. VIII., fig. 4.)

1863. *Anthocotyle merluccii*, v. Ben. and Hesse, *Rech. sur les Trématodes*, p. 105, Pl. X., figs. 8–12.

Habitat.—On the gills of a Hake, *Merlucius merluccius*, Lin., landed at the Fish Market at Aberdeen, June 20th, 1900. A few specimens only were obtained.

The authors referred to above give the following as the distinctive characters of this genus:—Four pairs of cupules (cotyles) posteriorly, of which one pair is inflated so as to resemble little bladders, each of which carries hooks and a sucker; the other three pairs, which are small and are borne on little stalks, terminate the body; the body is very thin, but broad in the middle, and very narrow at both the anterior and posterior ends. There appears to be only one described species of *Anthocotyle*—viz., *A. merluccii*.

The length of the specimen represented by the drawing is about 16 mm., but the fish on the gills of which the Trematodes were found had been dead for some time, and the specimen referred to may have been stretched slightly beyond its normal length.

The body is soft, flat, moderately broad in the middle, and considerably narrowed at both ends. The head is small, and is carried on a short, narrow neck; it is provided with a small sucker to the right and left of the mouth; these suckers are capable of being sub-divided by a constriction or septum.

Towards the posterior end, and in front of the lateral bladder-like expansions, the width of the body is considerably diminished, and forms a kind of neck. The lateral expansions are of large size, of a somewhat complicated structure on the ventral aspect, and are each provided with a small sucker on the extreme outer edge (not seen in the drawing). From between these expansions on their posterior aspect there springs a narrow proboscis-like appendage which terminates in six small pediculated and bilobed suckers, three being to the right and three to the left of the apex of the appendage.

The learned authors of the *Recherches* speak of this species as being unquestionably the most strange form that has been discovered belonging to this group of worms. The two lateral appendages, the three pairs of pedunculated suckers which terminate the body posteriorly, together with the cephalic termination of the same, give to the creature a peculiar aspect.

* With regard to this appendage van Beneden and Hesse remark, "Le pédoncule, qui est très-mince et conséquemment très-fragile, manque quelquefois, et alors le trématode parait avoir la partie inférieure tronquée, ou bien il est replié sur ou sous le corps et échappe facilement à la vue." *Recherches*, p. 104.

Genus *Pterocotyle*, van Beneden and Hesse (1863).

Pterocotyle palmata (Leuckart). (Pl. VIII., fig. 27.)

1830. *Octobothrium palmatum*, Leuckart, *Zool. Bruch.*, vol. iii., p. 24, Pl. I., fig. 4.

1853. *Octodactylus inhærens*, Dalyell, *Powers of the Creator*, vol. ii., p. 262, Pl. XXXVI., figs. 1, 2.

1863. *Pterocotyle palmata*, v. Ben. and Hesse, *Recherches sur les Trématodes*, p. 107, Pl. XI., figs. 1–13.

Habitat.—On the gills of Ling, *Molua molva*, captured in the Moray Firth, and also on the same species of fish captured in the Clyde. This parasite is sometimes not uncommon on the gills of the Ling. Dalyell states that on one occasion twenty-nine specimens of various dimensions were removed from a portion of the gills of one of these fishes.

Pterocotyle palmata is a moderately large species; the specimen represented by the figure measures about 20 mm. The form of the body is elongate-lanceolate, slightly wider in the middle than at the anterior end; to the right and left of the posterior extremity are four pediculated sucker-like cupules, which are capable of being sub-divided into at least two compartments by a membranous septum; the eight pedicles—four on each side—extend outwards and backwards so as to have a somewhat fan-like appearance; moreover, the four pedicles of the one group can be folded so as to meet those of the opposite group, and thus form together a very effective clasping organ, by means of which the animal is able to partly enclose and securely grasp the gill-filament of its host.

(?) *Pterocotyle morrhuæ*, van Beneden and Hesse. (Pl. VIII., figs. 25, 26.)

1863. *Pterocotyle morrhuæ*, v. Ben. and Hesse, *Recherches sur les Trématodes*, p. 106.

Habitat.—On the gills of a Cod, *Gadus callarius*, L., about $11\frac{3}{4}$ inches in length, captured in Aberdeen Bay, November 9th, 1900. I have also observed what appears to be the same Trematode on the gills of one or two Whiting, *Gadus merlangus*. The specimen represented by the drawing is the one obtained from the gills of the Cod; it measures about 8·5 mm. in length, and 3·5 mm. in breadth at the widest part.

The head is small, and carried at the end of a short, narrow neck; the width of the body increases rapidly from the head backwards to near the middle, but the posterior half has the sides nearly parallel. The posterior end is almost truncate, and is provided with six sucker-like cupules arranged nearly in line across the truncate end; from behind the two middle cupules a short and moderately broad and thin prolongation extends backwards and carries at each of its outer angles a cupule somewhat similar to the others; but these two cupules, together with the two immediately in front of them, differ slightly from the other four in that they are borne at the ends of short ventral stalks; figure 26 represents two of these cupules seen in profile. This Trematode, seen from the ventral aspect, exhibits several longitudinal folds or plaits between each of the six cupules that are arranged nearly in line across the posterior end, and the plaits extend forward to near the middle of the body, and are so arranged that these six cupules appear as if they were borne at the ends of peduncles, each of which is joined to the next by an expansion of the dorsal surface. This plaited structure, together with the general outline of the worm, gives it a form not very unlike that of the human hand, opened, and with each finger touching the one next to it.

Although I have ascribed this curious Trematode to *Pterocotyle morrhuæ*, v. Ben. and Hesse, I regard its position here as a somewhat doubtful one. The examination of further, and, if possible, of living specimens, may reveal more clearly its true relationship, but till that is done I prefer to leave it in the genus to which, for the present, it has been ascribed.

Genus *Dactylocotyle*, van Beneden and Hesse (1863).

Dactylocotyle pollachii, van Beneden and Hesse. (Pl. VIII., figs. 28, 29.)

1863. *Dactylocotyle pollachii*, v. Ben. and Hesse, *Rech. sur les Trém.*, p. 110, Pl. XI., figs. 23–30.

Habitat.—On the gills of Pollack, *Gadus pollachius*, L., captured at various times during 1900 in the salmon-nets at Bay of Nigg, near Aberdeen.

This Trematode seen from above is somewhat of the form of an elongated wedge, thin and flat. The head is small, situated near the narrow end. The posterior extremity is broadly truncate, and on both margins at this end there are four peduncles nearly equal in length, furnished with terminal cupules which are divided into two portions by a membraneous septum; the peduncles are entirely free and more or less retractile, and capable of being used as a grasping organ, as shown in figure 29, which represents a Trematode clinging to a gill-filament by means of its pedunculated suckers.*

It would appear from the experiment described below that under certain conditions these parasites though separated from their host are able to survive for a considerable length of time; the experiment may be briefly described as follows:—At 11 a.m. on the 16th of February three specimens of *Dactylocotyle pollachii* were removed from the gills of a Pollack and placed in brackish water having a specific gravity of about 1011. In this medium the Trematodes exhibited at intervals a slow, clumsy, groping movement, as if trying to lay hold of something; there was no attempt to crawl about or move from one place to another, and when placed on their back they did not appear to have even the power to turn over on to the ventral surface. One of the specimens placed in the brackish water soon died, it had probably been injured in the course of removal from the gills of the fish, but the other two continued to be fairly lively. At 11.30 a.m. on the 19th, that is at the end of 72 hours, they were both transferred to clean fresh water, with the result that after a single hour's immersion in this water only faint traces of movement could be observed in either specimen; one of them was then removed back to the brackish water, and after a short time regained some of its former activity. The other one which had been left in the fresh water had at the end of the second hour ceased to move, and, though removed back to the brackish water, it continued motionless, and soon began to change colour. The specimen which had only been left one hour in the fresh water continued to show signs of life up to 4 p.m. of the 21st, or five days and five hours after being removed from the gills of the fish; when examined next morning the creature had succumbed. Probably had the trematode been kept in sea water instead of brackish water it might have lived for a longer time.

The species appears to be a common one on the gills of the Pollack in our seas, and van Beneden and Hesse state that they have found it at all times of the year in great abundance on the gills of the same fish.

The specimen represented by the figure measures about 10 mm.

*These suckers, on their anterior aspect, are beset with numerous minute prickles or spines; but they do not seem to extend round to the posterior aspect. The prickles are easily noticed when the suckers are exserted.

Genus *Onchocotyle*, Diesing (1850).

Onchocotyle appendiculata (Kuhn). (Pl. VIII., figs. 30, 31.)

1830. *Polystoma appendiculatum*, Kuhn, *Mém. du Mus. d'Hist. Nat.*, vol. xviii., p. 362.

1829. *Polystoma appendiculatum*, *idem*, *Ann. des Sc. d'observat.*, t. ii., p. 460, Pl. II., fig. 1–3.

1832. *Polystoma appendiculatum*, Nordm., *Mikrog. Beitr.*, t. i.

1850. *Onchocotyle appendiculata*, Diesing, *System. Helminth.*, vol. i., p. 419.

1858. *Onchocotyle appendiculata*, van Beneden, *Mém. sur les vers intestin.*, p. 54, Pl. VI.

Habitat.—On the gills of the Grey Skate, *Raia batis*, and the Thornback Skate, *Raia clavata*, landed at the Fish Market at Aberdeen in June, 1900.

These parasites are, according to van Beneden, distinguished by a body of extraordinary mobility, a mouth without lateral suckers, and by the body being bifurcated at the posterior end, and carrying at a certain distance from the extremity six large fleshy suckers supported by a stout plate.*

The posterior end is usually folded back upon the ventral aspect of the body. Figures 30 and 31 exhibit a front and side view, shewing the position of the six suckers on the recurved posterior end.

P. J. van Beneden found this Trematode in abundance on the gills of *Mustelus vulgaris;* it has also been recorded by the same author from the gills of *Galeorhinus galeus* (L.) and *Scylliorhinus catulus* (Cuv.).

DESCRIPTION OF PLATES.

PLATE VII.

		Diam.
	Ergasilus nanus, Edw. v. Beneden.	
Fig. 1.	Female, dorsal view	× 51.
Fig. 2.	Antennule	× 116.
Fig. 3.	Antenna	× 102.
Fig. 4.	Foot of first pair	× 96.
Fig. 5.	Foot of third pair	× 96.
Fig. 6.	Foot of fourth pair	× 96.
Fig. 7.	Foot of fifth pair	× 193.
Fig. 8.	Abdomen and caudal farca	× 64.
	Caligus scombri, Basset-Smith.	
Fig. 9.	Female, dorsal view	× 15·5.
Fig. 10.	Sternal fork	× 102.
	Clavella hippoglossi, Kröyer.	
Fig. 11.	Male, dorsal view	× 25·5.
	Lernæa lumpi, T. Scott (sp. n.).	
Fig. 12.	Female, side view (m—mouth)	× 2.

* P. J. van Beneden, Mém. sur les vers Intestinaux, p. 54.

Sphyrion lumpi (Kröyer). Daim.

Fig. 13. Female, dorsal view . . . . . × 5.

Chondracanthus ornatus, T. Scott.

Fig. 14. Female, dorsal view . . . . . × 10.

Charopinus dubius, T. Scott.

Fig. 15. Female, dorsal view . . . . . × 3·5.

Charopinus dalmanni, Retzius.

Fig. 16. Second maxilliped, enlarged.

Charopinus ramosus, Kröyer.

Fig. 17. Female, dorsal view . . . . . × 6.
Fig. 18. ,, side view . . . . . × 6.
Fig. 19. Antennule . . . . . × 154.
Fig. 20. Antenna . . . . . × 102.
Fig. 21. Mandible . . . . . × 128.
Fig. 22. Maxilla . . . . . × 102.
Fig. 23. First maxilliped . . . . . × 51.

Brachiella triglæ, Claus.

Fig. 24. Female, dorsal view, in part . . . . . × 25.
Fig. 25. Antennule . . . . . × 193.
Fig. 26. Antenna . . . . . × 128.
Fig. 27. Mandible . . . . . × 193.
Fig. 28. Maxilla . . . . . × 193.
Fig. 29. First maxilliped . . . . . × 72.

Brachiella ovalis, Kröyer.

Fig. 30. Female, side view, in part . . . . . × 17.
Fig. 31. Antennule . . . . . × 128.
Fig. 32. Antenna . . . . . × 124.
Fig. 33. Mandible . . . . . × 128.
Fig. 34. Maxilla . . . . . × 128.
Fig. 35. First maxilliped . . . . . × 128.

PLATE VIII.

Anchorella stellata, Kröyer.

Fig. 1. Female, side view, showing attachment to scale of fish . × 10.
Fig. 2 Front view of disk showing pellucid markings . . × 33.

Anchorella scombri, Kurz.

Fig. 3. Female, side view . . . . . × 10

(?) *Lernæopoda* sp.

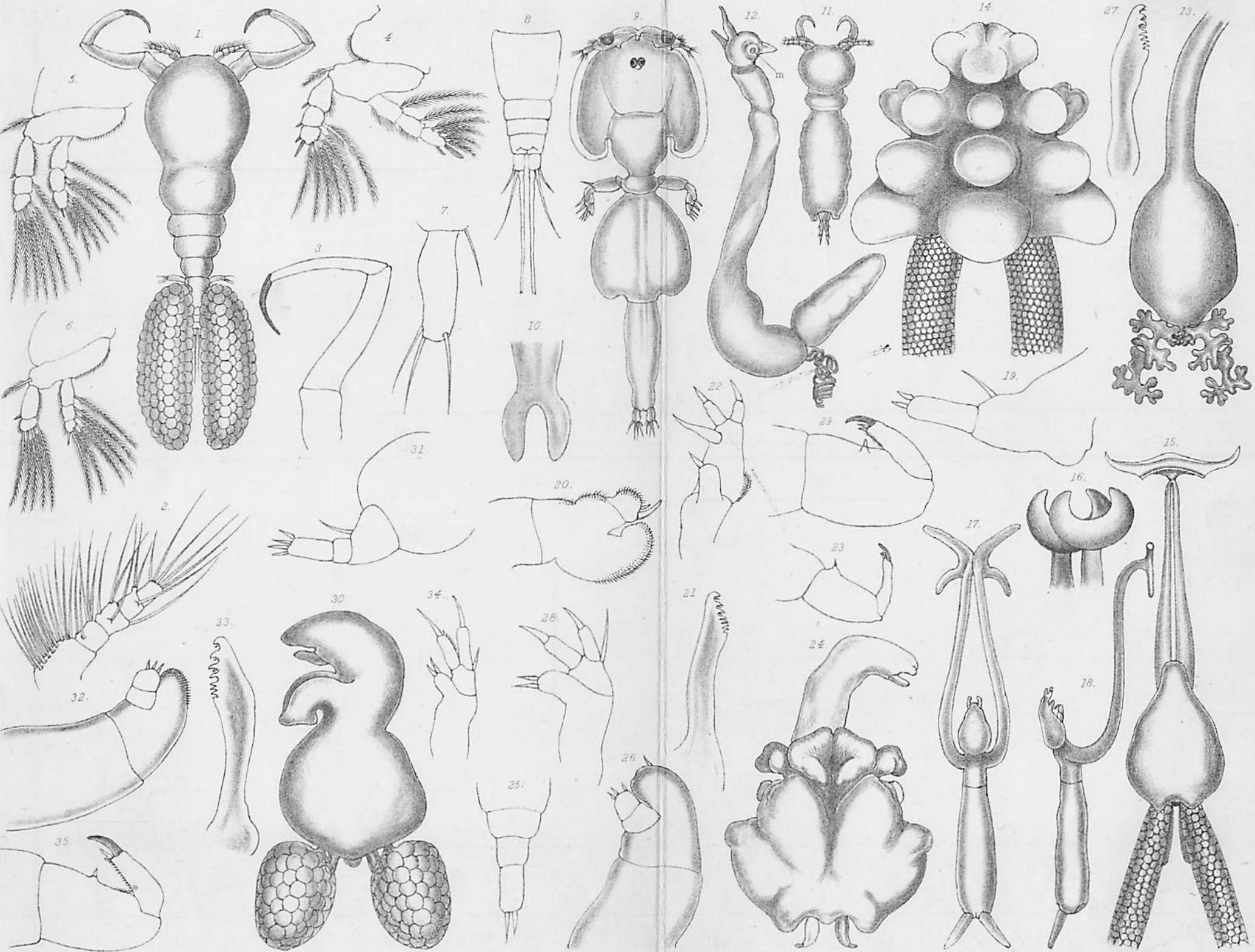
Fig. 4. (?) Male, side view . . . . . × 14.
Fig. 5. Antennule . . . . . × 154.
Fig. 6. Antenna . . . . . × 154.
Fig. 7. Mandible . . . . . × 193.
Fig. 8. Maxilla . . . . . × 145.
Fig. 9. First maxilliped . . . . . × 77.
Fig 10. Second maxilliped . . . . . × 51.

Anchorella (?) brevicollis, M.-Edw. Diam.

Fig. 11. Female, side view . . . . . × 15·5.
Fig. 12. Antennule . . . . . × 290.
Fig. 13. Antenna . . . . . × 154.
Fig. 14. Mandible . . . . . × 290.
Fig. 15. Maxilla . . . . . × 290.
Fig. 16. First maxilliped . . . . . × 96·5.

Trematodes.

Fig. 17. Phyllonella soleæ, van Beneden and Hesse . . . × 10.
Fig. 18. Trochopus lineatus, sp. n. . . . . × 19.
Fig. 19. Tristoma molæ, Blanchard . . . . . × 3.
Fig. 20. Octobothrium scombri (Kuhn) . . . . . × 24.
Fig. 21. ,, *alosæ*, Hermann . . . . . × 20.
Fig. 22. ,, esmarkii, sp. n. . . . . × 19.
Fig. 23. Phyllocotyle gurnardi, van Beneden and Hesse . . × 34.
Fig. 24. Anthocotyle merluccii, van Beneden and Hesse . . × 6.
Fig. 25. Pterocotyle morrhuæ, van Beneden and Hesse. . . × 8.
Fig. 26. ,, ,, side view of the central suckers . . × 10.
Fig. 27. ,, palmata (Leuckart) . . . . × 4.
Fig. 28. Dactylocotyle pollachii, van Beneden and Hesse . . × 7.
Fig. 29. ,, ,, showing specimen attached to a gill-filament . . . . . × 6.
Fig. 30. Onchocotyle appendiculata (Kuhn) . . . . × 7½.
Fig. 31. ,, ,, side view, showing arrangement of suckers . . . . . × 7½.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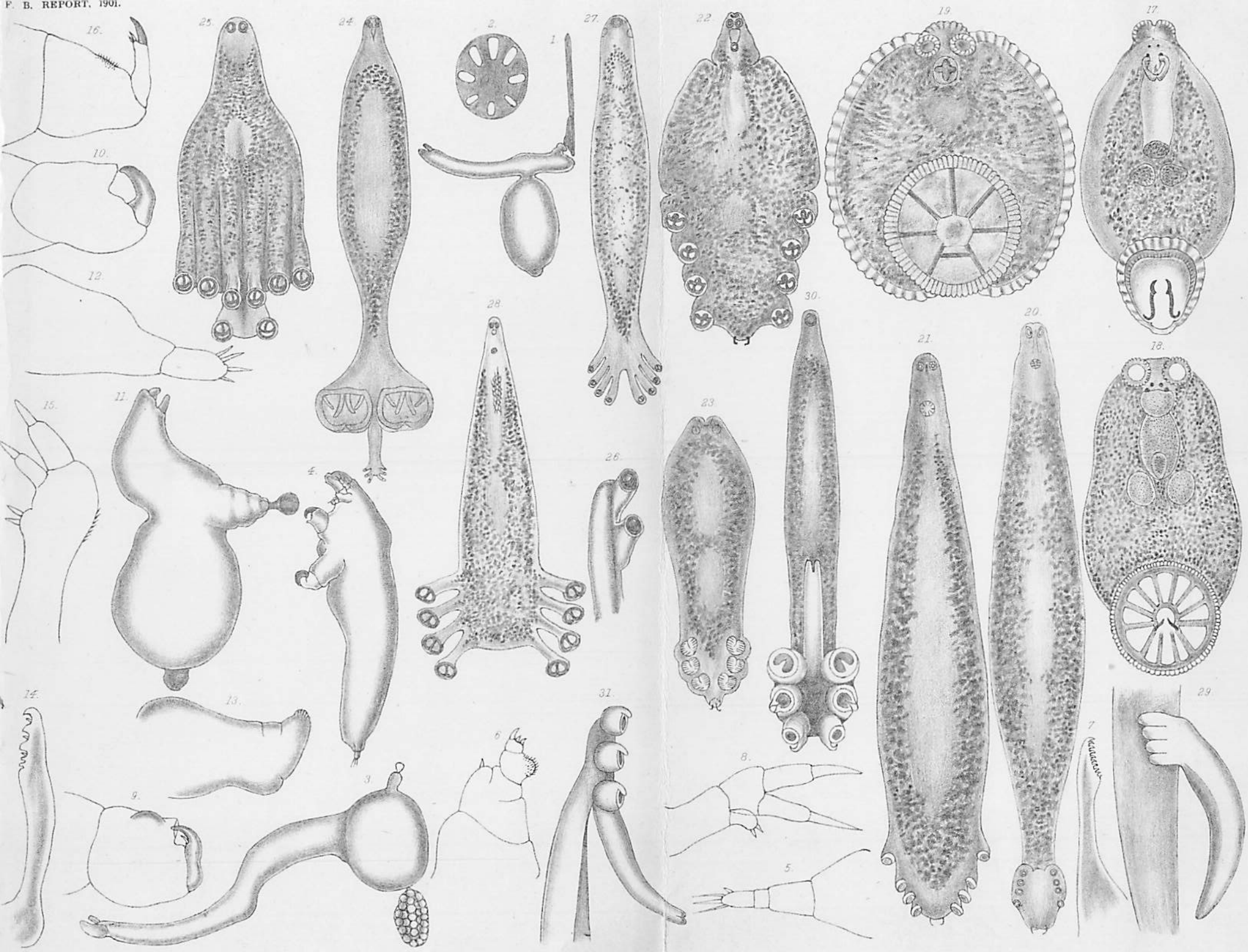

A. Scott, *del. ad nat.*

PARASITES OF FISHES— *Crustacea and Trematoda.*