1893

II.—ADDITIONS TO THE FAUNA OF THE FIRTH OF FORTH. (Pls. II.–V.)

PART V. By THOMAS SCOTT, F.L.S.

In this—the fifth—contribution towards a better knowledge of the invertebrate fauna of the Firth of Forth, only the lesser crustacea, and chiefly the copepoda, are dealt with. There are several points of interest in the natural history of the Forth crustacea referred to in this contribution: it is shown, for example, that the genus *Longipedia*, which has hitherto been considered to comprise only one species—*Longipedia coronata*—included not only a distinct variety (if it be not a distinct species) of the same genus, but also a supposed sexual form, for which it has been found necessary to provisionally institute a new generic name. Some of the species, though only now recorded for the first time for the Firth of Forth, were collected so long ago as 1889, but were allowed to stand over for want of sufficient information concerning them.

In preparing this paper, I have again the pleasure of thanking the kind friends mentioned in my papers of previous years for assistance and encouragement. I have also gratefully to acknowledge the kindness and sympathy of the following eminent French naturalists who have corresponded with me on matters relating to the subject of these papers :—MM. Le Baron Jules de Guerne and Jules Richard, Dr Raphael Blanchard, Dr Eugene Canu, and Dr Georges Roche. The drawings which accompany this paper are the work of my son, Mr Andrew Scott, who has also prepared the greater part of the necessary dissections. To carefully dissect a copepod, some of which are not more than the thirtieth to the fiftieth of an inch in length, requires no little detexerity; yet a complete series of dissections are often prepared from a single specimen. It is only by such careful work that I have been enabled to add so many rare and interesting species to the number of the Forth crustacea.

Perhaps the following brief statement of the method pursued by my son may be of interest to other students:—When necessary, the specimen is left to soak for a time in caustic potash, but this, while it clears the tissues, has sometimes a tendency to cause the specimen to shrivel up more or less, and not only while it remains in the caustic potash, but also after it is mounted in glycerine jelly—which is the medium generally made use of for mounting. To overcome this difficulty, the specimen, after being removed from the caustic potash, is well washed in fresh-water, which restores it to its normal form. If a full-sized drawing is wanted, and the specimen still shows a tendency to shrink in the glycerine jelly, it is simply mounted in water under a cover-glass till the full-sized drawing is made,—three or perhaps four tiny bits of stout paper being inserted at intervals under the edge of the cover-glass to keep it from pressing on the specimen. The manner in which shrinkage usually takes place is by the contraction of the tissue between each body segment, so that the one segment is more or less drawn in under the other—telescope fashion—and the specimen becomes in this way apparently shorter and more robust than it should be; it is seldom that mounting in glycerine jelly makes any difference on the dissected appendages of the copepoda. When the specimen is to be dissected, it is placed in a little water on a slide on the stage of the microscope—a one-inch objective is the power used—with a fine needle, the thick end of which has been pushed into a small bit of common timber for a handle, and fixed with

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sealing-wax; the specimen is usually divided into two parts by an incision immediately in front of the first pair of swimming feet. The mouth appendages and antennæ, or the swimming feet, are then first carefully dissected off—each pair by itself—and at once mounted under a separate cover-glass (or bit of cover-glass). A complete series of appendages is sometimes mounted on a single slide—this is done partly for convenience, and partly to save time—and when this is done the series always begins from the same end of the slide, and each appendage or pair of appendages occupies a particular position on the slide; and also, if very small, it is surrounded by a minute ring drawn with common writing-ink. There is thus no confusion, time is made the most of, and comparatively few slides are required.

CRUSTACEA.

COPEPODA.

Family HARPACTICIDÆ.

Genus *Longipedia*, Claus (1863).

Longipedia coronata, Claus.

As there appears to have been some misconception in regard to *Longipedia coronata*, Claus, the following description of what appears to be a typical female, and of two other and distinct forms that have probably been accidentally included with it in the same species, may be of interest.

Longipedia coronata, Claus. (Pl. II. figs. 1–13.)

1863. *Longipedia coronata*, Claus, 'Die frei lebenden Copepoden,' p. 110, pl. xiv.
1864. *Longipedia coronata*, Boeck, 'Oversigt Norges Copepoder,' p. 252.
1880. *Longipedia coronata*, Brady, 'Mon. Brit. Copep.,' vol. ii. p. 6, pls. xxxiv.-xxxv. (pars.).
1882. *Longipedia coronata*, Giesbrecht, 'Die frei lebenden Copep. 'der Kieler Föhrde,' p. 99, pls. i., iv.–xii. (? var.).
1892. *Longipedia coronata*, Canu, 'Les Copep. du Boulon.,' p. 146.
1893. *Longipedia coronata*, T. and A. Scott, 'Ann. Scot. Nat. 'Hist.,' vol. ii. pt. 2, p. 91, pl. ii. figs. 4–6.

Length from apex of rostrum to end of caudal stylets (exclusive of setæ) 1·5 mm. ($\frac{1}{16}$th of an inch). Rostrum broad, with a bluntly rounded apex. The form of the animal seen from above is narrow, elongate, and tapering gradually to the end of the abdomen; the whole length is about equal to four times the breadth at the posterior end of the first cephalothoracic segment. Anterior antennæ short, stout, and curved; densely setiferous, most of the setæ being plumose in varying degrees; an elongate sensory filament springs from the third joint, and two similar but short filaments from the extremity of the antennæ. Primary branch of the posterior antennæ, three-jointed. The secondary branch is rather longer than the primary and six-jointed; the joints become longer and narrower towards the apex, so that while the length of the first joint is equal to little more than half the breadth, the last is about one and a half times longer than broad. The posterior antennæ bear numerous plumose setæ. The mandibles have the masticatory portion broad, the truncate end of which is armed both with papilliform and pointed teeth. The two branches of the palp arise from a dilated base; one of the branches is stout and apparently one-jointed; the other is more

slender and two-jointed—both branches strongly setiferous. The maxillæ are very similar to those of the *Calanidæ* (fig. 5). Anterior foot-jaws furnished with several marginal setiferous processes; the last process armed with a strong spine in addition to three aculeate setæ; terminal joints small, furnished with a number of slender setæ. Posterior foot-jaws somewhat rudimentary, bearing numerous marginal and delicate plumose setæ. A long delicately plumose hair springs from the lateral aspect and near the base of the foot-jaw, and a few similar hairs from near the middle and distal extremity (fig. 7). The first pair of swimming feet are comparatively short; both branches are of about equal length, and composed of three sub-equal joints. The second joint of the outer branch bears a long, curved, spiniform, and blunt-pointed marginal seta. The last joint is armed with three spiniform marginal setæ, but these are considerably shorter than that on the second joint; both branches otherwise more or less setiferous. The second pair of swimming feet have the inner branches greatly elongated—being equal to about three times the length of the outer branches (the third joint alone is nearly equal to twice the length of the outer branch). The end of the outer branch extends to a little beyond the second joint of the inner one. The long joint of the inner branch is armed on the outer aspect and near the middle—but nearer the proximal than the distal end—with a large aculeate spine, and with two similar but smaller spines on the inner aspect—one near the middle of the joint, but posterior to the large outer spine, and one about one-fourth of the length of the joint from the distal end. This joint is also furnished with three stout and moderately long terminal spines. Both branches of the third and fourth pairs of feet are nearly equal and similar to each other, except that the fourth is a little smaller (figs. 10, 11). Fifth pair small, basal joint scarcely developed, produced exteriorly into an elongate digitiform process, bearing a single apical seta, and furnished interiorly with a very long and curved aculeate seta, the proximal part of which is stout. The secondary branch (or joint) is foliaceous, spathulate in form, the greatest breadth being rather less than half the length; the inner margin nearly straight, bearing several minute teeth; outer margin and end sinuate and provided with a number of setæ, the innermost being nearly three times the length of the joint from which it springs (fig. 12). The postero-lateral angles of the first abdominal segment are produced into tooth-like processes. The postero-lateral angles of all the thoracic and abdominal segments are acutely angular—the last abdominal segment is very short—with the dorsal part of the posterior margin spiniferous, the central spine being large and prominent, the others small. Caudal stylets short; the longest of the caudal setæ are scarcely equal to twice the length of the abdomen and caudal stylets combined. One ovisac.

No males of this form have yet been observed in the Firth of Forth, but females are frequent.

This appears to be the form described in the monograph of the British Copepoda as the 'male' of *Longipedia coronata*. It also closely agrees with the description and figures of Claus, both as regards its size and structural details, with the exception of the arrangement of the spines on the long joint of the inner branches of the second pair of swimming feet. Claus's figure agrees with that of Giesbrecht in this respect. But the form now described does not agree with that described by Giesbrecht in size, in the form of the second and fifth pairs of thoracic feet, and in some other important points. That described by Giesbrecht, on the other hand, agrees perfectly with a form recently discovered by my son, Andrew Scott, while examining some dredged material from the Firth of Forth, and which is provisionally described as *Longipedia coronata*, var. *minor*. The following is a description of this variety:—

Longipedia coronata, var. *minor*, T. and A. Scott. (Pl. II. figs. 14–20.)

1893. *Longipedia coronata*, var. *minor*, T. and A. Scott, 'Ann. Scot. Nat. Hist.,' vol. ii. pt. 2, p. 93.

1882. (?) *Longipedia coronata*, Giesbrecht, *loc. cit.*

Length from apex of rostrum to end of caudal stylets, exclusive of tail setæ, ·82 mm. (one-thirtieth of an inch). Female—anterior and posterior antennæ and mouth organs similar to those of *Longipedia coronata*, but smaller. Male—anterior antennæ short and robust, much less setiferous than those of the female, hinged between the third and fourth joints, terminal joint forming a comparatively small and curved claw-like appendage (fig. 15). First pair of swimming feet somewhat similar to those of *Longipedia coronata*, but smaller. The second pair in the female differ from those of *Longipedia coronata* in the following particulars: —The outer branch is considerably longer in proportion to the inner branch, the end of the second joint in the one reaching to about the end of the second joint in the other; and the long third joint of the inner branches is only about one and a half times the length of the outer branches; and the spine on the outer aspect of the long third joint is situated between the two spines on the inner aspect, but nearer to the proximal one (fig. 16). The exterior spine on the long third joint is wanting in the male; the outer branch of the second pair of the male is also somewhat proportionally shorter than in the female (fig. 17). The other swimming feet are nearly similar to those of *Longipedia coronata*, but are rather smaller. The fifth pair in the female differ considerably from those of *Longipedia coronata* in the form of the secondary branch (or joint). This branch is elongate and narrow (fig. 18), the greatest breadth being only equal to about one-fourth of the length; and also, though the var. *minor* is little more than half the length of the (supposed) typical form, the length of the secondary branch of its fifth foot is greater than that of the other. This difference may be indicated in another way —*i.e.*, in *Longipedia coronata* the length of the secondary branch of the fifth foot is scarcely equal to one-fourteenth of the entire length of the animal, but in *Longipedia coronata*, var. *minor*, the length of the secondary branch is equal to one-eighth of the length of the animal. In the male the fifth pair are small, and the basal joint is proportionally rather more developed than in the female; the secondary branch is rather broader and shorter; and the interior spiniform basal seta is straight, and considerably shorter than in the female (fig. 20). The appendages of the first abdominal segment in the male are nearly as large as the basal part of the fifth feet, and are furnished with three setæ. The central one of the three marginal spines of the last abdominal segment is not so large proportionally, and the apical setæ of the caudal stylets are much longer than in *Longipedia coronata* (fig. 19). One ovisac. Frequent in dredged material from Largo Bay and off Musselburgh. This is certainly not the form described as *Longipedia coronata* (male) in the monograph of the British Copepoda; neither does it appear to agree with that described by Claus, except in the arrangement of the spines on the last elongate joint of the inner branch of the second pair of swimming feet, but it agrees in size and in structural details with that described by Giesbrecht in his account of the free living Copepoda of Kiel fiord.

Genus *Canuella*, T. and A. Scott.

'Ann. Scot. Nat. Hist.,' 1893.

Longipedia, Brady (in part).

Somewhat like *Longipedia coronata*, Claus; but the inner branches of the second pair of swimming feet are not longer than the outer branches.

Fifth pair of feet in both sexes rudimentary; last abdominal segment not spiniferous; ovisacs two.

Canuella perplexa, T. and A. Scott. (Pl. II. figs. 21–35.)

1893. *Canuella perplexa*, T. and A. Scott, 'Ann. Scot. Nat. Hist.,' vol. ii. p. 92, pl. ii. figs. 1–3.

1880. *Longipedia coronata*, Brady (in part), 'Mon. Brit. Copep.,' vol. ii. p. 6, pl. xxxiv. figs. 3, 9; pl. xxxv. figs. 1, 3, 9.

1867. (?) *Sunaristes paguri*, Hesse, 'Ann. des Sci. Nat.,' 5th ser. (Zool.), vol. vii. p. 205, pl.

1884. (?) *Longipedia paguri*, W. Müller, 'Archiv. für Naturg.,' Jahrgang 50, 1st Band, p. 19, pl. 13.

Length (exclusive of caudal setæ) 1·4 mm. ($\frac{1}{18}$th of an inch). Body seen from above elongate, nearly cylindrical, tapering slightly to the posterior end; forehead produced into a stout and somewhat conical rostrum. Anterior antennæ of the female stout, especially the basal portion, curved, and indistinctly five-jointed, furnished with numerous elongate setæ, most of which are plumose; two sensory filaments spring from the third joint. In the male the middle joints of the anterior antennæ are narrower than the preceding joints, or than the one immediately following. This joint, which is the penultimate one, is dilated, while the last is small and hook-like—the two forming together an efficient grasping organ. Primary branch of posterior antennæ three-jointed, the middle joint short; secondary branch rather stouter than the other and six-jointed, tapering slightly towards the posterior end; the third joint is somewhat longer than the other five; the breadth of the first joint is equal to about three times the length, and of the last to about twice the length (fig. 23). Mouth organs nearly as in *Longipedia coronata*. First pair of swimming feet also similar to those of *Longipedia coronata*, but shorter, more robust, and armed with stouter spines and longer plumose setæ. The outer margin of the first joint of the outer branch bears a pectinate fringe of spine-like setæ immediately anterior to the large spine, and the outer margins of the second and third joints of the inner branch are similarly fringed. Both branches of the second pair of swimming feet are of about equal length. First joint of the inner branch very short, and armed on the lateral aspect with a stout conical and tooth-like process, which reaches slightly beyond the end of the next joint; the third joint in both branches is rather longer than the combined length of the other two (fig. 28). The third and fourth pairs are somewhat similar to those of *Longipedia coronata*. Fifth pair in both sexes rudimentary, and consisting of a very small basal joint bearing four setæ; the second seta from the inside is longer than the others and plumose. Caudal stylets strongly divergent; length equal to rather more than twice the breadth; caudal setæ comparatively short, scarcely equal to three-fifths the length of the animal. Ovisacs broadly ovate; their transverse diameter about three-fifths of the length.

This species is of frequent occurrence, especially in material dredged off Musselburgh and in Largo Bay, but specimens with ovisacs are scarce.

Canuella perplexa appears to be the form described in the monograph of the British Copepoda as the female of *Longipedia coronata*.

In 1867 Hesse described* a copepod he had discovered living in the same shell with a *Pagurus*, and to which he gave the name of *Sunaristes paguri*. This copepod resembles *Canuella perplexa* in some respects, but the difference in habitat, the difference in size (Hesse states, *loc. cit.*, that *Sunaristes* is 5 mm. long, but this probably includes the tail setæ), and the difference in important structural details is so great that it seems

* *Ann. des Sc. Nat.*, 5th ser. (Zoology), vol. vii. p. 205.

scarcely possible they can be the same species. In *Sunaristes* the genital segment of the female abdomen is equal to the entire length of the other abdominal segments, the ovisacs are elongate ovate, somewhat pointed at both ends, and reach to the end of the abdomen ; the buccal appendages and swimming feet also differ. Further, when describing the *habitat* of *Sunaristes* he says, *loc. cit.*, 'Sont les compagnons intimes des Pagures, et 'c'est avec la plus grande peine qu'on peut les en sépârer, non qu'ils 'soient fixés sur eux comme le sont leurs parasites, mais par leur adresse 'á ce cacher dans l'intérieure on en dessous des coquilles que ceuxci 'habitent.' But *Canuella* is free-living like *Longipedia*. Specimens both of *Paguri* and their shells have been examined without obtaining a single specimen of *Canuella;* all our specimens have been obtained in dredged material, or with hand-net, along with *Longipedia* and other free-living species. In 1884 Dr Wilhelm Müller described * a large copepod he also had obtained living as a messmate with a species of *Paguri* [*Pagurus* (*Eupagurus*) *bernhardus*], and which he named *Longipedina paguri*. This may be the same species as that described by Hesse as *Sunaristes paguri*, but if so the description and figures of the one certainly differ very widely from those of the other.

Longipedina paguri, W. Müller, has even a closer resemblance to *Canuella* than *Sunaristes* has, but there are still important differences—*Longipedina* is twice the size of *Canuella*, its length, exclusive of tail setæ, being, as stated by Müller, 2·7 mm. It is a messmate with *Pagurus bernhardus*, while *Canuella* is free-living. The second pair of swimming feet in the male are different from those of the female, but in *Canuella* they are alike in both sexes.

'After a careful study of the descriptions and figures of *Sunaristes* and '*Longipedina*, we find that' . . . . . 'the difference, both in respect 'of structure and *habitat*, between each of these and the species described 'by us, is apparently so great that we prefer for the present to consider 'the Forth species as distinct.' †

Zosime, Boeck (1872).

Zosime typica, Boeck. (Pl. V. figs. 14–17.)

1872. *Zosime typica*, Boeck, 'Nye Slægter og Arter af Saltvands-'Copepodar,' p. 14.

1880. *Zosime typica*, Brady, 'Mon. Brit. Cop.,' vol. ii. p. 15, pl. xxxix. figs. 1–12.

Habitat.—In material dredged off Musselburgh, frequent. The Forth specimens of this interesting and well-marked species agree thoroughly in structural details with the description and figures in 'British Copepoda.' The structure and armature of the first pair of swimming feet and of the female fifth pair are characters by which the species is readily distinguished.

Genus *Jonesiella*, Brady (1880).

Jonesiella hyænæ, I. C. Thompson. (Pl. III. figs. 1–6).

1889. *Jonesiella hyænæ*, I. C. Thompson, 'Proc. Biol. Soc. 'Liverpool,' vol. viii. p. 193, pl. ix. figs. 1–10.

This rather peculiar and interesting species was obtained among dredged material collected near Eyebrough Rock—a short distance west of Fidra

* *Archiv für Naturg., jahrgang* 50, 1st Band, p. 19.

† *Ann. Scot. Nat. Hist.* (April 1893), p. 94.

Lighthouse, Firth of Forth, during February this year. A number of specimens were obtained. The anterior antennæ are six-jointed, short, stout, and furnished with several strongly plumose setæ; the first joint is large and robust, the second, third, and fifth are short, while the fourth and the last joints are very small. The basal joint projects almost straightforward from the head, the remaining joints curve outwards so that the last three are nearly at right angles to the basal joint; two stout spines, setiferous on the upper margin, spring from the upper part of the distal end of the third joint, and an elongate sensory filament and a very long slender and plain seta from the upper distal angle of the same joint; the fifth joint is also furnished with a stout terminal spine similar to those on the end of the third joint (fig. 2). Rostrum prominent, moderately broad; extremity rounded, and extending beyond the geniculate anterior antennæ. Secondary branch of the posterior antennæ well developed, reaching beyond the end of the primary branch; three-jointed, middle joint very small (fig. 3). Mandible palp distinctly two-branched, one branch long and narrow, the other short, and each furnished with several apical setæ. Foot-jaws and swimming feet as described and figured by Mr Thompson. Fifth pair large, foliaceous; internal portion of the basal joint well developed, sub-triangular; apex broadly rounded; exterior portion of basal joint forming a small rounded process at the base of the secondary joint; secondary joint broadly ovate, scarcely reaching to the apex of the inner portion of the basal joint; lateral margins of both joints ciliate, distal margins furnished with several 'spear-shaped' setæ (fig. 6).

Jonesiella hyænæ differs from other British species of *Jonesiella* by having the inner branches of the first pair of swimming feet three-jointed, and also by the secondary branch of the posterior antennæ being three-jointed: * these differences may render it necessary to modify the generic description, or to remove *Jonesiella hyænæ* to another genus. There can be no doubt, however, that the general structure of this species agrees fairly well with the more typical members of the genus in which it is placed.

Genus *Delavalia*, Brady (1868).

Delavalia palustris, Brady.

1868. *Delavalia palustris*, Brady, Nat. Hist. Trans. Northumb. 'and Durham,' vol. iii. p. 134, pl. v. figs. 10–15.

1880. *Delavalia palustris*, *idem*, 'Mon. Brit. Copep.,' vol. ii. p. 43, pl. l. figs. 1–8.

Habitat.—Estuary of the Forth, in the vicinity of Culross, rather scarce. Common in brackish water pools at the mouth of the Peffer Burn, Aberlady Bay, ♀ with ovisacs. *Delavalia palustris* appears to be restricted to localities where the water is more or less brackish. In the monograph of the 'British Copepoda' it is recorded from only one locality —the mouth of the Seaton Burn, Northumberland.

It may be of interest to enumerate some of the Copepoda that have been found associated together in the upper reaches of the Forth estuary, as *Eurytemora affinis*, Poppe; *Tachidius crassicornis*, Scott; *Delavalia palustris*, Brady; *Thalestris harpactoides*, Claus; *Platychelipus littoralis*, Brady; *Hersiliodes littoralis* (Scott); *Acartia longiremis*, Lilljeborg; *Temora longicornis*, Müller, &c. A few of these, as *Eurytemora affinis*, *Tachidius crassicornis*, *Delavalia palustris*, and *Hersiliodes littoralis*, have

* We have recently ascertained that *Jonesiella spinulosa* has the secondary branch, also three-jointed, the intermediate joint being very small.

not been observed in the Forth beyond the area referred to, while others are not so restricted, and have been obtained in different localities—seaward as well as inshore.

Delavalia æmula,* sp. n. (provisional name). (Pl. IV. figs. 36–47.)

Length, ·73 mm. Similar in form to *Delavalia reflexa*, Brady and Robertson. Anterior antennæ of the female nearly as in *Delavalia robusta*, Brady and Robertson; male anterior antennæ nine-jointed, hinged between the sixth and seventh joints; a sensory filament springs from the end of the fourth joint in both sexes, but that of the female is shorter. The formula shows approximately the relative length of the joints of the antennæ in both male and female :—

Female antennæ, .	20 ·	10 ·	8 ·	6 ·	4 ·	8 ·	6 ·	4 ·	
	1 ·	2 ·	3 ·	4 ·	5 ·	6 ·	7 ·	8 ·	9 ·
Male antennæ, .	24 ·	11 ·	5 ·	13 ·	5 ·	10 ·	8 ·	5 ·	7 ·

Secondary branch of posterior antennæ three-jointed, middle joint very small. Basal joint of mandible palp—elongate—about three times longer than broad; the branches, which are subequal, are less than half the length of the basal joint. Posterior foot-jaws nearly as in *Delavalia robusta*, the last joint short, narrow, and curved, and appearing to be merely a continuation of the base of the terminal claw (fig. 41). Both branches of all the four pairs of swimming feet—except the inner branches of the second pair in the male—three-jointed; the inner branches of the first pair are rather longer than the outer, and the first joint is about one and a half times longer than the next one (fig. 42). The second joint of the inner branch of the second pair in the male is nearly twice the length of the first joint, and probably consists of two coalesced joints, rather slender, and with the inner margin of the proximal half strong, gibbous, and furnished with a plain, flexuous, terminal seta fig. 43). Fifth pair in both sexes nearly as in *Delavalia reflexa*, except that the basal joint carries one very small and four elongate stout plumose setæ, and the outer joint six plain setæ. Caudal stylets about equal in length to the last abdominal segment. The inner of the two principal caudal setæ very long, equal to the combined length of the abdomen and caudal stylets.

Habitat.—Largo Bay. Not rare.

Delavalia æmula differs especially in the inner branches of the first pair of swimming feet being three-jointed, and seems otherwise to combine characters belonging to all the other three British genera.

Genus *Cletodes*, Brady (1872).

(?) *Cletodes tenuiremis*, sp. n. (provisional name). (Pl. III. figs. 21–28.)

Animal resembling *Cletodes linearis* (Claus). Length, ·96 mm. Anterior antennæ seven-jointed, basal points robust; all the joints, with the exception of the first, subequal in length. The approximate length of the joints are shown by the formula—

14 ·	8 ·	7 ·	7 ·	5 ·	5 ·	6 ·	
1 ·	2 ·	3 ·	4 ·	5 ·	6 ·	7 ·	

Secondary branch of posterior antennæ small, uniarticulate, and bearing two short terminal setæ. Mandible palp consisting of a small one-jointed branch (fig. 24). The first pair of swimming feet have the inner branches

* *Æmulus*, an imitator.

short, two-jointed, the outer three-jointed branches also short, but rather longer than the inner branches; exterior marginal spines of the outer branches elongate, slender; inner and outer branches provided with very long, slender, and blunt-pointed terminal filaments (fig. 25). Inner branches of second, third, and fourth pairs very short, one-jointed; the intermediate terminal seta of both branches of the second and third pairs very long and sparingly plumose (fig. 26). Intermediate terminal seta of the inner branches of fourth pair not reaching much beyond the end of the outer branches. Fifth pair very small, almost rudimentary; basal joint furnished with four subequal plain setæ, and the secondary joint with five setæ of unequal length (fig. 28). Caudal stylets short, their breadth equal to about two-thirds the length; primary caudal seta equal to the combined length of the last abdominal segment and stylets, the other setæ minute. The last four abdominal segments are adorned with three to four transverse rows of minute cilia, and the posterior margins of thoracic and abdominal segments are fringed with aculeate setæ, as shown in figure .

Habitat.—Vicinity of Inchkeith. February 1893. Dredged; rare.

This species, which is doubtfully referred to *Cletodes*, differs from that genus in having the inner branches of all but the first pair of the swimming feet one-jointed, but as it agrees with *Cletodes* in most of the other important characters, and as no male has yet been obtained the structure of which might have assisted in more satisfactorily indicating the affinities of the species, it seems better in the meantime to place it in the genus *Cletodes*. One peculiar character of the species that distinguishes it from almost all others of the genus to which it is referred, is the long terminal filaments of the first pair of feet; they do not appear to be hairs or setæ in the proper sense, but have rather the appearance of filamentous conferva. There can be no doubt, however, that they are organically connected with the first feet, and are not accidental parasitic growths.

Genus, *Platychelipus*, Brady (1880).

Platychelipus littoralis, Brady. (Pl. V. figs. 11–13.)

1880. *Platychelipus littoralis*, Brady, 'Mon. Brit. Copep.,' vol. ii. p. 103, pl. lxxix. figs. 20–23; pl. lxxx. figs. 15–19.

Habitat.—Forth estuary, near Culross, and also off Musselburgh. This well marked species was of frequent occurrence in the material collected off Musselburgh. The long, curved, claw-like, and spiniform terminal seta of the inner branches of the first pair of swimming feet (fig. 12), together with the *Enhydrosoma*-like form of the animal, enable the species to be distinguished almost at first sight. *Platychelipus* is well described and figured by Dr Brady in the 'Monograph of the British 'Copepoda.' I do not know of any previous record of it from the Scotch coasts.

Genus, *Dactylopus*, Claus (1863).

Dactylopus rostratus, sp. n. (provisional name). (Pl. III. figs. 7–20.)

This copepod, for which I propose the provisional name *Dactylopus rostratus*, closely resembles *Dactylopus flavus*, Claus, in some structural details, and may be a large variety of that species. (*Dactylopus rostratus* is 1 mm. in length, whereas *Dactylopus flavus* is little more than half that size.) But besides being nearly double the size of *Dactylopus flavus*, it is readily distinguished from that species by the prominent and bluntly-rounded rostrum, which, like *Delavalia palustris*, is provided with two

minute lateral setæ. The anterior antennæ are short and seven-jointed (fig. 8). The formula shows the relative length of the joints :—

$$\frac{10 \cdot 12 \cdot 10 \cdot 10 \cdot 8 \cdot 5 \cdot 7 \cdot}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot}$$

The inner branch of the posterior antennæ is two-jointed (fig. 10). The mandibles are well developed; apex of biting part broad, truncate, and armed with a row of stout blunt-pointed teeth, and a marginal divergent seta; there is also a stout tooth, larger than the others, arising from the lateral distal aspect of the mandible. Posterior foot-jaws stout, with a long slender terminal claw; the inner margin of the second joint has an intermediate fringe of cilia, and two small setæ near the distal end; a prominent setose spine springs from the inner distal angle of the first joint, and immediately behind the seta is a transverse row of small hairs. The first pair of swimming feet, which somewhat resemble those of *Dactylopus flavus*, differ in the spines on the exterior distal angles of the first and second joints of the outer branches being not larger than the marginal spine of the third joint, and in the apical setæ of the third joint being non-geniculate; the outer margins of all the three joints are strongly setiferous; the inner branch, which has also the outer margin of all the joints fringed with small setæ, is armed with a stout, moderately long, and straight terminal spine and two setæ (fig. 14). The inner branches of the second pair in the male terminate in a stout, slightly curved, conical spine as long as the third joint (fig. 15). The fourth pair resemble those of *Dactylopus flavus*, but the outer margins of both branches are setiferous, and the elongate setæ on the inner margins are plumose (fig. 16). The inner segment of the basal joint of the fifth pair is slightly produced and rounded, and provided with four marginal setæ, one being greatly elongate; the secondary joint is short, obliquely truncate at the end, and furnished with four unequal terminal setæ; fifth pair in the male smaller, the inner portion of the basal joint less produced, and armed with two spine-like setæ of unequal length, the longer one being plumose (fig. 18). Abdominal segments strongly ciliate. Caudal stylets short and stout; the inner one of the two caudal setæ much longer than the other, and equal to half the length of the entire animal. Spermatophore broadly ovate (fig. 20).

Several specimens of this species were obtained by washing some shells inhabited by *Pagurus bernhardus*, and collected west of Inchkeith. The copepods may only have been accidentally harbouring about the shells; they have scarcely the appearance of 'commensals' or 'messmates.'

Family Saphirinidæ, Thorell.

Genus *Lichomolgus*.

Lichomolgus hirsutipes, sp. n. (provisional name). (Pl. IV. figs. 1–12.)

Length 1·4 mm. ($\frac{1}{18}$th of an inch). Seen from above, the first four segments of the cephalo-thorax are together broadly ovate, the first segment has a shield-like form, the fifth segment is narrow, and the proximal rather narrower than the distal end. Anterior antennæ seven-jointed. The relative length of the joints is shown by the formula—

$$\frac{19 \cdot 44 \cdot 8 \cdot 19 \cdot 20 \cdot 15 \cdot 11 \cdot}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot}$$

Posterior antennæ four-jointed, third joint short, last joint bearing two stout and hooked terminal claws. Mandibles nearly as in *Licho-*

molgus poucheti, Canu; the broad anterior margin of the basal portion is distinctly furrowed, the furrows extend to the edge, and give to it a crenate appearance (fig. 4), maxilla (*a*) with three terminal setæ. The moderately long slender extremity of the anterior foot-jaws is strongly pectinate on the upper edge, but plumose towards the end; a stout and strongly plumose seta, equal to about a third of the length of the slender terminal part of the foot-jaw, springs from the inner edge of the base, where there is also a small seta on the lateral aspect. Posterior foot-jaws of the female three-jointed; the first and second joints, which are subequal in length, are of moderate size, but the last joint is small; two setæ spring from near the middle of the second joint; the third joint, besides being furnished with a stout terminal seta, is armed at the apex with a robust conical spine, somewhat longer than the joint to which it is articulated (fig. 6). The posterior foot-jaw in the male is armed with a long, curved, terminal claw, fully twice the length of the joint from which it springs (fig. 7). In the female the fifth pair of feet are elongate; they reach to nearly the end of the genital segment of the abdomen; the whole of the upper portion of each foot is clothed with short aculeate setæ; the fifth pair in the male are much shorter, and without setæ. Female abdomen slender, and composed of five segments. Genital segment comparatively small, but fully twice the length of the next; breadth about equal to the length; the remaining four segments are nearly equal to each other in length. Caudal stylets fully one and a half times longer than the last abdominal segment, and provided with one subterminal and four apical setæ; the second seta from the inside is considerably longer than the others, being equal to the entire length of the abdomen. Genital segment of the male abdomen large, subquadrate, the sides slightly convex, the distal end truncate, and bearing two small setæ on each side of the following segment; the length of the genital segment is about equal to that of the other four segments and the caudal stylets combined. The caudal stylets of the male are somewhat shorter than those of the female (fig. 12).

The fifth pair of feet in the female of this species form a well-marked and distinctive character.

Habitat.—'Rath Ground,' a short distance north of the Bass Rock, Firth of Forth.

Genus *Modiolicola*, Aurivillius.

Modiolicola insignis, Aurivillius. (Pl. IV. figs. 13–24.)

1883. *Modiolicola insignis*, Aurivillius, 'Akademisk Afhandling,' Stockholm (1883), p. 10, t. ii., figs. 1–10; t. iv., figs. 1–8.
1885. *Lichomolgus insignis*, Raffaele é Monticelli, 'Mem. d. R. 'Accad. d. Lincei,' ser. 4, vol. i. p. 302, figs. 13–16.
1892. *Modiolicola insignis*, Canu, 'Les Copep. du Boulon.,' p. 238, pl. xxiv. figs. 14–20.

Length 1·2 mm. ($\frac{1}{20}$th of an inch). Cephalo-thorax broadly ovate; abdomen elongate, narrow, and equal to about two-thirds the length of the cephalo-thorax. First cephalo-thoracic segment subtriangular, and equal to the combined length of the other four thoracic and first abdominal segments. Forehead narrowly rounded. Anterior antennæ short, scarcely half the length of the first bony segment, seven-jointed, the second joint much longer than any of the others. The subjoined formula exhibits the relative length of the joints :—

$$\frac{8 \cdot 17 \cdot 4 \cdot 8 \cdot 10 \cdot 7 \cdot 4 \cdot}{1 \cdot \ 2 \cdot 3 \cdot 4 \cdot \ 5 \cdot 6 \cdot 7 \cdot}$$

Posterior antennæ four-jointed, joints subequal in length, but the last two are more slender than the first and second; the apex is furnished with three claw-like and hooked spines, and also a seta of about the same length as the spines. Mandibles nearly as in *Lichomolgus forficula*, Thorell. Basal part of the anterior foot-jaws stout, terminal part extremely long and slender, gradually tapering to a setiform extremity, and bent at nearly right angles to the basal part; the upper edge of the terminal part is furnished with a fringe of cilia which extend from the geniculation, where they are stout and setiform, but rapidly decrease in size towards the extremity. Posterior footjaws in the female rudimentary, three-jointed, the last very small, and without any spines or setæ; the posterior foot-jaws in the male form powerful grasping organs, composed of two stout joints, and a very long falciform terminal claw, which carries a small seta at its base; the second joint has the distal half of the inner edge fringed with cilia (fig. 19). Both branches of the first four pairs of swimming feet three-jointed, and of nearly equal length; the first basal joint of the first pair is furnished interiorly with an elongate and stout plumose seta, the inner margins of both branches are also provided with long plumose setæ; the armature of the inner branch comprises one seta on the distal end of the inner margin of the first joint, two on the second, and two on the third joint; there are also four short dagger-shaped spines round the end of the third joint, and the outer distal angles of the first and second joints form tooth-like processes; there is no seta on the inner edge of the first joint of the outer branch, one on the second and five on the third joint; the third joint is also armed on the outer margin and end with four dagger-shaped spines—the terminal one being the largest; the second also bears one dagger-shaped spine on the outer distal angle, and the first joint one. The armature of the fourth pair differs from that of the first in the following manner—there is no seta on the interior edge of the second basal joint, the first and second joints of the inner branch bear each a long plumose seta on the distal end of the inner margin, there is no seta on the third joint; this joint is truncate at the end, and armed with two stout dagger-shaped terminal spines; the outer distal angle of the second joint forms a bifid toothed process, and there is a small tooth on distal end of the outer margin of the first joint; the second joint of the outer branch bears one long seta on the inner margin, and the third joint five seta; the third joint is also armed at the extremity with a long sabre-like spine, ciliate along the inner edge, and with two short dagger-like spines on the outer margin; and the first and second joints are each provided with a similar spine on the outer distal angle (fig. 21). The fifth pair are small and one-jointed, the apex truncate, and furnished with one long, stout, and slightly curved spine, and a small spiniform seta, both of which are plain (fig. 22), fifth pair alike in both sexes. First abdominal segment in both sexes considerably dilated; that of the female has the sides rounded, is widest across the middle, and furnished on each side, on the ventral aspect, with a small setiferous appendage; that of the male is widest across the distal end, the distal angles are somewhat produced, and provided with three small setæ. The second, third, and fourth abdominal segments have the posterior margins in both sexes strongly setose. Caudal stylets about equal to twice the length of the last abdominal segment, and furnished with a small seta on the proximal half of the outer margin, and with four apical setæ; the male abdomen is rather smaller than that of the female. Ovisacs two, large. Colour of the animal, including ovisacs, usually brilliant red.

Habitat.—Living as a messmate within the shell of the 'horse mussel,' *Mytilus modiolus*. Frequent in the Firth of Forth. I have also obtained *Modiolicola* in *Mytilus modiolus*, both in the Moray Firth, on the East

Coast, and in the vicinity of Mull on the West Coast. It frequents the branchial lamellæ of the mollusc. A considerable number of specimens may sometimes be obtained in a single mussel, while in others it may be rare or altogether absent.

Family Artotrogidæ, Brady.

Genus *Cyclopicera*, Brady.

Cyclopicera purpurocincta, sp. n. (provisional name). (Pl. III. figs. 29–40.)

Length, exclusive of caudal seta, 1 mm. ($\frac{1}{25}$th of an inch). Seen from above, the cephalo-thorax is broadly ovate; the first segment is large, and equal to twice the combined length of the second, third, and fourth segments; the fifth thoracic segment is of about equal breadth with the narrow elongate abdomen; the colour of the second, third, and fourth segments is dark purple, and seems to be very little affected by a lengthened immersion in methylated spirit—the specimen figured was obtained in 1889, and though it has been in spirit since then, no perceptible change has taken place in the colour of these segments; the postero-lateral angles of the second and third segments are produced into tooth-like processes. Anterior antennæ slender, sixteen-jointed, sparingly setiferous; a sensory filament springs from the end of the third last joint. The subjoined formula shows the relative length of the joints:—

11	9	3	3	4	5	4	4	3	4	5	5	5	8	3	11
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Posterior antennæ nearly as in *Cyclopicera gracilicauda*, Brady. Mandibles also nearly as in that species; mandible palp slender, bearing two apical setæ—one very long and plumose, and scarcely half as long, plain, and very slender (fig. 32). The two simple branches of the maxillæ are about equal in length, but one branch is more slender than the other, and bears three apical setæ, while the stout branch bears five setæ at the apex (fig. 33). The anterior foot-jaws are furnished with a long, slender, and curved terminal claw. Posterior foot-jaws four-jointed, elongate, slender, resembling those of *Cyclopicera nigripes* Brady and Robertson (fig. 35). The inner portion of the second basal joint of the first pair of swimming feet is considerably delated, and the inner branch is attached to this part, while the outer branch is attached to the very reduced exterior portion, so that though the two branches are of about equal length, the outer branch does not extend much beyond the second joint of the inner one; the joints of the inner branches are subequal. In the second, third, and fourth pairs the inner portion of the second basal joint is not so enlarged as in the first pair; the outer branches are considerably longer than the outer, and the first joint of the inner branches is much shorter than the second or third joints (figs. 36, 37). Fifth pair small, two-jointed; the breadth of the first joint is greater than the length, and the length of the secoud joint, which is narrower than the first, is greater than the breadth; a small seta springs from the anterior distal angle of the first joint, and also from each of the later angles of the truncate apex of the second joint, which is also armed with a large dagger-shaped apical spine, intermediate between the small angular setæ. Abdomen slender, composed of four segments of nearly equal breadth; genital segment nearly as long as the next three together; and the second segment is nearly equal to the combined length of the third and fourth. Caudal stylets slender, rather longer than the two last abdominal segments; the inner

margin of each stylet is ciliated, the outer margin plain; terminal setæ, four unequal, the two intermediate densely plumose, and slightly thickened in the middle.

Habitat.—'Rath ground,' north of the Bass Rock, Firth of Forth, rare, in material dredged November 20th, 1889. One specimen was also obtained in some material dredged in 1892 off the south end of the Island of Mull.

Cyclopicera purpurocincta appears to be intermediate between *Cyclopicera gracilicauda* and *Cyclopicera nigripes*, but is at once distinguished from either by the colour of the second, third, and fourth thoracic segments.

Cyclopicera lata, Brady. (Pl. III. figs. 41, 42.)

1872. *Cyclopicera lata*, Brady, 'Nat. Hist. Trans. Northumb. and 'Durham,' vol. iv. p. 433, pl. xviii. figs. 3–8.
1868. *Ascomyzon echinicola*, Norman, 'Brit. Assoc. Report,' p. 300.
1880. *Cyclopicera lata*, Brady, 'Mon. Brit. Copep.,' vol. iii. p. 56, pl. lxxxix. fig. 12; pl. xc. figs. 11–14.

Habitat.—West of Gullane Ness, Firth of Forth. Washed from sponges, 1889. Several specimens were obtained. *Cyclopicera lata* closely resembles *Artotrogus boeckii*, Brady, which I have also obtained by washing *Chalina oculata* (a kind of sponge), and for this reason I had some doubts as to its being distinct, and deferred recording its occurrence; but having recently been enabled to make a careful examination of its structure, I have now no doubt that it is the species described as *Cyclopicera lata* in the Monograph of the British Copepoda: the structure of the anterior and posterior antennæ is the same, the mandible palp, which is very small, bears two apical setæ, one very long, slender, and sparsely plumose, and one very short (fig. 41). The abdomen is less robust, and the caudal stylets distinctly more elongate than in *Artotrogus boeckii*.

Genus *Parartotrogus*, T. and A. Scott (1893).

Parartotrogus richardi, T. and A. Scott. (Pl. IV. figs. 25–35.)

1893. *Parartotrogus richardi*, T. and A. Scott, 'Ann. and Mag. 'Nat. Hist.,' ser. 6, vol. xi. p. 210, pl. vii. figs. 1–11.

Habitat.—Near Fidra, Largo Bay, the 'Fluke Hole' (off St Monans), and other parts of the Forth between Inchkeith and May Island.

This species, which is only about the one-fiftieth of an inch in length, is readily distinguished by the peculiar subrhomboidal form of the cephalo-thorax (fig. 25). Seen from above, the sides of the cephalo-thorax diverge rapidly from the broad, almost truncate rostrum to about the middle of the first segment, where they form bluntly-rounded angles by again tapering quickly towards the last segment; the greatest breadth of the first segment is about equal to three-fifths of the entire length of the animal; the abdomen is moderately stout, and equal to about three-sevenths of the length of the cephalo-thorax. Anterior antenna, nine-jointed, sparingly setiferous, the third, fourth, and fifth joints much shorter than any of the others. The relative length of the joints is shown by the formula—

$$\frac{12 \cdot 12 \cdot 6 \cdot 5 \cdot 6 \cdot 10 \cdot 12 \cdot 13 \cdot 4 \cdot}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot}$$

Posterior antennæ four-jointed, and terminating in a stout hooked claw; a small curved and stout spine springs from near the middle of the last

joint; secondary branch small, one-jointed, arising from the middle of the second joint, and bearing four slender apical setæ. Mandibles stylet-shaped, produced at the base into a barb-like process (fig. 28). Maxillæ two-branched, one branch stout, and bearing three apical spines and two plumose setæ, the other branch small, with three apical setæ (fig. 29). The first joint of the anterior foot-jaws stout, second joint elongate and slender, and terminating in a moderately long curved claw and a small spine (fig. 30). Posterior foot-jaw four-jointed; second joint about three times longer than broad, and bearing a small seta near the middle of the inner margin; third and fourth joints narrow, and together scarcely equal in length to two-thirds of the second joint; terminal claw rather longer than the two preceding joints, and provided with a small seta near the middle of the inner margin. Both branches of the first pair of swimming feet two-jointed, the second joint of the inner branch large and foliaceous (fig. 32). ?Third and fourth pairs somewhat similar to those of *Lichomolgus fucicolus*, Brady; slender, and with the marginal and terminal spines of the outer branches broadly dagger-shaped (figs. 33, 34). Fifth pair rudimentary, bilobed, with about three apical setæ (fig. 35, *a*). Genital segment of the abdomen considerably dilated; second and third segments short, and together scarcely equal in length to the first; last segment equal to twice the length of the preceding one; caudal stylets rather shorter than the last abdominal segment, furnished with five apical setæ, the second seta from the inside being considerably longer than the others, and about equal in length to the last three abdominal segments. Ovisacs two, large.

This species has been known to us since 1889, but, because of some uncertainty as to whether the first specimens obtained were mature, it was considered expedient to defer recording it. A few months ago a specimen with ovisacs was obtained, and quite recently several others, also with ovisacs, have been secured. By the discovery of these specimens our uncertainty as to the maturity of those previously obtained has in a great measure been set at rest.

Parartotrogus richardi resembles in some respects a curious parasitic copepod, described by Sir John Dalyell in 1851* under the name of *Cancerilla tubulata*, and which was discovered by him adhering to the base of one of the arms of a species of *Amphiura* (a kind of starfish). The same copepod has since been obtained on the coasts of France, and is described and figured by Dr Canu in his work 'Les Copepodes du 'Boulonnais.' But in *Cancerilla* the cephalo-thorax is greatly dilated, the abdomen is very short, the anterior antennæ are only six-jointed, and the first pair of swimming feet are more rudimentary than in *Parartotrogus;* and a further difference of considerable importance is, *Cancerilla* has only been obtained as a parasite, whereas all the specimens of *Parartotrogus* that have yet been obtained were free.

Genus *Bomolchus*, Nordman (1832).

Mikrograph. Beit. zur Naturg., II. Heft., s. 135–137.

Animal somewhat like *Lichomolgus* in form. Anterior antennæ seven-jointed. Posterior antennæ three-jointed. (?) Mandibles stylet-shaped. Maxillæ simple, the apex truncate, and provided with two broadly ovate appendages. Foot-jaws rudimentary; (?) anterior footjaw, consisting of a simple stylet-shaped joint, bearing a single plumose seta. Both branches of all the swimming feet three-jointed, first pair short, foliaceous, furnished with spathulate and densely-plumose setæ; the

* *The Powers of the Creator*, vol. i. p. 233, pl. lxii. figs. 1–5.

second, third, and fourth pairs rather longer, the outer branches armed with hooked marginal spines. Fifth pair nearly as in *Lichomolgus*.

Bomolchus soleæ, Claus. (Pl. V. figs. 1–13.)

1864. *Bomolchus soleæ*, Claus, Zeitschrift fur Wissenschaft zool. vol. xiv. p. 374, pl. 35, figs. 16–20.

Length, exclusive of tail setæ, 1·3 mm. Anterior antennæ furnished with numerous moderately long and densely plumose seta; the relative length of the joints are shown by the formula—

$$\frac{25 \cdot 15 \cdot 15 \cdot 17 \cdot 15 \cdot 11 \cdot 13 \cdot}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7.}$$

Middle joint of posterior antennæ short, bearing a single small hair, the last joint covered with small prickles and furnished with three pectinate setiferous appendages and three apical setæ (fig. 3). The mandibles (?) have the basal portion considerably dilated, d the terminal portion curved and stylet-shaped (fig. 4). First pair of swimming feet short, broadly foliaceous, somewhat distorted; joints of inner branch subequal in length; the middle joint of the outer branch very short (fig. 7). The second and third pairs longer and much narrower comparatively than the first; inner margins furnished with elongate, densely plumose setæ; the exterior margin and end of the outer branches armed with stout spines bearing terminal hook-like processes; joints of the inner branches subequal; middle joint of outer branches shorter than either of the other two (fig. 8). In the fourth pair the inner branches are rather longer than the outer, but otherwise this pair is similar to the second and third. The fifth pair consist each of a single two-jointed branch; the first joint is very short, the second is about four times the length of the first, and is provided with three terminal and one marginal setæ. Abdomen short, tapering from the somewhat stout genital segment; the third, fourth, and fifth segments shorter than the preceding one. Caudal stylets rather longer than the last abdominal segment; the principal caudal seta is about one and a half times longer than the abdomen; other tail setæ short.

Habitat.—"Fluke Hole" off St Monans, Firth of Forth. This curious copepod seems to be closely allied to the *Saphirinidæ*, and probably belongs to that group. The peculiar structure of the first pair of swimming feet give it a somewhat abnormal character. New to Britain.

Besides the *Copepoda* now described, there are still some others that do not apparently agree with known species, and which are held over for further study.

AMPHIPODA.

GAMMARIDÆ.

Genus *Anonyx*, Kroyer (1838).

Anonyx nugax, Phipps. (Pl. V. figs. 18–21.)

Cancer nugax, Phipps, 'Voyage au Pöle boréale,' p. 192, pl. 12, fig. 8.

Anonyx ampulla, Kröyer (not Phipps).

1891. *Anonyx nugax*, G. O. Sars, 'Crust. of Norway,' vol. i. p. 88, pl. 31.

Several specimens of this fine species were obtained in February 1889, near May Island, Firth of Forth, but were not then recorded; it was only when I read the description in G. O. Sars' excellent work, the 'Crustacea of Norway,' that the species was recognised. The largest of the Forth specimens measure 20 mm. (fully three-quarters of an inch) in length.

The eyes are lageniform, and, being large and black, give a marked character to the species.

Genus Bathyporeia, Lindström (1855).

Bathyporeia norvegica, G. O. Sars. (Pl. V. fig. 22.)

Bathyporeia pilosa, Boeck (not Lindström).

1891. *Bathyporeia norvegica*, G. O. Sars, *loc. cit.*, p. 128, pl. 43.

1892. *Bathyporeia norvegica*, T. and A. Scott, 'Ann. and Mag. 'Nat. Hist.,' s. 6, vol. x. p. 205.

Specimens of this species are occasionally obtained in various parts of the Firth of Forth. It may be distinguished by its larger size, and especially by the tooth-like form of the postero-lateral angles of the epimeral plates of the third metasome.

Bathyporeia pelagica, Sp. Bate. (Pl. V. figs. 23–25.)

1862. *Bathyporeia pelagica*, Sp. Bate, 'Cat. Amphip. Brit. Mus.,' p. 174, pl. xxxi. fig. 6.

1891. *Bathyporeia pelagica*, G. O. Sars, *op. cit.*, p. 129, pl. 44, fig. 1.

After a careful examination of a considerable number of Forth specimens of *Bathyporeia*, I have been enabled, with the assistance of Prof. G. O. Sars' 'Crustacea of Norway,' to distinguish this and the following species. The exceedingly long flagellum of the posterior antennæ of the adult male enables *Bathyporeia pelagica* to be readily distinguished except from *Bathyporeia norvegica;* but in this case, not only is there a difference in size, there is also the difference in the form of the epimeral plates of the third metasome, which, in all but *Bathyporeia norvegica*, have postero-lateral angles more or less rounded. In *Bathyporeia pelagica* the dorsal flexure of the first urosome is very marked, and the four small submedian setæ on its lower convex portion are present on all the specimens observed in the Forth; the two lower ones are short, stout, and distinctly spiniform.

Bathyporeia robertsoni, Sp. Bate. (Pl. V. figs. 26–29.)

1862. *Bathyporeia robertsoni*, Sp. Bate, 'Cat. Amphip. Brit. Mus.,' p. 173, pl. xxxi. fig. 5.

1891. *Bathyporeia robertsoni*, G. O. Sars, *op. cit.*, p. 131, pl. 44, fig. 2.

In this species the flagellum of the adult male posterior antennæ is comparatively short, and the first urosome wants the two posterior submedian dorsal spiniform setæ; it also differs in having the last joint of the last pair of uropods very small. In the 'Revised List of the Crustaceæ of the Firth of Forth,' *Bathyporeia pelagica* and *Bathyporeia robertsoni* are included under *Bathyporeia pilosa*, Lindström, as forms of that species.

Genus *Argissa*, Boeck (1870).

Argissa hamatipes (Norman). (Pl. V. figs. 30, 31.)

1868. *Syrrhoe hamatipes*, Norman, Report on Dredging among the Shetland Islands (in 'Report of the 38th Meeting of the 'British Association, 1868,' London, 1868).

1870. *Argissa typica*, Boeck, 'Crust. Amphip. bor. et arct.,' p. 45.

1891. *Argissa typica*, G. O. Sars, *op. cit.*, p. 141, pl. 48.

This curious and somewhat anomalous Amphipod has been observed during the past autumn and winter in various parts of the Forth. It has

also been obtained in Aberdeen Bay. One of its peculiar characteristics is the structure of the eyes, which consist of four pairs of small lenses about equidistant from each other, and arranged round the circumference of a nearly circular patch of pigment. In the male the second segment of the urosome has the dorsal part produced backward in the form of a free tooth-like process, that extends to nearly the end of the next segment.

Argissa hamatipes has been recorded for Shetland (Norman) and for the Clyde district (Robertson).

Genus *Ampelisca*, Kroyer (1842).

Ampelisca assimilis, Boeck. (Pl. V. figs. 32–35.)

1870. *Ampelisca assimilis*, Boeck, 'Crust. Amphip. bor. et arct.,' p. 142.

1891. *Ampelisca assimilis*, G. O. Sars, *op. cit.*, p. 168, pl. lviii. fig. 2.

Habitat.—Vicinity of May Island. Apparently scarce.

This, which is one of the smaller species, is distinguished by the anterior antennæ reaching very little beyond the end of the basal joints of the posterior antennæ; the two last basal joints of the posterior antennæ are of about equal length. The epimeral plates of the last segment of the mesosome have the postero-lateral angles broadly rounded. The telson is rather longer than broad; sides of the proximal half straight and parallel; of the distal half slightly rounded, and converging to the blunt-pointed apex, and bearing a few very small marginal setæ.

Mr Robertson records this species from the Clyde.

Ampelisca lævigata, Lilljeborg. (Pl. V. figs. 36, 37.)

1855. *Ampelisca lævigata*, Lilljeborg, 'Ofv. af. Kgl. Vet. Akad. 'Förh.,' p. 123.

1862. *Ampelisca Belliana*, Sp. Bate, 'Cat. Amphip. Crust. Brit. 'Mus.,' p. 93, pl. xv. fig. 3.

1891. *Ampelisca lævigata*, G. O. Sars, *op. cit.*, p. 169, pl. lii. fig. 1.

Habitat.—Largo Bay and one or two other places in the Firth of Forth, but not common.

In this species the anterior antennæ scarcely reach to the end of the basal joints of the posterior antennæ. The penultimate basal joint of the posterior antennæ is considerably longer than the next, and the flagellum is comparatively short, being less than twice the length of the peduncle. The posterior pair of pereiopoda are robust; the meral joint is produced exteriorly, and forms a lobe-like process as long as the next joint, and densely fringed with cilia. The postero-lateral margins of the epimeral plates of the last segment of the mesosome are doubly and strongly sinuate, the postero-lateral angles being produced into acutely slender teeth. Telson moderately broad, with a pointed apex.

According to Professor G. O. Sars, this species is the *Ampelisca belliana* of Sp. Bate, and *Ampelisca lævigata*, Sp. Bate, is the same as *Ampelisca tenuicornis*, Lilljeborg, which was described by Lilljeborg in 1855.

Ampelisca spinipes, Boeck. (Pl. V. figs. 38–40.)

1870. *Ampelisca spinipes*, Boeck, 'Crust. Amphip. bor. et arct.,' p. 143.

1891. *Ampelisca spinipes*, G. O. Sars, *op. cit.*, p. 173, pl. 60, fig. 2.

Habitat.—Vicinity of May Island, Firth of Forth. Not common.

The superior antennæ of *Ampelisca spinipes* are proportionally much longer than in the last species, as they extend considerably beyond the end of the peduncle of posterior antenna. The terminal joints of the last pair of pereiopods are comparatively narrow. The posterior margin of the expanded plate of the basal joint bends obliquely upwards at a moderately acute angle. The postero-lateral angles of the epimeral plates of the last segment of the mesosome are nearly rectangular. The telson is comparatively narrow. Length of Forth specimens, 15 mm.

Genus *Amphilochoides*, G. O. Sars (1892).

Amphilochoides odontonyx, Boeck. (Pl. V. figs. 41, 42.)

1870. *Amphilochoides odontonyx*, Boeck, 'Crust. Amphip. bor. et 'arct.,' p. 51.

1892. *Amphilochoides odontonyx*, G. O. Sars., *op. cit.*, p. 221, pl. lxxv. fig 2.

Habitat.—Vicinity of Fidra Island, Firth of Forth.

This, though a small species, is quite easily distinguished from *Amphilochus manudens*, which it resembles in size and form by the structure of the gnathopods. The inner edge of the dactylus of the first and second gnathopods, but especially of the second pair, is produced near the hinge into a small but quite distinct blunt-pointed tooth, that interlocks into an opposing notch on the palm. It is further distinguished from *Amphilochoides pusillus*, G. O. Sars, which has the claws of second pair of gnathopods similarly toothed, by the postero-lateral margins of the epimeral plates of the third segment of the mesosome being sinuate, and the angles slightly produced and tooth-like. Professor Sars does not give (*loc. cit.*) any British locality for *Amphilochoides odontonyx*, but, on the authority of Meinert, records its occurrence in the Kattegat and Skagerak. He has also obtained it in a few places off the west coast of Norway. Mr David Robertson, of Millport, records its occurrence in the Clyde district.

Genus *Cerapus*, Say (1817).

Cerapus crassicornis (Spence, Bate).

1855. *Siphonœcetes crassicornis*, Sp. Bate, 'Rep. Brit. Assoc.,' p. 59.

1857. *Siphonœcetes crassicornis*, White, 'Pop. Hist. Brit. Crust.,' p. 197.

This species was obtained among some material collected by a tow-net fixed to the head of the beam-trawl. It occupied a tube a little longer than itself, composed of blackish mud, held together by some kind of glutinous substance. It was able to move freely about with its tube, and to withdraw itself at pleasure. Only one specimen has been obtained.

CUMACEA.

Genus *Petalomera*, Stimpson (1858).

Petalomera declivis, G. O. Sars. (Pl. V. fig. 43.)

1892. *Petalomera declivis*, T. and A. Scott, 'Ann. and Mag. Nat. Hist.,' ser. vi., vol. x. p. 206.

This Cumacean was obtained in Largo Bay in 1892. It appears to be a rare species in the Firth of Forth. More recently (April 1893) several specimens were obtained in bottom material collected a few miles east of May Island.

EXPLANATION OF THE PLATES.

Plate II.

Longipedia coronata, Claus (♀).

Fig. 1. Female, dorsal view, ... × 32
Fig. 2. Anterior antenna, ... × 152
Fig. 3. Posterior antenna, ... × 152
Fig. 4. Mandible and palp, ... × 190
Fig. 5. Maxilla, ... × 127
Fig. 6. Anterior foot-jaw, ... × 190
Fig. 7. Posterior foot-jaw, ... × 152
Fig. 8. Foot of first pair of swimming feet, ... × 100
Fig. 9. Foot of second pair, ... × 95
Fig. 10. Foot of third pair, ... × 100
Fig. 11. Foot of fourth pair, ... × 100
Fig. 12. Foot of fifth pair, ... × 190
Fig. 13. Abdomen and caudal stylets, ... × 53

Longipedia coronata, var. *minor*, T. and A. Scott.

Fig. 14. Female, dorsal view, ... × 40
Fig. 15. Anterior antenna—male, ... × 190
Fig. 16. Foot of second pair of swimming feet—female, . . . × 127
Fig. 17. Foot of second pair of do.—male, ... × 127
Fig. 18. Foot of fifth pair—female, ... × 190
Fig. 19. Last abdominal segment and caudal stylets, . . . × 80
Fig. 20. Portion of last thoracic segment and first abdominal segment—male (*a*. fifth foot ; *b*. abdominal appendage), . . × 23

Canuella perplexa, T. and A. Scott.

Fig. 21. Female, dorsal view, ... × 32
Fig. 22. Anterior antenna—female, ... × 152
Fig. 23. Anterior antenna—male, ... × 152
Fig. 24. Posterior antenna, ... × 190
Fig. 25. Mandible, ... × 190
Fig. 26. Maxilla, ... × 190
Fig. 27. Anterior foot-jaw, ... × 190
Fig. 28. Posterior foot-jaw, ... × 190
Fig. 29. Foot of first pair of swimming feet, ... × 152
Fig. 30. Foot of second pair, ... × 100
Fig. 31. Foot of third pair, ... × 100
Fig. 32. Foot of fourth pair, ... × 84
Fig. 33. Fifth pair of thoracic feet, ... × 506
Fig. 34. Genital segment, ventral view—female, ... × 127
Fig. 35. Genital segment, ventral view—male, ... × 127

Plate III.

Jonesiella hyænæ, I. C. Thompson (♀).

Fig. 1. Female, dorsal view, ... × 64
Fig. 2. Anterior antenna, ... × 380
Fig. 3. Posterior antenna, ... × 300
Fig. 4. Mandible palp, ... × 380
Fig. 5. Foot of first pair of swimming feet, ... × 200
Fig. 6. Foot of fifth pair, ... × 300

Dactylopus rostratus, sp. nov.

Fig. 7. Female, dorsal view, ... × 42
Fig. 8. Anterior antenna and rostrum—female, ... × 152
Fig. 9. Anterior antenna—male, ... × 200
Fig. 10. Posterior antenna, ... × 170
Fig. 11. Mandible and palp, ... × 300
Fig. 12. Maxilla, ... × 253
Fig. 13. Posterior foot-jaw, ... × 380
Fig. 14. Foot of first pair of swimming feet, ... × 127
Fig. 15. Foot of second pair—male, ... × 127
Fig. 16. Foot of fourth pair, ... × 127
Fig. 17. Foot of fifth pair—female, ... × 127
Fig. 18. Foot of fifth pair—male, ... × 190
Fig. 19. Last abdominal segments and caudal setæ, . . . × 84
Fig. 20. Spermatophore, ... × 127

(?) *Cletodes longiremis*, sp. nov.

Fig. 21. Female, dorsal view, ... × 92
Fig. 22. Anterior antenna, ... × 380
Fig. 23. Posterior antenna, ... × 380
Fig. 24. Mandible and palp, ... × 506
Fig. 25. Foot of first pair of swimming feet, ... × 506
Fig. 26. Foot of second pair, ... × 253
Fig. 27. Foot of fourth pair, ... × 253
Fig. 28. Foot of fifth pair, ... × 570

Cyclopicera purpurocincta, sp. nov.

Fig. 29. Female, dorsal view, ... × 70
Fig. 30. Anterior antenna and rostrum, ... × 230
Fig. 31. Posterior antenna, ... × 480
Fig. 32. Mandible and palp, ... × 325
Fig. 33. Maxilla, ... × 325
Fig. 34. Anterior foot-jaw, ... × 253
Fig. 35. Posterior foot-jaw, ... × 200
Fig. 36. Foot of first pair of swimming feet, ... × 220
Fig. 37. Foot of second pair, ... × 163
Fig. 38. Foot of fourth pair, ... × 190
Fig. 39. Foot of fifth pair, ... × 506
Fig. 40. Abdomen and caudal stylets, ... × 80

Cyclopicera lata, Brady.

Fig. 41. Mandible and palp, ... × 253
Fig. 42. Abdomen and caudal stylets, ... × 127

Plate IV.

Lichomolgus hirsutipes, sp. nov.

Fig. 1. Female, dorsal view, ... × 48
Fig. 2. Anterior antenna, ... × 100
Fig. 3. Posterior antenna, ... × 100
Fig. 4. Mandible and palp, ... × 333
Fig. 5. Anterior foot-jaw, ... × 380
Fig. 6. Posterior foot-jaw—female, ... × 200
Fig. 7. Posterior foot-jaw – male, ... × 300
Fig. 8. Foot of first pair of swimming feet, ... × 152
Fig. 9. Foot of fourth pair, ... × 152
Fig. 10. Foot of fifth pair—female, ... × 200
Fig. 11. Foot of fifth pair—male, ... × 380
Fig. 12. Abdomen and caudal stylets, ... × 64

Modiolicola insignis, Aurivillius.

Fig. 13. Female, dorsal view, ... × 54
Fig. 14. Anterior antenna, ... × 253
Fig. 15. Posterior antenna, ... × 170
Fig. 16. Mandible and palp, ... × 455
Fig. 17. Anterior foot-jaw, ... × 253
Fig. 18. Posterior foot-jaw—female, ... × 380
Fig. 19. Posterior foot-jaw—male, ... × 300
Fig. 20. Foot of first pair of swimming feet, ... × 152
Fig. 21. Foot of fourth pair, ... × 127
Fig. 22. Foot of fifth pair, ... × 380
Fig. 23. Abdomen and caudal stylets—female, ... × 63
Fig. 24. Abdomen and caudal stylets—male, ... × 115

Parartotrogus richardi, T. and A. Scott.

Fig. 25. Female, dorsal view, ... × 126
Fig. 26. Anterior antenna, ... × 253
Fig. 27. Posterior antenna, ... × 253
Fig. 28. Mandible, ... × 460
Fig. 29. Maxilla, ... × 253
Fig. 30. Anterior foot-jaw, ... × 253
Fig. 31. Posterior foot-jaw, ... × 253
Fig. 32. Foot of first pair of swimming feet, ... × 253
Fig. 33. Foot of third pair, ... × 253
Fig. 34. Foot of fourth part, ... × 253
Fig. 35. Abdomen and caudal stylets (*a.* fifth foot), . . . × 170

Delavalia æmula, sp. nov.

Fig. 36. Female, lateral view, ... × 80
Fig. 37. Anterior antenna—female, ... × 253
Fig. 38. Anterior antenna—male, ... × 325
Fig. 39. Posterior antenna, ... × 200
Fig. 40. Mandible and palp, ... × 335
Fig. 41. Posterior foot-jaw, ... × 506
Fig. 42. Foot of first pair of swimming feet, ... × 253
Fig. 43. Foot of second pair—male, ... × 300
Fig. 44. Foot of fourth pair, ... × 152
Fig. 45. Foot of fifth pair—female, ... × 380
Fig. 46. Foot of fifth pair—male, ... × 300
Fig. 47. Last abdominal segment and caudal stylets, . . . × 152

PLATE V.

Bomolchus soleæ, Claus.

Fig. 1. Female, dorsal view, ... × 40
Fig. 2. Anterior antenna, ... × 190
Fig. 3. Posterior antenna, ... × 127
Fig. 4. Mandible, ... × 300
Fig. 5. Maxilla, ... × 380
Fig. 6. (?) Anterior foot-jaw, ... × 380
Fig. 7. Foot of first pair of swimming feet, ... × 163
Fig. 8. Foot of second pair, ... × 127
Fig. 9. Foot of fourth pair, ... × 127
Fig. 10. Foot of fith pair, ... × 127

Platychelipus littoralis, Brady.

Fig. 11. Female, dorsal view, ... × 70
Fig. 12. Foot of first pair of swimming feet, ... × 253
Fig. 13. Foot of fifth pair, ... × 169

Zosime typica, Boeck.

Fig. 14. Female, dorsal view, ... × 70
Fig. 15. Foot of first pair of swimming feet, ... × 253
Fig. 16. Foot of fifth pair, ... × 338
Fig. 17. Second-last abdominal segment, ... × 380

Anonyx nugax (Phipps).

Fig. 18. Cephalon with superior and inferior antennæ, . . . × 7·6
Fig. 19. Mandible and palp, ... × 20
Fig. 10. One of the last epimeral plates of metasome, . . . × 9
Fig. 21. Telson, ... × 26

Bathyporeia norvegica, G. O. Sars.

Fig. 22. One of the last epimeral plates of metasome, . . . × 13

Bathyporeia pelagica, Sp. Bate.

Fig. 23. One of the last epimeral plates of metasome, . . . × 26
Fig. 24. Dorsum of first segment of urosome, ... × 26
Fig. 25. One of the last pair of uropods, ... × 26

Bathyporeia robertsoni, Sp. Bate.

Fig. 26. Cephalon with superior and inferior antennæ, . . . × 21
Fig. 27. One of the last epimeral plates of metasome, . . . × 16
Fig. 28. Dorsum of first segment of urosome, ... × 40
Fig. 29. One of the last pair of uropods, ... × 20

Argissa hamatipes (Norman).

Fig. 30. Cephalon with superior and inferior antennæ (*a.* eye), . . × 24
Fig. 31. Urosome, ... × 21

Ampelisca assimilis, Boeck.

Fig. 32. Cephalon with superior and inferior antennæ, . . . × 26
Fig. 33. One of the epimeral plates of metasome, . . . × 13
Fig. 34. Telson, ... × 40
Fig. 35. One of the last pair of pereiopods, ... × 13

Ampelisca laevigata, G. O. Sars.

Fig. 36. One of the last epimeral plates of metasome, . . . × 21
Fig. 37. One of the last pair of pereiopods, ... × 20

Ampelisca spinipes, Boeck.

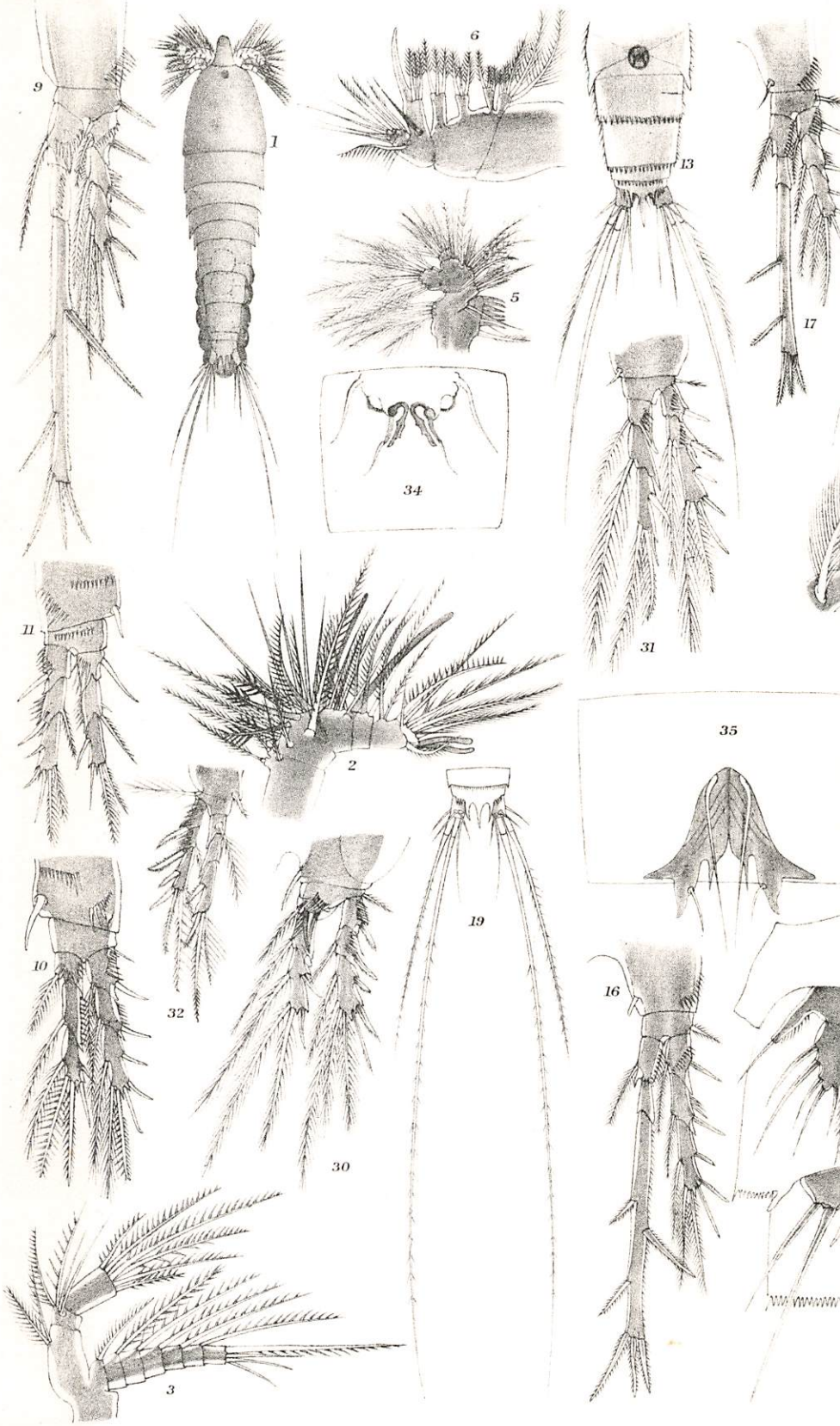
Fig. 38. Cephalon with superior and inferior antennæ, . . . × 21
Fig. 39. One of the last epimeral plates of metasome, . . . × 8
Fig. 40. Telson, ... × 13

Amphilochoides odontonyx (Boeck).

Fig. 41. One of the second gnathopods, ... × 53
Fig. 42. One of the last epimeral plates of metasome, . . . × 18

Petalomera declivis, G. O. Sars.

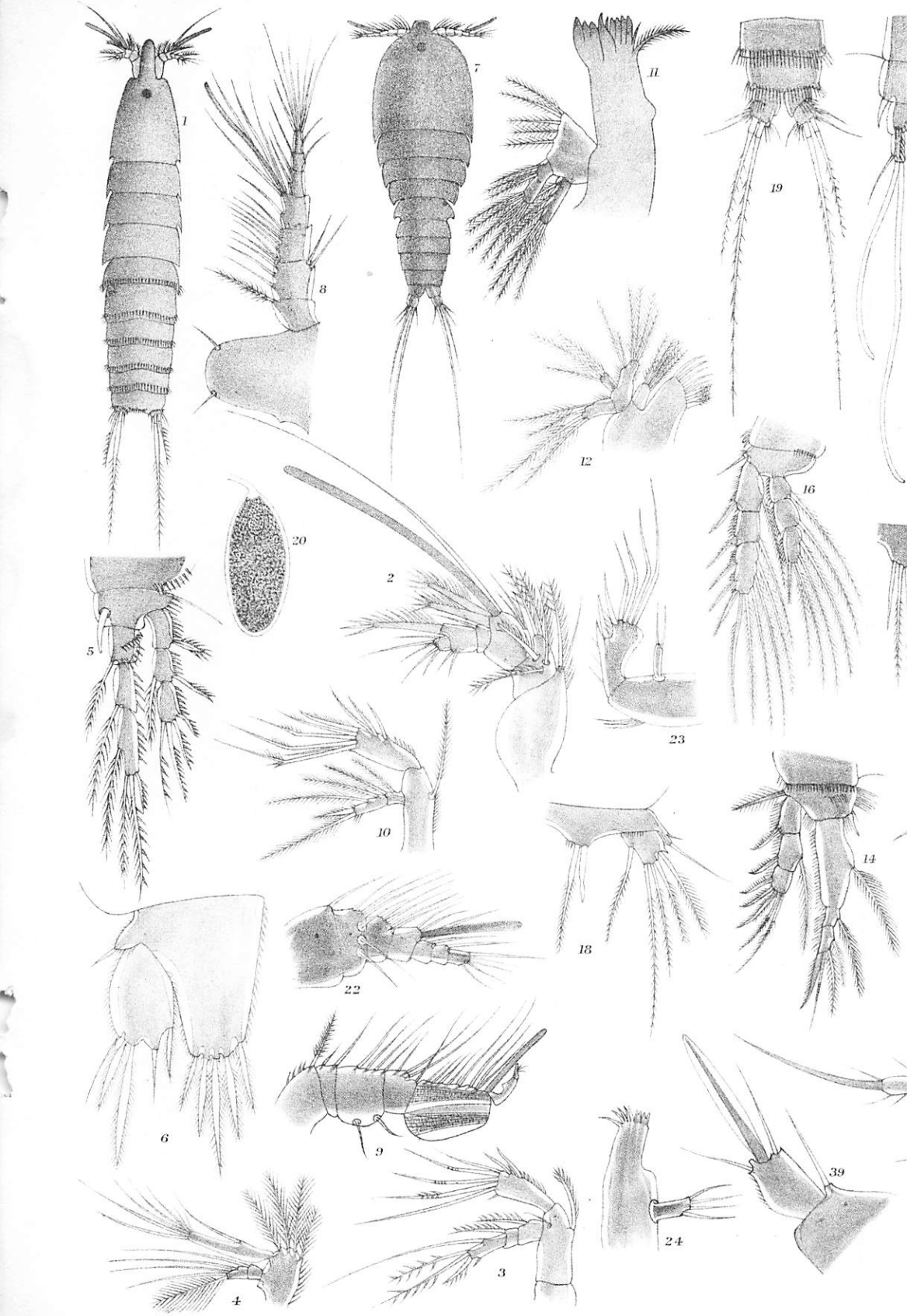
Fig. 43. One of the thoracic appendages, ... × 40



Andrew Scott, del. ad nat.

Figs. 1 13.—Longipedia coronata *Claus*. Figs. 14 20.—Long

pedia coronata, *var*, minor. Figs. 21 35.—Canuella perplexa *T. and A. Scott*.



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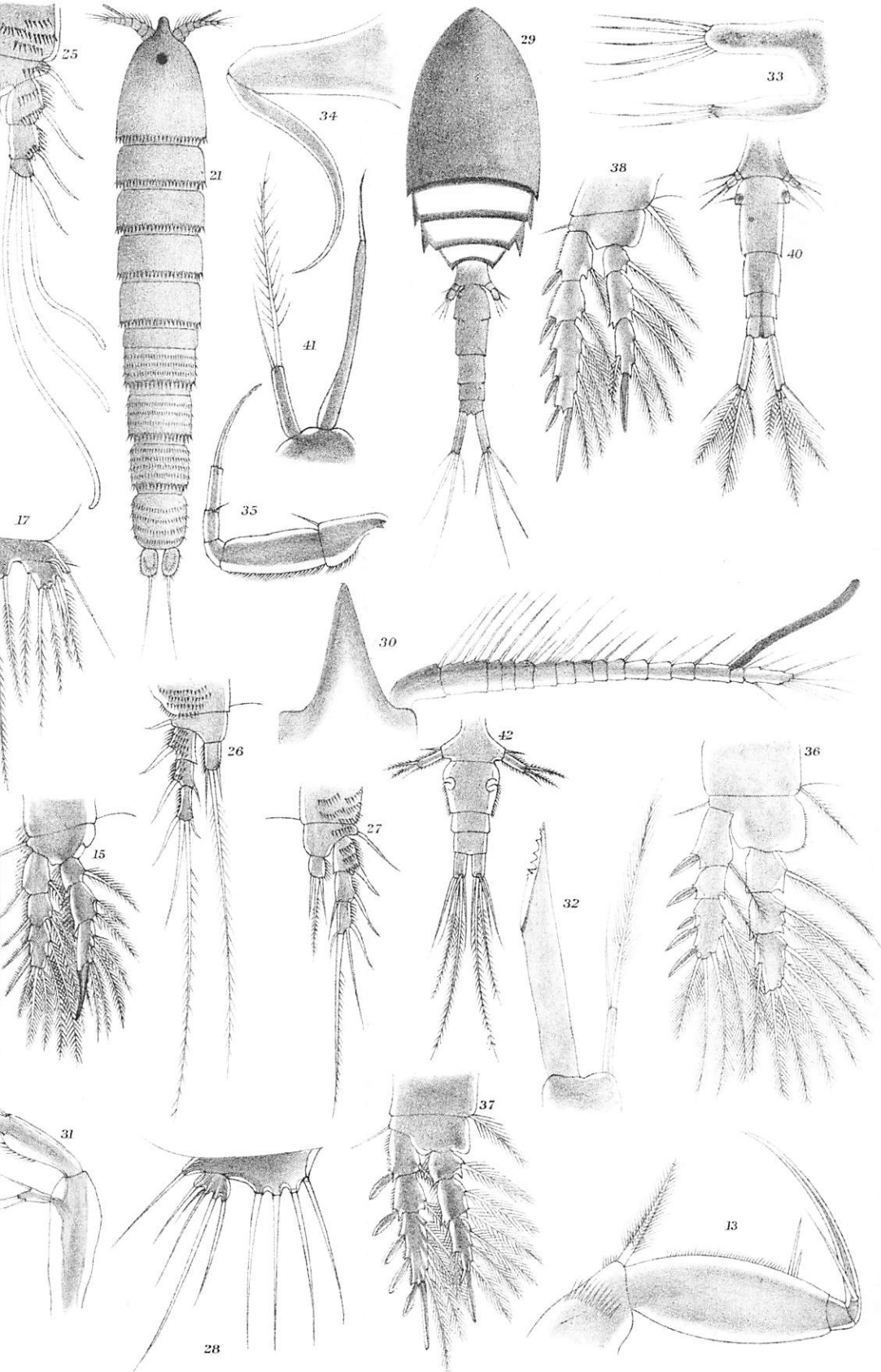
Figs. 1 6.—Jonesiella hyænæ *I. C. Thompson*. Figs. 7 20.—Dactylopus rostratus, *sp.*
Figs. 41 42.—Cyclopic



. Figs. 21 28.—? Cletodes tenuiremis, *sp. n.* Figs. 29 40.—Cyclopicera purpurocincta, *sp. n.*
ra lata (*Brady*).

Figs. 1 12.— Lichomolgus hirsutipes, *sp. n.* Figs. 13 24.—Modiolicola
Figs. 36 47.—I

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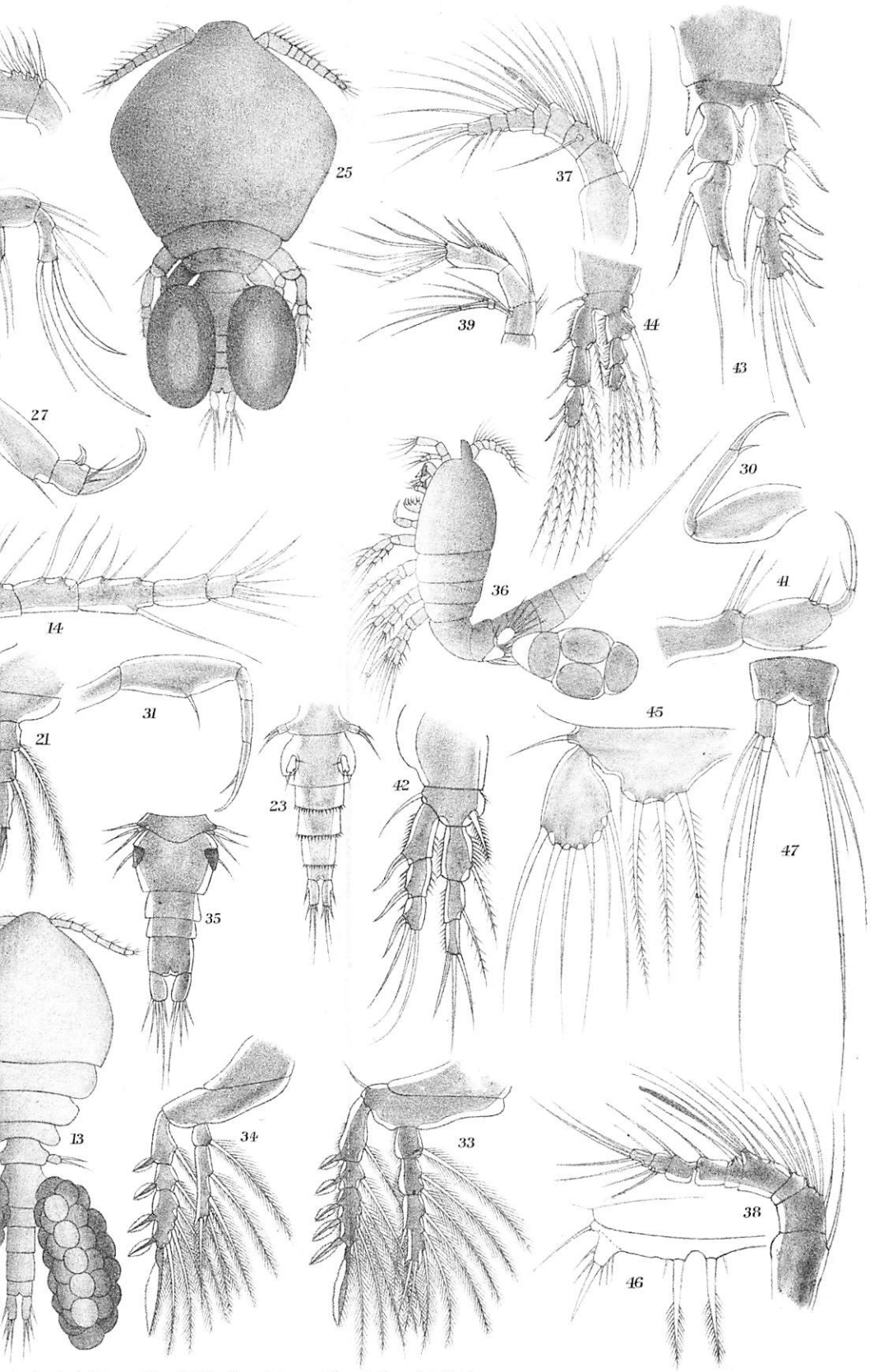
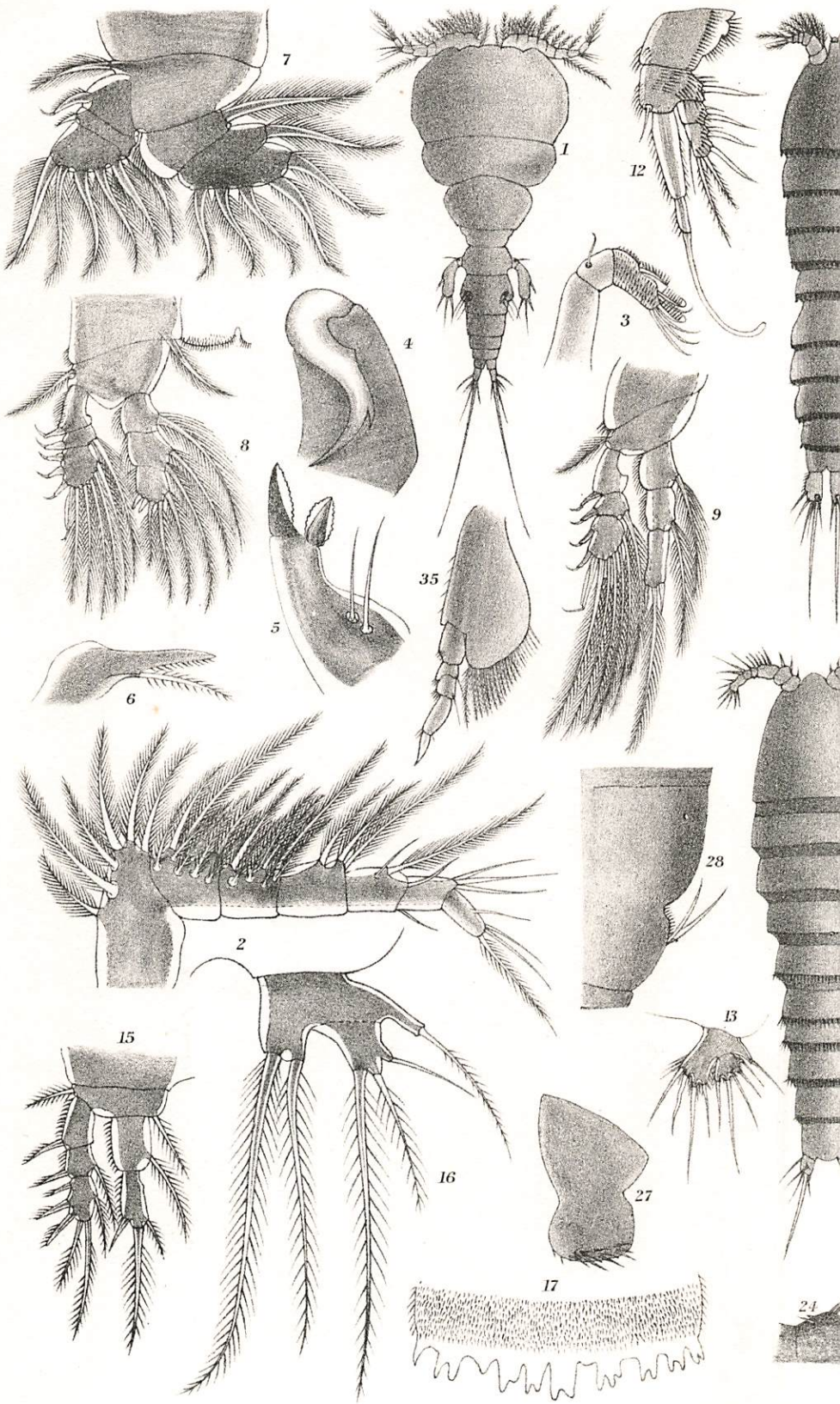


nsignis *Aurivillius*. Figs. 25–35.—Parartotrogus richardi *T. and A. Scott*.
lavalia æmula, *sp. n.*

Figs. 1 10.—Bomolchus soleæ *Claus*. Figs. 11 13.—Platychelipus litt

Fig. 22.—Bathyporeia norvegica *G. O. Sars*. Figs. 23 25.—Bathyporeia pelagica *S*

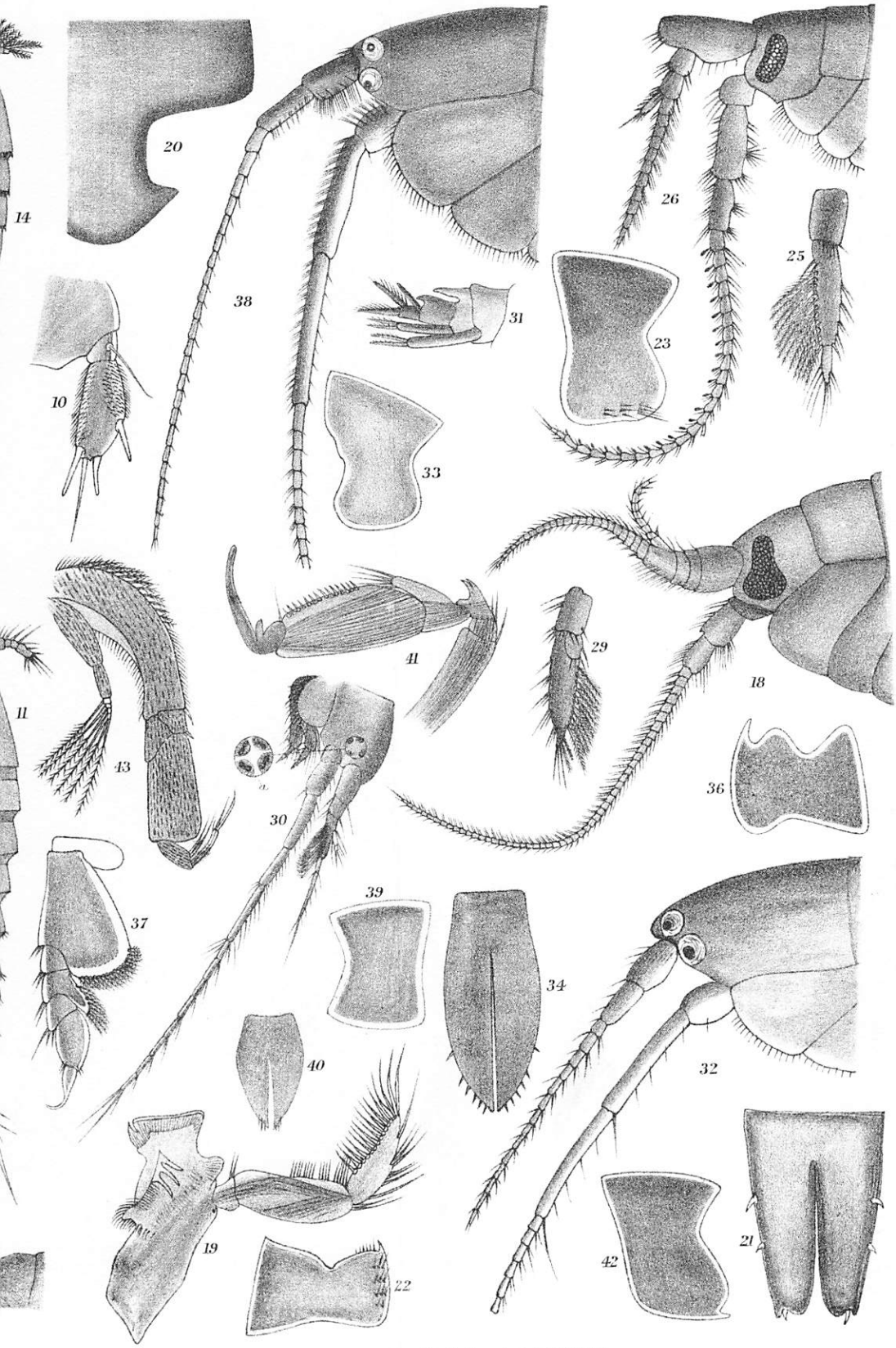


Figs. 32 35.—Ampelisca assimilis *Boeck*. Figs. 36 37.—Ampelisca lævigata *Lilljeborg*.

Fig. 43.—P

Andrew Scott, del. ad nat.

Brady. Figs. 14 17.—Zosime typica *Boeck*. Figs. 18 21.—Anonyx nugax *Phipps*.
te. Figs. 26 29.—Bathyporeia robertsoni *Sp. Bate*. Figs. 30 31.—Argissa hamatipes (*Norman*).



org. Figs. 38 40.—Ampelisca spinipes *Boeck*. Figs. 41 42.—Amphilochoides odontonyx (*Boeck*).
Halomera declivis *G. O. Sars*.