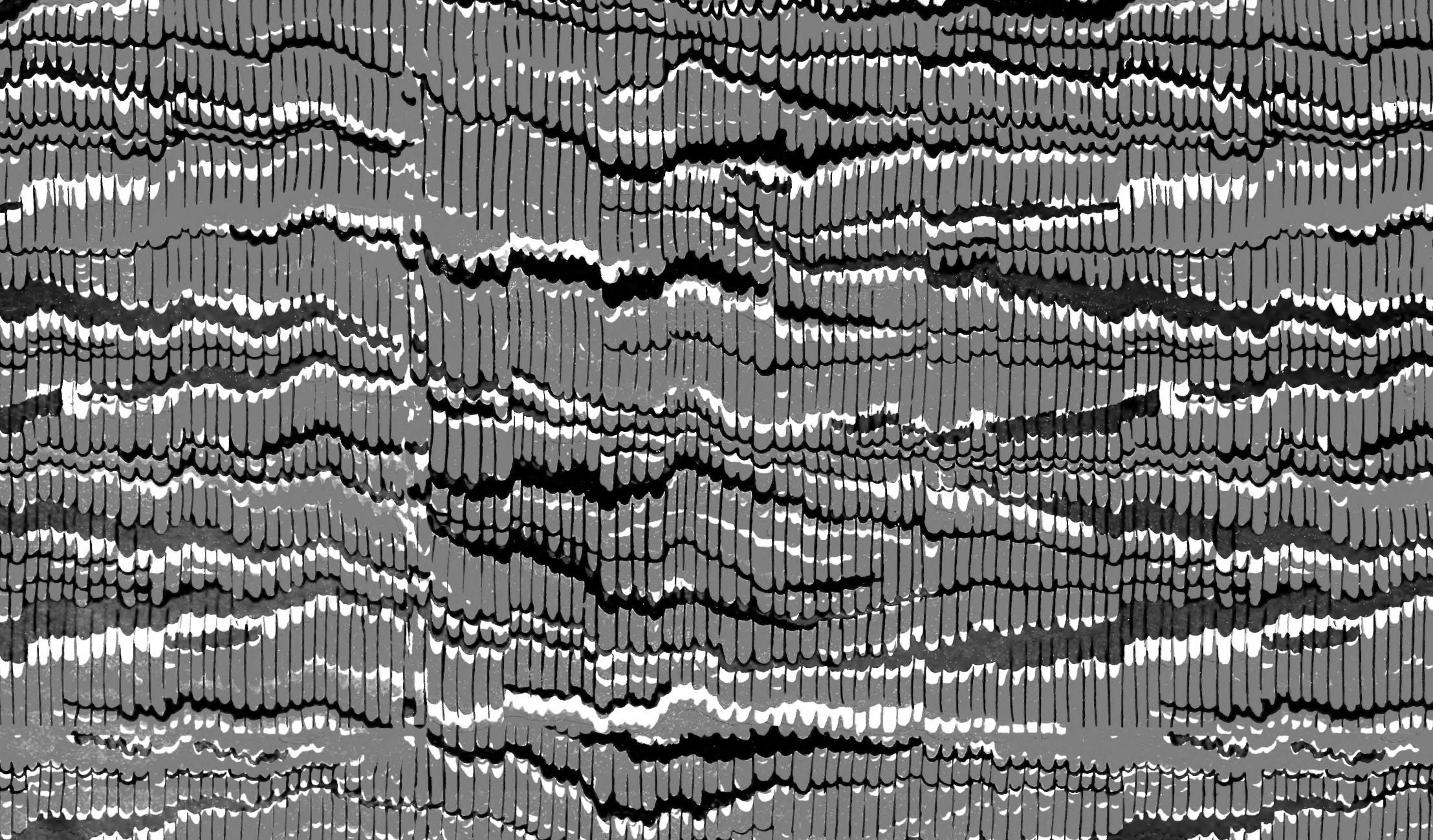

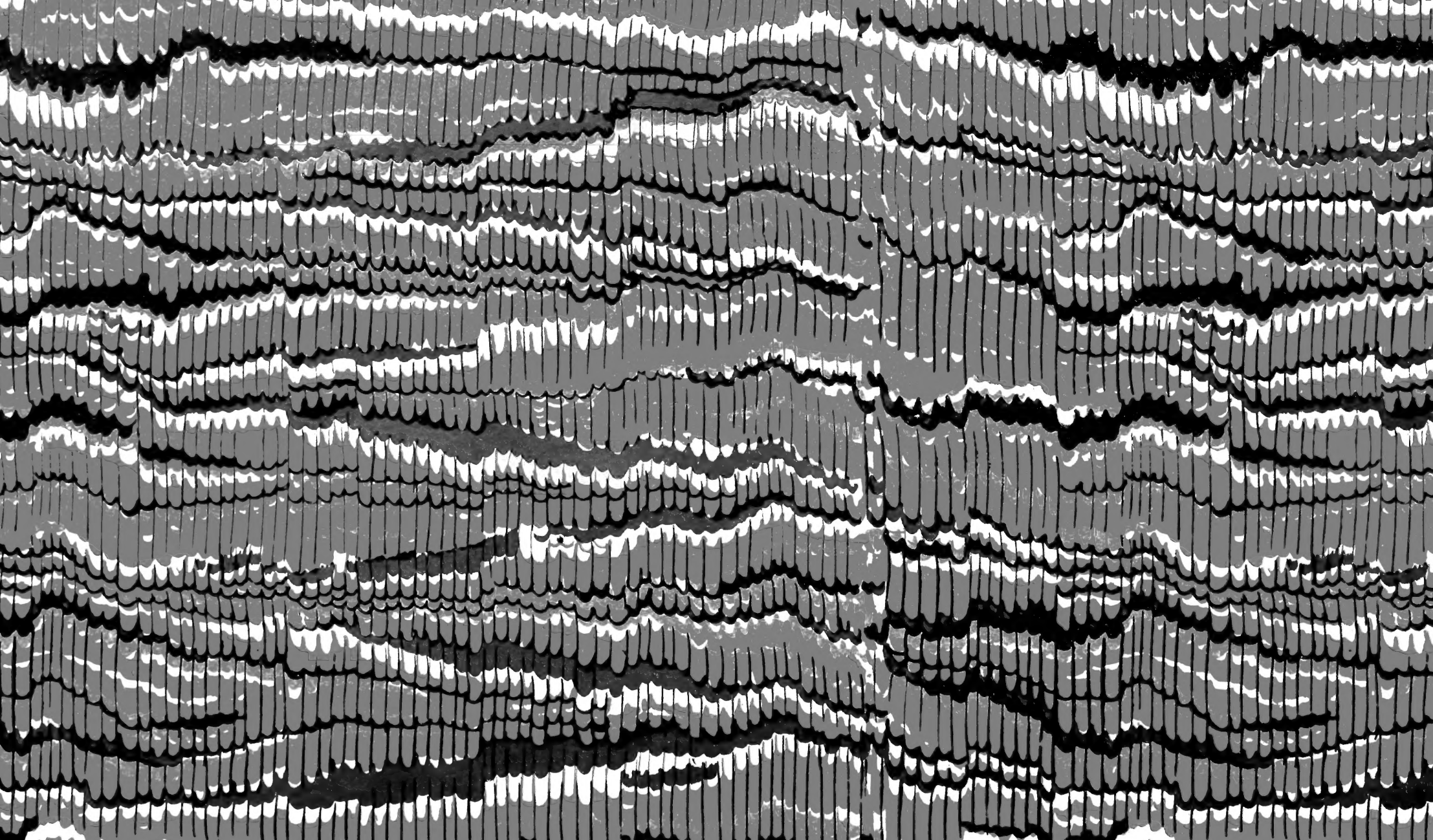

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FISHERIES BRANCH.

SCIENTIFIC INVESTIGATIONS, 1908.

No. I.

The Decapoda Natantia of the Coasts of Ireland,

BY

STANLEY KEMP, B.A.

This paper may be referred to as—
"*Fisheries, Ireland, Sci. Invest.*, 1908, *I.* [1910].

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Substance of Reports received from Clerks of Conservators relative to Salmon Fisheries, pp. 22, and

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THE DECAPODA NATANTIA OF THE COASTS OF IRELAND,

BY

STANLEY KEMP, B.A.

Plates I–XXIII.

INTRODUCTION.

The material which forms the basis of this paper was almost entirely accumulated during the course of the fishery research work carried out by the s.s. *Helga* since the year 1901. Owing to the limited opportunities for work of this nature, it has only been possible to investigate some of the more important areas with any degree of thoroughness; it thus happens that from the north coast of Ireland records are available from a single district only, Rathlin Deep, while several species have doubtless escaped detection on the rich southern grounds. The extensive and systematic trawling operations carried out off the east coast, more particularly on the grounds between Dublin and the Isle of Man, have probably yielded a fairly complete census of the forms occurring in the Irish Sea, and considerable attention has been paid to the deep-water districts to the south-west of Ireland off the coasts of Co. Kerry and Co. Cork. As might be expected, it is in this latter area, in soundings of from 200 to 1,000 fathoms, that the majority of the more interesting species have been obtained. These south-western investigations have been well supplemented by other deep-water work further north, both inside and outside the Porcupine Bank, and off the coasts of Co. Mayo, but the more inshore grounds inside the 100 fathom line still require further examination.

In addition to the material obtained by the *Helga*, a small collection made by the Danish fishery steamer *Thor* has been examined. These specimens, which were kindly communicated to us by Dr. J. Schmidt, were all taken in the Atlantic trough over an area ranging from the Färöe Is. to the Bay of Biscay.

Canon Norman, to whom I am indebted for the loan of numerous specimens and for the opportunity of consulting literature which was not available in Dublin, has very kindly allowed me to use several hitherto unpublished records, and I have also to thank Dr. Calman, who has spared neither time nor trouble in answering my numerous queries, for the readiness with which he has placed his extensive knowledge of this group at my disposal.

The researches carried out by the Marine Laboratory, which was stationed for some years in Bofin and Ballynakill Harbours, Co. Galway, have probably provided a fairly complete list of the fauna which exists in the shallow waters of the bays and creeks facing the Atlantic, while Kinahan's Dublin and Belfast lists give a good idea of the littoral east coast species.

Previous records of Natantia from Irish waters are not numerous, and it has been thought best to incorporate in the present paper all references to any of the scarcer forms.

On the *Helga* the beam trawl was responsible for the capture of the vast majority of the specimens; more especially bags of sprat and mosquito netting attached to the back of the trawl have proved invaluable for obtaining all except the very largest species. If placed in the proper position, in the path of the swirl caused by the passage of the footrope, these nets[1] invariably catch numbers of organisms which would otherwise escape. The nets fish, though very inefficiently, while being hauled to the surface, and it consequently happens that midwater species are occasionally caught. Errors arising from this source have been obviated by the frequent use of large midwater nets which secure only such forms as swim freely at intermediate depths. In the case of species occurring in both beam and midwater trawls, further evidence (such as their presence in the stomachs of fish frequenting the floor of the ocean) is necessary before they can rightly be considered to be members of the bottom fauna.

Pelagic species of Natantia seem to be active animals, and townets of large size are necessary to effect their capture. A net with a triangular frame, with sides 6 feet long, and a bag of mosquito netting, has yielded good results on the *Helga*, but in the last few years has been largely superseded by a midwater trawl designed by Dr. C. G. Johan Petersen. In this, the bag is made of very stout cheese-cloth, supported by bolt ropes down the seams; it is kept open by means of a pair of otter boards, which are attached by short bridles to the upper and lower extremities of two poles forming the vertical sides of the mouth. Two sizes of this net have been employed; the opening in one case is 8 ft. by 4 ft., in the other $10\frac{1}{2}$ ft. by 7 ft. Both triangle net and midwater trawl fish while being hauled to the surface, and consequently it is impossible to be certain of the depth at which the specimens were actually caught.

Dredges, although frequently employed, more especially on rough ground, do not seem to be very efficient instruments for the capture of the species here dealt with.

The material taken by the *Thor* was for the most part collected in a midwater trawl, but fine-meshed otter trawls working on the bottom were also fished.

Tables have been provided which will, it is hoped, furnish a ready means of determining the various families, genera, and

[1] In the lists of records these nets are all included under "trawl."

species found off our coasts; in order to give them a somewhat wider application, species found in British waters, but not up to the present known from Ireland, have been included with a brief note on their distribution.

All Irish species discovered since Bell's monograph of British Decapods was published (1853) have been described and figured[1]. The synonymy of many of the species has been fully treated by recent authors, and it has not been thought necessary to repeat it here; in the majority of cases references will be found only to the more important papers.

The descriptions of colour were drawn up from notes taken from living or freshly caught specimens on board the *Helga*. Among littoral and shallow-water forms great variation is often found, and in such cases notes based on the examination of at most a few specimens probably do not convey an adequate idea of the different phases of colouration to be met with; the case is different in deep-water species, which do not, as a rule, show any marked divergence from a standard type.

During the course of townetting observations a large collection of larvae has been acquired. The vast amount of time which would be required for a full treatment of this material prohibits its inclusion in the present paper, but it has been found possible to discuss a few deep-water larvae which could be definitely traced to adult forms.

In dealing with all except the commonest species the actual records are given. The temperature and salinity of the water are now regarded as having an important bearing on questions of distribution, and consequently such data, where available, have been appended to each station; it is hoped that this method, though rather cumbrous, will be found of greater service than mere reference to lists published separately. In treating of specimens caught in midwater, temperature and salinity are given for the surface as well as for the greatest depth fished, as it is impossible to be certain that the specimens were not caught during the ascent of the net.

The positions are to be regarded as the approximate central point of each haul. Soundings were, as a rule, taken at the beginning and end of each station; both are given, and it will be noticed that in a few cases, in deep water on the Atlantic slope, the two differ widely, owing to the comparatively rapid shelving of the sea bottom in those particular localities.

Unless otherwise stated, measurements of all specimens are given in mm. from the apex of the rostrum to the tip of the telson.

According to the views of the committee which sat in 1890 the western limit of the British area coincides with the 1,000-fathom line. All the species hereafter noticed have been found within this area. On a few occasions midwater nets were fished from the *Helga* outside this western limit; specimens caught at such localities do not seem to call for separation from the rest, for it is obvious that there is no natural faunistic

[1] With the exception of some Pandalidae, which have been very fully dealt with in recent years by Calman (1896).

division at or about this line. Although for museum purposes it certainly seems necessary to define some western limit to the British and Irish area, it is evident that its creation is of purely local interest and offers no assistance to the study of distributional problems.

Fifty-four species [1] of Decapoda Natantia are known from British and Irish waters, and forty-seven of these have been found off the Irish coasts.[2]

Ten species are practically restricted to the littoral and laminarian zones, which extend from high water mark to 15 or 20 fathoms. These are :—

Hippolyte varians.	*Leander adspersus.*
Hippolyte prideauxiana.	*Leander squilla.*
Spirontocaris Cranchi.	*Crangon vulgaris.*
Athanas nitescens.	*Philocheras trispinosus.*
Leander serratus.	*Philocheras fasciatus.*

Hippolyte varians, *Leander squilla*, and *Crangon vulgaris* are not infrequently found in brackish ditches where the water is of low salinity, while *Palaemonetes varians* occurs abundantly in water that is only slightly brackish.

Several species, such as *Pandalus Montagui* and *Pandalina brevirostris*, may be reckoned as visitors to the laminarian zone, recurring there regularly at definite seasonal periods.

Beyond the laminarian zone there is no distinct line of demarcation in the fauna, the species changing by almost imperceptible gradations until the greatest depths of the Atlantic are reached.

The large majority of the British Decapoda Natantia live on or very close to the bottom. The following species have, however, been taken under circumstances which afford the clearest proof that they are free-swimming[3] :—

Amalopenaeus elegans.	*Parapasiphaë sulcatifrons.*
Sergestes robustus.	*Acanthephyra purpurea.*
Sergestes arcticus.	*Acanthephyra debilis.*
Pasiphaë sivado.	*Hymenodora glacialis.*
Caridion Gordoni.	

P. sivado and *C. Gordoni* occur constantly on the bottom, but are nevertheless sometimes found in midwater, usually in soundings of no considerable magnitude. The seven remaining forms are, as a general rule, bathypelagic, but *S. robustus* and *A. purpurea*, having been found in the stomachs of fish

[1] Excluding the following three species, which have as yet only been taken near the Channel Islands :—

Lysmata seticaudata (Risso), Norman, 1907.
Hippolyte gracilis (Heller), Walker, 1899 (see p. 170).
Anchistia scripta (Risso), Norman, 1907.

[2] An Index to the genera and species mentioned in this paper will be found at p. 179.

[3] Three other species also probably occur in midwater—*Pasiphaë tarda* and the two species of *Ephyrina*, *E. Hoskyni* and *E. Benedicti*.

which are known to frequent the ocean floor, must be regarded as members of the benthos as well as of the nekton.

Only a very few species are definitely associated with other animals. *Typton spongicola* is found living within sponges of the order Monaxonida, while *Richardina spinicincta*, the only representative of the Stenopidea yet found in British waters, is probably restricted to the areas peopled by the Hexactinellid sponge, *Pheronema*, and often referred to as the "*Holtenia*" ground. *Leontocaris lar* has only been found on two occasions, and in each haul *Antipatharia* and branching corals of the genus *Lophohelia* occurred abundantly. This, coupled with the highly specialized structure of the species, suggests the possibility of an Alcyonarian association.

The following table indicates the months in which ovigerous females of the various species have been found off the Irish coasts. *Crangon vulgaris* (which is omitted in this table) is to be found bearing ova at almost any time of the year. It is probable that on the Irish coast—as was found to be the case in Lancashire (Herdman, 1893)—*C. vulgaris* has two principal breeding periods: in late autumn and early summer.

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Pasiphaë sivado	X	X	X	....	X*							
Acanthephyra purpurea	....	X										
Acanthephyra debilis	....	....	....	....	X							
Nematocarcinus ensifer, v. *exilis.*	....	X										
Pandalus Montagui	X	....	....	X	....	....	....	....	....	....	....	X
Pandalus propinquus	....	X	....	....	X							
Pandalus Bonnieri	X	X	X	....	....	....	....	....	....	....	....	X
Plesionika martia	....	....	....	....	X	....	....	X	X			
Pandalina brevirostris	X	X	X	X	X	X	....	X				
Hippolyte varians	....	X	X	X	X	X	X	X	X	X		
Spirontocaris Cranchi	....	....	X	X	X	X						
Spirontocaris pusiola	....	X	....	X	X							
Caridion Gordoni	....	....	....	....	....	X						
Processa canaliculata	X	....	X	....	X	....	....	X				
Leander serratus												
Leander adspersus	....	....	....	....	....	....	X					
Leander squilla	....	....	....	....	....	X	X					
Crangon Allmanni	X	X	X	X	X							
Philocheras echinulatus	X	X	X	X	X	....	X					
Philocheras trispinosus	X	....	X	....	X	....	X					
Philocheras sculptus	....	....	....	....	X	....	X	X				
Philocheras bispinosus	X	X	X	X	X	X	X	X	....	X		
Philocheras bispinosus, v. *neglectus*	....	....	....	....	X							
Pontophilus spinosus	X	X	X									
Pontophilus norvegicus	....	X										
Richardina spinicincta	....	....	....	....	X	....	....	....	X			

* Only in deep water off the West Coast.

ATLANTIC DISTRIBUTION OF BRITISH

–	——	British and Irish Area.							East Coast of North America.	W. Greenland.	Iceland.	Spitzbergen.
		West Coast of Ireland.	South Coast of Ireland.	Irish Sea.	South Coast of England.	East Coast of England.	East Coast of Scotland.	West Coast of Scotland and Shetlands.				
1	*Amalopenaeus elegans* ..	X	....	....	....	....	....	X	X	X	X	....
2	*Solenocera siphonocera* ..	X	....	....	....	....	....	....	....	....	....	....
3	*Sergestes robustus*	X	....	....	....	....	....	X	X	....	....	....
4	*Sergestes arcticus*	X	....	....	....	....	....	X	X	X	....	....
5	*Pasiphaë sivado*	X	....	X	....	....	X	X	....	....	....	....
6	*Pasiphaë tarda*	X	....	....	....	....	....	X	X	X	X	....
7	*Pasiphaë princeps*	X	....	....	....	....	....	X	X	....	....	....
8	*Parapasiphaë sulcatifrons*	X	....	....	....	....	....	....	X	....	X	
9	*Acanthephyra purpurea* ..	X	....	....	....	....	....	X	X	....	X	....
10	*Acanthephyra debilis*	X	....	....	....	....	....	....	X	....	X	....
11	*Ephyrina Hoskyni*	X	....	....	....	....	....	....	....	....	....	....
12	*Ephyrina Benedicti*	X	....	....	....	....	....	....	X			
13	*Hymenodora glacialis*	X	....	....	....	....	....	....	X	....	X	X
14	*Nematocarcinus ensifer*[1] ..	X	....	....	....	....	....	....	X	....	X	....
15	*Bresilia atlantica*	X										
16	*Pandalus borealis*	....	....	....	....	X	....	....	X	X	X	X
17	*Pandalus Montagui*	X	X	X	X	X	X	X	X	X	X	....
18	*Pandalus propinquus* ..	X	....	X	....	....	....	X	X	....	X	....
19	*Pandalus Bonnieri*	X	....	X	....	....	....	X	X	....	X	....
20	*Plesionika martia*	X	....	....	....	....	....	....	....	....	....	....
21	*Pandalina brevirostris* ..	X	X	X	X	X	X	X	....	....	....	....
22	*Hippolyte varians*	X	X	X	X	X	X	X	....	....	....	....
23	*Hippolyte prideauxiana* ..	X	....	....	X	....	....	X	....	....	....	....
24	*Spirontocaris spinus*[2]	....	X	X	X	X	X	X	X	X	X	X
25	*Spirontocaris Gaimardi* ..	....	....	....	–	....	X	X	X	X	X	X
26	*Spirontocaris polaris*	....	....	....	....	....	....	X	X	X	X	X
27	*Spirontocaris Cranchi* ..	X	X	X	X	X	X	X	....	....	....	....
28	*Spirontocaris pusiola*	....	....	X	X	X	X	X	X	....	X	X
29	*Caridion Gordoni*	X	X	X	....	....	X	X	X	....	X	....
30	*Leontocaris lar*	X										
31	*Bythocaris gracilis*	X	....	....	....	....	....	X	X	X	X	
32	*Alpheus ruber*	X	X	X	X	....	....	....	....	....	....	....
33	*Alpheus macrocheles*	....	....	....	X	....	....	....	....	....	....	....
34	*Athanas nitescens*	X	....	X	X	....	....	....	....	....	....	....
35	*Processa canaliculata*	X	X	X	X	X	X	X	....	....	....	....
36	*Typton sponqicola*	....	....	....	X	....	....	....	....	....	....	....
37	*Leander serratus*	X	X	X	X	X	....	?	....	....	....	....
38	*Leander adspersus*	X	....	....	X	X	....	....	....	....	....	....
39	*Leander squilla*	X	X	X	X	X	X	X	....	....	....	....
40	*Palaemonetes varians*	X	X	X	X	X	....	X	....	....	....	....
41	*Crangon vulgaris*	X	X	X	X	X	X	X	X	....	X	....
42	*Crangon Allmanni*	X	X	X	X	X	X	X	....	....	X	....
43	*Sclerocrangon Jacquoti* ..	X	....	....	....	....	....	X	X			
44	*Philocheras echinulatus* ..	X	....	X	....	....	....	X	....	....	....	....
45	*Philocheras trispinosus* ..	X	....	X	X	X	X	X	....	....	....	....
46	*Philocheras sculptus*	X	X	X	X	....	....	X	....	....	....	....
47	*Philocheras fasciatus*	X	....	X	X	X	X	X	....	....	....	....
48	*Philocheras bispinosus* ..	X	X	X	X	X	X	X	....	....	....	....
49	*Philocheras bispinosus*, v. *neglectus*	....	X	....	....	....	X	X	....	....	....	....
50	*Aegeon Lacazei*	X	....	....	....	....	....	....	....	....	....	....
51	*Pontophilus spinosus*	X	X	X	X	X	X	X	....	....	....	....
52	*Pontophilus norvegicus* ..	X	....	....	....	....	....	X	X	X	....	X
53	*Sabinea Sarsi*	....	....	....	....	....	....	X	X	X	X	....
54	*Richardina spinicincta* ..	X	....	....	....	....	....	....	....	....	....	....

[1] The species from the Irish coast and from near Iceland are referred to the var. *exilis*.
[2] The majority of the British and Irish records refer to tho var. *Lilljeborgi*.

AND IRISH DECAPODA NATANTIA.

	Kara Sea.	Coast of Norway N. of Arctic Circle.	Coast of Norway S. of Arctic Circle.	Sweden.	Denmark.	Bay of Biscay.	Mediterranean.	Black Sea.	Azores.	C. Verde Is. and Senegambia.	S. and S.W. Africa.	Falkland Is.	West Indian region.
1						X	X			X			
2						X	X						X
3						X	X						
4						X	X						
5			X			X	X						
6		X	X		X								
7			X			X							
8													
9						X	X		X	X	X	X	
10						X			X				
11						X							
12													
13		X	X			?							
14						X	X						
15													
16	X	X	X	X	X								
17		X	X	X	X								
18		X	X			X							
19			X			X							
20						X	X						
21		X	X	X	X	X	X						
22		X	X	X	X	X	X						
23						X	X	X					
24		X	X	X	X								
25	X	X	X	X	X								
26	X	X	X	X									
27			X	X	X	X	X						
28	X	X	X	X	X								
29		X	X	X	X	X							
30													
31													
32						X	X						
33							X			X			X
34			X	X	X	X	X		*	X			
35			X		X	X	X	X			X		X
36							X						
37					X	X	X						
38			X	X	X	X	X	X					
39			X	X	X	X	X	X	X	X			
40				X	X		X	X					
41		X	X	X	X	X	X						
42	X	X	X		X	X							
43													
44			X			X							
45						X	X		X				
46						X	X						
47						X	X		X				
48		X	X	X	X				X				
49													
			X			X							
50						X	X						
51			X	X	X	X	X						
52		X	X	X	X	X							
53		X	X	X									
54						X							

* Known from Madeira.

The tables on this and the preceding pages will give an idea of the Atlantic and extra-Atlantic distribution of the species known from British and Irish waters. From these it will be seen that of fifty-four species, nineteen have been found north of the Arctic Circle, while twenty-six occur in the Mediterranean.

Five species of British and Irish Natantia (four of which have not been found S. of Scotland) are known to live on the bottom in water below freezing point. These are

Pandalus borealis. *Spirontocaris spinus.*
Spirontocaris polaris. *Spirontocaris Gaimardi.*
Sabinea Sarsi.

Other species, now known to be bathypelagic, have been recorded from localities with temperatures below 0°C., but it is extremely likely that in all these cases (with the possible exception of *Hymenodora glacialis*) the specimens were swimming in much warmer layers well above the bottom and were caught during the ascent of the net.

EXTRA-ATLANTIC DISTRIBUTION OF BRITISH AND IRISH DECAPODA NATANTIA.

—	Arabian Sea.	Ceylon.	Bay of Bengal and Andaman Sea.	East Indies.	S. and E. Australia.	New Zealand.	Hawaiian Is.	S. of Japan.	Okhotsk Sea.	Behring Sea and Alaska.	British Columbia to San Diego.	San Diego to Ecuador.
Sergestes robustus							?					
Sergestes arcticus					X							
Pasiphaë sivado			X							X	X	X
Pasiphaë princeps												
Acanthephyra purpurea				X	X	X		X				X
Acanthephyra debilis							X					
Ephyrina Hoskyni	X	X	X									
Ephyrina Benedicti								X				
Hymenodora glacialis										X		X
Nematocarcinus ensifer	X		X				X	X				X
Pandalus borealis									X	X	X	
Pandalus Montagui, v. *tridens*										X	X	
Plesionika martia	X	X	X	X	X	X	X					
Spirontocaris spinus										X		
Spirontocaris Gaimardi										X		
Spirontocaris polaris										X		
Spirontocaris pusiola										X		
Alpheus ruber						?						
Alpheus macrocheles											?	
Athanas nitescens		X										
Processa canaliculata		X						X				X

Shrimp[1] fisheries are practically non-existent in Ireland; nowhere have they anything like the importance of similar industries in England. During the last eight years the average value of the catch landed on the Irish coast is much below £350 per annum, and the figures show no indication of rising.

It is evident that the want of enterprise in this respect is not due to any natural lack of shrimping grounds or to a scarcity of supply, the reason is rather to be sought in the fact that this particular form of food is nowhere in Ireland held in any great estimation. This, naturally enough, has prevented the foundation of any extensive fisheries for the supply of fresh shrimps and also appears to have seriously hindered any attempt to start an export trade of preserved material. At the present moment potted or preserved shrimps are only prepared by a single Irish firm.

Crangon vulgaris, the common shrimp *par excellence*, is in Ireland almost wholly neglected as a source of food. Samples of fresh shrimps from the Dublin market were found to consist entirely of *Leander serratus*, and it is this species, in company with its congener, *L. squilla*, which forms the basis of such fisheries as exist. At present the principal centre of *Leander* fisheries is Queenstown, Co. Cork, but even there the industry assumes only very slight importance.

Leander is frequently employed as a bait in salmon fishing, and small quantities, destined for this purpose, may usually be found on sale at the more important angling centres.

Off the south coast of England the largest specimens of *L. serratus* are worth as much as 1*d*. apiece to the fisherman who catches them; as might be expected, such high prices do not prevail in Ireland.

In certain Norwegian fjords a valuable fishery of *Pandalus borealis* has been started during recent years. *P. borealis* is a large species of fine red colouring and is chiefly found in deep water at the head of those fjords which are not obstructed by a bar at the entrance. This industry, which owes its origin to the Norwegian Fishery Investigations, is now in a very flourishing condition.

Pandalus borealis has not as yet been found in Irish waters, although it is not impossible that it exists in small numbers off the north coast. Two closely allied species, *Pandalus Montagui* and *P. Bonnieri*, do however occur in large quantities, but it may be doubted whether any profitable fishery is possible. Investigations, made with this object in view, give no indications of a promising nature. The grounds which these species frequent lie for the most part at a considerable distance from the land and the supply is spread over a large area. Nowhere are they found in the concentrated form and

1 The species with which the present paper is concerned are in Ireland known almost exclusively by the term "shrimp," "prawn" is employed only for *Nephrops norvegicus*.

2 *Pandalus Montagui* migrates shorewards periodically.

convenient situation which have proved such important factors in the success of the Norwegian fishery.

Natantia form a valuable source of food supply to many marketable fish. In their early free-swimming stages they are consumed by Herring and Spring Mackerel, but do not, of course, constitute such an important item in their dietary as the ubiquitous Copepod. Certain forms, principally the more abundant species of *Crangon* and *Pandalus* seem to be esteemed above all other food by such fish as the grey gurnard, while, along with other Crustacea, they are freely eaten by many valuable species of Gadoids (more especially by the Haddock) and by Rays and Skate.

Adult flat fish do not seem to partake of Natantia to any great extent, they are none the less of some importance to certain species, notably the Long Rough Dab.

Leander is a favourite food of the Bass, and is doubtless eaten largely by other fish frequenting rocky localities near the shore.

DECAPODA NATANTIA.

Tribe PENAEIDEA.

The two families may be separated thus :—

I. Last two pairs of pereiopods well developed; branchiae numerous, Penaeidae.

II. Last two pairs of pereiopods reduced in size; branchiae not more than eight on either side, sometimes absent, ... Sergestidae (p. 24).

Family *PENAEIDAE*.

Of this family three genera have been recorded from British and Irish waters, but the presence of one of them requires confirmation.

I. Inner border of first segment of antennular peduncle bearing a twisted setose scale, forming an incomplete inner wall to the orbit; second joint of mandibular palp longer than first; second maxillipedes not foliaceous; rostrum well developed, with numerous dorsal teeth.

A. Antennular flagella cylindrical; one arthrobranch but no epipod on fourth pair of pereiopods, ... *Penaeus* (p. 13).

B. Antennular flagella thin, compressed and internally channelled throughout their length, thus forming a tube when closely approximated; two arthrobranchs and an epipod on fourth pair of pereiopods, *Solenocera* (p. 20).

II. No scale on inner border of first segment of antennular peduncle; first joint of mandibular palp much longer than second; second maxillipede with the merus very broad and foliaceous; rostrum very short, with only one dorsal tooth, ... *Amalopenaeus*.

One species of *Penaeus*, *P. caramote* (Risso),[1] has been recorded from British waters. Leach reported two specimens from the Welsh coast, and Cocks stated that it was found at Falmouth in the stomachs of cod and haddock. These records are more than fifty years old, and, in the absence of any recent information, it is doubtful if the species should be retained in the British list. *P. caramote* is a common Mediterranean species.

Genus **Amalopenaeus**, Smith.

Amalopenaeus, Smith, 1882.

This genus bears the closest possible resemblance to *Gennadas*, Spence Bate (1881 and 1888), but is distinguished from it by the total absence of podobranchs on the pereiopods. The gill formula is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	1	2	2	2	2	2	2	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

In *Gennadas* the formula, as determined from an examination of the type specimen of *G. parvus*, is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	1+ep.	1+ep.	1+ep.	1+ep.	ep	...
Arthrobranchiae, ...	1	2	2	2	2	2	2	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

[1] For synonymy see Senna, 1903.

The absence of podobranchs in *Amalopenaeus* is not merely a feature of immaturity, for specimens of 40 mm. in length show no trace of them, while the petasma and thelycum are well developed in examples little more than half this length.

Several recent authors regard *Amalopenaeus* as a synonym of *Gennadas* and, even when describing new species, omit all reference to this question of the podobranchs. The presence or absence of these gills is, however, acknowledged to be of great importance in separating the genera of Penaeidae (see Alcock, 1901, p. 12), so that although no other valid distinctions can be given it seems best to retain the two genera as distinct. The absence of podobranchs in *Amalopenaeus* is a factor of considerable importance in the study of the evolution of this and of the allied genera, for in this respect *Amalopenaeus* is more highly specialized than *Gennadas*, which forms an intermediate link between it and the still more primitive *Benthesicymus* (see Bouvier, 1906, pp. 9–13).

Amalopenaeus elegans,[1] Smith.

Pl. I, Figs. 1–16.

Amalopenaeus elegans, Smith, 1882, Pl. xiv, figs. 8–14; Pl. xv, figs. 1–5.
Gennadas elegans, Bouvier, 1908, Pl. vii (*ubi syn.*).

Bouvier (1908) has already given a long and complete description of this species; it will suffice here to mention the characters which separate it from allied forms.

The distance between the cervical and post-cervical grooves, measured dorsally, is not more than one-sixth of the distance from the latter groove to the hinder margin of the carapace. The antennary angle is acute and prominent; the infra-antennary angle is also acute, but is bluntly rounded at its apex. A small branchiostegal spine is present. The second joint of the antennular peduncle, measured dorsally, is only half the length of the ultimate joint. The antennal scale is three times as long as wide and the convex outer margin terminates in a very small spine, which does not extend as far forwards as the lamella.

The second joint of the mandibular palp (fig. 7) is about as long as the width of the basal joint. In the second maxilla (fig. 5) the anterior lobe of the internal lacinia is strongly contracted behind its apex. The chelae of the second pair of pereiopods are shorter than the carpus, while in the third pair the merus is distinctly longer than the carpus.

[1] My statement (1906, 2) that *A. elegans* is a synonym of *Gennadas parvus*, Sp. Bate, I now regard as erroneous. In a paper on the *Challenger* species of *Gennadas*, published recently (1909) I have given fresh descriptions and figures of Spence Bate's types.

The abdominal somites are smoothly rounded above, with the exception of the sixth, which is dorsally carinate. The forms assumed by the sternal plates of the cephalothorax (the thelycum) in the female and by the membranous expansion of the endopod of the first pair of pleopods (the petasma) in the male are shown in figs. 15 and 16.

Size.—The largest Irish specimen examined is a female measuring 38 mm.; Smith has recorded an example 43 mm. in length.

Colour in life.—The carapace is red, anteriorly of a dark brownish tint. The abdomen is also red, but considerably paler than the carapace. The eyes are brown, with a golden reflection; their stalks are red, with a jet-black spot on their superior and external aspect, near which is a patch of very deep red pigment. Both these patches are of variable size and shape. The antennal scale and all three pairs of flagella are practically colourless. All the pereiopods are very dark brownish red.

There are also found, in addition to the prevailing red pigmentation, patches and suffusions of a deep blue colour. This is one of the most interesting features of the species, and hitherto has only been noticed very briefly. The better defined patches of this pigment occupy positions much the same as certain of the photophores which are known in *Acanthephyra debilis*, A. Milne-Edwards.[1] Now in that species a deep blue pigment is invariably associated with the luminous organs, in only one series of which (i.e., those at the base of the pleopods) has a lens-like structure been demonstrated. The question, therefore, arises whether this pigment in *A. elegans*, although it is rather lighter in colour and much more diffuse, may not nevertheless prove in some way connected with a luminous function.

In small specimens of about 18 mm. large portions of the oral appendages and the basal joints of all the pereiopods are suffused with blue pigment. In this case the pigment is in solution, for it is sometimes observed flowing out from the cut edge of a dissected portion. The first five abdominal somites each possess inferiorly a pair of large ill-defined patches of this blue pigment of a streaky character (fig. 8) and the interior margins of the first and second sternal plates are also edged with the same colour.

In large specimens only slight traces remain of these abdominal patches and the suffusions on the oral appendages and bases of the pereiopods are also much fainter; but the following, which also occur in young specimens, are found to persist in the majority of the older examples:—

On the antennular peduncle (fig. 13): a streak on the inner face of the penultimate joint and another, sometimes merely a faint suffusion, in the middle of the basal segment

[1] Compare Bouvier's coloured figure of *A. valens* (1908, pl. I, fig 3) with pl. VI, fig. 1 of this paper.

on its upper face near the distal end, situated in a sort of recess overhung by the thickened inner anterior portion.

On the first maxillipede (fig. 4) : a bright blue patch at the inner side of the apex of the exopod.

On the third maxillipede (fig. 12) : a granulated suffusion on the upper half of the ischium and on the basus, a denser granular patch at the distal end of the merus and propodus, a similar but very dense patch at the apex of the carpus and a rather obscure spot near the base of the dactylus.

On the first three pereiopods (figs. 9-11) : a dense granular patch on the propodus just behind the insertion of the dactylus, a similar patch (very strongly marked on the first pereiopod) at the distal end of the carpus and another of a less defined character at the distal end of the merus, the latter having in addition another small patch or streak at the proximal end of the same segment.

On the fifth pereiopods : a single spot behind the coxal articulation.

Blue pigmentation is of great rarity in deep-sea shrimps, although not a very uncommon feature of the ova of certain Caridea (chiefly Pandalidae). The only instance that I am aware of, apart from cases in which it is associated with luminous organs, is *Benthesicymus Tanneri*, Faxon (1895, Pl. II.). This species, which is very closely allied to *A. elegans*, has peculiar patches of deep blue pigment on the dorsal surface of the abdomen. In the present state of our knowledge it does not seem at all probable that these are luminous.

The fact that small specimens of *A. elegans* possess relatively more of the blue pigment than older examples is rather antagonistic to any theory of its being directly involved in a luminous function, for the photophores of *A. debilis* increase in number with age. Unfortunately the specimens found off the Irish coast are invariably dead when caught, so that no direct observation is possible. For the present the question must remain undecided, until more is known of the association, which apparently exists, between blue pigment and a luminous function.

General distribution.—Amalopenaeus elegans seems to be very widely distributed in the N. Atlantic. It has been recorded from the east coast of N. America from between lat. 31° 41′ and 41° 13′ N., long. 66° 0′ and 76° 12′ W. (Smith); from West Greenland (lat. 65° 25′ N., Hansen); from Davis Straits and the neighbourhood of Iceland (Hansen); from the Sargasso Sea and near the Cape Verde Is. (Ortmann and Bouvier); from the Bay of Biscay (Kemp) and N.E. Atlantic (lat. 52° 18′ N., long. 15° 53′ W., Calman). In the Mediterranean it has been found in the Straits of Messina and near Naples (Lo Bianco), and in other localities (Bouvier).

As suggested by Hansen (1908), it is probable that this species never occurs in temperatures below 0°C., although it doubtless exists in warm layers overlying water below freezing point.

Irish distribution.—This species has been repeatedly found off the west coast of Ireland. The small size of the majority of the specimens is perhaps due to the fact that the older individuals descend to water of a greater depth than that in which the investigations were conducted. The records are :—

Helga.—

CXX.—24/8/'01.—53° 58′ N., 12° 22′ W., 382 fathoms. Trawl—Two, 10·5 and 14 mm.

S.R. 139.—11/8/'04.—55° 0′ N., 10° 48′ W., soundings $\dot{1},\overline{000}$ fathoms. Triangle net, 0–1,000 fathoms. Surface temperature 14·6° C., temperature at 800 fathoms 7·0° C.—Four, 11–12 mm.

S.R. 140.—11/8/'04.—54° 50′ N., 10° 45′ W., soundings $\dot{1},\overline{000}$ fathoms. Surface temperature 14·5° C., temperature at 480 fathoms 8·7° C. Townet, 0–530 fathoms.—One, 12 mm. Triangle net, 0–730 fathoms.—Fourteen, 11–26 mm.

S.R. 175.—14/9/'04.—54° 53′ N., 10° 42′ W., soundings 670 fathoms. Triangle net, 0–600 fathoms. Surface temperature 10·9° C., salinity 35·44°/$_{oo}$; temperature at 670 fathoms 4·5° C., salinity 35·46°/$_{oo}$—Twelve, 14–23 mm.

S.R. 193.—10/2/'05.—54° 50′ N., 10° 30′ W., soundings $\dot{6}\overline{50}$ fathoms. Triangle net, 0–630 fathoms. Surface temperature 9·6° C., salinity 35·41°/$_{oo}$; temperature at 480 fathoms 9·2° C.—Five, 19–29 mm.

S.R 197.—11/2/'05.—54° 57′ N., 10° 51′ W., soundings $\dot{1},\overline{000}$ fathoms. Triangle net, 0–680 fathoms—Three, 21–26 mm.

S.R. 224.—12/5/'05.—53° 7′ N., 15° 6′ W., soundings 860 fathoms. Midwater trawl, 0–750 fathoms—Four, 22–28 mm.

S.R. 231.—20/5/'05.—55° 1′ N., 10° 45′ W., soundings 1,200 fathoms. Midwater trawl, 0–1,150 fathoms—Twelve, 20–26 mm.

S.R. 282.—18/11/'05.—54° 59′ N., 10° 53′ W., soundings $\dot{1},\overline{000}$ fathoms. Triangle net, 0–700 fathoms. Surface temperature 10·6° C., salinity 35·30°/$_{oo}$; temperature at 700 fathoms 9·0° C.—Five, 17–18 mm.

S.R. 299.—5/2/'06.—50° 13′ 30″ N., 11° 16′ W., soundings 500 fathoms. Triangle net, 0–400 fathoms. Surface temperature 10·8° C., salinity 35·30°/$_{oo}$; temperature at 500 fathoms 9·7° C.—One, 19 mm.

S.R. 331.—9/5/'06.—51° 12′ N., 11° 55′ W., 610–680 fathoms. Trawl—One, 26 mm.

S.R. 364.—10/8/'06.—51° 23′ 30″ N., 11° 47′ W., 620–695 fathoms. Trawl. Temperature at 600 fathoms 7·92° C.—Few.

S.R. 470.—24/8/'07.—50° 16′ N., 11° 27′ W., soundings 770 fathoms. Midwater trawl, 0–500 fathoms. Surface temperature 15·8° C., salinity 35·30°/$_{oo}$; at 500 fathoms 9·03° C., salinity 35·35°/$_{oo}$—Fifteen, 13·5–19 mm.

S.R. 477.—28/8/'07.—51° 15′ N., 11° 47′ W., 707–710 fathoms. Trawl. Temperature at 700 fathoms 7·19° C.—Three, 17–38 mm.

S.R. 478.—28/8/'07.—51° 17′ N., 11° 44′ W., 560–707 fathoms. Trawl—Two, 15 and 16 mm.

S.R. 481.—29/8/'07.—50° 59′ N., 11° 52′ W., soundings 920-1,064 fathoms. Midwater trawl, 0–900 fathoms—Eleven, 16–20 mm.

S.R. 484.—30/8/'07.—51° 35′ N., 11° 57′ W., 602–610 fathoms. Trawl. Temperature at 550 fathoms 8·34° C., salinity 35·32°/$_{oo}$—Four, 16–27 mm.

S.R. 485.—30/8/'07.—51° 33′ N., 12° 1′ W., 602–630 fathoms. Trawl—Five, 15–21 mm.

S.R. 487.—3/9/'07.—51° 36′ N., 11° 57′ W., 540–660 fathoms, Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—Two, 17 and 29 mm.

S.R. 488.—4/9/'07.—51° 35′ N., 11° 57′ W., soundings 540–720 fathoms Triangle net, 0–400 fathoms—Five, 14–21 mm.

S.R. 489.—4/9/'07.—51° 35′ N., 11° 55′ W., 720 fathoms. Trawl —Three, 16–19 mm.

S.R. 493.—8/9/'07.—51° 58′ N., 12° 25′ W., 533–570 fathoms. Trawl. Temperature at 500 fathoms 8·53° C., salinity 35·44°/$_{oo}$—Four, 17–19 mm.

S.R. 494.—8/9/'07.—51° 59′ N., 12° 32′ W., 550–570 fathoms. Trawl—One, 18 mm.

S.R. 496.—8/9/'07.—51° 54′ N., 12° 54′ W., 473–500 fathoms. Trawl —Five, 14–18 mm.

S.R. 497.—10/9/'07.—51° 2′ N., 11° 36′ W., 775–795 fathoms. Trawl—One, 19 mm.

S.R. 498—11/9/'07.—50° 58′ N., 11° 33′ W., soundings 775–778 fathoms. Triangle net, 0–600 fathoms—Ten, 17–20 mm.

S.R. 499—11/9/'07.—50° 55′ N., 11° 29′ W., 666–778 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·41°/$_{oo}$—Two, 21 mm.

S.R. 500.—11/9/'07.—50° 52′ N., 11° 26′ W., 625–666 fathoms. Trawl—Three, 18–20 mm.

S.R. 506.—12/9/'07.—50° 34′ N., 11 19′ W., 661–672 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·53°/$_{oo}$—One, 16 mm.

Thor.

59° 49′ N., 8° 58′ W. Midwater trawl, 0–600 fathoms—Three, 22–23 mm.

Vertical range.—Bouvier (1906) has recently investigated the bathymetric range of this species, and has established the fact that it is an abyssal free-swimming form. It does not appear to occur normally on the bottom, and the specimens which were found in the fine-meshed nets attached to the trawl (recorded above) were most likely caught during the ascent of the net. It is difficult to say what is the maximum depth to which the species penetrates, but according to Bouvier's account adults seem to be more frequently taken below than above 1,000 metres (about 550 fathoms).

Larval and immature forms occur at less considerable depths, sometimes not far from the surface; it appears that

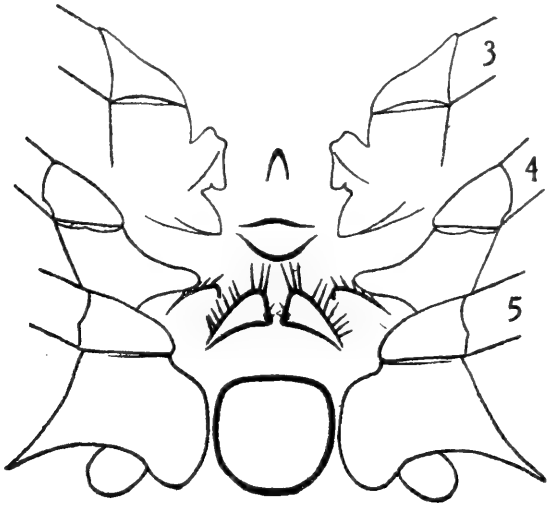
these on the completion of their metamorphosis descend to deeper water. Lo Bianco kept some young specimens alive in an aquarium, and found that they always swam head downwards, as though endeavouring to reach greater depths.

? **Amalopenaeus valens,** Smith.

? *Amalopenaeus valens*, Smith, 1884, Pl. x, fig. 2.
? *Gennadas valens*, Bouvier, 1908, Pl. i, fig. 3, Pl. ix, figs. 1–20.

The principal characters of the solitary Irish specimen (a female, 48 mm. in length) are as follows :—

1. Eyes proportionally slightly larger than in *A. elegans*.
2. Second joint of antennular peduncle, measured dorsally, fully three-quarters the length of the ultimate joint.
3. Apical spine of antennal scale extending beyond the lamellar portion.
4. Ultimate joint of mandibular palp four-fifths as long as the width of the first joint.
5. Anterior prominence of merus of second maxillipede slightly less than one-third the total length of the joint.
6. Chela of second pereiopod slightly shorter than carpus.
7. Merus of third pereiopod very evidently shorter than carpus.
8. Thelycum as in text figure; its principal features being a single large plate, almost round, between the fifth pair of pereiopods, and a pair of triangular plates furnished with a few stiff setae at the base of the fourth pair.



Amalopenaeus valens *(?)*, Thelycum.

The branchial formula is the same as in *A. elegans*. The colouring is also much the same as in that species; the deep blue pigment has almost exactly the same distribution,[1] but the black spot on the dorsal aspect of the eyestalk behind the cornea is almost obsolete.

[1] Neither this specimen nor numerous examples of *A. elegans* (examined when freshly caught) showed such large areas of dark blue pigment on the abdomen as are depicted by Bouvier for *valens* (1908, Pl. i, fig. 3); otherwise this coloured illustration gives an excellent idea of the appearance of Irish specimens of this genus.

Of the six species of *Amalopenaeus* and *Gennadas* known from Atlantic waters, this specimen undoubtedly stands nearest to *valens*. It differs, however, from Bouvier's account and figures of that species (1908) in respect of numbers 5 and 8 of the characters mentioned above. The second maxilla is also different, and appears to resemble that of *A. elegans* far more closely than Bouvier found to be the case in *valens*. In this appendage the narrow terminal prolongation of the endopod is provided with a tuft of setae, and bears two pairs of curved dorsal spines. The anterior lobe of the internal lacinia is slightly constricted behind its apex, and is distinctly narrower than the adjacent lobe of the external lacinia. The thelycum is certainly widely different from the typical form known in *valens*, but Bouvier states that considerable variation exists and has figured (1908, Pl. IX, fig. 20) an example which in this respect shows a good deal of resemblance to that figured above; the female of a very closely allied species, described as *Gennadas Talismani* (Bouvier, 1906), is, however, unknown, and it is consequently impossible to determine this specimen with any degree of confidence.

The specimen was found under the following circumstances:—

Helga.

S.R.590.—3/8/'08. 51° 51′ 30″ N., 12° 8′ W. Soundings 480 fathoms. Midwater trawl, 0–480 fathoms. Temperature at 450 fathoms, 9·28° C., salinity 35·46°/$_{00}$.—One, 48 mm.

Amalopenaeus valens has been recorded from the east coast of the United States, lat., 37° 16′ N., long., 74° 20′ W. (Smith), and from the W. coast of Portugal, W. coast of Morocco, the Azores, the Canary Is., and the Sargasso Sea (Bouvier).

Genus **Solenocera**, Lucas.

Pl. II, Figs. 1–8.

Solenocera siphonocera (Philippi).

Penaeus membranaceus, H. Milne Edwards, 1837 (nec Risso).
Penaeus siphonocerus, Philippi, 1840, Pl. IV, fig. 3.
Solenocera Philippi, Lucas, 1850, Pl. VII, fig. 2.
Penaeus siphonocerus, Heller, 1863, Pl. X, fig. 12.
Solenocera siphonocera, Calman, 1896.
Solenocera membranacea, Bouvier, 1908.

The *rostrum* is very slightly upturned at the apex and reaches almost to the tips of the eyes; it is armed on its superior margin with five to seven forwardly directed teeth, three or four of which are situated on the carapace behind the posterior edge of the orbit. On its inferior margin the

rostrum is unarmed except for a fringe of long plumose setae, shorter setae of a similar character occurring in the spaces between the dorsal teeth. On the *carapace* a pronounced mid-dorsal carina runs backwards from the rostrum, disappearing in its posterior third. The cervical groove is deeply cut on each side and extends up to, but not across, the dorsal carina; from its lower extremity a short carina runs downwards and forwards ending in a prominent hepatic spine. There is a strong post-orbital spine, and small but acute spines also mark the orbital and antennal angles; an obtuse prominence represents the branchiostegal spine.

The *abdomen*, when straightened, is about twice the length of the carapace (excluding rostrum), but in one very large female it is considerably shorter than this. The last four somites are dorsally carinate; on the third the carina is rather faint and obsolete anteriorly, while on the sixth it is very sharply defined and is produced posteriorly to a short spine. The sixth somite is about as long as the fifth, and its pleura are provided with a short spine in front of the rounded postero-basal angle.

The *telson* is about equal in length to the outer uropod; it is deeply channelled dorsally, and its margin is finely setose and armed with a single pair of stout lateral spines at about one quarter of its length from the pointed apex.

The *antennules* exceed the combined length of the carapace and rostrum by about two-thirds the length of the latter; the peduncle reaches almost to the apex of the antennal scale. The basal pedunclar point, which is about the same length as that succeeding it, is deeply hollowed for the reception of the eye, the bottom of the joint being in fact quite membranous. The internal and external margins are thickened; the former bears a twisted setose scale reaching beyond the tip of the rostrum, while the latter is provided distally with a sharp spine-like lateral process. The antennular flagella are internally channelled throughout their length, and by the apposition and overlapping of their edges form a complete tube which is specially characteristic of the genus *Solenocera*. The upper part of the tube is formed by the two upper (and outer) rami which are twisted inwards and are partially overlapped by the much broader lower (and inner) flagella.[1] These upper flagella are somewhat crescentic in transverse section with an obscure midrib, and their dorsal edges are maintained in close conjunction by the interlocking of short stiff setae. The inferior and broader rami are strongly crescentic in transverse section with a pronounced midrib on which the lower edges of the upper pair rest; they interlock basally by means of numerous long curved setae set on the outer aspect of their inferior edge, while other long setae from the middle point of their upper edge lap over on the superior pair. Pl. II, fig. 3, shows the appearance of the flagella in transverse section.

[1] Various authors have stated that the upper and outer flagella are entirely ensheathed by the lower and inner, but this was not found to be so in any of the specimens examined.

The *antennal scale* is widest basally and about three times as long as broad. The outer margin is straight or very slightly concave, and terminates distally in a strong spine which reaches as far as, or slightly beyond, the narrow apex of the lamellar portion.

The *mandible* (fig. 4) is provided with a large two-jointed palp; both joints are approximately triangular in shape, the ultimate being considerably longer than the penultimate. The endopod of the *first maxillae* (fig. 5) is hooked at its apex and bears a small round setiferous lobe at its base. In the *second maxillae* (fig. 6) the broad endopod is apically emarginate and is provided with numerous short stout spinules on its inner distal aspect; the basal lobe of the exopod is broadly rounded. The endopod of the *first maxillipedes* (fig. 7) is long and filamentous, but its inner margin is much widened near the base; the exopod is narrow and lanceolate. The *second maxillipede* (fig. 8), which, like the first, bears a large epipod, is provided with a podobranch and two arthrobranchs. The exopod is short, reaching to about half the length of the merus. The *outer maxillipedes* are very long, reaching beyond the antennal scale; their exopods are very short.

The *first pair of pereiopods* is short and rather stout, reaching almost to the tips of the eyes; the *third pair* is much longer, with a long and slender carpus, and reaches to the apex of the antennal scale. The *second pair* is intermediate, as regards length, between the first and third. A stout spine is present on the inferior aspect of the basus of the first two pairs, and a similar spine is also present on the lower margin of the ischium of the first pair. The *fourth pair* of pereiopods is stouter and rather shorter that the *fifth*, the latter, when stretched forwards, reaching to the tips of the eyes.

All the pereiopods bear long exopods and large foliaceous epipods are present on the first four pairs. The branchial formula is—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	2	2	2	2	2	2	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

The *petasma* attached to the first pair of pleopods of the male is very large, and consists of two plates with numerous vertical folds. These two plates are firmly connected internally for about half their basal length by means of a series of small hooks or cincinnuli. Each plate is divided distally into two lobes, the outer of which is longer and more pointed than the inner. Normally the whole structure forms a rough tube, the two outer edges being capable of approximation owing to the numerous vertical folds. Fig. 2 shows the appearance of the petasma seen from behind, and slightly flattened.

In both sexes the exopods of the pleopods are well developed and longer than the endopods.

The outer *uropod* is a trifle longer than the inner; its outer margin is perfectly straight right up to the apex, and it is about two and a half times as long as wide.

Size.—The largest specimen observed is a female measuring 71 mm.

Colour in life.—The walls of the carapace are semi-transparent, with brownish buff gastric and hepatic regions. There are two small patches of minute whitish chromatophores on the inferior margin of the carapace, one at about its middle point and the other just posterior to it. The rostrum is reddish buff. The abdomen is also tinged with reddish buff, but the walls are largely transparent and the intestine shows through very plainly. The eyes are grey, with a coppery reflection. The antennal scale is transparent, and the antennules, antennae, pereiopods, pleopods, uropods, and telson are all suffused with red or reddish buff.

This description was drawn up from a large female of 71 mm.: the colour is, perhaps, somewhat different in small examples.

General distribution.—*S. siphonocera* is a common Mediterranean species, but records from other seas are scarce. Three specimens have been found in the Bay of Biscay (Caullery) and three off the Azores (Bouvier). Smith (1885) considers that some specimens taken by the *Albatross* Expedition in the Gulf of Paria, Venezuela, should be referred to this species.

Irish distribution.—This species was first noticed from the west coast of Ireland by Calman (1896). The two specimens recorded by him were obtained at the following localities:—

Lord Bandon.

1886.—Lat. 51° 11′ N., Long. 11° 31′ W., 325 fathoms—One.

Flying Falcon.

1888.—Lat. 51° 2′ N., Long. 11° 27′ W., 345 fathoms—One.

Since 1888 the species has been again found on five occasions:—

Helga.

S.R. 97.—3/5/'04.—50° 30′ N., 10° 51′ W., 199 fathoms. Trawl. Bottom temperature 10·7° C.—Two; one 50 mm.

S.R. 187.—31/1/'05.—51° 14′ 30″ N., 9° 43′ W., 57 fathoms. Trawl. Bottom temperature 10·2° C., salinity 35·48°/$_{oo}$—One, 32 mm.

S.R. 353.—6/8/'06.—50° 38′ N., 11° 32′ W., 250–542 fathoms. Trawl. Temperature at 500 fathoms 8·85° C.—Two, 60 and 68 mm.

S.R. 447.—18/5/'07. 50° 20′ N., 10° 57′ W., 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—One, 71 mm.

Thor.

30/5/'06.—51° 27′ N., 11° 10′ W., 110 fathoms. Trawl—One, 51 mm.

Vertical range.—S. siphonocera is found commonly in the Mediterranean between 30 and 100 fathoms, and has been taken in deeper water up to 400 fathoms (Adensamer). Smith's Venezuelan specimens were caught in 31 fathoms, while in the Bay of Biscay the species was found in 218 fathoms.

FAMILY *SERGESTIDAE.*

GENUS **Sergestes,** H. Milne-Edwards.

Sergia, Ortmann.

Fifteen years ago our knowledge of this genus was in a state of great confusion, for the literature abounded in descriptions of species founded only on immature specimens. It is entirely due to Hansen's important revision (contained in two papers, 1896 and 1903 (1)) that this unsatisfactory condition of things no longer exists. Hansen was able to connect a large number of described larvae with their adults, thus making a very considerable reduction in the total number of known species, and he also drew attention to the importance of certain characters, of great specific value, which had previously been neglected.

Two species of *Sergestes, S. robustus* and *S. arcticus,* have been found off the Irish coast; both belong to that section of the genus which is characterised by Hansen thus:—

> *Third maxillipede at most but little longer, sometimes shorter, than third pereiopod, its first joint rarely, the second-fourth joints never obviously incrassated in proportion to the joints in the third pereiopod; its two distal joints with numerous bristles along both margins. On the outer uropod the ciliated part never occupies half the exterior margin. The body not very long and slender; the distance between eyestalks and mandibles not very long. The first joint of the antennular peduncle considerably or much longer than third.*

The two species may be readily distinguished from one another by the following characters:—

I. Rostrum reaching almost to middle of corneal portion of eye; no post-ocular spine, gastro-hepatic groove very faint; *second and third joints of antennular peduncle stout;* antennal scale but little narrowed apically and less than three times as long as broad; fifth pereiopod almost two-thirds the length of the carapace (excluding rostrum); outer uropod four to four and a half times as long as broad, ... *S. robustus* (p. 25).

II. Rostrum only reaching as far forward as the basal articulation of the eyestalks; a post-ocular spine present, gastro-hepatic groove well marked; *second and especially third joint of antennular peduncle slender*, antennal scale very strongly narrowed apically and more than three times as long as broad; fifth pereiopod less than half the length of the carapace (excluding rostrum); outer uropod five to five and a half times as long as broad, . . *S. arcticus* [1] (p. 30).

Young *mastigopi* of these two species, in which the eyes are not wholly black, are most easily distinguished from one another by the stout or slender second and third joints of the antennular peduncle; some of the other characters mentioned above are not valid for these young specimens.

Sergestes robustus, Smith.

Plate III, Figs. 1–12.

Sergestes robustus, Smith, 1882, Pl. xvi, figs, 5–8.
Sergestes robustus, Smith, 1884, Pl. VIII, figs. 3–6.
Sergestes robustus, Smith, 1886, Pl. XX, fig. 6.
Sergia robusta, Ortmann, 1893.
Sergestes robustus, Hansen, 1896.
Sergestes robustus, Hansen, 1903 (2), figs. 6 and 7.
Sergestes inermis, Hansen, 1903 (2), figs. 1–5.
Sergestes robustus, Hansen, 1908.

The *carapace* is laterally compressed and is about half the length of the abdomen, excluding the telson. It is evenly rounded dorsally, and is produced anteriorly to a strongly laterally compressed *rostrum*, which reaches as far forward as the middle of the corneal portion of the eye. The rostrum (fig. 2) is usually provided with two obscure denticles on its dorsal aspect near the apex; the inferior margin is slightly convex and is furnished basally with a fringe of plumose setae. The gastro-hepatic and cardiac grooves of the carapace are almost obsolete; dorsally no trace of either is visible. The branchial region is defined superiorly by a well-marked groove. The position of the hepatic spine is occupied by a slightly elevated but obscure lobe; there is no post-ocular spine.

The third and fourth *abdominal somites* exhibit a shallow dorsal depression, the others are evenly rounded above. The sixth somite is rather more than one and a half times the

[1] In the lists of species caught during the Scotch International Plankton Investigations *Sergestes atlanticus* and "*Sergestes Colletti*" appear (see *Pub. Circ.*, 1909, No. 48, p. 135). Dr. T. Scott, who has kindly replied to my queries on the subject, is now of the opinion that the specimens referred to the former species are only young *S. arcticus*, and he also informs me that "*Sergestes Colletti*" is a misprint for *Siphonoecetes Colletti*.

length of the fifth and is provided with a minute posterior dorsal spine. The *telson* reaches to about half the length of the outer uropod; it is sulcate above, with a pair of prominent dorso-lateral carinae, and terminates acutely. The inferior margins are finely setose.

The *eyes* (fig. 12) are about two-fifths the length of the antennal scale; viewed from above, the cornea, which is much wider than the peduncle, extends over more than half the length of the whole organ.

The antennular peduncle (fig. 12) is about one and a quarter times the length of the antennal scale. The wide basal joint is one and a half times the length of the ultimate segment. Its inner and outer margins are turned upwards at the base; between them is a deep cavity which extends forwards and serves for the reception of the eye; an obscure notch on the outer edge represents the lateral process. Both second and third joints are very stout, the latter being about twice as long as wide. Of the flagella, the secondary or lower ramus of the male (fig. 3) bears a single-jointed appendix, tipped with setae, on the basal segment. The second segment is internally concave and provided with stiff setae and a cluster of strong spines; the third is convex and swollen, and under a high power is seen to be covered with very numerous fine transverse ridges. The stouter upper flagella and the lower rami of the female are broken off in all the specimens examined.

The *antennal scale* (fig. 12) is approximately half the length of the carapace and is rather more than two and a half times as long as wide. The outer margin is convex and terminates in a small acute spine which scarcely surpasses the broadly-rounded end of the lamellar portion. The flagella are very long and show the curious kink or bend which Kishinouye (1905, figs. 1 and 2) has described in *Acetes japonicus* (see inset to fig. 1).[1] The fringe of setae (two to each segment), which exists on the proximal part of the flagellum, stops abruptly at this bend, beyond which the segmental divisions are oblique instead of transverse.

The *mandibles* (fig. 9) are provided with a long two-jointed palp, which is densely setose; the basal joint is rather less than two and a half times the length of the ultimate. The forms of the maxillae and first two maxillipedes are shown in figs. 5-8, and do not call for detailed description.

The *third maxillipedes* reach beyond the tips of the antennular peduncle, but are nevertheless considerably shorter than the third pair of pereiopods. The four proximal joints are not thicker or coarser than those of the third pair of pereiopods. The ultimate and penultimate segments are setose along both margins, the former (fig. 4) being sub-divided into five joints,

[1] Bouvier (1908) has observed a similar bend in the antennae of *Gennadas* and *Amalopenaeus*.

[2] The podobranch at the base of the second maxillipede is omitted in fig. 5.

of which the proximal one is almost as long as the remaining four taken together.

The *first pair of pereiopods*, which is not chelate, reaches slightly beyond the middle of the antennular peduncle. The merus is long and about equal to the slender multiarticulate propodus; the dactylus is distinct but very minute and is provided with a single long seta. The *second* and *third pairs* possess a minute but perfectly formed chela; the latter are considerably longer than the former, and both when stretched forwards reach beyond the apex of the antennular peduncle. In both, the merus is slightly longer than the carpus, but a little shorter than the multiarticulate propodus. The distal joints of all the first three pairs are provided with setae along both margins, as a general rule long and short setae alternate with one another.

The *fourth* and *fifth pairs* are much shorter, strongly compressed and laminar, and one of the joints, presumably the dactylus, is missing. The posterior margins of both pairs are clothed with numerous very long plumose setae, and a similar but shorter fringe is found on the anterior margin of the ischium and merus of the fourth and on all the segments of the fifth pair. The fourth pair when stretched forwards reaches to the distal end of the basal peduncular joint. The propodus, or distal segment, is lanceolate and rather less than three times as long as broad; it is about equal in length to the carpus, but is considerably shorter than the merus. The fifth pair is little more than half the length of the fourth, and is about two-thirds the length of the carapace. The ischium, merus, and carpus are of about equal length; the lanceolate propodus is considerably shorter.

There are no exopodites on the last two pairs of maxillipedes or on any of the pereiopods. The branchial formula is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ..	ep.	1+ep.	...	...	...	...	...	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	1,	1+L.	1+L.	1+L.	2	2	...

Both the pleurobranchs over the base of the fourth pair of pereiopods are large and only slightly smaller than the pair which precede them. The pleurobranch at the base of the third maxillipede and one of those on each of the three succeeding somites is represented merely by a simple lamella ('L' in table).

The complicated form assumed by the petasma[1] of the male

[1] The minute hooks, sunk in pits, with which some of the stylets of this organ are provided, have been described and figured by Smith (1882).

is shown in fig. 11, and in the same sex a small lobe with a few setae is also found at the base of the endopod of the second pair of pleopods. The outer uropod (fig. 10) is almost one and a half times the length of the inner; in an adult female it is just four times as long as broad. The external margin is distally ciliate over a distance less than one-third the total length of the uropod.

Size.—The largest specimen observed is a female measuring 87 mm.; Hansen (1908) records a specimen 90 mm. in length.

Colour in life.—Uniform clear scarlet lake, much darker, with bluish reflections, on the anterior portions of the carapace. The antennal scale is scarlet lake with a row of faint crimson spots; similar spots are also found along the basal edge of the sixth abdominal somite and near the apices of the inner and outer uropods. The eyes are jet black, and all the finer setae with which the species is clothed are reddish gold. *Sergestes robustus* probably possesses the finest colouring of any of the deep-water prawns found off the west coast of Ireland. The blue reflections are very conspicuous and beautiful; though most marked on the anterior parts of the carapace, they can be detected over the whole of it and on the abdomen also.

Alcock has suggested (1901) that *Sergestes bisulcatus*, Wood-Mason, is a synonym of this species, and Miss Rathbun (1906) has included it under her synonymy of *S. robustus*. I am unable to agree with this view. The definite cervical groove and the forms of the rostrum, secondary flagellum of the male, antennal scale and petasma in *S. bisulcatus* (all figured by Faxon, 1895, pl. LII.) offer ready means of distinguishing it from the form here described. In particular, attention is drawn to the petasma, which, as described by Alcock and figured by Faxon, shows just as great differences from that of *S. robustus* as exist between the latter species and *Sergestes arcticus*.

General distribution.—*Sergestes robustus* has been recorded by Smith from the east coast of the United States between Lat. 34° 28′ and 39° 38′ N., and Long. 68° 21′ and 75° 22′ W. It has been found in the Mediterranean near Crete (Adensamer) and in the neighbourhood of Sicily (Lo Bianco and Riggio) and was taken in the Bay of Biscay by the *Caudan* Expedition (Caullery). Further north it is known from Lat. 59° 49′ N., Long. 9° 46′ W., and S.W. of the Färöes in Lat. 61° 8′ N. (Hansen). Miss Rathbun has recorded specimens under this name from the vicinity of the Hawaiian Islands; it is, however, very probable that these examples should be referred to a distinct species, *S. bisulcatus*. If this is so, *S. robustus*, as at present understood, is restricted to the Atlantic Ocean and Mediterranean.

I have examined specimens taken at the following localities south of the British and Irish area :—

Thor.

5/6/'06.—49° 17′ N., 14° 3′ W., soundings $\overline{2{,}000}$ fathoms. Mid-water trawl, 0–164 fathoms—One, 22 mm.

9/6/'06.—49° 23′ N., 12° 13′ W., 665 fathoms. Trawl—One, 48 mm.

Irish distribution.—Sergestes robustus has been found off the west coast of Ireland on the following occasions :—

Helga.

S.R. 139—11/8/'04.—55° 0′ N., 10° 48′ W., soundings $\overline{1{,}000}$ fathoms Triangle net, 0–1,000 fathoms. Surface temperature, 14·6° C., at 800 fathoms 7·0° C.—Two (*Mastigopus*).[1]

S.R. 164.—3/11/'04.—52° 6′ N., 12° 0′ 30″ W., soundings 375 fathoms. Triangle net, 0–350 fathoms. Surface temperature 13·2° C., at 350 fathoms 9·78° C., salinity 35·70°/$_{oo}$—One, larval.[1]

S.R. 282.—18/11/'05.—54° 59′ N., 10° 53′ W., soundings $\overline{1{,}000}$ fathoms. Triangle net, 0–700 fathoms. Surface temperature 10·6° C., at 700 fathoms 9·0° C.—One, 80 mm.

S.R. 299.—5/2/'06.—50° 13′ 30″ N., 11° 16′ W., soundings 500 fathoms. Triangle net, 0–400 fathoms. Surface temperature 10·8° C., at 370 fathoms 10·8° C.—Two, 35 and 87 mm.

S.R. 397.—2/2/'07.—51° 46′ N., 12° 5′ W., 549–646 fathoms. Trawl. Temperature at 500 fathoms 8·71° C., salinity 35·57°/$_{oo}$—Two, 46 and 69 mm., and fragments in stomach of a Ray.

S.R. 481.—29/8/'07.—50° 59′ N., 11° 52′ W., soundings 1,064 fathoms. Midwater trawl, 0–900 fathoms—Three, 19–21 mm.

S.R. 494—8/9/'07.—51° 59′ N., 12° 32′ W., 550–570 fathoms. Trawl. Temperature at 500 fathoms, 8·8° C., salinity 35·30°/$_{oo}$—One, 68 mm.

S.R. 503—12/9/'07.—50° 42′ N., 11° 26′W., soundings 990 fathoms. Triangle net, 0–80 fathoms, Surface temperature 16·2° C., at 80 fathoms about 10·0° C.—One, 39 mm.

Oceana (Hansen, 1903 (2) and 1908)—

52° 4′ 30″ N., 12° 27′ W. Soundings 620 fathoms.—One, 24 mm.

Vertical range.—S. robustus was on one occasion (S.R. 397) found in the stomach of a species of Ray, and this record furnishes conclusive evidence that the species sometimes occurs actually on the bottom. Beyond this isolated fact, little definite information of the bathymetric range can be given. The species has been caught in nets lowered to the depth of 2,574 fathoms (Smith), while a half-grown specimen was found at only 80 fathoms, or less, below the surface (S.R. 503) in soundings of nearly 1,000 fathoms. The shallowest water in which the species has been found is 372 fathoms (Smith, 1882).

[1] Named by Dr. H. J. Hansen.

Sergestes arcticus, Kröyer.

Plate III, figs. 13-19.

Sergestes articus, Kröyer, 1859, Pl. 3, figs. 7 a-g; Pl. 5, fig. 16.
Sergestes Meyeri, Metzger, 1875, Pl. 6, fig. 7.
Sergestes arcticus, Smith, 1882, Pl. xvi, fig. 4.
Sergestes arcticus, Smith, 1886, Pl. xx, figs. 1 and 2.
Sergestes magnificus, Chun, 1888, Pl. 4, figs. 4 and 5.
Sergestes arcticus, Hansen, 1896.
Sergestes articus, Hansen, 1903 (1), Pl. xii, fig. 1, a-c.
Sergestes arcticus, Stebbing, 1905.
Sergestes arcticus, Hansen, 1908.

The *carapace* is laterally compressed and more than half the length of the abdomen, excluding the telson. Dorsally it is rounded and produced anteriorly to a very short pointed crest or *rostrum* (fig. 18) which only reaches as far as the basal articulation of the eyestalks. Close to the anterior margin there is a small but well marked ocular spine situated on a short carina; there is also a very prominent hepatic spine. The gastro-hepatic groove is rather deeply cut and extends right over the dorsum of the carapace; the cardiac groove is almost obsolete, but that which defines the superior limit of the branchial region is strong and well-marked. The anterior margin of the carapace is straight on either side of the rostrum and does not protrude forwards as it does in *S. similis*.

The third and fourth *abdominal somites* are slightly flattened above; the remainder are dorsally smooth and rounded. The sixth somite is deep; it is usually about two and a half times the length of the preceding somite, but in very large specimens is sometimes rather shorter. The *telson* is shorter than both uropods and is about two-thirds the length of the sixth somite; as in the case of *S. robustus*, it is sulcate above, with a pair of dorso-lateral carinae and a fringe of setae along its inferior margin.

The *eyes* (fig 13) are long and slender; the cornea is round and wider than the stalk. Viewed dorsally they are strikingly different from those of the preceding species, for the corneal portion is not much more than one-third the length of the whole eye.

The joints of the *antennular peduncle* (fig. 13) also differ widely from those of *S. robustus*. The basal segment is long, and considerably narrowed distally; it is deeply hollowed for the reception of the eye, and the lateral process is represented by an obscure notch in the outer margin. The second and third joints, which, taken together, are about as long as the basal segment, are very slender. The ultimate is rather longer than the penultimate and is about five times as long as wide. The lower flagellum of the male (fig. 15) is similar

to that of *S. robustus*, but the appendix is provided with a single very stout apical spine. In the female the lower flagellum is simple and considerably shorter than the ultimate peduncular segment. The upper flagella are almost as long as the abdomen and telson; proximally they are swollen and setose.

The *antennal scale* (fig. 13) is more than half the length of the carapace; it is rather less than four times as long as broad and is much narrowed distally. The outer margin is convex, terminating anteriorly in a very small spine which scarcely surpasses the lamellar portion. The very long antennal flagella show the characteristic bend or kink noticed in the last species.

The mandibles, maxillae, and first two pairs of maxillipedes do not differ much from those of *S. robustus*. The ultimate joint of the *mandibular palp* is a trifle longer in proportion to the penultimate; the exopod of the *second maxilla* reaches a little further forward, while the endopod of the *first maxillipede* is much longer. The *third maxillipedes* reach beyond the distal segments of the antennular peduncle by more than the ultimate segment; they are thus rather longer proportionally than in *S. robustus*, but, as in that species, the proximal joints are not obviously thicker or coarser than those of the third pereiopod, and the two terminal segments bear setae on both margins. The ultimate segment (fig. 17) is sub-divided into six joints, the proximal of which is equal in length to the three distal.

The *first pair of pereiopods* reaches almost to the middle of the ultimate segment of the antennular peduncle, the *second* reaches beyond it by about one-third of the propodus, while the *third*, which is considerably longer than the third maxillipedes, surpasses it by about half the length of the propodus. The propodi of all three pairs are multiarticulate. The *fourth* and *fifth pairs* of pereiopods are considerably shorter, and their joints, although laminar, are much less broad than is the case in the preceding species. The proportional lengths of the segments of the fourth pair are much the same as in *S. robustus*, but in the fifth the merus is longer than either the ischium or the carpus. The fourth pair is slightly shorter than the length of the carapace; the fifth is only half as long.

The *branchial formula* is the same as that of *S. robustus*, but the pair of pleurobranchiae over the base of the fourth pereiopod are much smaller, in comparison with those of the preceding somite, than is the case in that species.[1]

In the male the *petasma* (fig. 14) is identical in general plan with that of *S. robustus*, but differs from it in several minor details. The chief of these are the sharp point with which it is provided on the inferior margin, near the line of connection of the right and left halves, and the series of processes, tipped

[1] For a fuller description of these branchiae and an account of their difference from those of the allied *S. similis*, see Hansen, 1903 (sub *S. similis*).

with spines, with which the long median style is furnished on its inner aspect. The male also possesses the usual small lobe at the base of the second pair of pleopods.

The outer *uropod* (fig. 16) is rather less than one-third longer than the inner, and, in adults, is usually more than five times as long as broad. [1] The external margin is distally ciliate for less than one-third the length of the uropod; a short spine emphasises the division between the naked and setose portions.

Size.—The largest specimen found off the Irish coast is 47 mm. in length; I have, however, examined a female which measured 65 mm.

Colour in life.—The walls of the carapace are transparent, with a few small scarlet red chromatophores; the black stomach and scarlet hepatic and cardiac regions show through very distinctly. There are a few red chromatophores on the first two abdominal somites, and there is a faint suffusion of the same colour on the remaining somites, telson, and uropods. The cornea is jet black. The joints of the antennular peduncle are transparent, but are tinged with red on their outer distal margins; the antennal scale is perfectly transparent, and all three pairs of flagella are reddish. The mandibles, maxillae, and first two pairs of maxillipedes are red; the third pair and the first three pairs of pereiopods are dotted with red; the last two pairs of pereiopods are very faintly suffused with the same colour.

A fuller synonymy than is found above is given by Stebbing (1905), but Lo Bianco's record of *Sergia magnifica*, which is included, has been referred by Senna (1903) to *Sergestes vigilax*, Stimpson. An additional synonym is *S. Rinki*, Kröyer, which Hansen states is the *mastigopus* of *S. arcticus*.

General distribution.—In the Atlantic Ocean *Sergestes arcticus* is common and widely distributed; it is known from Lat. 65° 20′ N. (Hansen), and as far south as 40 miles off Table Mt. (Stebbing), and Lat. 38° 5′ S. (Hansen). The species has been recorded from the Mediterranean, and three specimens were found by the *Challenger* to the south of Australia (Hansen).

I have examined specimens taken by the *Thor* at the following localities:—

21/5/'05.—47° 47′ N., 8° 0′ W., soundings 454–881 fathoms. Mid-water trawl, 0–274 fathoms—Twenty-one, 22–28 mm.

28/5/'05.—61° 11′ N., 11° 0′ W., soundings 527 fathoms. Mid-water trawl, 0–492 fathoms—Three, 30–49 mm.

28/8/'05.—63° 42′ N., 13° 2′ W., soundings 360 fathoms. Mid-water trawl, 0–35 fathoms—Five, 14–22 mm.

[1] In a very large female the outer uropod is a trifle less than five times as long as broad.

31/8/'05.—57° 46′ N., 9° 55′ W. Midwater trawl, 0–164 fathoms—Five, 20–28 mm.
5/6/'06.—49° 17′ N., 14° 3′ W. Midwater trawl, 0–164 fathoms—Three, 37–45 mm.; 0–110 fathoms—Ten, 9–19 mm.
8/6/'06.—48° 41′ N., 11 30′ W. Midwater trawl, 0–164 fathoms—Eight, 14–49 mm.
9/6/'06.—49° 23′ N., 12° 13′ W., 722 fathoms. Trawl—Two, 39 and 48 mm.

Irish distribution.—As may be seen from the following list of records, *Sergestes arcticus* is quite abundant off the west coast of Ireland. Only specimens of 9 mm. or more in length are listed.

Helga.

S.R. 139.—11/8/'04.—55° 0′ N., 10° 48′ W., soundings $\overline{1{,}000}$ fathoms. Surface temperature 14·6° C.; at 320 fathoms 9·04° C., at 800 fathoms 7·0° C. Triangle net, 0–1,000 fathoms—Two, 16 and 27 mm. Townet, 0–200 fathoms—One, 23 mm.
S.R. 164.—3/11/'04.—52° 6′ N., 12° 0′ 30″ W., soundings 375 fathoms. Triangle net, 0–350 fathoms. Surface temperature 13·2° C., at 350 fathoms 9·78° C., salinity 35·70°/$_{oo}$—One, 34 mm.
S.R. 175.—14/11/'04.—54° 53′ N., 10° 42′ W., soundings 670 fathoms. Triangle net, 0–600 fathoms. Surface temperature 10·9° C., salinity 35·49°/$_{oo}$; temperature at 670 fathoms 4·5° C.—Four, 28–31 mm.
S.R. 197.—11/2/'05.—54° 57′ N., 10° 51′ W., soundings $\overline{1{,}000}$ fathoms. Triangle net, 0–680 fathoms—One, 40 mm.
S.R. 217—9/5/'05.—52° 44′ N., 12° 30′ W., 208 fathoms. Trawl. Temperature at 200 fathoms, 10·0° C.—One, 38 mm.
S.R. 224.—12/5/'05.—53° 7′ N., 15° 6′ W., soundings 860 fathoms. Midwater trawl, 0–750 fathoms—One, 35 mm.
S.R. 231.—20/5/'05.—51° 1′ N., 10° 45′ W., soundings 1,200 fathoms. Midwater trawl, 0–1,150 fathoms—One, 42 mm.
S.R. 272.—5/11/'05.—51° 54′ N., 11° 58′ W., soundings 411 fathoms. Midwater trawl, 0–75 fathoms. Surface temperature 12·2° C., salinity 35·55°/$_{oo}$; temperature at 75 fathoms 10·5° C., salinity 35·57°/$_{oo}$—One, 25 mm.
S.R. 282.—18/11/'05.—54° 59′ N., 10° 53′ W., soundings $\overline{1{,}000}$ fathoms. Surface temperature 10·7° C., salinity 35·30°/$_{oo}$; temperature at 250 fathoms 9·3° C., salinity, 35·39°/$_{oo}$. Triangle net, 0–700 fathoms—Six, 17–38 mm. Triangle net, 0–200 fathoms—Four, 15–40 mm.
S.R. 328.—9/5/'06.—51° 32′ N., 11° 53′ W., 445–515 fathoms. Trawl. Temperature at 400 fathoms about 9·5° C.—One, 42 mm.
S.R. 329.—9/5/'06.—51° 21′ N., 11° 35′ W., 215–415 fathoms Trawl. Temperature at 400 fathoms 9·55° C., salinity 35·33°/$_{oo}$—Two, 34 and 44 mm.

S.R. 334.—10/5/'06.—51° 35′ 30″ N., 12° 26′ W., 500–520 fathoms. Trawl. Temperature at 500 fathoms 9·2° C., salinity 35·10°/$_{oo}$—One.

S.R. 337.—13/5/'06.—51° 21′ 30″ N., 12° 9′ W., soundings 768 fathoms. Midwater trawl, 0–20 fathoms. Surface temperature 11·0° C.—Four, 38–47 mm.

S.R. 351.—5/8/'06.—50° 19′ 30″ N., 11° 6′ W., 230–250 fathoms. Trawl—Twenty-one, 18–34 mm.

S.R. 363.—10/8/'06.—51° 22′ N., 12° 0′ W., 695–720 fathoms. Trawl. Temperature at 600 fathoms 7·9° C.—Three, 25–35 mm.

S.R. 366.—11/8/'06.—51° 24′ N., 11° 40′ W., soundings 461 fathoms. Midwater trawl, 0–400 fathoms. Surface temperature 15·6° C.; at 380 fathoms 9·44° C.—Two, 22 and 31 mm.

S.R. 386.—6/11/'06.—51° 48′ N., 12° 4′ W., soundings 450 fathoms. Surface trawl. Surface temperature 12·3° C., salinity 35·37°/$_{oo}$—Four, 17–35 mm.

S.R. 442.—16/5/'07.—51° 34′ N., 11° 48′ W., 465–508 fathoms. Trawl—Seven, 9–19 mm.

S.R. 447.—18/5/'07.—50° 20′ N., 10° 57′ W., 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—Two.

S.R. 449.—19/5/'07.—50° 28′ N., 11° 39′ W., soundings 950 fathoms. Midwater trawl, 0–800 fathoms—Twelve, 14–44 mm.

S.R. 470.—24/8/'07.—50° 16′ N., 11° 27′ W., soundings 770 fathoms. Midwater trawl, 0–500 fathoms. Surface temperature 15·8° C., salinity 35·30°/$_{oo}$; temperature at 500 fathoms, 9·03° C., salinity 35·35°/$_{oo}$—Three, 26–36 mm.

S.R. 476.—26/8/'07.—51° 42′ 30″ N., 12° 15′ 30″ W., soundings 640 fathoms. Midwater trawl, 0–300 fathoms. Surface temperature 15·45° C., salinity 35·37°/$_{oo}$; temperature at 250 fathoms, 10·19° C., salinity 35·34°/$_{oo}$—Thirteen, 10–26 mm.

S.R. 481.—29/8/'07.—50° 59′ N., 11° 52′ W., soundings 920–1,064 fathoms. Midwater trawl, 0–900 fathoms—Three.

S.R. 486.—3/9/'07.—51° 37′ 30″ N., 12° 0′ W., 600–660 fathoms. Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—Two, 28 and 29 mm.

S.R. 488.—4/9/'07.—51° 35′ N., 11° 57′ W., soundings 540–720 fathoms. Triangle net, 0–400 fathoms—One, 35 mm.

S.R. 492.—8/9/'07.—51° 57′ 30″ N., 12° 19′ W., soundings 520–533 fathoms. Triangle net, 0–400 fathoms. Surface temperature 15·35° C., salinity 35·39°/$_{oo}$; temperature at 500 fathoms, 8·53° C., salinity 35·44°/$_{oo}$—One.

S.R. 494.—8/9/'07.—51° 59′ N., 12° 32′ W., 550–570 fathoms. Trawl, Five, 25–42 mm.

S.R. 503.—12/9/'07.—50° 43′ N., 11° 23′ W., soundings 515–990 fathoms. Surface temperature 16·2° C., salinity 35·34°/$_{oo}$. Triangle net, surface—Thirty-three, 9–27 mm. Triangle net, 0-80 fathoms—Sixteen, 9–17 mm.

Vertical range.—Sergestes arcticus is a free-swimming species. Adults are usually found at considerable depths, but

have on some occasions been taken at the surface; the young stages seem to be confined to the upper strata of the water. The species has been caught over soundings of 139 and 2,516 fathoms (Smith), but although frequently taken by the trawl, there is no certain record that it has ever occurred actually on the bottom.

Tribe CARIDEA.

This tribe comprises the vast majority of the species of Decapoda Natantia found in British and Irish waters. Ten families are represented, one of which (Bresiliidae) was established for the reception of a single species, which has, so far, been found only in the deep water of the Irish Atlantic slope.

A. Exopods on at least first four pairs of pereiopods.

I. Pereiopods not enormously long and not all slender, all five pairs with long exopods.

A. Exopods of second maxillipedes absent or rudimentary; first two pereiopods much longer and stouter than remaining three, . . Pasiphaeidae (p. 36).

B. Exopods of second maxillipedes well developed, but without terminal lash; first two pereiopods not longer or materially stouter than remaining three, . . . Hoplophoridae (p. 55).

II. Pereiopods very slender and of enormous length, especially the three posterior pairs; small exopods on the first four pairs only; exopods of second maxillipedes with terminal lash, Nematocarcinidae (p.75)

B. Pereiopods with only two exopods on the first two pairs, . . . Bresilidae (p. 82).

C. Exopods usually entirely absent from pereiopods, when present on the first pair only.

I. Carpus of second pereiopods divided into two or more segments.

A. Eyes not covered by a projection of frontal margin of carapace.

i. First pereiopods both simple or both chelate; rostrum usually of considerable size and armed with spines.

a. First two pairs of pereiopods slender, the first either simple or microscopically chelate, the second with chelae of small size; mandibles with palp, and with incisor and molar processes, . . . PANDALIDAE (p. 84).

b. First two pairs of pereiopods not both very slender, the first with chelae of moderate size, although occasionally smaller than those of second pair; mandibles with or without incisor process and palp, HIPPOLYTIDAE (p. 99).

ii. Of the first pair of pereiopods, one is simple, the other chelate; rostrum short and unarmed; mandibles without palp or incisor process, . PROCESSIDAE (p. 123).

B. Eyes usually covered, at least partially, by a projection of the frontal margin of carapace; first pereiopods very robustly chelate, . . . ALPHEIDAE (p. 119).

II. Carpus of second pereiopods unsegmented, simple.

A. First pereiopods with small chelae, second pair with larger and more robust chelate, . . PALAEMONIDAE (p. 127).

B. First pereiopods sub-chelate, second pair slender (rarely absent), minutely chelate or simple, . . CRANGONIDAE (p. 134).

For the purposes of the present paper I have not thought it necessary to make use of super-families as in the scheme proposed by Borradaile (1907). Certainly in the Caridea such groups can at present only be regarded as hypothetical, at any rate until the families themselves are more satisfactorily defined.

FAMILY *PASIPHAEIDAE*.

Of this family two genera are now known from British and Irish waters. They may be distinguished thus :—

I. Rostrum in the form of a post-frontal spine; mandible without palp; gill formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	...	...	± ep. rud.	...	...	...	...	...
Arthrobranchiae, ...	...	...	...	1	1	1	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

Pasiphaë (p. 37).

II. Rostrum a regular prolongation of the carapace; mandible with a two-jointed palp; gill formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	ep.	...	...	...	...	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

Parapasiphaë (p. 47).

Genus **Pasiphaë**, Savigny.

The three species of this genus known from British and Irish waters fall into two groups :—

I. Abdominal somites laterally compressed, but not dorsally carinate; telson truncate at apex, ... *P. sivado.*

II. Abdominal somites laterally compressed and sharply carinate dorsally; telson forked at apex, ... { *P. tarda.* / *P. princeps.*

A tabular statement of the distinctions between these last two species will be found on p. 42.

Pasiphaë sivado, (Risso).

Pl. IV, fig. 12.

Pasiphaea sivado, Bell, 1853, fig., p. 312.

The very rudimentary character of the pleurobranch at the base of the last pereiopod is an interesting feature of this well known form. It consists of a short process bearing five or six lamellae and is apparently developed quite late in the post-larval history of the species; even in specimens measuring 30 mm. no trace of it could be found (cf. Calman, 1903). In the other two representatives of the genus known from Irish waters this podobranch is well developed although smaller than that at the base of the preceding limb.

Size.—The largest specimen observed measures 79 mm.; individuals up to 4 ins. in length have, however, been recorded from Loch Fyne (Henderson). Off the Irish coast ovigerous females are rarely found to measure less than 65 mm., but Alcock has recorded an egg-laden female from Indian waters of only 48 mm., while a specimen from the Portuguese coast examined by the author was only 2 mm. longer.

Colour in life.—The carapace and abdomen are perfectly clear and transparent, with the exception of a red spot or aggregation of spots near the posterior edges of the second to fifth somites inclusive; the sixth somite has a red dorsal streak on its posterior half and another similarly situated on the ventral aspect. The eyes are black, with a dull reddish reflection. The antenna and outer flagellum of the antennule are dotted with small red spots, a few of which are also present on the inner antennular flagellum; the peduncle and antennal scale are colourless. The first and second pairs of pereiopods are transparent, with a red streak or row of spots along the under side of the basus, ischium, merus and carpus; the digits are suffused with red and in the first pair there is an additional red spot at the base of the propodus. The third pair is transparent; the fourth shows red spots on the ischium and merus; the fifth is similar, with red spots, in addition, on the carpus. At the base of each pereiopod there is a red spot on the sternum. The basal joint of the pleopods is marked with a red spot or streak and the tips of the rami are sometimes tinged with the same colour; the distal third of the outer uropods is also red. The eggs are quite transparent or very faintly greenish.

This description details the maximum development of red pigment observed; in many specimens it is restricted to only a few of the areas noted above. In no case is there enough red colouring present to detract from the general invisibility of the animal in the water; a feature which has gained for *P. sivado* the suitable name of "ghost prawn."

General distribution.—This species is well known in the Mediterranean (Heller, etc.), and has been found rather commonly off the Portuguese coast (Wolfenden, 1906) and in the Bay of Biscay; it is apparently quite absent from the English Channel and North Sea. It has been taken in the Bristol Channel and is frequent off the west coast of Scotland (Scott). In Norway it is found rarely off the south and west coasts (Sars and Norman). The only extra-European record is from the neighbourhood of India, where three specimens have been recorded from the Andaman Sea and Bay of Bengal (Alcock).

Irish distribution.—Adult *P. sivado* are found fairly commonly throughout the Irish Sea in soundings of 20 fathoms or more; post-larval specimens are sometimes found at much shallower depths (8-9 fathoms). The species is always to be found in the area known as Lambay Deep, where the soundings range from 50 to 73 fathoms. Like *Pandalus Montagui* and *Meganyctiphanes norvegica* it is sometimes found in astonishingly large numbers; these assemblages appear, however, to be quite temporary. *P. sivado* has not so far been taken off the south coast of Ireland and in the west is quite scarce and confined to deep water; the records are:—

Helga.

15/7/'03.—53° 34′ N., 11° 31′ W., 110 fathoms. Trawl—Three 11·5–14 mm.

S.R. 169.—4/11/'04.—51° 50′ N., 11° 26′ W., 129 fathoms. Trawl —Seven, 16–24.

S.R. 321.—1/5/'06.—50° 58′ N., 11° 17′ W., 208–480 fathoms. Trawl —Eleven, 60–73 mm.; several ovigerous.

S.R. 329.—9/5/'06.—51° 21′ N., 11° 34′ W., 215–415 fathoms. Trawl. Temperature at 400 fathoms 9·55° C., salinity 35·33°/$_{oo}$—Three, 56–74 mm.

S.R. 351.—5/8/'06.—50° 19′ 30″ N., 11° 6′ W., 230–250 fathoms. Trawl—One, 32 mm.

S.R. 383.—6/11/'06.—51° 57′ N., 11° 34′ W., soundings 143–180 fathoms. Midwater trawl, 0–100 fathoms. Surface temperature 12·25° C., salinity 35·35°/$_{oo}$; at 100 fathoms, temperature 10·3° C., salinity 35·35°/$_{oo}$—Seventeen, 11–17 mm.

S.R. 447.—18/5/'07.—50° 20′ N., 10° 57′ W., 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—Three; two ovigerous.

Vertical range.—Off the Irish coast this species has been found between 8 and 230 fathoms; in Indian waters it is recorded from 200 to 250 fathoms; in the Bay of Biscay it has been trawled by the *Huxley* in 412 fathoms; while in the Mediterranean it is stated to have occurred in 543 fathoms (Adensamer). Post-larval specimens, up to 30 mm. in length, are frequently caught in midwater and less commonly at the surface. Although the adult is occasionally found under similar conditions, there can be little doubt that it lives normally on, or very near, the bottom.

Pasiphaë tarda, Kröyer.

Pl. IV, figs. 8–11.

Pasiphaea tarda, Kröyer, 1845.
Pasiphaea norwegica, M. Sars, 1868, Pls. 4 and 5, figs. 65–90.
Pasiphaea tarda, G. O. Sars, 1882.
Pasiphaë tarda, Wollebaek, 1900, Pl. II, fig. 3.
Pasiphaë tarda, Hansen, 1908.

The *rostrum* is in the form of a procurved post-frontal spine rising from the dorsal carina; the apex usually reaches slightly beyond the anterior margin of the carapace. The *carapace* is slightly less than half the length of the abdomen (excluding the telson) and its greatest depth is about half its length. As in *P. sivado* it is furnished with a sharp spine at the base of the antennae above the obtusely rounded sinus. A carina defines the superior boundary of the branchial chamber, disappearing before it reaches the posterior margin.

All the *abdominal somites* are sharply carinate dorsally with the exception of the posterior third of the sixth; this somite is about one and a half times the length of the preceding and on each side of it a rather conspicuous carina may be seen. The

telson (fig. 10) is about as long as the sixth somite, and is shorter than both inner and outer uropods; it is strongly sulcate dorsally, apically it is deeply forked and furnished, in the bifurcation, with eight or nine pairs of spines, those at the outer angles being the longest.

The *eyes* are rather larger than in *P. sivado*, and with a slightly shorter stalk. The basal joint of the *antennular peduncle* is the longest, and the middle joint the shortest; the lateral process is sharply pointed, and reaches to the distal end of the basal segment. The *antennal scale* (fig. 9) is rather more than half the length of the carapace, its outer margin is slightly convex and terminates apically in a long strong spine; the lamellar portion is rather less than four times as long as broad.

The outer *maxillipedes* do not quite reach to the apex of the antennal scale; the ultimate joint is about one and a third times the length of the penultimate. The *first pair of pereiopods* reaches beyond the tip of the antennal scale by one half the length of the propodus. The basus and ischium are not armed with ventral spines, but the former is produced distally and basally to an acute point. The merus, which is rather shorter than the propodus, is provided with ten to twelve ventral spines; the carpus is very short, not much more than one-fifth the length of the propodus. The fingers of the chela are curved near the tip and cross one another when closed; the dactylus is rather more than one-third the length of the whole hand. The *second pair* of pereiopods reaches beyond the first pair, the greater length being due to the longer merus and propodus. The basus is armed below with eight or nine spines, and the ischium with two (fig. 11); the merus bears along its basal edge about eighteen to twenty-five rather strong spines, and the lower distal edge of the carpus is produced forwards to form a strong tooth. The palm of the chela is rather strongly contracted behind the fingers, and is but little longer than them; the digits are curved near their tips and cross one another when closed. In both the first and second pairs the fingers are provided with numerous stout spinules along their inner faces. The *third pair* of pereiopods is extremely slender, and reaches to the carpus of the second pair. The dactylus and carpus are very short; the merus is very long, being four times the length of the ischium and two and a quarter times that of the propodus. The *fourth pair* is very short and reaches only to about the middle of the merus of the third pair; the propodus, which is slightly longer than the ischium, is less than half the length of the merus; the minute dactylus bears a fringe of stiff setae. The *fifth pair* is almost as long as the third and much stouter; the ischium is equal in length to the carpus and about one-third as long as the merus; the merus and propodus are about equal. The dactylus is rather shorter than the carpus, it is spatulate and is provided with stiff apical and ventral setae. Exopods are, of course, present at the base of all the pereiopods; they decrease in size from before backwards.

The outer *uropod* is much longer than the inner, and is rather less than four times as long as broad.

Of the four specimens examined, none possess the secondary stylet at the base of the inner branch of the second pair of pleopods which is characteristic of the mature male.

Size.—The four specimens examined yield the following measurements in mm. :—

Total length.	Carapace.[1]	Abdomen.	Antennal scale.[2]
70	19·5	39·5	11
65	18	35	9·5
59·5	16·5	34	8·5
51	14·5	28	8

100 mm. probably represents the maximum length of this species. Larger specimens (up to 160 mm.) have been recorded, but there is evidence to show that these should more properly be referred to *Pasiphaë princeps*.

Colour in life.—According to Wollebaek, in larger specimens "the top part of the carapace presents a colourless transparency, being elsewhere more or less translucent and milky in hue. The smaller individuals are quite transparent, with parts of the legs and lamellae red."

General distribution.—*Pasiphaë tarda* is known along the Scandinavian coasts from S. Norway to W. Finmark (Sars, Norman, etc.), from Denmark (a single specimen, Meinert), from Iceland and Jan Mayen (Hansen), from Davis Straits and the coasts of Greenland (Hansen and Kröyer), and from the East Coast of the United States north of Cape Cod (Smith). Three of the specimens examined by the author were caught by the Danish Fishery Steamer *Thor* at the following localities :—

29/8/'05.—61° 20′ N., 11° 0′ W. Soundings 710 fathoms. Midwater trawl, 0–164 fathoms—One, 51 mm.

31/8/'05.—57° 46′ N., 9° 55′ W. Midwater trawl, 0–274 fathoms—One, 70 mm.

29/8/'05.—60° 0′ N., 10° 35′ W. Soundings $\frac{\cdot}{574}$ fathoms. Midwater trawl, 0–548 fathoms—One, 59·5 mm.

Lo Bianco (1903) records several small *Pasiphaë* (8–35 mm.), caught in the Mediterranean near Capri, as *P. tarda*. In our present state of ignorance regarding the differential characters of post-larval "fork-tail" *Pasiphaë*, this record must be looked on with suspicion.

[1] Measured in mid-dorsal line.

[2] Including apical spine.

Irish distribution.—A single specimen only has been found off the Irish coast :—

Helga.

S.R. 212—6/5/'05.—51° 54′ N., 11° 57′ W. 370–411 fathoms. Trawl. Temperature at 350 fathoms 9·82° C., salinity 35·28°/$_{oo}$—One, 65 mm.

This is the most southern locality from which the species has been recorded in East Atlantic waters.

Vertical range.—P. tarda is not confined to the bottom, but is frequently found swimming at intermediate depths. It has been recorded from 60 and 525 fathoms off the Norwegian coast and during the Swedish Arctic expedition was caught in a vertical net lowered to 1,640 fathoms (Ohlin). A single specimen has been found at the surface in the North Sea (Meinert), and off the East Coast of the United States it has been trawled in 140–175 fathoms (Smith).

Pasiphaë princeps, Smith.

Pl. IV, figs. 1–7.

Pasiphaë princeps, Smith, 1884, Pl. v, fig. 2.
Pasiphaë princeps, Smith, 1886.
Pasiphaeia princeps, Faxon, 1895.
Pasiphaea princeps, Rathbun, 1904.

Several specimens trawled in deep water off the west coast of Ireland are referred to this species. They differ from the original description in certain particulars, but subsequent authors have shown that in most of these very particulars a considerable range of variation exists ; there can be little doubt that these Irish specimens, the first that have been found in the East Atlantic, represent a European race of *P. princeps*.

This species is very closely related to *Pasiphaë tarda*, but attains to a much larger size. *P. tarda* does not appear to reach a length of more than 10 cms., while the type of *P. princeps* was more than twice this size.

Specimens of *P. tarda* and *princeps* of 40 mm. in length, or more, may be separated thus :—

P. tarda.	*P. princeps.*
1. Rostrum a procurved post-frontal spine, strongly ascendant from the dorsal carina of the carapace and anteriorly concave.	1. Rostrum a post-frontal elevation of the dorsal carina of the carapace, not strongly ascendant, and almost invariably distinctly sinous anteriorly (figs. 4–6).
2. Carapace, measured in the mid-dorsal line, very little, if at all, more than half the length of the abdomen (excluding the telson).	2. Carapace, measured in the mid-dorsal line, considerably more than half the length of the abdomen (excluding the telson).

P. tarda—cont'd.	*P. princeps*—cont'd.
3. Antennal scale (including spine) rather more than half the length of the carapace.	3. Antennal scale (including spine) not more than half the length of the carapace.
4. Antennal scale evenly convex throughout its length, furnished apically with a long, stout spine (fig. 9).	4. Antennal scale strongly convex in its distal third, furnished apically with a small, short spine (fig. 2).
5. Basus of second pereiopod with eight or nine ventral spines (fig. 11).	5. Basus of second pereiopod with at most four ventral spines, sometimes unarmed (fig. 7).
6. Telson narrow at its apex, with a deep bifurcation (fig. 10).	6. Telson broader at its apex, with a shallower bifurcation (fig. 3).

The mouth parts of the two species do not appear to offer any important differential characters.

Of the fifteen perfect specimens of *P. princeps* examined, the largest two are males measuring 116 and 132 mm. in length; the others, none of which measure more than 75 mm., show no trace of the additional stylet at the base of the endopod of the second pair of pleopods.

In the largest specimen the rostrum (fig. 1) is dorsally arched behind the apex, and in some of the smaller examples traces of this feature are apparent (fig. 5). As will be seen from the figures, the rostrum differs very considerably in shape and forward extension; in that of the smallest specimen (37 mm.) no trace even of the sinuous anterior margin is apparent. The specimens yield the following measurements in mm. (cf. p. 41) :—

Total length.	Carapace.[1]	Abdomen.	Antennal scale.[2]
132	48	77	20·5
116	36	60	16
75	24	38·5	11
69	21·5	37·5	10
68·5	21	36	10
67	20·5	35	10
65	20	36	10
62	19	33	9·5
57	17·5	31·5	8·5
55	16	29·5	8
53	16·5	29	7·5
52·5	16	29	8
51·5	15·5	27·5	7·5
47	14·5	25	7
37	12	20·5	5

[1] Measured in mid-dorsal line.

[2] Including apical spine.

The carapace in all the specimens is dorsally carinate throughout its length, and the abdominal somites, with the exception of the posterior portion of the sixth, show a similar character. The usual lateral carinae are present on the sixth somite and on the carapace above the branchial region. The antero-lateral sinus is almost rectangular in the large specimens; in small individuals it is slightly obtuse.

The antennal scale is about four times as long as wide and, as mentioned above, its outer margin is strongly convex distally and terminates in a very short tooth.

The merus of the first pair of pereiopods bears from 4 to 8 spines on its ventral margin; the inferior distal angle of the basus is produced to a rather blunt point, and neither it nor the ischium are furnished with spines. The merus of the second pair is provided with 12 to 18 ventral spines; the ischium in some specimens shows a single spine on its basal edge, in the others it is unarmed. The basus is in some specimens unarmed, in the others it bears from 2 to 4 spines. Fig. 7 shows the greatest development of these spines found.

These spines on the basal and ischial joints have not been noticed before, and they are very possibly absent in West Atlantic and Pacific examples. The spinulation of the merus is, however, known to be very variable (cf. Faxon, 1895, and Rathbun, 1904); in some specimens the merus of the first pair is reported to be unarmed, while that of the second pair is provided with only six spines.

The Irish specimens differ from the original description in having the telson shorter than the inner uropod; the authors mentioned above have not made any reference to this character when dealing with other specimens of the species, but, judging from the great variation shown in certain other Caridea, is not of any special importance from a systematic point of view.

I am of the opinion that some at least of the specimens recorded by Wollebaek (1909) as *Pasiphaë tarda* should be referred to this species. His figure (pl. XIII) of one of the "gigantic specimens, 140 to 160 mm. long," from the S. coast of Norway, is evidently drawn from a specimen of *P. princeps*.

Size.—The largest specimen observed is a male measuring 132 mm.; the type specimen is a female, and measured 215 mm. (Smith).

Colour.—The carapace and abdomen are of a uniform bright vermilion red; the pereiopods are the same colour, with the exception of the fingers of the chelae, which are much darker, almost maroon in fact. The eyes are leaden black. The antennal scale is milk white, with a narrow red stripe externally and a broader stripe along its inner margin; the basal segment is also milk white, outlined with the same red tint. The antenna is white, with a red dorsal stripe; the antennules and all the other appendages partake of the prevailing vermilion red colouring.

The large example from which this description was drawn up was found dead in the mouth of a fish. Although the specimen was apparently quite fresh, it is possible that the colouring had already been altered in some degree by post-mortem changes.

General distribution.—Pasiphaë princeps has been found in the Pacific near the Aleutian Is., in the Behring Sea, off Washington, and off Ecuador (Rathbun and Faxon). In the West Atlantic it has been taken between lat. 37° 59′ and 39° 39′ N., and between long. 70° 58′ and 73° 48′ W. (Smith). I have recently examined specimens of this species from the north side of the Bay of Biscay, from the south of the Wyville Thomson ridge, and from the west coast of Norway.

Irish distribution.

Helga.

S.R. 327.—8/5/'06.—51° 41′ N., 12° 16′ W. 550–800 fathoms Trawl. Temperature at 500 fathoms 9·22° C., salinity 35·16°/$_{oo}$—Two, 75 and 37 mm.

S.R. 229.—9/5/'06.—51° 21′ N., 11° 35′ W. 215–415 fathoms. Trawl. Temperature at 400 fathoms 9·55° C., salinity 35·33°/$_{oo}$—One, 67 mm.

S.R. 397.—2/2/'07.—51° 46′ N., 12° 5′ W. 549–646 fathoms. Trawl. Temperature at 500 fathoms 8·71° C., salinity 35·57°/$_{oo}$—One, 132 mm., and macerated fragments of another large specimen.

S.R. 400.—5/2/'07.—51° 19′ N., 11° 49′ W. 525–600 fathoms. Trawl —Macerated fragments.

S.R. 440.—16/5/'07.—51° 45′ N., 11° 49′ W. 350–389 fathoms. Trawl. Temperature at 300 fathoms 9·93° C., salinity 35·46°/$_{oo}$—Two, 57 and 51·5 mm.

S.R. 447.—18/5/'07.—50° 20′ N., 10° 57′ W. 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—Five, 47–69 mm.

S.R. 487.—3/9/'07.—51° 36′ N., 11° 57′ W. 540–660 fathoms. Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—Macerated fragments of a large specimen.

S.R. 490.—7/9/'07.—51° 57′ 30″ N., 12° 7′ W. 470–491 fathoms. Trawl. Temperature at 480 fathoms 8·68° C.—Macerated fragments of a large specimen.

S.R. 493.—8/9/'07.—51° 58′ N., 12° 25′ W. 533–570 fathoms. Trawl. Temperature at 500 fathoms 8·53° C., salinity 35·44°/$_{oo}$—One, 116 mm.

S.R. 495.—8/9/'07.—52° 0′ N., 13° 10′ W. 346–400 fathoms. Prawn trawl—One, 68·5 mm.

S.R. 505.—12/9/'07.—50° 39′ N., 11° 14′ W. 464–627 fathoms. Trawl—One, 52·5 mm., and macerated fragments of a large specimen.

S.R. 506.—12/9/'07.—50° 34′ N., 11° 19′ W. 661–672 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·53°/$_{oo}$—One, 53 mm.

The large perfect specimen of 132 mm. (S.R. 397) was found in the mouth of the deep-water Gadoid fish *Mora mediterranea;* the other large example (S.R. 493), which is unfortunately very macerated, was taken from the stomach of the deep-water eel *Synaphobranchus pinnatus*—an enormous meal for a fish only 33 cms. in length. Judging from the numerous occasions on which half-digested fragments of large specimens have been found, the adult is not rare in Irish waters; it seems probable that the species is very active and manages to evade the trawl in its passage along the bottom.

Vertical range.—As far as at present known *Pasiphaë princeps* is restricted to the bottom. It has been trawled in the W. Atlantic between 444 and 1,342 fathoms (Smith); off Ecuador in 1,132 fathoms (Faxon), in the N. Pacific in 399 and 859 fathoms (Rathbun) and in the Bay of Biscay in 246 fathoms. The vertical range is, therefore, 246 to 1,342 fathoms.

Pasiphaë sp. juv.

On several occasions small specimens of *Pasiphaë*, ranging up to 25 mm. in length, have been met with in deep water off the Irish coast. These specimens show the bifurcated telson typical of *P. tarda* and *P. princeps*, but to which of these species they should be referred is by no means clear. The rostra present a close similarity to that found in *P. tarda*, but a specimen of 37 mm., which can clearly be referred to *P. princeps*, differs so little from *tarda* in this respect that the character must be considered untrustworthy in very small individuals. None of these post-larval specimens show traces of spines on the ischium and basus, and the shape of the antennal scale and comparative measurements—features by which *tarda* and *princeps* may easily be distinguished at sizes of 40 mm. and upwards—do not suffice to determine the two species among the material examined. Seeing that only a single example of *P. tarda* has been found off the Irish coast, while *P. princeps* is not uncommon, it is probable that these post-larval specimens belong to the latter species, but it is impossible to be certain of this without comparison with authentic young *P. tarda*.

Post-larval specimens have been found on the following occasions:—

Helga.

CXX.—24/8/'01.—53° 58′ N., 12° 22′ W. 382 fathoms. Trawl—One.

S.R. 227.—14/5/'05.—53° 20′ N., 13° 0′ W. 164 fathoms. Trawl. Temperature at 120 fathoms 9·5° C.—One.

S.R. 351.—9/8/'06.—50° 19′ 30″ N., 11° 6′ W. 230–250 fathoms. Trawl. Temperature at 245 fathoms 10·1° C., salinity 35·43°/$_{oo}$—Twenty-six.

S.R. 359.—8/8/'06.—52° 0′ N., 12° 6′ W. 465–492 fathoms. Trawl. Temperature at 475 fathoms, 9·04° C., salinity 35·37°/$_{oo}$—One.

S.R. 440.—16/5/'07.—51° 45′ N., 11° 49′ W. 350–389 fathoms. Trawl. Temperature at 300 fathoms 9·93° C., salinity 35·46°/$_{oo}$—One.
S.R. 447.—18/5/'07.—50° 20′ N., 10° 57′ W. 221–343 fathoms. Trawl. Temperature at 300 fathoms, 9·87° C., salinity 35·48°/$_{oo}$—Two.
S.R. 449.—19/5/'07.—50° 28′ N., 11° 39′ W. Soundings 950 fathoms. Midwater trawl, 0–800 fathoms—One.
S.R. 484.—30/8/'07.—51° 35′ N., 11° 57′ W. 602–610 fathoms. Trawl. Temperature at 550 fathoms, 8·34° C., salinity 35·32°/$_{oo}$—One.
S.R. 497.—10/9/'07.—51° 2′ N., 11° 36′ W. 775–795 fathoms. Trawl—Two.

Thor.

7/6/'05.—57° 47′ N., 11° 33′ W. Soundings 975 fathoms. Midwater trawl, 0–820 fathoms—One.

Genus **Parapasiphaë**, Smith.

Parapasiphaë, Smith, 1884.
Parapasiphaea, Alcock, 1901.

Parapasiphaë sulcatifrons, Smith.

Pl. V, figs. 1–21.

Parapasiphaë sulcatifrons, Smith, 1884, Pl. v, fig. 4; Pl. vi. figs. 1–7.
Parapasiphaë sulcatifrons, Smith, 1886.
Parapasiphaë sulcatifrons, Hansen, 1908.

The *rostrum* is a regular prolongation of the carapace, not a post-frontal spine, as in *Pasiphaë*; it is acute, unarmed above and below, and reaches to about one-half the length of the eyestalks. The *carapace* is about half the length of the abdomen and telson combined and is dorsally arched behind the rostrum; posteriorly it is deep, anteriorly rather narrowed, but not to such an extent as is found in the previous genus. Dorsally it is carinate throughout its length, the anterior third of the carina being depressed and dorsally sulcate; this is evidently a notable feature in large specimens (cf. Smith, Pl. V, fig. 4), but is not so conspicuous in the smaller examples found off the Irish coast. The anterior margin of the carapace is almost straight below the orbital notch and is provided with a minute point between the insertions of the antennae and antennules; the antero-lateral sulcus is rounded, and rather obtuse. Laterally a well-marked sinuous carina runs across the carapace near its inferior margin, disappearing shortly before it reaches the posterior edge, while anteriorly it terminates behind the base of the antennal peduncle.

All the *abdominal somites* are dorsally rounded with the exception of the fourth, which shows traces of a dorsal carina, and is produced posteriorly to a short spine which overhangs the succeeding somite. The sixth is less than two-thirds the length of the fifth and is more than half as deep as long. The *telson* is about half as long again as the last abdominal somite; it is dorsally sulcate and tapers to a narrow rounded apex (fig. 2), armed with eight spines, of which the outer pair is much the longest.

The *eyes* are two-fifths as long as the antennal scale. The rounded cornea is scarcely as wide as the stalk and is set obliquely on it; it is quite devoid of black pigment, but it is none the less distinctly facetted. The stalk is produced anteriorly to a small tubercle on its inner dorsal aspect. The *antennular peduncle* reaches to rather more than half the length of the antennal scale. The ultimate joint is longer than the penultimate; both together are shorter than the basal segment, which bears externally a lateral process, which does not quite reach to its distal end. The *antennal scale* is about three and a half times as long as broad[1]; externally it is convex, and is produced distally to a strong spine, which reaches beyond the rather narrow apex of the lamellar portion. The basal joints of the flagellum reach to about half the length of the scale.

The mandibles, maxillae and maxillipedes are figured by Smith (1884, pl. vi. figs. 2–7). The *mandibles* bear a palp composed of two joints of approximately equal length. The *second maxillae*, like those of *Pasiphaë*, do not possess the laciniae found in some other genera belonging to this family. The *first* and *second maxillipedes* possess epipods, but no exopods; in the first pair the epipod is large and bilobed and the rounded ultimate segment of the endopod is little more than one-third the length of the penultimate. The epipod of the second pair is very small and rudimentary. The *third maxillipedes* are provided with a small epipod and a long exopod, which reaches to about half the length of the penultimate segment. The two distal segments are together about equal in length to the anti-penultimate.

The *first pair of pereiopods* reaches beyond the antennal scale by more than half the length of the propodus. The chela is about half the length of the carapace and its dactylus is about two-thirds the length of the palm. In the *second* pair the merus is much longer, and is provided with a few spinules on its inferior margin. The chela is much longer and more slender and the dactylus is only a little shorter than the palm. When stretched forward this pair of legs reaches beyond the apex of the antennal scale by five-sixths the length of the chela. The *third pair* of pereiopods is very slender and reaches beyond the apex of the eyes. The ischium is nearly half the length of the propodus, the latter being less than two-thirds as long as the merus; both carpus and dactylus are

[1] Smith states that the antennal scale is three times as long as broad; his description was drawn up from large specimens in which the antennal scale (and uropods) are wider than in the smaller Irish examples.

extremely short. The *fourth pair* is scarcely as long as the chela of the first pair; the *fifth* is longer—about equal to the carpus and chela of the first pair. The joints of these two limbs have much the same proportion as in *Pasiphaë tarda*. The exopods of all five pereiopods are well developed, and decrease in size from before backwards.

The small endopod of the first pair of *pleopods* has much the same form as in the three British and Irish species of *Pasiphaë*. None of the three large specimens show the secondary stylet on the second pair characteristic of the male. The outer *uropods* are about four times as long as wide; apically they are broadly rounded and possess a short spine on their outer margin behind the apex.

Size.—The largest specimen found off the Irish coast measures only 47 mm.; one of Smith's type specimens is an ovigerous female, 83 mm. in length.

Colour in life.—The whole animal is of an evenly distributed bright scarlet red colour, with very numerous darker red chromatophores, which are less distinct on the flagella and on the first two pairs of pereiopods. The corneal portions of the eyes are reddish crimson in colour.

Development.—According to Smith (1884), the eggs of this species reach the enormous size of 4 by 5 mm. in shorter and longer diameter; in an ovigerous specimen from Canon Norman's Museum (now in the British Museum) they are hardly as large as this, measuring 3 by 3·7 mm.

On two or three occasions larval forms of rather unusual appearance have been found off the Irish coast; these may undoubtedly be referred to *P. sulcatifrons*. Although only a few specimens were obtained, a number of stages are represented, the largest of which are clearly specifically identical with post-larval specimens of this species found in the same and in other hauls.

The smallest example in the collection measures only 8·5 mm. This specimen is, unfortunately, not in good condition, and cannot be described in detail. It shows, however, that at this stage the rostrum is represented only by a minute point, the eyestalks are extremely short and almost invisible in dorsal view, while the antennules are merely formless lobes. The antennal scales are present, but show no trace of the spine at the outer distal angle, the flagella being only about one-third the length of the scale. Three pairs of maxillipedes and the first two pairs of periopods are evident, the remaining pairs of the latter being represented merely by buds. No gills could be observed, and neither pleopods nor uropods are developed. The telson is laminar (fig. 3), with an emarginate apex, furnished apparently with six pairs of setae.

In the same haul (S.R. 231) with this small specimen are two others, measuring about 13·5 and 14 mm. This stage (figs. 4 and 5), with its swollen carapace and very broadly rounded telson, presents a peculiar and very distinct appear-

ance. The carapace is rather more than half the length of the abdomen and telson combined; it is produced anteriorly to a short rostrum. Viewed from above, the carapace conceals almost the whole of the eyes. The latter are, of course, unpigmented and at this stage show no trace of facets. A single joint composes the antennular peduncle and another, of about the same length, the outer flagellum; a small process from the inner distal angle of the peduncular joint represents the first beginning of the inner flagellum. The antennal scales are well developed, nearly half the length of the rostrum and carapace, and rather more than two and a half times as long as wide. The outer margin is convex, terminating in a triangular distal spine; the setae of the inner margin are all broken off. The antennal flagella are about two-thirds the length of the scale.

The mandibles are simple lobes, without trace of dentition or of palps. A trilobed process (fig. 6) represents the first maxilla; in the second maxilla (fig. 7) the endopod is short, while the exopod bears numerous plumose setae. The maxillipedes are biramous and much longer than the pereiopods; the endopods, which hardly show any trace of segmentation, are shorter than the exopods. Five pereiopods, all unsegmented and all possessing exopods, are present; the exopods decrease in size from before backwards. The endopod of the fourth pair is already slightly shorter than that of the fifth. Of the branchiae (fig. 8), five pleurobranchs are developed over the bases of the five pereiopods; that over the first is the largest, while the gill over the fifth is little more than a papilla.

Five pairs of pleopods are represented by minute buds. The sixth somite and telson, which are not clearly differentiated from each other, are longer than the carapace. No uropods are free as yet. The telson is very broadly laminar; in width it is almost equal to two-thirds the length of the sixth somite and telson combined. It is roughly triangular and apically slightly convex; in perfect specimens it is doubtless provided with spines at the extremity.

Other larval specimens, five in number, were taken in a different haul (S.R. 224), and show the transition between the form with the broad telson, described above, and post-larval individuals. The youngest example found in this haul measures a little more than 15 mm. in length; it is a trifle longer than the other four specimens, which represent a later stage. With such a small number of specimens it is impossible to determine if there is a real reduction in length between these stages; it would not be altogether surprising if such was the case.

In the youngest of the five larval specimens in this haul, the antennular peduncle shows traces of sub-division, the outer flagellum reaches to the apex of the antennal scale, the inner ramus being about half its length. The antennal flagellum also reaches about to the apex of the scale. The rostrum, eyes and carapace are much the same as in the later stage, described

further on. The exopods of the maxillipedes are reduced in size; only those of the second pair now remain longer than the endopods. The first three pairs of pereiopods are faintly divided into segments; in the first two pairs a rudimentary chela is formed by an outgrowth of the propodus parallel with the dactylus. Five pleurobranchs only can be seen. The last four pairs of pleopods are biramous, short buds at the base of the endopods representing the rudimentary appendices. The telson (fig. 9) is broad and laminar and less than twice as long as wide; apically it is very slightly emarginate, and shows traces of having borne setae. The uropods are now free; the outer branch is provided with a spine at its outer distal angle, and is about two-thirds the length of the telson. The specimen was about to moult and the much narrower telson, characteristic of the later stages, may be seen lying within the broad lamina, which forms such a prominent feature of the earlier larvae.

It is, of course, obvious that one or more stages, which are not present in the collection, occur between this and the form previously described.

The other four specimens all measure approximately 15 mm. In this stage (fig. 11) the rostrum and carapace together are rather longer than the first five abdominal somites. Dorsally the carapace is carinate for the greater part of its length, terminating anteriorly in a rostrum which reaches to, or beyond, the distal extremity of the eye-stalks. The carina, though high, is not very sharp, but as yet there is no trace of the dorsal sulcus found in the adult. Viewed from above, the eyes are still largely concealed by the hooded anterior margin of the carapace. They are now considerably longer than in the early stages, but still show no traces of facets. The antennular peduncle is subdivided into its three segments; an external outgrowth from the basal one represents the lateral process. The flagella have lengthened; the inner ramus, which is about half the length of the outer, falls short of the apex of the antennal scale. The scale itself is about three times as long as wide and is slightly shorter than the antennal flagellum.

The mandibles (fig. 12) are still rounded lobes, but the specimen figured was about to moult, and teeth similar to those of the adult may be seen within the margin of the cutting edge. There is no trace of the palp. The maxillae (figs. 13 and 14) show considerable development. In the first maxillipedes (fig. 15) the exopod is dwindling, being now much shorter than the endopod. The exopod of the second maxillipede (fig. 16) is still well developed and about as long as the endopod; in the latter the dactylus is only obscurely separated from the propodus, the other joints being distinctly marked. A short outgrowth from the base of the third maxillipede (fig. 17) is the first indication of an epipod; the exopod is a trifle longer than the ante-penultimate joint. All the joints of the pereiopods are clearly marked; they have now assumed a form closely resembling that of the adult; the chelae of the first two

pairs are fully developed. Of branchiae, the five pleurobranchs noticed in the earlier stages are very conspicuous and all are subdivided into lamellae. There is as yet no trace of any arthrobranch.

The last four pairs of pleopods are biramous, with a conspicuous appendix or stylet at the base of the endopod. The stylet at the proximal end of the exopod of the first pair is also represented. The telson (fig. 10) is about three and a half times as long as wide and is only slightly longer than the outer uropods; apically it is emarginate and provided with several pairs of setae. Within its margin the form which it assumes at the next moult is clearly visible; in this, the apex is not so strongly emarginate and is furnished with four pairs of setae, the outermost of which are the longest.

The majority of the remaining specimens in the collection may conveniently be termed post-larval. In these the eyes exceed the rostrum in length, the pereiopods, pleopods and uropods are fully formed and the telson is narrow.

In a specimen measuring 16·5 mm. the eyes are longer than the rostrum and the corneal area, which is now distinct from the stalks, exhibits faint traces of facets. The mandibles have a dentate cutting edge, but possess no palp. The first maxillipede (fig. 18) carries a bilobed epipod and still possesses a short exopod; the ultimate joint of the endopod is about two-thirds the length of the penultimate. The second maxillipede (fig. 19) bears an exopod of considerable length; the joints of the endopod are taking on the adult form, but the ischium is less than one-third the length of the merus. A prominent papilla at the base of the third maxillipede represents the epipod. The telson is very slightly emarginate at the apex and is provided with eight spines.

A specimen slightly longer, barely 17 mm. in length, shows a much smaller exopod on the second maxillipede (fig. 20), the ischium has increased in length in proportion to the merus, but there is as yet no trace of the small epipodal outgrowth present in the adult. In the first maxilla the ultimate joint is shorter, in proportion to the penultimate, than in the previously described specimen and the exopod is dwindling rapidly. The telson is abruptly truncate with the usual four pairs of setae.

In a specimen 19 mm. in length the exopods on the first and second maxillipedes have entirely disappeared.

The small epipod of the first maxillipede first makes its appearance in a specimen 24 mm. in length.

The development of the branchiae is exceedingly slow. An example of 24 mm. possesses the usual five pleurobranchs over the five pereiopods, one arthrobranch (anterior) at the base of the third maxillipede and arthrobranchs at the base of the first two pereiopods. The arthrobranchs at the base of the third and fourth pereiopods are represented merely by papillae. A specimen of 28·5 mm. is provided with the full complement of gills, with the exception of two, viz., the posterior

arthrobranch of the third maxillipede and the arthrobranch over the base of the fourth pereiopod; both, however, are indicated by papillae. The complete series of gills is found in an example of 38 mm.

The extremely late development of the mandibular palp is one of the most interesting features of the development of this species. In specimens of 30 mm. and under no trace of it can be found, while in examples of 33 and 38 mm. it is present only as a simple lobe (fig. 21), without trace of subdivision or of setae. In the Irish collection the two-jointed mandibular palp, so essentially characteristic of the genus *Parapasiphaë*, is found only in the two largest specimens, measuring 44 and 47 mm.

The sulcar depression on the dorsal carina of the carapace is evident only in specimens of 28 mm. and upwards.

Several points in the development of *P. sulcatifrons* are rather remarkable, and call for special mention.

Throughout the metamorphoses the length of the rostrum remains practically unchanged in its relation to the other parts; the eyes, on the other hand, which are at first almost obsolete, gradually increase in proportional length, and in the later stages reach beyond the apex of the rostrum. Black pigment is absent throughout and it is only in specimens of 16 mm. and upwards that the corneal portion is differentiated from the stalk and shows traces of the obscure facets found in the adult.

The apex of the telson is at first emarginate, then definitely convex; later, it is again found to be emarginate, while in the adult it is once again convex. The very broad larval telson rapidly narrows down to the adult form in the course of a few moults, during which the total increase in length of the specimens is insignificant.

The late development of the arthrobranchs, the complete series of which are only present in specimens of 38 mm. and upwards, is in accordance with what was previously known in the case of the closely related genus *Pasiphaë* (cf. Calman, 1903). The retention of exopods on the first two pairs of maxillipedes until a comparatively late stage is rather remarkable, but much more astonishing is the complete absence of the mandibular palp in specimens 30 mm. in length, and its rudimentary, one-jointed, condition in examples of 33 and even 38 mm. The possession of a one or two-jointed palp is a most important generic distinction in the family Pasiphaeidae, but its rudimentary character in the present species, in a specimen in which even the branchiae are fully developed, indicates that considerable caution is necessary in its use in examples which are not clearly recognised as adult.

If, as seems probable, the specimen of 8·5 mm. represents the earliest free larva, the metamorphosis of *P. sulcatifrons*, as might be expected in an abyssal species bearing large eggs, is considerably curtailed. The presence in the specimen of all five pereiopods (though only in the form of buds) renders the term *zoea* inapplicable; the change from the true zoea to this stage is doubtless effected within the egg.

Coutière has recently (1907, 1 and 2) referred numerous larvae known by the name of *Anisocaris* to the family Pasiphaeidae, and considers that *Caricyphus angulatus*, Spence Bate (1888) is a closely allied larval form. While in no way dissenting from this view, it may be pointed out that *C. angulatus* and the forms of *Anisocaris*, with their long rostrum and pronounced elbow on the third abdominal somite, are strikingly different from any stage in the development of *P. sulcatifrons*.

General distribution.—In the W. Atlantic this species is known from between lat. 35° 12′ and 41° 53′ N., and long. 65° 35′ and 74° 57′ W. (Smith); in the N.E. Atlantic it has been recorded from three stations to the south and west of Iceland (Hansen). In the British Museum there is a single specimen, an ovigerous female 70 mm. in length, which was presented by Canon Norman[1]; it was taken in 1875 by the *Valorous* expedition in lat. 52° 33′ N., long. 26° 44′ W. I have also examined a specimen found by the *Thor* as follows:—

10/7/'04—61° 34′ N., 19° 5′ W. Soundings, 1180 fathoms. Midwater trawl, 0–985 fathoms—One, 16·5 mm.

Irish distribution.—*P. sulcatifrons* has been found rather frequently in deep water off the west coast. Large specimens are not common; the adults possibly occur in greater abunance further off shore. The records are:—

Helga.

S.R. 197.—11/2/'05.—54° 57′ N., 10° 51′ W. Soundings $\frac{1}{1,000}$ fathoms. Townet, 0–580 fathoms—One small, broken.

S.R. 224.—12/5/'05.—53° 7′ N., 15° 6′ W. Soundings 860 fathoms. Midwater trawl, 0–750 fathoms—Seven, 15–30 mm.

S.R. 231.—20/5/'05.—55° 1′ N., 10° 45′ W. Soundings 1,200 fathoms. Midwater trawl, 0–1,150 fathoms—Three, 8·5–14 mm., and one 28·5 mm.

S.R. 282.—18/11/'05.—54° 59′ N., 10° 53′ W. Soundings $\frac{1}{1,000}$ fathoms. Triangle net, 0–700 fathoms. Surface temperature 10·7° C., salinity 35·30°/$_{oo}$. Temperature at 700 fathoms 9·0° C.—Two, 16 and 38 mm.

S.R. 327.—8/5/'06—51° 48′ N., 12° 16′ W. 550–800 fathoms. Trawl. Temperature at 500 fathoms, 9·22° C., salinity 35·16°/$_{oo}$—One, 33 mm.

S.R. 352.—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Midwater trawl, 0–750 fathoms—One, 16 mm.

S.R. 363.—10/8/'06.—51° 22′ N., 12° 0′ W. 695–720 fathoms. Trawl. Temperature at 600 fathoms, 7·92° C., salinity 35·30°/$_{oo}$—One, 15 mm.

[1] In the bottle with the specimen is a note, in Norman's handwriting, which states that the specimen was erroneously recorded by him in the Proceedings of the Royal Society as *Pasiphaë tarda*.

S.R. 449.—19/5/'07.—50° 28′ N., 11° 39′ W. Soundings 950 fathoms. Midwater trawl, 0–800 fathoms—One, 44 mm.

S.R. 470.—24/8/'07.—50° 16′ N., 11° 27′ W. Soundings 770 fathoms. Midwater trawl, 0–500 fathoms. Temperature at 500 fathoms 9·03° C., salinity 35·35°/$_{oo}$—One, 19 mm.

S.R. 477.—28/8/'07.—51° 15′ N., 11° 47′ W. 707–710 fathoms. Trawl. Temperature at 700 fathoms, 7.19° C.—One, 15·5 mm.

S.R. 481.—29/8/'07.—50° 59′ N., 11° 52′ W. Soundings 920–1,064 fathoms. Midwater trawl, 0–900 fathoms—Two, one 16·5 mm., one broken.

S.R. 484.—30/8/'07.—51° 35′ N., 11° 57′ W. 602–610 fathoms. Trawl. Temperature at 550 fathoms, 8·34° C., salinity 35·32°/$_{oo}$—Two, 14·5 and 47 mm.

S.R. 500.—11/9/'07.—50° 52′ N., 11° 26′ W. 625–666 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·41°/$_{oo}$—One, 24 mm.

Vertical range.—Off the east coast of N. America *P. sulcatifrons* has been taken in soundings varying from 515 to 2,949 fathoms (Smith), but whether the specimens were actually living at the latter depth is very doubtful. The species is frequently taken in midwater; there is no certain record of its capture on the bottom, although it has on many occasions been caught in beam and Agassiz trawls. On one occasion (Smith, 1886, St. 2,223) the species has been recorded from the surface in soundings of 2,516 fathoms; Smith suggests that the specimen may have been wrongly labelled, but the occasional occurrence of other deep-sea forms at or near the surface renders this hypothesis open to doubt.

Family *HOPLOPHORIDAE*.

Of this family three genera, comprising four species, are now known from the deep water off the west coast of Ireland.

I. Endopod of first maxillipede composed of three segments; the two inner distal lobes (basipodite) of the second maxilla narrow and projecting beyond the basal lobe.

A. Merus and ischium of pereiopods normal, not broad or strongly compressed; rostrum rarely very short, and always armed with teeth or serrations, *Acanthephyra*, (p. 56).

B. Merus and ischium of pereiopods very broad, strongly compressed and laminar; rostrum very short and quite unarmed, *Ephyrina* (p. 68).

II. Endopod of first maxillipede composed of only two segments; the two inner distal lobes of the second maxilla rather broad and not projecting beyond the basal lobe; rostrum short and dorsally serrate, ... *Hymenodora* (p. 72).

GENUS **Acanthephyra,** A. Milne-Edwards.

Systellaspis, Spence Bate.

The two British and Irish species of this genus may be separated thus :—

I. Rostrum armed with five to eleven teeth above and three to seven below; all the abdominal somites except the first strongly carinate dorsally; posterior edges of fourth and fifth somites entire; telson not acutely pointed apically; no photophores present, . . . *A. purpurea.*

II. Rostrum armed with thirteen to sixteen teeth above and eight to eleven below; only the third abdominal somite dorsally carinate; posterior edges of fourth and fifth somites crenate; telson terminating acutely; numerous photophores present, . . . *A. debilis* (p. 59).

Acanthephyra purpurea, A. Milne-Edwards.

Acanthephyra purpurea, Kemp, 1906 (1) (*ubi syn.*), Pl. I and Pl. II, figs. 1–3.

Acanthephyra purpurea, Coutière, 1906, figs. 5–7 (post-larval development).

Acanthephyra purpurea, Kemp, 1907, Pl. XIV; Pl. XV, fig. 1 (larval development).

In my account of this species in the Report for 1905 (1906(1)), will be found a discussion of the lengthy synonymy together with a description and figures. Owing to a printer's error the gill-formula given on p. 14 thereof is incorrect, and should read as follows :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	ep.	(ep.)	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The rudimentary epipod at the base of the fourth pair of pereiopods is very short—not longer than broad.

Since November, 1905, *A. purpurea* has again been taken on many occasions and in all stages, and has been found in the stomachs of two deep-water fish, *Synaphobranchus pinnatus* and *Haloporphyrus eques*. The large majority of the Irish specimens are referable to Coutière's var. *multispina*.

The additional records are :—

Helga.

S.R. 299.—5/2/'06.—50° 13′ 30″ N., 11° 16′ W. Soundings 500 fathoms. Triangle net, 0–400 fathoms. Surface temperature 10·8° C.; temperature at 350 fathoms 10·8° C.—One, 60 mm.

S.R. 327.—8/5/'06.—51° 46′ N., 12° 14′ 30″ W. Soundings 550 fathoms. Townet, 0–50 fathoms. Surface temperature 11·5° C., salinity 35·14°/$_{oo}$; temperature at 50 fathoms 10·55° C., salinity 35·14°/$_{oo}$—Seven (*zoea* and *mysis* stages).

S.R. 334.—10/5/'06.—51° 35′ 30″ N., 12° 26′ W. 500–520 fathoms. Trawl—One, 91 mm.

S.R. 336.—12/5/'06.—51° 19′ N., 12° 20′ W. 673–720 fathoms. Trawl. Temperature at 700 fathoms 6·84° C., salinity 34·99°/$_{oo}$—One, 77 mm.

S.R. 337.—13/5/'06.—51° 22′ N., 12° 9′ W. Soundings 768 fathoms. Midwater trawl, 0–450 fathoms—Three, 22–32 mm.

S.R. 352.—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Midwater trawl, 0–750 fathoms. Surface temperature 15·85° C.; temperature at 750 fathoms 7·33° C.—Two, 23 and 37 mm., and fragments of four specimens in the *mysis* stage.

S.R. 359.—8/8/'06.—52° 0′ N., 12° 6′ W. 465–492 fathoms. Trawl. Temperature at 480 fathoms 9·04° C., salinity 35·37°/$_{oo}$—One, *parva* stage.

S.R. 363.—10/8/'06.—51° 23′ 30″ N., 11° 47′ W. 695–720 fathoms. Trawl. Temperature at 600 fathoms 7·92° C., salinity 35·37°/$_{oo}$—One, 66 mm., found in stomach of *Synaphobranchus pinnatus*.

S.R. 397.—2/2/'07.—51° 46′ N., 12° 5′ W. 549–646 fathoms. Trawl. Temperature at 500 fathoms, 8·71° C., salinity 35·37°/$_{oo}$—Two, *parva* stage.

S.R. 400.—5/2/'07.—51° 21′ N., 11° 49′ W. 525 fathoms. Townet on dredge—One, *parva* stage.

S.R. 401.—5/2/'07.—51° 14′ N., 11° 51′ W. 600–660 fathoms. Trawl. Temperature at 580 fathoms 8·35° C., salinity 35·50°/$_{oo}$—One, *parva* stage.

S.R. 403.—6/2/'07.—51° 12′ N., 11° 56′ W. Soundings 660 fathoms. Triangle net, 0–500 fathoms—One, ♀ ovigerous, 93 mm.

S.R. 404.—6/2/'07.—51° 14′ N., 11° 56′ W. Soundings about 700 fathoms. Triangle net, 0–500 fathoms—Three, 56-74 mm.

S.R. 442.—16/5/'07.—51° 34′ N., 11° 48′ W. 465–508 fathoms. Trawl—One, 24 mm.

S.R. 449.—19/5/'07.—50° 28′ N., 11° 39′ W. Soundings 950 fathoms. Midwater trawl, 0–700 fathoms—Five, 28-71 mm., and five *mysis* stage.

S.R. 470.—24/8/'07.—50° 16′ N., 11° 27′ W. Soundings 770 fathoms. Midwater trawl, 0–500 fathoms Surface temperature 15·8° C., salinity 35·30°/$_{oo}$. Temperature at 500 fathoms 9·03° C., salinity 35·35°/$_{oo}$—Three, 38–110 mm., five *parva* stage, one *mysis*.

S.R. 476 —27/8/'07.—51° 42′ 30″ N., 12° 15′ 30″ W. Soundings 640 fathoms Midwater trawl, 0–300 fathoms Surface temperature 15·45° C.,salinity 35·37°/$_{oo}$; temperature at 250 fathoms 10·19° C., salinity 35·34°/$_{oo}$—One, 43 mm., and twenty-eight *zoea* and *mysis* stage.

S.R. 477.—28/8/'07.—51° 15′ N., 11° 47′ W. 707–710 fathoms. Trawl. Temperature at 700 fathoms 7·19° C.—One, *parva* stage.

S.R. 478.—28/8/'07.—51° 17′ N., 11° 44′ W. 560–707 fathoms. Trawl—One, *parva* stage.

S.R. 481.—29/8/'07.—50° 59′ N., 11° 52′ W. Soundings 920–1,064 fathoms. Midwater trawl, 0–900 fathoms—Five, 15–94 mm.

S.R. 487.—3/9/'07.—51° 36′ N., 11° 57′ W. 540–660 fathoms. Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—One, *parva* stage.

S.R. 488.—4/9/'07.—51° 35′ N., 11° 57′ W. Soundings 540–720 fathoms. Midwater trawl, 0–400 fathoms—Three, *parva* stage.

S.R. 489.—4/9/'07.—51° 35′ N., 11° 55′ W. 720 fathoms. Trawl—One, large, from stomach of *Haloporphyrus eques*; one *parva* stage.

S.R. 494.—8/9/'07.—51° 59′ N., 12° 32′ W. 550–570 fathoms. Trawl.—One, 85 mm. (rostrum broken).

S.R. 497.—10/9/'07.—51° 2′ N., 11° 36′ W. 775–795 fathoms. Trawl.—One, *parva* stage.

S.R. 498.—11/9/'07.—50° 58′ N., 11° 33′ W. Soundings 775–778 fathoms. Triangle net, 0–600 fathoms—Five, *parva* stage.

S.R. 499.—11/9/'07.—50° 35′ N., 11° 29′ W. 666–778 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·41°/$_{oo}$—One, 107 mm.

Thor.

21/5/'05.—47° 47′ N., 8° 0′ W. Soundings 454–581 fathoms. Midwater trawl, 0–274 fathoms.—One, 54 mm.

28/5/'05.—61° 11′ N., 11° 0′ W. Soundings 527 fathoms. Midwater trawl, 0–492 fathoms—One, 35 mm.

9/6/'06.—49° 23′ N., 12° 13′ W. Soundings 722 fathoms. Midwater trawl, 0–600 fathoms—Two, 74 and 90 mm.

10/8/'06.—49° 27′ N., 13° 33′ W. Soundings $\dot{1},\dot{4}\dot{2}\dot{0}$ fathoms. Midwater trawl, 0–1,550 fathoms—One, 27 mm.

51° 4′ N., 11° 39′ W. Midwater trawl, 0–435 fathoms—Two, 28 and 54 mm.

Acanthephyra (**Systellaspis**) **debilis**, A. M.-Edw.

Pl. VI, figs. 1–15.

Acanthephyra debilis, Kemp, 1906 (1) (*ubi syn.*), Pl. II, figs. 4–7.

Systellaspis debilis, Coutière, 1906, figs. 1–4 (development).

Acanthephyra gracilis, Hansen, 1908.

The capture of further examples of this interesting form, ranging from very young larvae up to mature specimens, provides material for the consideration of some of the features of the development, and also allows a more complete specific diagnosis to be drawn up.

The *rostrum* is from one and a half to twice the length of the carapace; it trends downwards at its base, but from its middle point is again ascendant. On its basal crest it is armed with three to five spines, two or three of which are situated behind the posterior angle of the orbit; the blade of the rostrum is provided with from nine to twelve teeth above and with eight to eleven below. The complete rostral formula is usually found to be thirteen to sixteen above and eight to eleven below.

The *carapace*, measured in the middle line, is less than half the length of the abdomen (excluding the telson); from the rostrum a dorsal carina runs backwards, becoming obsolete at about the middle line. The margin of the orbit is evenly rounded as far as the supra-antennal angle (there is no prominence representing the orbital spine as in *A. purpurea*); the spine at the antero-lateral angle is sharp, but is not flanked by any definite carina.

All the *abdominal somites* are dorsally rounded, with the exception of the third, which is strongly carinate and produced posteriorly to a sharp spine projecting over about one-third of the following somite. The posterior margins of the fourth and fifth somites are also produced into short spines which are laterally compressed; the dorsal portions of the postero-lateral margins of these two somites are strongly crenate in mature specimens, less obviously in small examples. The sixth somite is in small individuals about twice the length of the fifth, in adults rather shorter. The *telson* is usually about equal in length to the outer uropod and bears a rather peculiar type of spinulation. The apex is very acutely pointed, and immediately behind it are four pairs of spines, above which there is a single pair of much stouter spines, which in some cases reach more than half way towards the tip. Over the base of each large spine a smaller one projects, which points straight towards the apex and is not directed outwards like the rest. Behind this terminal cluster there are three to five pairs placed in a dorso-lateral position.

An ocellus is present on the dorsal surface of the *eyestalk*

and two minute papillae on its internal aspect, quite close to the wide hemispherical cornea. The *antennular peduncle* is very short, reaching to only about one-third the length of the antennal scale; the basal joint is longest, its lateral process is not very acutely pointed anteriorly, and falls short of the distal end of the segment. The *antennal scale* is about five-sixths the length of the carapace in large specimens, in smaller examples shorter; at its base it is about three and a half times as long as wide, the lamellar portion being strongly narrowed apically. Externally it is slightly convex, and terminates anteriorly in a strong spine.

In the *first maxillae* the middle joint (basipodite) is much broader than in *A. purpurea;* in the *second* the same joint is also much broader than in that species, while the exopod is narrower. The endopod of the *first maxillipede* is more slender than in the allied form, with its terminal segment shorter, and the lamelliform exopod is very narrow apically. The terminal joint of the endopod of the *second maxillipede* is transversely articulated with the penultimate joint, not obliquely as in *A. purpurea.*

The *third maxillipedes,* which bear long exopods, reach rather beyond the middle of the antennal scale; the penultimate joint is scarcely more than half the length of the ultimate.

The five pairs of *pereiopods* all bear long exopods, decreasing in size from before backwards. The first two pairs are chelate and about equal in length—not quite reaching to the middle of the ultimate joint of the outer maxillipedes. The third and fourth pairs are much longer and when stretched forwards reach to considerably more than half the length of the antennal scale. The merus is armed with numerous short ventral spines and the propodus is at least three times the length of the carpus; the dactylus is very long—about two-thirds the length of the propodus. In small specimens these two pairs are only slightly longer than the others; in examples of 30-35 mm. they only reach as far forward as the first pair. The fifth pair is very much shorter, and when stretched forwards scarcely reaches beyond the distal end of the carpus of the fourth pair; the dactylus is very much longer than in *A. purpurea,* being nearly one-third the length of the propodus.

The *pleopods* show the usual structure; those of the second somite have two stylets at the base of the endopod in the male; one only in the female. The outer *uropods* are fully five and a half times as long as wide.

The *eggs* are very large, measuring about $3{\cdot}2 \times 2$ mm.; the two ovigerous females examined were carrying twelve and fourteen respectively.

Luminous organs.

Acanthephyra debilis is the only Decapod so far known from British and Irish waters which is possessed of photophores. In life these are always associated with a deep blue pigment

which is soluble in undiluted spirit, but fairly permanent in formalin. Specimens preserved for over a year in a mixture of 75 per cent. formalin (5 per cent.) and 25 per cent. spirit have lost all trace of the bright scarlet colour which is such a conspicuous feature of this and other deep-water Crustacea when living, but the photophores stand out very clearly as deep blue spots and streaks. In a paper in a previous report (1906 (1)) will be found a description of the luminous organs as they appear in a specimen of 43 mm.; although the number present is considerably greater in the mature animal, it seems unnecessary to give here a detailed account of them; reference to the table on p. 64 and to the figures will clearly show the position and numbers of those present in specimens of different sizes. Thus the larval form possesses only twelve photophores (six pairs), while no less than one hundred and forty-seven are to be found in the largest specimens.

The photophore on the exopod of the first maxillipede (fig. 10) is the chief addition here made to the very full list given by Coutière (1906); it is present in specimens of 33 mm. in length and upwards.[1] Pl. VI, fig. 1, shows an adult *A. debilis* in lateral view with its photophores; in large specimens it is impossible from this aspect to see any of the unpaired photophores, and those behind the coxa of the uropods and on the inner faces of the endopods of the pleopods and exopods of the pereiopods are also invisible. An attempt has been made to show, by means of fine lines round the luminous spots, those areas on the carapace and abdomen which are devoid of pigment. These have already been mentioned by the author (1907); they have the appearance of small windows in the prevailing red colouring of the animal, and their purpose is doubtless to enable the light to pass out from the photophore without being obstructed by pigmentation.

Size.—The largest specimen examined measures 78 mm. in length.

Hansen (1908) records a specimen of this species under the name of *Acanthephyra gracilis*, which is cited in my paper of 1906 (1) as a synonym of *A. debilis*. The discrepancies which this author notes between his specimen and my figure are doubtless due to the fact that at that time I had only very young examples at my disposal. Hansen also states that he could find no vestige of photophores, but the great difficulty of observing these organs in specimens which have been preserved for any length of time in alcohol probably accounts for their apparent absence. Once the blue pigment, which characterises them in life, has disappeared, it is only by the closest scrutiny that their existence is noticed, for a definite lens has only been demonstrated in the case of a single series, viz., those on the protopodites of the pleopods.

[1] I have not been able to discover the photophore which Coutière mentions on the exopodite of the second pair of maxillipedes. Maxillipède II. in his list is perhaps a misprint for maxillipède I.

Development.

Among several extremely young examples of this species, caught off the west coast of Ireland in February, 1906, is one measuring only 10·2 mm. This specimen is of the greatest interest, for although by the presence of a small number of photophores in the usual positions it is at once recognised as a young *A. debilis*, it is nevertheless a typical larva. It had been previously thought (cf. Coutière, loc. cit.) that this species differed in a most remarkable way from the allied form, *A. purpurea*, in that the young left the egg in a post-larval condition.[1] The large size of the egg when compared with that of *A. purpurea* gave an air of probability to this view, and it is doubtless true that the period of larval life is much shorter in *A. debilis* than in the allied species.

The larval specimen of 10·2 mm., Pl. VI, fig. 5, presents a very different appearance from post-larval individuals only 2·5 mm. longer. The *rostrum* is extremely short, only very slightly longer than the eyes; it is arched above and, of course, shows as yet no traces of teeth. The *carapace* is not at all laterally compressed and is about half the length of the abdomen and telson. Dorsally it is faintly carinate in its anterior half; there is a blunt prominence at the base of the orbit and the antero-lateral angle is sharp and spine-like.

The *abdominal segments* show no trace of carination, and none of them are produced backwards in the dorsal line to form spines; the sixth somite and telson combined are almost three and a half times as long as the fifth. The *telson* (fig. 7) closely resembles that found in a true zoëa, it is broadly lamellar, apically rounded and emarginate, and is furnished with seven pairs of spines. The uropods are not free in this stage.

The eye is almost globular, about one-sixth of the length of the carapace in diameter; the cornea is rather small and faintly pigmented. The *antennualr peduncle* is a trifle shorter than the antennal scale; the basal joint is about twice the length of the two others combined and the rudimentary flagellum is scarcely longer than the terminal peduncular joint. The *antennal scale* (fig. 8) is about two-fifths the length of the carapace and slightly more than twice as long as wide; apically it is broadly lamellar and only shows faint indications of a distal spine. The *antenna* is only about half the length of the scale; it is swollen basally, but the proximal joint is not marked off from the flagellum.

The *mandible* consists of a simple lobe, without teeth; no trace of a palp was observed. The *second maxilla* (fig. 12) consists of a basal portion which is four-lobed on its inner aspect, a lamellar exopod and an unjointed endopod. These

[1] Coutière has, indeed, figured his youngest post-larval specimen (11 mm.) tucked away inside the egg, in order to prove that it could have been little, if at all smaller, when it was hatched. It must be admitted, however, that the eggshell is an uncomfortably tight fit for the specimen in question.

last two are almost equal in length; the exopod is slightly produced basally and bears a few setae, distally it is furnished with four stout plumose setae. The endopod is provided with two similar setae apically and four others on its internal margin. In the *first maxillipede* (fig. 11) the endopod, which appears to be three-jointed, is only about half the length of the exopod; it is provided with a few apical setae, one in the middle of the inner margin of the terminal joint and one each on the inner distal margins of the two basal joints. In the *second* and *third maxillipedes* (figs. 9 and 10) the endopod is slightly longer, and is provided with apical setae only; in that of the third there is only the very faintest indication of the joints of which it is composed. The five *pereiopods* are present as biramose appendages, very much shorter than the maxillipedes; a simple forwardly directed process at the base of each represents an undeveloped pleurobranch. The *pleopods* are short and bud-like, but the endopod and exopod are differentiated.

Only six pairs of *luminous organs* are present. Those on the eyes and last pair of legs, which are present in even the youngest post-larval stages, are quite undeveloped, but the pair of vertical streaks behind the base of the fifth pereiopods are very conspicuous and those above the bases of the pleopods are also evident.

Most of the features of the post-larval development have been dealt with by Coutière (1906); a few additional remarks will be all that is necessary here.

A specimen of 12·7 mm. (fig. 13) represents the transitional stage between the larval and post-larval forms. In this example the rostrum, although it is of enormous size when compared with the larva, is still shorter than the antennal scale; it shows traces of ten teeth above and four below. The two pairs of chelae are imperfect, for the outgrowth of the propodus parallel to the dactylus is not yet completed. As will be seen from the figure the conspicuous tooth on the posterior margin of the third abdominal somite is now developed, and smaller ones are present on the two following somites.

The sixth somite is more than two and a half times the length of the fifth. The uropods are free, and the telson (fig. 14) is of interest because it shows the transition between the rectangular form of apex described and figured by Coutière and the normal acute tip of the adult. The specimen was evidently about to moult and the mature shape of the telson is seen lying within the outline of the earlier form. In this example the three photophores have developed on the eyestalk and also the three on the carpus and propodus of the last pereiopod and the pair above the base of the uropods. This is rather an unlooked-for mode of development, for it would a priori have been expected that those on the last pereiopod would have been the last to appear.

In an example of 13·9 mm. the photophores on the third maxillipedes and on the last three pairs of legs are developed, while the rostrum is slightly longer than the antennal scale. Another of 15·8 mm. (fig. 15) shows in addition the first of the

Length of specimen, mm.	10·2[1]		12·7[2]		13·9		15·8[3]		22		33		57		76	
	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.	Paired.	Unpaired.
Carapace : along inferior margin	.....	.....	.....	.....	.....	.....	1	.....	3	.....	3	.....	9	.....	12	.....
Do. others	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	3	.....	6	1	11	2
Eyestalks	.....	.....	3	.....	3	.....	3	.....	3	.....	3	.....	3	.....	3	.....
1st maxillipede : exopodite	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....	1	.....
3rd do. do.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
3rd do. ultimate joint	.....	.....	.....	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
2nd to 5th pereiopods : exopodites	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	4	.....
3rd pereiopod : carpus	.....	.....	.....	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
4th do. do.	.....	.....	.....	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
5th do. carpus and propodus	.....	.....	3	.....	3	.....	3	.....	3	.....	3	.....	3	.....	3	.....
Sternum and epimeron, behind 5th pereiopods	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
1st abdominal somite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	3	1	3	1
2nd do. do.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	4	1	7	1
3rd do. do.	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	2	.....	3	.....
4th do. do.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	3	1
5th do. do.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	2	1
6th do. do.	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	1	1	1	1
Telson	.....	.....	.....	.....	.....	.....	.....	1	.....	2	.....	2	.....	2	.....	2
1st pleopod : protopodite	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
1st do. exopodite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
2nd do. protopodite	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
2nd do. endopodite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
3rd do. protopodite	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
3rd do. endopodite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
4th do. protopodite	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
4th do. endopodite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
5th do. protopodite	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
5th do. endopodite	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	1	.....
Above base of coxopodite of uropod	.....	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....	1	.....
	2×6		2×13		2×16		2×17	2	2×23	3	2×35	3	2×54	6	2×69	9
Total number,	12		26		32		36		49		73		114		147	

[1] Plate VI, Figs. 7–12. [2] Plate VI, Figs. 13 and 14. [3] Plate VI, Fig. 15.

series along the inferior margin of the carapace and single unpaired photophores on the inferior aspect of the sixth somite and on the dorsal surface of the telson.

The table here given will show the number and positions of all the luminous organs present in a selected series of specimens ranging in size from larvae up to the adult.

The other more interesting features in the post-larval history are the development of the rostrum, eyes and branchiae.

The rostrum remains perfectly straight up to about 20–25 mm., and after this is almost always distally ascendant. It attains its greatest proportional length in examples of 35–40 mm., when it is often rather more than twice the length of the carapace.

The eyes, as Coutière (loc. cit.) has shown, reach their maximum size in proportion to the body area of the specimen at a length of about 15 mm.

As has been already stated, the branchiae are very rudimentary in the larval stage, the buds of five pleurobranchs being alone present. Their development in the earliest post-larval stages has already been dealt with by Coutière (loc. cit. fig. 2 D). In the specimens of 12·7 mm. they are exactly as he has described, i.e. five pleurobranchs, which are only pinnate basally, corresponding to the five pereiopods; two buds, representing arthrobranchs, over the third maxillipedes and an arthrobranchial and an epipodal bud at the bases of the first four pereiopods. Rudimentary epipods are also present on the first and second maxillipedes. The arthrobranchiae seem to develop slowly after this, for in a specimen of 27 mm., although they are completely pinnate, they are still very small, and have only grown a very short way up between the large fully-formed pleurobranchs.

The mandibular palp is fully developed in an example of only 15 mm.

General distribution.—Four isolated specimens have been found in the West Atlantic between New York and the West Indies (Milne-Edwards, Faxon and Smith). In the N.E. Atlantic the species is known from near the Azores (Coutière), from the Bay of Biscay (Kemp), from the mouth of the English Channel and off the Brittany coast (Hansen), while a single example has been found S. of Iceland in Lat. 62° 47′ N. (Hansen). A solitary individual has been recorded from the Pacific, near the Hawaiian Is. (Rathbun).

Several of the specimens examined were caught by the Danish Fishery steamer *Thor* at the following localities :—

Thor.

31/5/'06.—51° 4′ N., 11° 39′ W. Midwater trawl, 0–437 fathoms—Three, 30–71 mm.

7/6/'06.—48° 29′ N., 14° 15′ W. Midwater trawl, 0–940 fathoms—Two, 38 and 66 mm.

5/6/'06.—49° 17′ N., 14° 3′ W. Midwater trawl, 0–164 fathoms—Four, 28–42 mm.

49° 20′ N., 12° 39′ W. Midwater trawl, 0–218 fathoms—Three, 65–78 mm. (two ovigerous).

Irish distribution.—The following records may be added to those previously given :—

Helga.

S.R. 212.—6/5/'05.—51° 54′ N., 11° 57′ W. 375–411 fathoms. Trawl. Temperature at 350 fathoms, 9·82° C., salinity 35·28°/$_{oo}$—One, 14 mm.

S.R. 299.—4/2/'06.—50° 13′ 30″ N., 11° 16′ W. 500 fathoms. Trawl. Temperature at 500 fathoms, 9·7° C.—One, 15·8 mm.

S.R. 330.—9/5/'06.—51° 16′ N., 11° 37′ W. 374–415 fathoms. Trawl. Temperature at 400 fathoms, 9·55° C., salinity 35·33°/$_{oo}$—One, 15 mm.

S.R. 336.—12/5/'06.—51° 19′ N., 12° 20′ W. 673–720 fathoms. Trawl. Temperature at 700 fathoms, 6·84° C., salinity 34·99°/$_{oo}$—One, 62 mm., rostrum broken.

S.R. 337.—13/5/'06.—51° 21′ 30″ N, 12° 9′ W. Soundings 768 fathoms. Midwater trawl, 0–20 fathoms. Surface temperature 11·0° C.—One, 29 mm.

S.R. 403.—6/2/'07.—51° 12′ N., 11° 55′ W. Soundings 450 fathoms. Triangle net, 0–450 fathoms—Three, 10·2–13·9 mm.

S.R. 442.—16/5/'07.—51° 34′ N., 11° 48′ W. 465–508 fathoms. Trawl—One, 15 mm.

S.R. 470.—25/8/'07.—50° 16′ N., 11° 27′ W. Soundings 770 fathoms. Midwater trawl, 0–500 fathoms. Surface temperature 15·8° C., salinity 35·30°/$_{oo}$. Temperature at 500 fathoms. 9·03° C., salinity 35·35°/$_{oo}$—One, 22 mm.

S.R. 476.—26/8/'07.—51° 42′ 30″ N., 12° 15′ 30″ W. Soundings 640 fathoms. Midwater trawl, 0–300 fathoms. Surface temperature 15·45° C., salinity 35·37°/$_{oo}$. Temperature at 250 fathoms, 10·19° C., salinity 35·34°/$_{oo}$—One, 57 mm.

S.R. 503.—12/9/'07.—50° 42′ N., 11° 26′ W. Soundings 990 fathoms. Triangle net, 0–80 fathoms. Surface temperature 16·2° C., salinity 35·34°/$_{oo}$—Two, 34 and 70 mm.

Vertical range.—Acanthephyra debilis is a free swimming species; it has been trawled in soundings varying from 411 to 2,512 fathoms, but there is no evidence to prove that the species ever lives actually on the bottom. On a few occasions adults and larvæ have been caught quite near the surface (S.R. 337 and S.R. 503).

[**Acanthephyra pellucida,** A. Milne-Edwards *fide* Perrier.]

In a table of the species of *Acanthephyra* (Kemp, 1906 (1)) *A. pellucida* is queried as a *nomen nudum* attributed to A. Milne-Edwards by Gadeau de Kerville. M. Gadeau de

Kerville has since drawn my attention to the inaccuracy of this statement, and has very kindly supplied me with further references to the species.

A. pellucida is of especial interest as being the only species of *Acanthephyra*, with the exception of *A. debilis*, in which photophores have been described, and it is unfortunate that the additional references still leave the validity of the species open to question.

Perrier (1886) mentions *A. pellucida*, and attributes it to A. Milne-Edwards, giving a list of the photophores observed, and Filhol in the same year very briefly notices the species on the same authority. Gadeau de Kerville, in his book on luminous animals and plants, repeats Perrier's account of the luminous organs, and a German translation of this passage is quoted by Hansen (1903). Milne-Edwards himself never seems to have published any description of this species; our information is accordingly limited to Perrier's account, from which all subsequent reference is derived.

After indicating a few of the characters[1] of *A. pellucida*, Perrier describes the photophores in the following terms :—

> "..... et l'animal peut projeter tout autour de lui une vive lumière à l'aide de tout l'arsenal d'appareils d'éclairage dont il est pourvu. L'énumeration de ces appareils n'est pas sans interêt. Ce sont :—
>
> 1. Le bord antérieur d'une écaille, qui protège extérieurement les yeux.
> 2. Une ligne le long du bord externe du tarse de la 5e paire de pattes ; une tache ovale à la base interne de ce tarse ; une autre à la base de l'article qui le précède.
> 3. Une tache semblable à la base du 2e article de la 3e et de la 4e paire de pattes, et une à la base du tarse de ces pattes.
> 4. Une tache longue à la base du dernier article de la dernière paire de pattes-machoires.
> 5. Une bande transversale sur la hanche des dernières pattes thoraciques.
> 6. Une double ligne de points correspondant à chacun des articles du fouet externe des pattes thoraciques et de la lame externe des pattes abdominales.
> 7. Une ligne le long du fouet extérieur des petites antennes ; une ligne continue en arrière, pointillée en avant, parallèle au bord inférieur de la carapace et un peu áu-dessus de ce bord.

1 These characters are of very slight value. It is merely stated that the species is very closely allied to *A. purpurea*, having a long denticulate rostrum, enormous eyes, chelae on the first two pairs of legs, and dorsal spines on the third, fourth, and fifth abdominal somites, that on the third being the longest.

Avec un semblable luxe d'organes phosphorescents, la silhouette lumineuse de l'*Acanthephyra pellucida* doit être dessinée d'une manière complète dans l'obscurité."

The photophores mentioned in sections 2, 4, 5, and the latter half of 7 bear the closest resemblance to those known in *A. debilis*, but no trace is found of those described in sections 1 and the first half of section 7. The double row of luminous points on the exopods of the pereiopods and pleopods (section 6) is represented in *A. debilis* by a single point at the base of the exopods of the five legs and first pair of pleopods and, in the last four pairs of the latter, by a similar point at the base of the endopod. On the third and fourth pairs of legs *A. debilis* possesses a single photophore only—at the proximal end of the carpus; section 3 seems to imply that in *A. pellucida* there are two, one on the basus and one on the propodus. Many of the photophores present in *A. debilis* are not described in the above account, the most important omissions being those on the eyestalks, on the abdominal pleura and sternum of the sixth somite, above the bases of the pleopods and on the telson. There is no mention of the dark blue pigment which seems to be invariably associated with photophores in the Decapoda Natantia. *A. pellucida* is described as being found "assez souvent à partir de 500 mètres de profondeur."

Perrier's account is very probably based on MS. notes by Milne-Edwards, and it would not be surprising if it were found to contain many errors. Two other species of *Acanthephyra*, *A.* (*Systellaspis*) *lanceocaudata*, Spence Bate, and *A. affinis*, Faxon, are so extremely closely allied to *A. debilis* that it is highly probable that they also possess luminous organs. When the positions of the photophores on these two species have been determined it may be possible to decide on the validity of *Acanthephyra pellucida*.

Genus **Ephyrina,** Smith.

Ephyrina, Smith, 1885.
Tropiocaris, Spence Bate, 1888.
Ephyrina, Alcock, 1901.

This genus may be readily separated from *Acanthephyra* by the short, unarmed, elevated rostrum, and by the greatly expanded ischial and meral joints of the pereiopods.

Ephyrina Hoskyni, Wood-Mason.

Pl. VII, figs. 1–6.

Ephyrina Hoskyni, Wood-Mason, 1891.
Ephyrina Hoskyni, Caullery, 1896.
Ephyrina Hoskyni, Alcock, 1901, and *Investigator*, 1901, Pl. LII, fig. 3.

The *rostrum* is unarmed and has the form of a high thin frontal crest; it reaches but little beyond the middle point of

the eyes. Superiorly its margin is strongly ascendant from the carina of the carapace; anteriorly it is deepest, and almost squarely truncate, showing no trace of an apical point.

The carapace is dorsally carinate almost to its posterior edge; anteriorly it is produced to a strong spine at the base of the orbit, while another spine, which reaches about as far forward, marks the antero-lateral angle. From the orbital notch a strong carina runs the whole length of the carapace, disappearing shortly before reaching the posterior margin; below, a deep groove branches off from this carina and extends almost to the base of the carapace, forming the posterior limit of the hepatic region, while a fainter groove defines the superior limit of the same region. The rostrum and carapace combined are less than half[1] the length of the abdomen, excluding the telson.

The *abdominal somites* are all dorsally smooth and rounded, and none are produced posteriorly as spines; the fourth is notched at its infero-posterior angle, but this is possibly due to an injury. The sixth somite is more than twice the length of the fifth. The *telson* is longer than the sixth somite, but is shorter than both inner and outer uropods; it tapers to a very narrow apex armed with a few spines, and is furnished dorso-laterally with numerous pairs of very minute spinules.

In the single specimen the cornea of the *eyes* is damaged; near it on the inner face the stalk bears a minute and very obscure tubercle. The *antennular peduncle* is not half the length of the antennal scale, the basal joint being much the longest, and furnished with a scale which lies closely pressed against it laterally. The *antennal scale* is more than half the length of the carapace and rostrum combined; externally it is convex and produced distally to a short spine which reaches beyond the rather narrow apex of the lamellar portion.

The oral appendages differ in a few details from those of *Acanthephyra purpurea*: the terminal joint of the *mandibular palp* (fig. 2) is rather longer and less expanded, the basipodite of the *second maxilla* (fig. 4) is divided into two portions, of which the anterior is very much broader than the posterior, and in the *second maxillipede* (fig. 6) the dactylus and exopod are both longer, the former being about half the length of the propodus.

The *external maxillipedes* are much the same as in *A. purpurea*, but the penultimate joint is somewhat longer; they reach very slightly beyond the tips of the antennal scales.

All the *pereiopods* are provided with exopodites, those of the last pair being the shortest, and in all the ischium and merus are thin and broadly expanded. The *first pair* reaches to about the middle of the ultimate joint of the outer maxillipedes, the merus is about three times as long as broad, and the carpus is about equal in length to the propodus; in the *second pair*, which reaches to the tip of the antennal scale, the merus is slightly broader and the carpus is shorter than

[1] Alcock states that in his specimens the rostrum and carapace combined are little over half the length of the abdomen.

the propodus. The chelae of the second pair are longer than those of the first. In the *third pair* of legs the merus is rather more than one-third as broad as long; it is furnished ventrally with numerous short spinules interspersed with fine setae and there is also a single spine at the outer basal angle of the triangular ischium. The propodus is more than one and a half times the length of the carpus, the latter being about twice the length of the dactylus. The *fourth pair* is very similar to the third, but is provided with a few stout spines on the outer basal edge of the ischium; the slender dactylus is about as long as the propodus. In the fifth pair the merus is more than one-third as broad as long, the ischium bears three or four stout spines in the middle of its ventral border, and the propodus is twice the length of the carpus. The dactylus is about one-third the length of the carpus; it is somewhat truncate apically, and is furnished with numerous stiff bristles.

The *branchial formula* is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	ep.	(ep.)	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The rudimentary epipod at the base of the penultimate leg is very inconspicuous; it consists of a small plate scarcely one-third the length of the horizontal portion of the epipod on the third pereiopod.

The single specimen examined is a female; in the first pair of *pleopods* the endopod is narrow, about one-third the length of the exopod, and bears setae along both its margins. The appendix interna, which is present on the last four pairs, is almost one-third the length of the endopod to which it is attached.

The outer *uropods*, which are longer than the inner, are about four and a half times as long as wide.

As will be seen from the figure, this species is very well provided with setae, but their absence on the antennal scale and uropods shows that the full number has not been retained in the case of this trawled specimen. Although carefully examined immediately after capture no trace of photophores could be detected.

Size.—The Irish specimen measures 97 mm.; the specimen taken in the Bay of Biscay was 110 mm. in length (Caullery).

Colour in life.—Dark crimson red verging to dark purple on the anterior portions of the carapace.

After five months in a mixture of alcohol and formalin most of the red pigment has disappeared; the pereiopods, however, are very clearly edged with dull purple. In life this colour was obscured by the prevailing red pigmentation.

General distribution.—Arabian Sea, in the neighbourhood of the Laccadives and northwards; Bay of Bengal, off Ceylon (Alcock); Bay of Biscay, one specimen (Caullery).

Irish distribution.—A single specimen only has been found:—

Helga.

S.R. 363—10/8/'06.—51° 22′ N., 12° 0′ W. 695–720 fathoms. Trawl. Temperature at 600 fathoms, 7·92° C., salinity 35·37°/$_{oo}$—One, 97 mm.

Vertical range.—*E. Hoskyni* has been trawled in 487–890 fathoms (Alcock) and in 656 fathoms (Caullery). Judging by its structure, the species is almost certainly pelagic; in all the recorded captures the specimens may have been caught while the net was being hauled to the surface.

Ephyrina Benedicti, Smith.

Pl. VII, fig. 7.

Ephyrina Benedicti, Smith, 1886, Pl. XIV, fig. 3; and Pl. XVI, fig. 4.
Tropiocaris planipes, Spence Bate, 1888, Pl. CXXXVI, fig. 1.

A single small specimen, 24 mm. in length, is referred to this species. It differs from the original description in two particulars, viz., in the length of the rostrum (fig. 7), the apex of which only reaches about to the middle of the cornea of the eye, and in the absence of the dorsal spine on the posterior margin of the third abdominal somite. In these two characters certain allied species are now known to show very considerable variation, so that there can be but little doubt that the specimen in question is specifically identical with *E. Benedicti*. The small size of the specimen suggests the possibility that the longer rostrum and the dorsal spine on the abdomen might be acquired in the course of time.

With the exception of the characters just mentioned, there is the closest possible resemblance between *E. Benedicti* and *E. Hoskyni*. In the two Irish specimens the mandibles, maxillae, and maxillipedes are as nearly as possible identical.

If the small example be correctly assigned to *E. Benedicti*, the distinctions between that species and *E. Hoskyni* are reduced to a minimum, the form of the rostrum being the only differential feature available. Only nine specimens of *Ephyrina* have ever been found, and in consequence practically nothing is known of the range of variation in the genus. It is not altogether improbable that further investigation may reduce *E. Hoskyni* to a mere synonym of *E. Benedicti*, but there is so far no evidence to show that the differences in the form of the rostrum do not constitute a valid character.

Size.—The type specimen measures 56 mm. (Smith), while the example taken by the *Challenger* expedition is 57 mm. in length.

General distribution.—Two specimens only are known. One was found off the east coast of the United States, lat. 40° 26′ 40″ N., long. 67° 5′ 15″ W. (Smith), while the other was taken in the Pacific, lat. 26° 29′ N., long. 137° 57′ E. (Spence Bate).

Irish distribution.—

Helga.

S.R. 449—19/5/'07.—50° 28′ N., 11′ 39′ W. Soundings 950 fathoms. Midwater trawl, 0–700 fathoms.—One, 24 mm.

Vertical range.—Trawled in 949 fathoms (Smith) and 2,425 fathoms (Spence Bate); probably a midwater species.

Genus **Hymenodora,** G. O. Sars.

Hymenodora, Spence Bate, 1888 (*partim*).[1]

Hymenodora glacialis (Buchholz).

Pl. VIII, figs. 1-3.

Hymenodora glacialis, G. O. Sars, 1885, Pl. iv.
Hymenodora glacialis, Smith, 1886, Pl. xv, figs. 3 and 10; Pl. xvi, fig. 5.
Hymenodora gracilis, Smith, 1886, Pl. xii, fig. 6.
Hymenodora glacialis, Faxon, 1895.

The *carapace* is hardly at all compressed; it is dorsally carinate in the anterior half and is produced to a short, acutely pointed *rostrum* which reaches about as far forward as the eyes. The anterior part of the carapace and rostrum form a sort of hood which projects over a portion of the ocular region. Dorsally the rostrum is provided with from four to six small forwardly directed teeth. From the orbital sinus a well-marked groove runs backwards and downwards and another, less pronounced, defines the superior boundary of the branchial region.

The *abdominal somites* are all evenly rounded above; the sixth is rather less than twice the length of the fifth. The *telson* reaches considerably beyond the outer uropods; it is dorsally sulcate and is narrowest in its distal third, becoming broader again terminally. The apex is rounded and is furnished with from four to seven spines, of which the outermost are much the longest; dorso-laterally it is provided with a few pairs of minute spinules.

[1] In a previous paper (1906, (1), p. 19) I have shown that two of the species which appear in the *Challenger* Report under this genus, must be transferred to *Acanthephyra.*

The *eyestalks* are wide at the base and narrower distally; they bear a rounded, irregular facetted and unpigmented cornea which is not wider than the stalk. On their interior and superior aspect the stalks bear a small but rather conspicuous ocular papilla near the cornea. The *antennular peduncle* reaches to about three-fifths the length of the antennal scale; the basal joint is longer than the two distal combined and bears externally a short, acutely pointed lateral process which does not nearly reach to the distal end of the segment. The *antennal scale* is rather less than half the length of the carapace and is about three times as long as wide; its outer margin is practically straight and terminates in an apical spine which reaches to or slightly beyond the narrow apex of the lamellar portion.

The *mandible* bears a three-jointed palp, in which the penultimate joint is nearly twice the length of the ultimate. In the *second maxillae* (fig. 2) the two lobes of the basus do not project conspicuously beyond the coxa as they do in the allied genera, while in the *first maxillipedes* (fig. 3) the endopod is composed of two joints, a very short basal and a long distal (this being one of the chief distinctions between *Hymenodora* and other Hoplophoridae). The *third maxillipedes* reach about to the apex of the antennal scale; the long exopod extends to the middle of the penultimate segment.

The *first two pairs* of *pereiopods* are about equal in length, the foremost reaching a little beyond the middle of the antennal scale; in both, the carpus is rather less than half the length of the chela, while the dactylus is a little more than half the length of the palm. The *third pair* reaches beyond the apex of the antennal scale by the whole of the long styliform dactylus; the *fourth pair* is almost exactly the same length and also possesses a long dactylus—this joint being only a trifle less than half the length of the propodus. In both these pairs the ischium is shorter than the merus. In the *fifth pair* of legs, which reaches to about one-third the length of the antennal scale, the ischium is longer than the merus; the dactylus is extremely short and almost concealed by a fringe of long setae from the distal end of the preceding joint.

All five pereiopods bear long exopods; the *branchial formula* is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.+1	ep.	ep.	ep.	ep.	...	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The podobranch on the second maxillipede was first noticed by Smith (*H. gracilis*, 1886); it is sometimes represented by a few lamellae only and in many cases is totally absent.

The *outer uropod* is longer than the inner and is four and a half times as long as wide.

Size.—Sars (1885) records an example of 83 mm.

Colour in life.—Sars (1885) states that freshly caught specimens are of an exceedingly vivid and brilliant blood red colour. The ocular pigment is opaque white, and the antennal flagella exhibit at their base more or less distinctly alternating transverse bands.

All the examples of this species found off the Irish coast are very small, measuring only 10 to 29 mm. in length; they nevertheless agree very closely with the description of the adult given above. In the very smallest specimens the teeth on the rostrum are few in number or wholly obsolete and only a single series of gills—pleurobranchs—are apparent. The ocular papilla, a rather conspicuous feature in the adult, is still more evident in these young individuals.

General distribution.—Hymenodora glacialis was first described from a specimen found floating on the surface off the East Coast of Greenland. Sars (1885) recorded the species from the collections made by the Norwegian North Atlantic Expedition from many stations between lat. 63° and 80° N. and between Greenland and Spitzbergen, and it was again found in the same area by the Swedish Arctic Expedition (Ohlin). The Danish-Ingolf Expedition collected numerous examples near Jan Mayen and Iceland (Hansen). The species has been taken in the Färöe Channel (Norman), and fragments of a single specimen which may almost certainly be referred to this species were obtained in the Bay of Biscay (Kemp). In the West Atlantic the species has been found between lat. 35° 45′ and 40° 26′ N. and between long. 67° and 74° 36′ W. (Smith). In the Pacific it has been recorded from the Bering Sea and Alaska (Rathbun) and from the Gulf of California, the Gulf of Panama and the Ecuador coast (Faxon).

I have examined a specimen caught by the *Thor* at the following locality :—

10/8/'06. — 49° 27′ N., 13° 33′ W. Soundings $\frac{1420}{}$ fathoms. Midwater trawl, 0–1,550 fathoms—One, 12 mm.

Irish distribution.—This species has been found off the west coast of Ireland on the following occasions :—

Helga.

S.R. 139—11/8/'04.—55° 0′ N., 10° 48′ W. Soundings $\frac{1,000}{}$ fathoms. Triangle net, 0–1,000 fathoms. Surface temperature 14·6° C., at 800 fathoms 7·0° C.—Three, 13–25 mm.

S.R. 224—12/5/'05.—53° 7′ N., 15° 6′ W. Soundings 860 fathoms. Midwater trawl, 0–750 fathoms—Thirteen, 10–15 mm.

S R. 231—20/5/'05.—55° 1′ N., 10° 45′ W. Soundings 1,200 fathoms. Midwater trawl, 0–1,150 fathoms—Fourteen, 15–29 mm.

S.R. 352—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Midwater trawl, 0–750 fathoms—Four, 11–17 mm.

S.R. 363—10/8/'06.—51° 22′ N., 12° 0′ W. 695–720 fathoms. Trawl. Temperature at 600 fathoms, 7·92° C., salinity 35·37°/$_{oo}$—One, 12 mm.

Vertical range.—Hymenodora glacialis has been found in soundings of 137 fathoms (Ohlin) and 2,949 fathoms (Smith). Although as a general rule the species is certainly bathypelagic, it has on one occasion been found at the surface (Buchholz). There is no proof that it ever lives actually on the bottom.

Although it has not as yet been determined with any certainty, it is probable that this species occurs in temperatures below freezing point.

Family *NEMATOCARCINIDAE.*

Genus **Nematocarcinus,** A. Milne-Edwards.

Nematocarcinus, A. Milne-Edwards, 1881.
Eumiersia, Smith, 1882.
Nematocarcinus, Spence Bate, 1888.
Stochasmus, Spence Bate, 1888.
Nematocarcinus, Alcock, 1901.

Nematocarcinus ensifer (Smith).

Eumiersia ensifera, Smith, Pl. xiii, figs. 1–9.
Nematocarcinus ensiferus, Smith, 1884, Pl. vii, fig. 1.
Nematocarcinus tenuipes, Spence Bate, 1888, Pl. cxxxii, fig. 6.
Nematocarcinus ensifer, Faxon, 1895.
Nematocarcinus ensiferus, Adensamer, 1898.
Nematocarcinus tenuipes, Alcock, 1901.
Nematocarcinus ensiferus, Senna, 1903.
Nematocarcinus ensiferus, Rathbun, 1906.

N. ensifer, var. **exilis,** Spence Bate.

Pl. IX, figs. 1–10.

Stochasmus exilis, Spence Bate, 1888, Pl. cxxxii, fig. 14.
Nematocarcinus exilis, Calman, 1896.
Nematocarcinus exilis, Hansen, 1908.

The *rostrum* is straight or slightly ascendant from the dorsal line of the carapace and is from one-third to three-fifths its length. It is strengthened by a strong ridge on either side and is armed dorsally with from twenty-three to thirty-one

forwardly directed spines, most of which are articulated; the posterior eight or ten of these lie behind the orbit and are rather more closely set than the others. Ventrally the rostrum is unarmed but carries a series of plumose setae.

The *carapace* is less than half the length of the abdomen; it is furnished anteriorly with a dorsal carina which becomes obsolete shortly before reaching the well marked cervical groove. This groove is continued downwards and forwards on either side and terminates in a small but distinct depression in the hepatic region. The branchial regions are defined superiorly by a groove and another groove also runs back from the posterior edge of the orbit. Anteriorly the supra-antennal and antero-lateral angles are defined by spines.

The *abdominal somites* are rather laterally compressed, but are all dorsally rounded. The third is somewhat produced posteriorly and forms an obtuse hood over the succeeding somite; it does not take the form of a spine in any of the specimens examined. The sixth somite is rather more strongly compressed than the others and is more than twice the length of the fifth. The telson (fig. 7), which is sulcate above, is about as long as the outer uropod; dorso-laterally it is furnished with six or seven pairs of short spines. It is evenly narrowed to an apex (fig. 8) armed with three spines; at the outer angles are two of considerable length, over the bases of which two shorter spines are situated, which perhaps represent the distal pair of the dorso-lateral series, while between the two large spines two, much shorter, are found, which are borne on a rounded lobe or projection.

The *eyes* are pyriform, with the black cornea much wider than the stalk and about three-quarters the width of the antennal scale. The *antennular peduncle* reaches to slightly more than half the length of the antennal scale. The lateral process is acutely pointed distally and does not reach the anterior margin of the basal segment; the terminal joint is very slightly longer than the second. The flagella are of great length; in the male the outer pair are much stouter at the base than the inner and strongly setose ventrally for a distance about equal to the length of the carapace. The *antennal scale* is about two-thirds the length of the carapace and is only very slightly narrowed apically; it terminates distally in a small spine which does not surpass the lamellar portion. In older specimens (fig. 2) the outer margin is slightly convex, the scale being little more than four times as long as wide; in a specimen 36 mm. in length (fig. 3) it is about five times as long as wide and the outer margin is practically straight. The flagellum is very long, sometimes quite three times the entire length from the rostrum to the telson.

The *oral appendages* have been adequately described and figured by Smith (1882). The *third maxillipedes* reach to about three-quarters the length of the antennal scale; the terminal segment is about two-thirds the length of the penultimate and the slender exopod reaches to about three-quarters the length of the proximal joint.

All the *pereiopods* are very slender, the last three pairs being of enormous length. The first four pairs bear slender exopods which decrease in size from before backwards.

The first pair reaches beyond the tip of the antennal scale by the length of the chelae and sometimes by one quarter of the carpus as well. The carpus is quite three times the length of the chela and is longer than the basus and ischium combined. The ischium is not quite as long as the merus and like it may bear a few short spines ventrally.

The second pair reaches beyond the tip of the antennal scale by the whole length of the carpus and chela. The chela is a trifle longer than that of the first pair; the carpus which is five times its length is about one and a half times as long as the merus. As in all the succeeding pairs a few spines are usually present on the merus and occasionally on the ischium also.

The third, fourth, and fifth pairs are very long, surpassing the tip of the antennal scale by the whole of the dactylus, propodus and carpus and a considerable portion of the merus also. The carpus, propodus, and dactylus together are rather shorter than the merus and ischium combined. In the third and fourth pairs the dactylus is spiniform and slightly longer than the propodus; in the last pair it is short, only about one quarter the length of the preceding joint; in all three pairs it is partially concealed by a fringe of very long setae from the distal end of the propodus.

The *branchial formula* is the same as in all the other species of the genus :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	..
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The endopod of the first *pleopod* is in the female (fig. 4) about two-thirds the length of the exopod and strongly setose along both margins. In the male (fig. 5) the endopod is a rather broad lamella less than half the length of the exopod; it is apically emarginate and is provided with a prominence bearing small hooks or cincinnuli in the middle of its inner margin. In the last four pairs of pleopods the endopod is only slightly shorter than the exopod and bears a stylet or appendix interna at its base. In the male an additional stylet, the appendix masculina, is present on the second pair (fig. 6).

The outer *uropods* are longer than the inner and rather less than four times as long as wide.

The following table will show the measurements (in mm.) of a few of the more perfect specimens examined.

Total length, rostrum to telson.	Sex.	Length of rostrum.	Length of carapace.	Length of abdomen.	Length of first pereiopod.	Length of fifth pereiopod.	No. of dorsal teeth on rostrum.
73·5	♀	8·5	17	37·5	27·5	60	27
73	♂	8	17·5	37	27·5	58	27
72	♀	8·5	17	36·5	27 5	56·5	29
70	♀	9·5	17	35·5	28	59	26
58	♂	6	14·5	30	23	47·5	25
53	♀	5	12·5	28	20	43	25
49	♂	4·5	12	25	20	43	24
47	♀	5	10·5	24·5	17·5	38·5	27
36	♀?	3	9	19	14	...	27

The eggs are small, some on the point of hatching do not measure more than 1·1 × ·67 mm.; they are, of course, considerably smaller than this when not so far advanced. Smith gives ·75 to ·8 × ·55 mm. as the average size. This author also states (1886) that one female examined was carrying more than 20,000 eggs.

Colour in life.—The carapace and abdomen are transparent pinkish white; the anterior portions of the former usually appear dull scarlet owing to the oral appendages and gastric regions showing through the faintly pigmented walls. In the abdomen the intestine shows through very plainly dorsally; in some specimens the pink pigment is very faint, in others much darker, becoming quite red at the posterior margin of each of the first four somites. The rostrum is quite clear and transparent. The eyes show traces of red pigment on the stalks; the cornea is black, with orange red reflections. The antennules are faintly reddish basally, with red flagella. The basal joints of the antennae are milk-white; the scale is milk-white proximally with its distal two-thirds pale red. The outer maxillipedes and pereiopods are red, the former almost scarlet; the basal joints of the pleopods are pinkish, the rami are pale red. The uropods and tip of the telson are pale red. The fringes of setae are colourless, and the small and numerous eggs are dark orange.

Size.—This species seems to be of much smaller average size in the East Atlantic than in the West. The largest specimen examined measures 83 mm., and ovigerous females may measure as little as 60 mm. Smith has recorded an example of 145 mm. from the east coast of the United States and numbers of his specimens were more than 100 mm. in length.

The East Atlantic specimens here described as *N. ensifer*, var. *exilis*, differ from Smith's description of *ensifer* (1882, 1884) in certain details which probably justify the retention of

the varietal name. In typical specimens of *N. ensifer* the rostrum is very frequently fully as long as the carapace and is in rare cases furnished with one or two spines on its ventral border. The third abdominal somite is prolonged into an acute tooth and the pereiopods seem to be all slightly shorter, the first pair reaching only to the tips of the antennal scales.

Indian specimens (described by Alcock as *N. tenuipes*) appear to resemble the Irish examples rather more closely. The rostrum is two-thirds the length of the carapace and bears about twenty-two dorsal teeth. The third abdominal somite is "strongly and subacutely" produced, but the pereiopods are exactly as in the form here described. Possibly *tenuipes* will also be found worthy of retention as a varietal name. It is worth noting that Alcock describes the colour of his specimens as bright orange, whereas the East Atlantic specimens are invariably pinkish white with red appendages.

Faxon (1895) has described an interesting feature of the variation of this species off the Pacific coast of America. He finds that the typical form occurs between lat. 0° 36′ S. and 7° 5′ N., while in specimens taken north of lat. 16° 30′ N. the third abdominal somite is much less produced posteriorly and the rostrum bears from one to three ventral teeth. Intermediate forms are found in intermediate localities.

The eggs attached to one of the female specimens were just about to hatch, and from one of these a *zoëa* (fig. 9) was extracted. The chief features of this larva are the long, sharp, downwardly curved rostrum and an obtuse angle in the posterior third of the third abdominal somite. The telson (fig. 10) is apically emarginate and bears seven pairs of plumose setae. The mandibles, maxillae, and maxillipedes are present, but no pleopods or pereiopods are developed. None of the intervening stages between this zoëa and the adult are yet known.

General distribution.—In the Atlantic it is known from the east coast of N. America between lat. 31° 41′ N. and 41° 43′ N. (Smith), from the Bay of Biscay (Caullery), from the neighbourhood of Iceland (Hansen), near the Canary Is. (Sp. Bate) and from the Mediterranean (Adensamer, Senna). In Indian waters it has been found in the Arabian Sea and Bay of Bengal (Alcock); and in the Pacific from the neighbourhood of the Hawaiian Is. (Rathbun), from the west coasts of America between lat. 0° 36′ S. and 27° 34′ N. and from the Admiralty Is. and S. of Japan (Sp. Bate).

Irish distribution.—N. ensifer is found quite plentifully in deep water off the coast of County Kerry, as the following records will show :—

Helga.

S.R. 327—8/5/'06.—51° 41′ N., 12° 16′ W. 550–800 fathoms. Trawl. Temperature at 500 fathoms 9·22° C., salinity 35·16°/$_{oo}$—Twelve, 51–71 mm.

S.R. 331—9/5/'06.—51° 12′ N., 11° 55′ W. 610–680 fathoms. Trawl—Nineteen, 36–62 mm.

S.R. 333—10/5/'06.—51° 37′ N., 12° 9′ W. 557–579 fathoms. Trawl. Temperature at 500 fathoms, 9·2° C., salinity 35·10°/$_{oo}$—One, 72 mm.

S.R. 334—10/5/'06.—51° 35′ 30″ N., 12° 26′ W. 500–520 fathoms. Trawl—Five, 58–69 mm.

S.R. 335—12/5/'06.—51° 15′ N., 12° 17′ W. 673–893 fathoms. Trawl—Eleven, 61–85 mm., one ♀ ovigerous.

S.R. 336—12/5/'06.—51° 19′ N., 12° 20′ W. 673–720 fathoms. Trawl. Temperature at 700 fathoms, 6·84° C., salinity 34·99°/$_{oo}$—Eight, 48–78 mm.

S.R. 352—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Midwater trawl[1], 750–800 fathoms Temperature at 700 fathoms 7·33° C.—One, 48 mm.

S.R. 363—10/8/'06.—51° 22′ N., 12° 0′ W. 695–720 fathoms. Trawl—Twenty-one, 42–77 mm.

S.R. 397—2/2/'07.—51° 46′ N., 12° 5′ W. 549–646 fathoms, Trawl. Temperature at 500 fathoms 8·71° C., salinity 35·57°/$_{oo}$—One, 36 mm.

S.R. 401—5/2/'07.—51° 14′ N., 11° 51′ W. 600–660 fathoms, Trawl. Temperature at 580 fathoms 8·35° C., salinity 35·50°/$_{oo}$—Two, 60 mm., one ♀ ovigerous.

S.R. 477—28/8/'07.—51° 15′ N., 11° 47′ W. 707–710 fathoms, Trawl, Temperature at 700 fathoms 7·19° C.—Four, 42–72 mm.

S.R. 484—30/8/'07.—51° 35′ N., 11° 57′ W. 602–610 fathoms. Trawl. Temperature at 550 fathoms 8·34° C., salinity 35·32°/$_{oo}$—One, 55 mm.

S.R. 487—3/9/'07.—51° 36′ N., 11° 57′ W. 540–660 fathoms. Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—Two, 49 and 43 mm.

S.R. 489—4/9/'07.—51° 35′ N., 11° 55′ W. 720 fathoms. Trawl —Seven, 50–62 mm.

S.R. 497—10/9/'07.—51° 2′ N., 11° 36′ W. 775–795 fathoms. Trawl—Fifteen, 43–80 mm.

S.R. 499—11/9/'07.—50° 55′ N., 11° 29′ W. 666–778 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·41°/$_{oo}$—Three, 48–58 mm.

S.R. 506—12/9/'07.—50° 34′ N., 11° 19′ W. 661–672 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·33°/$_{oo}$—Eighteen, 51–66 mm.

This species was originally recorded from the Irish coast by Calman (1896) from lat. 51° 1′ N., long. 11° 50′ W., 750 fathoms.

Vertical range.—Found off the Irish coast in 520–775 fathoms, in the Bay of Biscay in 439–935 fathoms (Caullery), in the Mediterranean between 411 and 1,980 fathoms (Adensamer and Senna) and off Iceland in 800–1,128 fathoms (Hansen). In the West Atlantic it is known from between 384 and

[1] Touched bottom.

2,033 fathoms (Smith); in Indian waters between 824 and 1,310 fathoms (Alcock); off the Hawaiian Is. in 293–1,314 fathoms (Rathbun), and off the Pacific coast of America in 660–1,879 fathoms (Faxon).

Although this species was on one occasion found in a mid-water trawl (S.R. 352), there is evidence to show that the net was actually on the bottom, at any rate for part of the haul.

sp. juv. (*nom. incert.*)

Larva allied to *Caricyphus*, Kemp, 1909, Pl. xv, figs. 2–8.

The specimens found off the Irish coast are, on the whole, considerably larger than those originally described from the Bay of Biscay. The larger examples possess a palp, composed of three rather obscure segments, on the mandible and a stylet at the base of the inner branch of the last four pairs of pleopods; in other respects the appendages differ only very slightly from those of the smaller individuals. *The branchial formula* appears to be :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The first four pleurobranchs are large and well developed, but that over the hindmost pereiopod, although about two-thirds the length of that immediately preceding it, is very narrow. All the arthrobranchs are very small, but all, with the exception of the upper one on the third maxillipede, are pinnate.

When describing this form (1906), I remarked on its resemblance to some of the members of Spence Bate's larval genus *Caricyphus*. Some of the ill-assorted larvae in this genus have been relegated to the Hippolytidae, while for others new generic names have been instituted. I have placed the examples here dealt with near the family Nematocarcinidae, as it does not seem altogether improbable that the form will ultimately be found to represent a stage in the life-history of some species of *Nematocarcinus*—presumably *N. ensifer*.

If this theory should prove correct, it is evident that the rather considerable changes between this form and *N. ensifer* must take place very rapidly (probably, indeed, accompanied by a shrinkage in total length), for the largest larva found off the Irish coast is 35 mm. in length, while the smallest specimen of *N. ensifer* is only 1 mm. longer.

Without older intermediate specimens it is, of course, quite impossible to be at all certain of the affinities of this larva; attention may, however, be drawn to the very close resemblance between its branchial formula and that of *Nematocarcinus*. The only gill wanting in the larva is the podobranch at the base of the second maxillipede, and this (1906, pl. xv, fig. 7) is represented by a papilla.

This larva has been found on the following occasions :—

Helga.

S.R. 352—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 800 fathoms. Midwater trawl, 0–750 fathoms. Surface temperature 15·85° C., at 700 fathoms, 7·53° C.—One, 25 mm.

S.R. 470—24/8/'07.—50° 16′ N., 11° 27′ W. Soundings 770 fathoms. Midwater trawl, 0–500 fathoms. Temperature at 500 fathoms, 9·03° C., salinity 35·35°/$_{oo}$—One, 29 mm.

S.R. 481—29/8/'07.—50° 59′ N., 11° 52′ W. Soundings 920–1,064 fathoms. Midwater trawl, 0–900 fathoms—Five, 31–35 mm.

S.R. 484—30/8/'07.—51° 35′ N., 11° 57′ W. 602–610 fathoms. Trawl. Temperature at 550 fathoms, 8·34° C., salinity 35·32°/$_{oo}$—One, 33 mm.

S.R. 503—12/9/'07.—50° 42′ N., 11° 26′ W. Soundings 990 fathoms. Triangle net, 0–80 fathoms. Surface temperature 16·2° C., salinity 35·34°/$_{oo}$—Four, 24–33 mm.

S.R. 506—12/9/'07.—50° 34′ N., 11° 19′ W. 661–672 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·53°/$_{oo}$—Two, 31 and 33 mm.

Family *BRESILIIDAE.*

Genus **Bresilia,** Calman.

Bresilia atlantica, Calman.

Pl. x, figs. 1–7.

Bresilia atlantica, Calman, 1896, Pls. i and ii, figs. 1–18.

The specimen trawled by the *Flying Falcon* expedition of 1888 and described as a new species, *Bresilia atlantica*, has hitherto remained unique and the only representative of the family created for it. During the last two years four more specimens have been caught off the Kerry coast which agree in almost every detail with Calman's careful description and figures.

Calman, when describing the species, stated that there was very little doubt that the type had assumed adult characteristics, but more recent investigations have demonstrated such astonishing differences between the post-larval and adult forms

of many deep water Natantia that it was thought possible that *Bresilia* might, by further growth, be modified so far as to justify its inclusion in some well known family of Caridea. Coutière (1907) remarks on its resemblance to *Caridion* and refers it tentatively to the family Hippolytidae. Nevertheless the additional material found by the *Helga* has completely vindicated Calman's view, for one of the specimens bears on the inner branch of the second pair of pleopods the accessory stylet or *appendix masculina* (fig. 6) which, so far as is yet known, is found only in males which are almost or fully adult. Short of the capture of an ovigerous female, no stronger evidence in favour of the maturity of a Carid can be adduced.

This male measures only about 20 mm. and is therefore considerably smaller than the type (29 mm.); two of the remaining specimens measure 20 and 23 mm. respectively and (like the type) are presumably female. The fourth example is 17 mm. in length and may be of either sex. Little can be added to Calman's long and complete description. The rostrum (figs. 2 and 3) is provided with sharp dorsal and ventral teeth (not blunt as in the type) the number of which seems subject to considerable variation; the four specimens show $^4/_4$, $^4/_2$, $^3/_3$, and $^3/_3$ respectively. In the eyes the corneal area, though without a trace of black pigmentation, is distinctly defined from the stalk and shows very faint traces of facets. The mandibles, maxillae, maxillipedes and pereiopods all agree closely with the figures published in 1896. Calman's reading of the branchial formula is also confirmed—four pleurobranchs are found over the bases of the first four pereiopods and a papilla, representative of a rudimentary pleurobranch, above the fifth pereiopod.

In the male the endopod of the first pair of pleopods (fig. 7) is about half the length of the exopod; apically it is deeply emarginate and is furnished with setae on both anterior and posterior margins, the latter possessing a greater number than the former. In the female this endopod is almost exactly similar in shape, but seems to be more abundantly provided with setae on its anterior margin.

The telson bears from six to eleven pairs of dorso-lateral spinules; distally it is truncate and rather rounded and bears twelve spines, of which the outermost are much the longest.

Colour in life.—The carapace is semi-translucent, anteriorly very pale orange pink, verging to red at the orbital notch. The first three abdominal somites are colourless, the last three and the margins of the telson are pale vermilion. The eyestalk is vermilion, the cornea whitish orange and strongly refractive. The lower half of the basal joint of the antennular peduncle is vermilion; otherwise the antennules, antennae, and antennal scales are quite transparent. The third maxillipedes are tinged with vermilion proximally and similar colouration prevails on the basal joints of the pereiopods. The red tone is found on the coxa, basus and ischium of all the legs; in the

last three pairs it is also present on the merus, while in the fourth and fifth it extends to the carpus. A suffusion of the same colour occurs on the basal portions of the pleopods and uropods.

The additional specimens do not throw any further light on the affinities of *Bresilia*. Calman has already dealt with the subject in detail, and has shown that the family must be regarded as occupying a rather isolated position among Caridea. Borradaile has recently (1907) included the Bresiliidae with the Pasiphaeidae in his super-family Pasiphaeoidea, and although some characters, such as the undistorted terminal segments of the second maxillipedes, lend colour to this view, yet the highly specialized character of the mouth parts and last three pairs of pereiopods in the Pasiphaeidae suggests that the creation of separate super-families for each might more adequately express our knowledge of their mutual relations.

Irish distribution.—The type was trawled by the *Flying Falcon* in 750 fathoms, lat. 51° 1′ N., long. 11° 50′ W. The other four examples were found at the following stations :—

Helga.

S.R. 352—5/8/'06.—50° 22′ N., 11° 40′ W. Soundings 750–800 fathoms. Midwater trawl[1], 0–750 fathoms—One, 20 mm.

S.R. 477—28/8/'07.—51° 15′ N., 11° 47′ W. 707–710 fathoms. Trawl. Temperature at 700 fathoms 7·19° C.—One, 23 mm.

S.R. 499—11/9/'07.—50° 55′ N., 11° 29′ W. 666–778 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·41°/$_{oo}$,—One, 20 mm.

S.R. 506—12/9/'07.—50° 34′ N., 11° 19′ W. 661–672 fathoms. Trawl. Temperature at 600 fathoms, 8·22° C., salinity 35·53°/$_{oo}$—One, 17 mm.

Vertical range.—672–750 fathoms.

Family *PANDALIDAE*.

Until comparatively recently all the six species mentioned in this paper were referred to the genus *Pandalus*. Three genera, *Pandalus*, *Plesionika*, and *Pandalina*, are now recognised by some authors. There can be no reasonable doubt that *Pandalina* is established on trustworthy characters, but it is by no means so clear that this is the case with *Plesionika*. The question of the validity of the latter genus must wait until that much needed work, a revision of the whole *Pandalus* group, is undertaken; for the present I have retained it as

[1] There is evidence to show that on this occasion the midwater trawl was fishing on or very close to the bottom.

distinct. The three genera may be thus separated in tabular form :—

I. Rostrum at least as long as carapace ; branchial formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	...	1+ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	...	2	1	1	1	1	...
Pleurobranchiae, ...	..	...	1	1	1	1	1	1

A. Lateral process of antennules distally broad and rounded ; posterior lobe of exopod of second maxilla acutely pointed ; second pair of pereiopods unequal, ... *Pandalus*.

B. Lateral process of antennules acutely pointed distally ; posterior lobe of exopod of second maxilla broadly rounded ; second pair of pereiopods subequal, ... *Plesionika* (p. 93).

II. Rostrum not more than half the length of the carapace ; posterior lobe of exopod of second maxilla truncate, branchial formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Pleurobranchiae, ...	..	1+ep.	ep	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	...	2	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

Pandalina (p. 97).

Genus **Pandalus**, Leach.

Dichelopandalus, Caullery.

Four species of this genus have been found in British and Irish waters ; they may be separated thus[1] :—

I. Third maxillipede without exopod.

A. Carpus of second pereiopod on right side with many (at least twenty) annulations ; antennal scale not much narrowed in front, outer edge straight.

1 Calman's admirable paper on the British Pandalidae (1899) contains descriptions and figures of *Pandalina brevirostris* and of the species of *Pandalus* (excepting *P. borealis*, which was not then known to occur in British waters). The above table is borrowed from this work, *P. borealis* being included.

i. Rostrum with twelve to sixteen teeth above and seven below, the dorsal teeth extending well into the anterior third; lamellar portion of antennal scale extending beyond apical spine; a blunt dorsal carina terminating in a tubercle on the third abdominal somite, . *P. borealis.*

ii. Rostrum with ten to twelve teeth above and five or six below, the dorsal teeth not extending beyond the middle of the rostrum; apical spine of antennal scale extending beyond lamellar portion; third abdominal somite smooth dorsally, ... *P. Montagui.*

B. Carpus of second pereiopod on right side with four annulations; antennal scale very narrow in front, outer edge concave, . *P. propinquus* (p. 89).

II. Third maxillipede with exopod; carpus of second pereiopod on right side with four annulations, ... *P. Bonnieri* (p. 92).

Pandalus borealis, Kröyer, has only recently been added to the British fauna. In July, 1907, about thirty examples were caught in 57 fathoms, E.N.E. of the Coquet Lighthouse, off the Northumberland coast. The specimens were caught and named by Mr. R. A. Todd, of the Marine Biological Association, and their identification subsequently verified by Canon Norman. *P. borealis* is described and figured in detail by G. O. Sars, 1900.

Within the last few years this species has been fished commercially in certain Norwegian Fjords. The industry, which owes its origin to the Norwegian Fishery Investigations, is now in a very thriving condition, and numerous boats, using special nets, are devoted exclusively to it.

Pandalus Montagui, Leach.

Pl. X, fig. 8.

Pandalus annulicornis, Bell, 1853, fig., p. 297.

Pandalus leptorhynchus, Kinahan, (nec Sars, nec Stimpson), 1858, fig., p. 80.

Pandalus Montagui, Calman, 1889 (*ubi syn.*), Pls. I–IV, fig. 1.

Pandalus annulicornis, Wollebaek, 1908.

Colour in life.—Semi-translucent with patches of small red chromatophores on the carapace and abdomen. The carapace with two bright red stripes, one from the antennal scale

running backwards along the inferior edge of the carapace for nearly three-quarters of its length, and a second running vertically down from the cardiac region to meet the first posteriorly; a red stripe runs the whole length of the rostrum. The abdomen, in addition to the small spots already mentioned, shows several lateral, oblique, forwardly directed orange stripes. The eyes are greyish black and the antennal scale is transparent except for a red streak along its inner edge. The two terminal joints of the outer maxillipedes are somewhat yellowish; the thoracic legs are finely spotted with red, the two basal joints of the fourth pair being entirely bright red. The telson and uropods are rather more thickly spotted with chromatophores of the same red colour. The eggs are pale green. In specimens from shallow water the red colouring is, as a rule, very much less evident than in those taken at greater depths.[1]

Size.—Wollebaek (1908) states that *P. Montagui* attains a length of 16 cms. off the Norwegian coast. In Irish waters it is rarely found to exceed half this length.

Among half a bucketful of small *P. Montagui* trawled off the mouth of Dublin Bay in October, 1906, a single specimen was observed with a very abnormal rostrum (Pl. X, fig. 8). This specimen, which measures 31 mm. in length, is in all essential features identical with the form described and figured by Kinahan under the name of *Pandalus leptorhynchus*. I am, therefore, enabled to confirm Calman's suggestion (1899, p. 36) that Kinahan's species was founded on an aberrant specimen of *P. Montagui*.

Like *Crangon vulgaris* this abundant species is not commercially fished in Ireland. In England its capture forms the basis of a very considerable trade; it is known in Liverpool as the "shank," in the Humber as the "prawn," while in the London markets it is usually termed the "pink shrimp." Fishermen, of course, do not recognise the distinctions between this form and *P. Bonnieri*.

The life-history of *P. Montagui* is of great interest, but is as yet by no means fully understood; still there seems to be no doubt that for a considerable portion of its existence the species is gregarious and migratory. Late in spring large assemblages of *P. Montagui* travel shorewards; they remain in shallow water throughout the summer and autumn; but in November and December, at a time when the females are just beginning to bear eggs on their pleopods, they journey outwards again to depths of 20 to 30 fathoms, where they stay until the close of the breeding season.

Mr. Holt has noticed a specific instance of this in the Humber Estuary, to which *P. Montagui* regularly resorts

[1] This applies even to small differences in depth. For instance, in the Humber the catch from a 10-fathom haul is always much redder than that from the shallower grounds (*teste* Holt).

every year,[1] and it has also been observed in other places. Murie (1903) gives a good account of it in his Report on the Sea Fisheries of the Thames Estuary.

Although these migratory movements have not so far been noticed on the Irish coast, there is no reason to suppose that the habits of Irish specimens are in any essential way different from those on the east coast of England. The migrations in any district must be largely dependant on the nature of the sea bottom and the presence of a good food supply. Tubicolous polychaetes, more especially *Sabellaria alveolata*, are a favourite food of this species.

Wollebaek has recently (1908) brought to light a very interesting feature of *P. Montagui*. Calman in 1896 showed that in the male two different forms of the endopod of the first pair of pleopods exist, and Wollebaek has been able to identify these with the breeding and non-breeding phases of the species. In the autumn months (at the commencement of the breeding season) this endopod is provided with a sharply pointed terminal process and the appendix masculina on the second pair of pleopods is fully developed and furnished with setae; in spring and summer the appendix masculina is greatly diminished or wholly absent and the process on the endopod of the first pair of pleopods is shrunken and blunted.

This is the only instance[2] in which an alternating dimorphism has been demonstrated in Decapoda Natantia; among Reptantia, phenomena of an analogous nature are known in *Cambarus* and in certain Oxyrhyncha.

General distribution.—From the extreme north of Norway to the English Channel. The species is abundant over the whole of the North Sea and is found in the Skagerrak, Cattegat and Baltic. It is common off the English and Scotch coasts, and has been recorded from the Shetlands. It is known from the White Sea (Birula), Iceland (Sars), Rockall (Calman), and W. Greenland to lat. 69° 14′ N. (Hansen); it is plentiful off the east coast of N. America as far south as lat. 41° 25′ N., and has been found in Baffin Bay (Hansen). In the Pacific it has been recorded from the Bering Sea (Richters) and southwards along the American coast to Point Arena, California (Rathbun). The majority of the Pacific specimens have been referred to the var. *tridens*.

Irish distribution.—Off the east coast *P. Montagui* is abundant inside the 30-fathom line, but is scarcer in deeper water. In the south it is apparently quite rare; I know of only one record—from the vicinity of Ballycotton (Dublin Museum). In the west the species does not seem common, but it has

[1] The Humber shrimp-trawlers know quite well that the appearance of "green bellies," *i.e.*, ovigerous females, is a sign that the prawns will soon be off to sea.

[2] Wollebaek, strangely enough, was unable to discover similar phenomena in other species of *Pandalus*.

been found several times off the Cork and Kerry coasts in Bantry Bay, Kenmare River, near the Skelligs, and at Valencia. An occasional specimen was found in Ballynakill Harbour, Co. Galway, during the period in which the marine laboratory was stationed there and examples have also been obtained in Blacksod and Clew Bays, Co. Mayo. In the north *P. Montagui* has been found in some abundance off the Antrim coast.

Vertical range.—Rarely found in the Irish Sea in more than 35 fathoms of water; in the area known as "Rathlin Deep," off Co. Antrim, it has occurred between 100 and 130 fathoms, this being about the maximum depth in which *P. Montagui* is found in European waters. In the Pacific the species ranges from 3 to 351 fathoms (Rathbun), while several specimens are recorded from 430 fathoms off the east coast of N. America (Smith).

Pandalus propinquus, G. O. Sars.

Pl. XI, figs. 1-4.

Pandalus propinquus, Calman, 1899 (*ubi syn.*), Pls. I–IV, fig. 2.
Pandalus propinquus, Hansen, 1908.

Colour in life.—The carapace is sometimes uniform pale red, but the posterior quarter is often colourless. The rostrum is bright red distally, proximally paler and dotted with red. There are transverse bands of red on the first abdominal somite, on the anterior parts of the second and third and on the posterior parts of the second, third and fourth; these bands are darkest and widest dorsally. The fifth somite is pale red, with darker dots; while the sixth somite, telson and uropods are of a rather deeper tone of red. The eyes are black or dark grey, with golden reflections. The antennular peduncle and antennal scale are pale red with darker dots; the flagella are all bright red. In specimens from deep water the third maxilliped and five pereiopods are all pale red, with the exception of the chelae of the second pair, which are colourless. In specimens caught in shallow water the carpus and the greater part of the propodus of the last three pairs are pure milk white in colour, thus contrasting very strongly with the bright red dactylus and distal extremity of the propodus. This colouring, when present, affords a ready means of separating *P. propinquus* from any of the allied species which may occur in the same haul, while it may be noticed in addition that there are no oblique bands of red on the carapace as in *P. Montagui*, nor yellow pigmentation on the body as in *P. Bonnieri.*

Size.—The largest specimen examined measures 86 mm.; an ovigerous female is only about 50 mm. in length. Wollebaek has recorded an example of 150 mm.

This species is not very common in Irish waters. In the Irish Sea it has only been found three times, but it has been taken on several occasions off the north coast in soundings of 110–130 fathoms, and off the west between 470 and 627 fathoms.

In addition to the colour distinctions noticed above, the west coast specimens differ from those found in the north and east in the *longer rostrum, more slender pereiopods, and larger eyes*. In figs. 1 and 2 is shown the anterior part of an east coast specimen measuring 52·5 mm.[1], while figs. 3 and 4 represent the same views of an example from deep water on the west coast measuring 57 mm.[1] These figures give an idea of the range of variation in the size of the eye and length of the rostrum which exists in the collection.

The following tables show the relation which the length of the rostrum bears to the length of the body in all the perfect specimens obtained :—

WEST COAST.
470—627 fathoms.

Sex.	Length of body.[1]	Length of rostrum.	Ratio of rostrum to body (100).
♂	57	29	50
♂	49	29	59
♂	44	27	61
♀	41	21·5	52
♀	38	18	47

NORTH COAST.
110—130 fathoms.

Sex.	Length of body.[1]	Length of rostrum.	Ratio of rostum to body (100).
♀	51	18	35
♂	45	15·5	34
♂	42	14	33
♂	41·5	16	38
♂	41	15·5	38
♀	40	15	37
♂	39	16	41
♂	39	15	39
♂	32·5	14	43
♀	25	9	36

EAST COAST.
34—42 fathoms.

Sex.	Length of body.[1]	Length of rostrum.	Ratio of rostrum to body (100).
♀	52·5	20	38
♀	51	19	37
♂	40	13	32

The average length of the rostrum, compared with the body, is found to be 54 per cent. in the case of the west coast examples, while in those from the north and east it is 36½ per cent. and 35½ per cent. Unfortunately the specimens are so few in number that little reliance can be placed on such data; nevertheless it seems probable that the deep waters of the Irish Atlantic slope are inhabited by a race of *P. propinquus*

[1] Measured from the back of the orbit to the apex of the telson.

which differs from the typical form occurring in shallower soundings in certain fairly constant characteristics, of which the three mentioned above are the most prominent.

General distribution.—West Norway to lat. 69° 30′ N. (Norman, Sars, etc.); west coast of Scotland, Loch Long and Lower Loch Fyne (Calman); off the Färöe Is., off Iceland and in Davis Straits (Hansen); east coast of the United States between Boston and New York (Smith). A specimen of this species, hitherto unrecorded, is in Canon Norman's museum; it was taken by the *Porcupine* Expedition—Sept., 1869, lat. 59° 41′ N., long. 7° 34′ W., 458 fathoms.

Irish distribution.—Off the Irish coast this species has only been found at all plentifully in a single locality—Rathlin Deep, off Co. Antrim; on the few occasions on which dredging has been successfully accomplished on the rocky bottom of this area, *P. propinquus* has always been found.

Helga.

CXX.—24/8/'01.—53° 58′ N., 12° 22′ W. 382 fathoms. Trawl. —One, 22 mm.

S.R. 118—13/5/'04.—Rathlin Deep, 55° 20′ N., 6° 8′ W. 115 fathoms. Dredge.—Three, 46–69 mm.

S.R. 200—14/2/'05.—Rathlin Deep, 55° 20′ N., 6° 12′ W. 125 fathoms. Dredge. Temperature at 113 fathoms 7·85° C. —One, 34 mm., and one ovigerous female about 50 mm.

S. 270—24/5/'05.—13 miles W. of Chicken Rock, Isle of Man. 34–37 fathoms. Trawl.—One, 70 mm.

S. 272—24/5/'05.—15 miles W. by S. of Chicken Rock, Isle of Man. 36 fathoms. Trawl—One, 53 mm.

S.R. 233—21/5/'05.—Rathlin Deep, 55° 20′ N., 6° 11′ W. 110–130 fathoms. Dredge—Six, 54–57 mm.

S.R. 359—8/8/'06.—52° 0′ N., 12° 6′ W. 465–492 fathoms. Trawl. Temperature at 475 fathoms 9·04° C., salinity 35·37°/$_{oo}$ —Six, 20–22 mm.

S.R. 490—7/9/'07.—51° 57′ 30″ N., 12° 7′ W. 470–491 fathoms. Trawl. Temperature at 480 fathoms 8·68° C.—One, 86 mm.

S.R. 491—7/9/'07.—51° 57′ 30″ N., 12° 13′ W. 491–520 fathoms. Trawl. Temperature at 500 fathoms 8·53° C., salinity 35·44°/$_{oo}$—One, 71 mm.

S.R. 494—8/9/'07.—51° 59′ N., 12° 32′ W. 550–570 fathoms. Trawl.—One, 78 mm.

S.R. 502—11/9/'07.—50° 46′ N., 11° 21′ W. 447–515 fathoms. Trawl. Temperature at 500 fathoms 8·8° C., salinity 35·37°/$_{oo}$—One, broken.

S.R. 504—12/9/'07.—50° 42′ N., 11° 18′ W. 627–728 fathoms Trawl.—Two, 46 and 62 mm.

S. 558—24/10/'07.—21½ miles W.S.W. of Chicken Rock, Isle of Man, 39½–42 fathoms. Trawl. Temperature at 40 fathoms. 12·82° C., salinity 33·84°/$_{oo}$—One, 72 mm.

Vertical range.—In Irish waters this species has been found between 36 and 626 fathoms. Off the Scotch coast it has occurred in 40 fathoms (Calman) and 458 fathoms (*Porcupine* Exp.), while near Iceland it has been recorded from as much as 1,089 fathoms (Hansen). In the N.W. Atlantic it has been found between 122 and 582 fathoms (Smith, Hansen).

Pandalus Bonnieri, Caullery.

Pandalus leptorhynchus, G. O. Sars, 1882, Pl. I, figs. 8–10.
Pandalus leptorhynchus, Sars, Calman, 1896.
Pandalus (*Dichelopandalus*) *Bonnieri*, Caullery, 1896, Pl. XV, figs. 7–15.
Pandalus Bonnieri, Calman, 1899, Pls. I–IV, fig. 3.
Pandalus leptorhynchus, Kin., Wollebaek, 1900.
Pandalus leptocerus var. *Bonnieri*, Appellöf, 1906.

Colour in life.—The carapace is laterally pale reddish; the gastric and hepatic regions are blueish green and show clearly through the semi-transparent walls. The tip of the rostrum is bright red, the proximal half transparent. The abdomen is pale red, somewhat darker laterally, with rather prominent patches of lemon yellow; traces of this same yellow tint may also, in most cases, be found on the carapace. A minute fleck of pure white is usually to be seen on the pleura of the third somite; in one specimen examined this white pigment was very evident, spreading over the whole of the third pleuron and on portions of the first and second also. The cornea is greyish green or black, with golden reflections; the ocellus is jet black and is much more prominent than in the preceding species. The antennal scales are transparent, the pereiopods transparent with red banding; the pleopods, uropods and apex of the telson are bright red. The eggs are of a dark sea-green colour.

Size.—The largest specimen observed measures about 120 mm.

An example of this species taken in the Irish Sea shows a rather peculiar type of variation, which might be termed "sinistral." The long multiarticulate second pereiopod, which is normally on the left side of the animal, is in this specimen on the right, while the short leg with only four annulations is situated on the left. This abnormality has been already noticed in *P. leptocerus*, *P. borealis*, and *P. propinquus*.

Dr. Calman has recently made a critical comparison of this species and of *Pandalus leptocerus*, Smith, and has come to the

conclusion that the two species are quite distinct, at any rate in the material preserved at the British Museum.

P. Leptocerus is most easily recognised from *P. Bonnieri* by the numerous small crescentic elevations or rugosities, furnished with short hairs, that exist all over the body. These are specially conspicuous on the sixth abdominal somite. In *P. leptocerus*, moreover, all the appendages are evidently more slender than in *P. Bonnieri* and the lateral process from the basal segment of the antennular peduncle has a slightly different form.

General distribution.—*Pandalus Bonnieri* is known from S. and W. Norway to lat. 67° 20′ N. (rare, Sars, Wollebaek, etc.), from the south of Iceland (Hansen), from the Bay of Biscay (Caullery), and off the Scotch coasts from Loch Long and Loch Fyne (Calman).

Irish distribution.—Abundant in the Irish Sea and off the west coast, but not so far known from the south.

Vertical range.—Found in 20 to 80 fathoms off the east coast of Ireland and in the Bay of Biscay between 100 and 666 fathoms.

Genus **Plesionika,** Spence Bate.

Plesionika martia (A. Milne-Edwards).

Pl. XII. figs. 1–4.

Pandalus martius, A. Milne-Edwards, 1883, Pl. xviii.
Plesionika semilaevis, Spence Bate, 1888, Pl. cxiii, fig. 3.
Pandalus martius, Wood-Mason, 1892.
Plesionika martia, Caullery, 1896, Pl. xv, figs 1–6.
Pandalus martius, Adensamer, 1898.
Plesionika (*Pandalus*) *Sicherii*, Riggio, 1900.
Pandalus (*Plesionika*) *martius*, Alcock, 1901.
Pandalus martius, Senna, 1903, Pl. xiv, figs. 6–13; Pl. xv, figs. 1–4.
Pandalus martius, Riggio, 1906, Pl. ii, figs. 8–11.
Pandalus martius, Rathbun, 1906.

The *rostrum* is laterally compressed and from one and a quarter to more than two and a half times the length of the carapace; basally it is depressed and bent downwards, but commences to ascend again before reaching the middle of the antennal scale and from thence to the apex it is quite straight.

Dorsally it is armed with from five to ten teeth, usually eight or nine. The posterior of these are rather close set and decrease in size from before backwards; they are situated on the basal crest of the rostrum and several of them are on the carapace proper, behind the orbital notch. The foremost two or three teeth are more distantly spaced, but the anterior one is not set further forward on the rostrum than the distal extremity of the antennular peduncle; from this point onwards to the apex the rostrum is smooth and unarmed on its dorsal margin. Ventrally it is furnished with a very closely set series of fine forwardly directed teeth which extends almost to the apex; the proximal member of the series is situated immediately above the ultimate joint of the antennular peduncle. The ventral serrations are somewhat concealed proximally by the thick fringe of setae which overlies them on each side, and there are also a few fine cilia interspersed between the dorsal teeth. All the teeth, both dorsal and ventral, are fixed. The rostrum is continued backwards as a carina which becomes evanescent at about the middle of the carapace. Anteriorly the *carapace* is provided with a sharp spine at the base of the orbit and another below the insertion of the antennae; a faint carina marks the superior boundary of the branchial chamber.

The *abdominal somites* are smooth and show no trace of carination. The sixth somite is just twice the length of the fifth. The *telson* is dorsally depressed and rather longer than the last somite. It is shorter[1] than the inner uropod and is armed with three pairs of terminal spines and a few pairs of dorso-lateral spinules.

The *eyes* are very large and the ocellus is not independent of the cornea. The basal joint of the *antennular peduncle* is much longer than the second and third combined; its lateral process is laminar, acutely pointed anteriorly, and reaches to the distal end of the segment. The *antennal scale* is more than three-quarters of the length of the carapace; it is convex externally and is more than four times as long as wide; the small apical spine reaches slightly beyond the lamellar portion.

Senna states that the cutting edge of the *mandible* bears six teeth; in a dissected specimen five teeth were found on the right side and seven on the left. The outer lobe of the *first maxilla* is apically rather more deeply sub-divided than in the British species of *Pandalus*. The posterior lobe of the exopod of the *second maxilla* (fig. 2) is rounded, not pointed as in *Pandalus*, nor truncate as in *Pandalina*. The *third maxillipedes*, which bear long exopods reaching to almost half the length of the ischium, extend beyond the apices of the antennal scales.

[1] In some of *Challenger* specimens the telson is equal in length to the inner uropod.

The first pair of *pereiopods*, which only possesses rudiments of the microscopic chelae found in *Pandalus*, is about the same length as the outer maxillipedes. The second pair reaches slightly beyond the carpus of the first, and is symmetrical. Distally the carpus shows eight to ten very distinct annulations, while twelve or fourteen more, which are much less clearly defined, may be seen in the proximal part. The last three pairs of pereiopods are very long and slender; the fifth, which is the longest of all, is in a female specimen more than two and a quarter times the length of the first pair; in fact, the propodus alone is considerably longer than that limb. The dactyli of these last three pairs are short and the merus of each is armed ventrally with a number of short spines the precise number of which seems subject to much variation. The exact length of these limbs is by no means constant; the female specimen mentioned above probably represents an extreme case.

The *branchial formula* is the same as in *Pandalus Montagui*.

In the male the endopod of the first pair of *pleopods* (fig. 3) is internally concave, with a broadly rounded apex. It is thickly setose on the proximal half of its convex outer margin; internally it is provided with a fringe of much shorter setae at its middle and with a series of minute hooks nearer the apex. In the female the endopod (fig. 4) is strongly setose on both margins and is produced to a narrow and acute termination. The eggs are very small and extremely numerous. The outer *uropod* is much longer than the inner and is about four times as long as wide.

Colour in life.—The carapace and abdomen are thickly sprinkled with bright red chromatophores; the former is dorsally of a dark purple tint, while in the latter the red pigmentation is darker on the posterior portions of each somite. The rostrum is bright red distally, less deeply coloured proximally. The eyes are black, with golden reflections; the antennules are red, and the antenna and antennal scale are more sparsely pigmented with the same colour. The outer maxillipedes and pereiopods are more or less thickly spotted with red; the pleopods, telson and uropods are light red. All the fringes of setae are golden in colour.

Size.—The largest specimen examined measures 110 mm. from the back of the orbit to the apex of the telson. In this example the rostrum is broken. In the largest perfect example the above measurement is 108 mm., or from the tip of the rostrum to the apex of the telson 169 mm.

Alcock (1901) suggests that *Plesionika semilaevis*, Spence Bate, should be regarded as a synonym of *P. martia*. With this view I am inclined to agree, although the rostra of the *Challenger* specimens are considerably shorter, in proportion, than those of the Irish examples.

The Irish specimens with perfect rostra yield the following measurements :—

Sex.	Lengthof body.[1]	Length of rostrum.	Ratio of rostrum to body (100).
♀	108	61	56
♀	106	63	59
♀	105	65	62
♀	98	62	63
♂	96	58	60
♂	94	48	51
♂	92	58	63
♀	89	57	64
♂	89	54	60
♂	79	53	57
♂	73	49	67

Senna's measurements (1903) of seven specimens from the Mediterranean show that the rostrum varies from 45 per cent. to 58 per cent. of the length of the body, as compared with 51 per cent. to 67 per cent. in the case of the Irish examples.

General distribution.—First taken by the *Travailleur* in the East Atlantic (exact locality not published) and also known from the Mediterranean (Adensamer, Senna, etc.), from the Spanish coast (Wolfenden, *Silver Belle*, 1906) and from the Bay of Biscay (Caullery). Found by the *Challenger* between the Philippines and Borneo, off Sydney Harbour, off the Kermadec Is. and near Fiji (Spence Bate, sub *P. semilaevis*). *P. martia* has also been taken by the *Investigator* in the Arabian Sea, Andaman Sea, Bay of Bengal and off Ceylon (Alcock) and is reported as common in the neighbourhood of the Sandwich Islands (Rathbun).

Irish distribution.—The slender rostrum is broken in the majority of the specimens obtained; the measurements in the following list are therefore given from the back of the orbit to the apex of the telson.

Helga.

S.R. 171—5/11/'04.—52° 7′ N., 11° 58′ W. 337 fathoms. Trawl —One, 66 mm.

S.R. 188—3/2/'05.—51° 53′ N., 11° 59′ W. 320–372 fathoms. Trawl. Temperature at 300 fathoms 10·12° C., salinity 35·50°/$_{oo}$—Ten, 84–97 mm.

S.R. 353—6/8/'06.—50° 38′ N., 11° 32′ W. 250–542 fathoms. Trawl. Temperature at 500 fathoms 8·58° C., salinity 35·46°/$_{oo}$—Four, 97–110 mm. (two ovigerous females).

[1] Measured from the back of the orbit to the apex of the telson.

S.R. 368—11/8/'06.—51° 39′ N., 12° 0′ W. 450–608 fathoms. Trawl—One, 98 mm., and fragments of a second specimen.

S.R. 447—18/5/'07.—50° 20′ N., 10° 57′ W. 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—Two, 65 and 73 mm.

S.R. 448—18/5/'07.—50° 22′ N., 11° 0′ W. 343–346 fathoms. Trawl—Five, 93–107 mm. (several ovigerous females).

S.R. 495—8/9/'07.—52° 0′ N., 13° 10′ W. 346–400 fathoms. Prawn trawl—One, 90 mm.

S.R. 502—11/9/'07.—50° 46′ N., 11° 21′ W. 447–515 fathoms. Trawl. Temperature at 500 fathoms 8·8° C., salinity 35·37°/$_{oo}$—One, 92 mm.

S.R. 505—12/9/'07.—50° 39′ N., 11° 14′ W. 464–627 fathoms. Trawl—Eighteen, 60–108 mm. (several ovigerous females).

Vertical range.—*P. martia* has been found in the East Atlantic between 218 and 666 fathoms (Milne-Edwards and Caullery); in the Mediterranean it is known from 278 and 478 fathoms (Senna and Adensamer). In Indian waters it is recorded from 142 to 430 fathoms (Alcock) and in the Pacific from 165 to 684 fathoms (Rathbun), while two specimens were dredged by the *Challenger* in 1,200 fathoms, off Sydney Harbour.

Genus **Pandalina**, Calman.

Pandalina brevirostris (Rathke).

Hippolyte Thompsoni, Bell, 1853, fig., p. 290.
Pandalina brevirostris, Calman, 1899 (*ubi syn.*), Pls. I–IV, fig. 4.
Pandalina brevirostris, Hansen (1908).
Pandalina brevirostris, Wollebaek (1908).

Colour in life.—The carapace is thickly sprinkled with bright red chromatophores; the rostrum is sometimes colourless, sometimes with a patch of red pigment spots at about its middle. Behind the rostrum a subquadrate whitish patch is often found. The abdomen is semi-translucent, with minute yellow dots and a few small red chromatophores on the sixth somite and on the pleura of the fifth. A few yellow and several small red pigment spots are present on the telson and uropods. The eyes are greyish black; the antennal scales and antennules are practically colourless. The outer maxillipedes and the first four pereiopods are faintly blotched and banded with yellow; the

last pair are bright red basally. The protopodites of the pleopods each bear a single red spot at the distal end.

Size.—The largest specimen examined measures 28 mm.

Specimens from very deep water differ from those found in the Irish Sea in the slightly larger eye and the longer rostrum; the latter, in some extreme cases, reaches to the middle of the ultimate segment of the antennular peduncle.

General distribution.—North-east Atlantic from west Finmark to the Mediterranean, but unknown from Iceland.

There is a single record from Lat. 74° 16′ N., 29° 47′ E. (Hoek); Hansen is of the opinion that this may be taken as correct, although the locality is far to the north of the usual range of the species.

Irish distribution.—*P. brevirostris* is found all round the Irish coasts, often in abundance. On the Atlantic slope, it has been trawled in depths exceeding 300 fathoms on the following occasions:—

Helga.

S.R. 5—14/2/'03.—52° 5′ N., 12° 0′ W. 312–334 fathoms. Dredge—One, 12 mm.

S.R. 151—27/8/'04.—54° 17′ N., 11° 33′ W. 388 fathoms. Dredge. Temperature at 380 fathoms 9·15° C.—Three, 22–23 mm.

S.R. 171—5/11/'04.—52° 7′ N., 11° 58′ W. 337 fathoms. Trawl—Two, one 20 mm., and one broken.

S.R. 172—5/11/'04.—52° 2′ N., 12° 8′ W. 454 fathoms. Trawl—Seven, 16–22 mm.

S.R. 188—3/2/'05.—51° 53′ N., 11° 59′ W. 320–372 fathoms. Trawl. Temperature at 300 fathoms, 10·12° C., salinity 35·50°/$_{oo}$—Seventeen, 18–23 mm.

S.R. 212—6/5/'05.—51° 54′ N., 11° 57′ W. 375–411 fathoms. Trawl. Temperature at 350 fathoms, 9·82° C. Salinity, 35·28°/$_{oo}$—Few.

S.R. 399—5/2/'.07—51° 28′ N., 11° 33′ W. 342 fathoms. Dredge—One, 20 mm.

S.R. 440—16/5/'07.—51° 45′ N., 11° 49′ W. 350–389 fathoms. Trawl. Temperature at 300 fathoms, 9·93° C. Salinity, 35·46°/$_{oo}$—Two.

Vertical range.—Littoral to 584 fathoms.[1] *P. brevirostris* is found in the Irish Sea at practically all depths, but seems to occur most commonly inside the 20-fathom line. In the west it is equally abundant, but becomes scarce in soundings of 100 fathoms and more.

[1] According to a note on the plate, the specimen figured by Milne-Edwards (1883, pl. 28) was found by the *Travailleur* at St. 2, 14/6/'81, 1,068 metres.

Family *HIPPOLYTIDAE*.

In a recent paper (1906) Calman has given an account of some of the genera of this family, and has supplied a most useful table for their discrimination. All the five[1] genera known from British and Irish waters fall under that section of the family which is characterized by the absence of arthrobranchs above the bases of the pereiopods. The chief characters of these genera are best shown in tabular form.

	Hippolyte. p. 100.	*Spirontocaris.* p. 102.	*Caridion.* p. 108.	*Leontocaris.* p. 113.	*Bythocaris.* p. 117.
Incisor process of mandible.	present.	present.	present.	present	absent.
Mandibular palp.	absent.	present 2-jointed.	present 3-jointed	present 1-jointed.	absent.
Supra-orbital spines of carapace.	present.	present or absent.	absent.	absent.	present.
Exopod of third maxillipedes.	present.	present or (rarely) absent	present.	absent.	present.
Epipods of maxillipedes and pereiopods.	2 pairs.	4–6 pairs.[2]	7 pairs.	2 pairs.	1 pair.
Carpus of second pereiopods.	3-jointed.	6–7-jointed.	2-jointed.	4-jointed.	9–10-jointed

The highly specialized genus *Leontocaris* may be at once distinguished from the others by the assymmetry of the second pair of pereiopods; both chelae of this pair are larger than those of the first, that of one side being of enormous size.

1 Since this was written another Hippolytid, *Cryptocheles pygmaea*, G. O. Sars, has been found within the British area. *C. pygmaea* is a very scarce deep-water species, and is readily distinguished from all other British Hippolytidae by its unpigmented eyes. It is described and figured by Norman, 1894, p. 271, pl. xii., figs. 2-5. The solitary British specimen was found by the Scotch Fishery Board off the N.W. coast of Scotland; elsewhere it is known only from the coasts of Norway.

2 In all British and Irish species of *Spirontocaris* five or six pairs of epipods are present, viz., on the three pairs of maxillipedes and first two or three pairs of pereiopods.

The genus *Bythocaris* may also be recognized at a glance by the great expanse of the antennal scales and by the extraordinary development of the supra-orbital spines, which, combined with the very short simple rostrum, give the frontal area of the carapace a highly characteristic tridentate appearance.

Genus **Hippolyte**, Leach.

Virbius, Stimpson.

Two species of this genus are known from British and Irish waters. The branchial formula in each is :—

	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	...	...	...	...	...	...
Arthrobranchiae, ..	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

I. Rostrum scarcely as long as carapace, with a prominent dorsal tooth at base; carapace (with rostrum) three times as long as deep; cornea large; antennal scale less than three and a half times as long as broad; third pereiopods reaching almost to apex of antennal scale, *H. varians*.

II. Rostrum longer than carapace, usually without a dorsal tooth at base; carapace (with rostrum) four times as long as deep; cornea much smaller; antennal scale fully four and a half times as long as broad; third pereiopods reaching only to ultimate segment of antennal peduncle, . . . *H. prideauxiana* (p. 101).

Hippolyte varians, Leach.

Pl. XIII, figs. 1–7.

Hippolyte varians, Bell, 1853, fig., p. 286.
Hippolyte fascigera, Gosse, 1853.
Hippolyte varians, Walker, 1899.

The striking colour variations[1] which this abundant species presents have been repeatedly noticed; no detailed description of the numerous phases is necessary here.

[1] This species has formed the subject of a very important memoir by Keeble and Gamble (1900, 1904, and 1905) on the colour physiology of the higher crustacea.

Size.—The largest specimen examined measures 31½ mm.

General distribution.—West Finmark to the Mediterranean, usually found in great abundance.

Irish distribution.—Extremely common all round the coast.

Vertical range.—*Hippolyte varians* has been found at practically all depths in the Irish Sea—it has frequently been taken in 70–80 fathoms in Lambay Deep. Off the west coast it has occurred in 75 fathoms, while in the north a single specimen has been dredged between 110 and 130 fathoms in Rathlin Deep. Between tide marks and down to 25 fathoms the species is abundant, but in the deeper water it is much scarcer.

Hippolyte prideauxiana, Leach.

Pl. XIII, figs. 8–10.

Hippolyte prideauxiana, Bell, 1853, fig., p. 292.
Hippolyte viridis, Heller, 1863, Pl. x, fig. 3.
Hippolyte prideauxiana, Norman and Scott, 1906 (*ubi syn.*).

Colour in life. Usually of a uniform brilliant green colour with or without a conspicuous longitudinal white stripe down the middle of the carapace and abdomen. Specimens coloured brown, crimson, and crimson with vertical white stripes have also been noticed. It seems probable that the range of colour is almost as great in the present species as it is in *H. varians*.

Size.—The largest example in the collection measures 42 mm.

The absence of a dorsal spine at the base of the rostrum cannot be regarded as a trustworthy character for the separation of this species from its congener, *H. varians*. Some specimens of *H. prideauxiana*, more especially those of small size, possess a small but well developed spine in this position (fig. 10), while in other examples rudimentary traces of its existence are apparent. The mouth parts of the two species are almost identical, but the characters noticed above will be found reliable—in particular, the long and slender form and the small eye of the present species distinguish it at a glance.

Some of the specimens examined possess tufts or plumes of setae on the carapace and abdomen exactly as in the fascigerous form of *H. varians*. This feature has also been noticed by Walker (1899) in *H. gracilis* (Heller).

General distribution.—This species has been recorded from the Mediterranean and Adriatic (Heller, etc.), from the Black Sea (Czerniavsky) and from the west coast of France (Fischer, Barrois, etc.). It is well known on the coasts of Cornwall and Devonshire (Bell, Norman, etc.) and has been taken at the Scilly Is. (Norman). There is a single record from Scotland, from the Firth of Clyde (Scott).

Irish distribution.—Although hitherto unrecorded from Irish waters, there can be little doubt that the species is far from uncommon on the west coast. Specimens are extant in the Dublin Museum from Belmullet, Co. Mayo, from Ventry Harbour, Co. Kerry, and from Dunbeacon Harbour, Co. Cork. Between 1899 and 1903 it was repeatedly found in Bofin and Ballynakill Harbours, Co. Galway.

H. prideauxiana has not yet been detected on the north coast or in the Irish Sea.

Vertical range.—On the Irish coast this species seems to be exclusively littoral, but in the Adriatic it has occurred in as much as 30 fathoms (Heller).

Genus **Spirontocaris,** Spence Bate.

Five species of this genus are known from British and Irish waters, but two of them, *S. Gaimardi* and *S. polaris*, have not so far been met with off the Irish coast.

I. Rostrum long, reaching to at least three-quarters the length of the antennal scale; a supra-orbital spine on carapace; [carpus of second pereiopod composed of seven segments].

A. Rostrum very deep in side view; antennular peduncle long, reaching to rather more than half the length of the antennal scale; an exopod and epipod on the third maxillipede; epipods on first three pereiopods, . *S. spina* (p. 103).

B. Rostrum not so deep in side view; antennular peduncle short, not reaching to half the length of the antennal scale; an exopod and epipod on the third maxillipede; epipods on first two pereiopods, ... *S. Gaimardi* (p. 103).

C. Rostrum not so deep in side view; antennular peduncle long, reaching to fully three-quarters the length of the antennal scale; an epipod but no exopod on the third maxillipede; epipods on first two pereiopods, . *S. polaris* (p. 103).

II. Rostrum short, not reaching to one-third the length of the antennal scale; no supra-orbital spine on carapace; [an exopod and epipod on third maxillipede].

A. Apex of rostrum bidentate; epipods on first two pereiopods; carpus of second pereiopod composed of six segments, . . *S. Cranchi* (p. 106).

B. Apex of rostrum simple, acuminate; epipods on first three pereiopods; carpus of second pereiopod composed of seven segments, . *S. pusiola* (p. 107).

The three species found off the Irish coast yield the following branchial formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1+ep.	ep.	ep.	ep.	±ep.	...	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

Spirontocaris Gaimardi (H. M.-Edw.) (=*Hippolyte pandaliformis*, Bell) has been recorded in British waters from the Firth of Forth and off Aberdeen (Scott) and from various localities on the west coast of Scotland (Scott, Bell, etc.); it has also occurred in abundance off the Shetland Is. (Norman).

Spirontocaris polaris (Sab.) (=*Hippolyte cultellata*, Norman) has, within the British Area, been recorded only from the neighbourhood of the Shetland Is. (Norman, 1867).

Spirontocaris spinus (Sowerby).

Pl. XIV, fig. 1.

Hippolyte spinus, Bell, 1853, fig., p. 284.

S. spinus, var. **Lilljeborgi** (Danielssen).

Pl. XIV, figs. 2–10.

Hippolyte Lilljeborgi, Danielssen, 1859.
Hippolyte securifrons, Norman, 1862.
Spirontocaris spinus, Spence Bate, 1888, Pls. CVI. and CVII.
Hippolyte securifrons, Appellöf, 1906.
Spirontocaris Lilljeborgi, Hansen, 1908.

It has always been rather a doubtful question whether *S. Lilljeborgi* is a distinct species from *S. spinus* or merely a variety of it. The evidence which has so far been produced inclines me to the belief that only one species and a fairly well marked variety are represented in the N.E. Atlantic, although in some localities one of the forms appears to exist to the exclusion of the other. The two forms may usually be separated thus :—

S. spinus, typical.

Dorsal teeth extending to the extreme posterior edge of the carapace, often finely serrate on their upper margins. Third abdominal somite produced posteriorly as a stout tooth over the succeeding somite.

S. spinus var. *Lilljeborgi*.

Dorsal teeth not extending as far as the posterior edge of the carapace, their upper margin usually smooth. Third abdominal somite not, or only slightly, produced over the succeeding somite.

Off the Scandinavian coasts these two forms seem to be well marked and restricted to different localities and authors who have recently dealt with the Natantia of these districts regard them as two distinct species (Wollebaek, 1900, and Appellöf, 1906). Appellöf, however, has put the case very clearly and refers to the capture of the two forms together near Iceland; on this occasion a few intermediate examples were also obtained.

The majority of the specimens caught by the *Challenger* expedition off the east coast of North America and described by Spence Bate[1] (1888) may be referred to the var. *Lilljeborgi*, but his var. η appears to be somewhat intermediate in character, with the teeth continued far back on the carapace and with some of them serrate on their upper margins.

Miss Rathbun (1906) has recently dealt with specimens from the Pacific coast; *S. spinus* is retained as distinct from *S. Lilljeborgi* (though without definitions) and several other extremely closely allied forms serve as the types of new species. It is difficult to see what useful end is attained by the erection of species founded on such exceedingly fine distinctions in a group well known for its very wide variation.

Typical forms of *Spirontocaris spinus* are of very rare occurrence off the British coasts, and the var. *Lilljeborgi*, although rather more frequently found, is also scarce and local. Of the specimens obtained in Irish waters, all except one are referred to the variety. In this one example (fig. 1) the teeth are continued rather far back on the carapace, but show no trace of serration, while the posterior margin of the third abdominal somite is very strongly produced.

In the remaining specimens the teeth, which also show no trace of serration, are not continued so far back on the carapace, and the third abdominal somite is not produced posteriorly (fig. 2).

The shape and dentition of the rostrum are more variable in this species than in any other known from British waters and the character is consequently of little value as a distinction between the two forms; but the type with a deep emargination immediately below the apex (fig. 1) is only rarely met with among examples of the var. *Lilljeborgi*.

Size.—The largest specimen found off the Irish coast is a female measuring 40 mm.; Ohlin (1902) records a specimen 62 mm. in length.

Colour in life (of the var. *Lilljeborgi*).—The carapace and abdomen are bright red, dark red or dark purplish brown, usually mottled and often with a sprinkling of very small white or pale yellow chromatophores. The sides of the carapace and pleura are, as a rule, much darker than the dorsal colouring. Rarely, a subquadrate white patch occurs on the

1 Spence Bate's figures (pl. CVII.) of certain appendages of this species fall rather below his general standard of inaccuracy; it is hoped that figs. 6–10, Pl. XIV, will be found a trifle less misleading.

dorsal part of the carapace. The rostrum is more or less thickly sprinkled with a pigment uniform with the general colouring, but the dorsal margin is often quite white. The eyes are greyish black. The antennules and antennae are pale with reddish mottling on the peduncle; the antennal scale is more or less thickly mottled with red, and occasionally exhibits a white patch near the apex. The outer maxillipedes and first pair of pereiopods are dark red; the remaining pairs of legs are paler red with whitish bands. The telson and uropods are, as a rule, paler than the general colouring, and are in some cases quite transparent.

General distribution.—*Spirontocaris spinus* appears to have a circumpolar distribution. It has been recorded from the Murman coast (Breitfuss), from Spitzbergen (Kröyer, Sars, etc.), from the east and west coasts of Greenland (Kröyer, Ohlin, etc.) from Grinnell Land to 81° 44′ N. lat. (Miers), from Labrador (Packard) and south to Massachusetts Bay (Smith), from the Bering Sea and Straits (Stimpson and Rathbun), and from Alaska southwards to Lituva Bay (Rathbun). It is also known from west Norway and Finmark (Sars), from Iceland (Appellöf), from Sweden (Goës), from Denmark (Meinert) and from the vicinity of Kiel.

The variety *Lilljeborgi* does not extend as far north as the type, but seems to replace it to a great extent in the more southern localities.

In British waters this species has been recorded from the Shetlands (Norman), from both east and west coasts of Scotland (Leach, Scott, etc.), from the Northumberland coast (Norman), off Norfolk (Patterson), off the Isle of Man (Bell) and near Plymouth (Sp. Bate). The majority of these records refer to the variety.

Irish distribution.—The single specimen (fig. 1) which is referred to the typical form was caught at the following station :—

Helga.

S.R. 118—13/5/'04.—Rathlin Deep, off Co. Antrim, 55° 20′ N., 6° 8′ W. 115 fathoms. Dredge—One, 26 mm.

The remaining records, all of the var. *Lilljeborgi* are :—

Helga.

S. 224—22/6/'06.—Lambay Deep, off Co. Dublin, 44 fathoms. Trawl.—One, 40 mm.

S. 273.—24/5/'05.—35 miles off Clogher Head, Co. Louth. 36–39 fathoms. Trawl.—One, 28 mm.

R. 9.—3/5/'05.—17 miles S.W. of Coningbeg Lightship, off Co. Wexford. 40 fathoms. Bottom temperature, 8·9° C.—One, 39 mm.

R. 29.—17/8/'06.—15 miles S.E. by S. of Mine Head, Co. Waterford. 40–42 fathoms. Trawl. Bottom temperature, 9·6° C.—Four, 17–19 mm.

S. 553.—16/8/'07.—10 miles E. of Bailey Lighthouse, Co. Dublin. 41–52 fathoms. Trawl.—Twelve, 18–37 mm.

Vertical range.—This species is usually found between 20 and 50 fathoms, but has occurred in deeper water down to 524 fathoms (Smith, 1882).

Spirontocaris Cranchi (Leach).

Pl. XV, figs. 1-5.

Hippolyte Cranchii, Bell, 1853, fig., p. 288.
Spirontocaris Cranchii, Norman and Scott, 1906 (*ubi syn.*).

This common littoral species has only very occasionally been met with during the investigations of the *Helga*, and, in consequence, no opportunity for observing the range of colouration has been forthcoming. A common form is semi-transparent with dark purplish brown blotchings, but numerous other varieties doubtless occur.

S. Cranchi seems to differ from all the other British species of *Spirontocaris* in the possession of six instead of seven segments to the carpus of the second pair of pereiopods (fig. 5). The rostrum, with its characteristic bifurcate apex, is shown in fig. 3; fig. 4 represents the trifid variety originally described as *Yarrelli*.

Size.—The largest specimen in the collection measures 19 mm., but specimens a few millimetres longer have been observed.

General distribution.—*S. Cranchi* occurs commonly from west Norway to the Mediterranean. The principal records are :—west and south Norway (Sars and Norman), Sweden (Goës), Denmark (Meinert), Belgium (van Beneden), north coast of France (Milne-Edwards and Bouchard-Chantereaux), west coast of France (Barrois and Fischer), Mediterranean and Adriatic (Carus, Heller, etc.).

This species is abundant on the south coast of England, and has also been recorded from the east and west coasts. In Scotch waters it is known from both east and west, and has been taken near the Shetlands.

Irish distribution.—*S. Cranchi* is probably common all round the Irish coast. It has been recorded from Bangor, Co. Down, and Whitehead, Co. Antrim (Kinahan), Lambay (Rankin), Dublin and Killiney Bays (Kinahan), Cork (Kinahan), Kenmare River (Dub. Mus.), Dingle Bay and

Valencia (Walker) and Galway Bay (Melville). In addition to these records, *S. Cranchi* has been taken in Clew Bay and Blacksod Bay and was found commonly in Bofin and Ballynakill Harbours, Co. Galway, during the periods in which the marine laboratory was stationed there.

Vertical range.—Off the Irish coast this species is essentially littoral; it has never, I believe, been taken in more than 10 fathoms of water. In the Adriatic it has been found between 20 and 30 fathoms (Heller) and in as much as 70 fathoms (Adensamer).

Spirontocaris pusiola (Kröyer).

Pl. XV, figs. 6–8.

Hippolyte pusiola, Kröyer, 1842, Pl. III, figs. 69–73.
Spirontocaris pusiola, Norman and Scott, 1906 (*ubi syn.*).

This species is readily recognized from *S. Cranchi* by the simple and acute termination of the rostrum and by the number of segments (seven) composing the carpal joint of the second pair of pereiopods. *S. pusiola* also possesses an epipod at the base of the third pereiopod, which is absent in *S. Cranchi*, but this seemingly constant characteristic has been shown to be so variable in at least one species of Hippolytidae (Smith, 1879, *S. Fabricii*) that its use in the present instance may prove untrustworthy. The mouth parts scarcely differ at all from those of the preceding species or of *S. spinus*. The inner branch of the first pair of pleopods is, in the female, much broader and shorter than in the corresponding part of *S. Cranchi* (cf. figs. 2 and 8); in the male the differences seem to be less pronounced (fig. 1[1] and fig. 7).

Size.—The largest specimen examined measures only 19 mm.; Smith mentions a female 25 mm. in length.

Colour in life.—The carapace and abdomen are dull semi-translucent white with red, red and maroon, or red and white mottlings, usually arranged in more or less regular series, especially on the carapace; the sixth somite is often more deeply pigmented with red than the rest of the carapace. The gastric and cardiac regions are generally of a dull greenish tint, showing through the walls of the carapace. In one specimen examined the red colouring was quite pale and a broad band of pure white extended from the rostrum to the apex of the telson. The eyes are black, with red stripes or mottling on the stalk. The antennae and antennules are

[1] Among the numerous specimens of *S. Cranchi* in the collection, the only male observed is an immature specimen. It seems not unlikely that the endopod of the first pair of pleopods (fig. 1) has not in this case assumed its full complement of setae.

thinly sprinkled with faint red chromatophores, often more numerous proximally. The outer maxillipedes and pereiopods are banded with scarlet, red, or pale red, sometimes with an admixture of very small golden yellow chromatophores. The red colouring is in many cases most strongly pronounced at the bases of the third and fourth pereiopods. The telson and uropods are pale, with a broad transverse band of red across the middle. The eggs are green.

Many colour varieties doubtless occur. Kinahan mentions rose pink, green and cobalt blue forms, and others are described by Smith (1879).

General distribution.—*Spirontocaris pusiola* has been recorded from the Murman coast (Birula), Spitzbergen (Sars), Iceland (Sars), E. Finmark to S. Norway (Norman and Sars), Sweden (Goës), Denmark (Meinert), Holland and North Sea generally (Metzger and Norman). In the West Atlantic it has been found between Connecticut and Nova Scotia (Smith), while in the Pacific it has occurred in the Bering Sea and off Alaska (Rathbun).

Off the English coasts this species has been once recorded in the south, from Plymouth (Spence Bate). It is known from the Lancashire coast (Piel, Walker) and in the east it is recorded from the coasts of Norfolk (Metzger) and Northumberland (Norman); there can be little doubt that it is far from scarce in both east and west. In Scotch waters it has been found on several occasions in the Firth of Forth and off Aberdeen (Scott) and has also been taken near the Orkneys (Fleming) and Shetlands (Norman).

Irish distribution.—This species is by no means uncommon on the east coast trawling grounds between Dublin and the Isle of Man, but has not as yet been found further south than Bray Head, Co. Wicklow. It has been recorded by Kinahan from Bangor, Co. Down, and from Whitehead and the Gobbins, Co. Antrim. Off the north coast it has been found on one occasion in Rathlin Deep, Co. Antrim. In the west *S. pusiola* seems to be very scarce; it has been found in Broadhaven, Co. Mayo, and there is a specimen in the Dublin Museum which was caught in Bantry Bay. In the south the species has not so far been observed.

Vertical range.—In the Irish Sea *S. pusiola* is most frequently trawled in depths exceeding 15 fathoms, but it has been found in shallower water up to 4 fathoms. In Rathlin Deep the species was taken in as much as 115 fathoms. Smith (1879) records it from between low-water mark and 105 fathoms on the E. coast of N. America, while in the Pacific it has occurred between 5 and 159 fathoms (Rathbun).

Genus **Caridion**, Goës.

Doryphorus, Norman, 1861 (*nom. praeoc.*).
Caridion, Goës, 1863.

Caridion Gordoni (Spence Bate).

Pl. XVI, figs. 1–12.

Hippolyte Gordoniana, Spence Bate, 1859, fig., p. 49.
Doryphorus Gordoni, Norman, 1861, Pl. XIII, figs. 6 and 7.
Caridion Gordoni, Goës, 1863.
Caridion Gordoni, Smith, 1879.

The *rostrum* is more than half the length of the carapace; in adult specimens it is rather deep, slightly upturned at the apex, and always extends beyond the antennular peduncle, reaching from two-thirds to three-quarters the length of the antennal scale. In small examples it is, as a rule, straight, not so deep, and considerably longer, in some instances almost the length of the carapace measured in the middle line. Dorsally the rostrum (figs. 2–4) is armed with six to ten teeth, one of which is situated behind the posterior line of the orbit; ventrally it is usually provided with one stout pro-curved tooth, more rarely with two or three. Of the forty specimens examined with perfect rostra—

9	have	6	teeth	above.	31	have 1	tooth below.
10	,,	7	,,	,,	8	,, 2	teeth ,,
14	,,	8	,,	,,	1	has 3	,, ,,
5	,,	9	,,	,,			
2	,,	10	,,	,,			

The *carapace* is considerably less than half the length of the abdomen, excluding the telson; it is deep posteriorly and but little compressed laterally. Dorsally it is not carinate behind the posterior rostral tooth; the antero-lateral angle is rounded and without any trace of a tooth, but there is a strong and acute spine below the base of the orbit. There is no supra-orbital spine.

The *abdominal somites* are all dorsally rounded. The *telson*, excluding its terminal spines, is longer than the sixth somite; apically it is truncate (fig. 12), though with a minute central prominence, and is furnished with a pair of spinules at the outer angles and with two pairs of setae, the outer of which is twice the length of the inner. The telson is not sulcate above and is provided with two pairs of dorso-lateral spinules.

The cornea of the *eye* is well pigmented and much wider than the stalk; it shows no trace of an ocellus. The peduncle of the *antennules* is more than half the length of the antennal scale; the basal joint (fig. 6) is much longer than the second and third combined and its lateral process is long, narrow, and acutely pointed anteriorly, usually reaching much beyond the distal end of the basal segment, but occasionally much shorter and falling considerably short of it. In both sexes the outer flagella are thickened basally for almost three-quarters of their length and are strongly setose ventrally; the inner pair are more slender and rather longer—about as long as the cara-

pace. The *antennal scale* (fig. 5) is about two-thirds the length of the carapace, only very slightly narrowed apically, and rather more than one-third as wide as long; externally it is straight or slightly concave and terminates in a stout tooth which does not reach as far forward as the lamellar portion. The antennal flagellum is about half the entire length of the animal.

The oral appendages differ from those of *Hippolyte varians* as follows:—The *mandible* (fig. 11) bears a palp composed of three joints and the molar is but little wider than the incisor process; in the *first maxilla* (fig. 10) the endopod is longer and the middle lobe or basipodite evenly rounded apically; the endopod of the *second maxilla* (fig. 9) is narrowed distally and is not flexed outwards and the distal lobe of the basipodite or protognath is wider than the proximal one. In the *first maxillipede* (fig. 8) the endopod is more slender than in *H. varians*, and is only set with a few setae; the lamellar portion of the exopod is oblong and is not contracted at its base and the epipod consists of two large lobes. In the *second maxillipede* (fig. 7) the exopod and endopod are longer and more slender, the terminal joint of the latter being very short and extremely wide. A comparison of the figures on plates XVI and XIII will show these and other less important distinctions more clearly than a long description.

The *third maxillipedes* reach beyond the antennal scale by nearly the whole of the terminal joint; the slender exopod is about half the length of the ante-penultimate segment. The *first pair of pereiopods* reaches slightly beyond the antennal scale; the merus is longer than the ischium, and the chela and short triangular carpus are rather shorter than the ischium and merus combined. The chela is very stout, and the dactylus is about two-thirds the length of the palm. In the *second pair* the ischium, which is much widened distally, is longer than the merus and about equal in length to the chela. The carpus is scarcely half the length of the merus and is divided into two joints by an oblique articulation; the chela is very narrow, much less robust than that of the first pair and its dactylus is not much less than twice the length of the palm. The *third* and *fourth pairs* of pereiopods are much longer than the first pair, the *fifth* is still longer. In all, the ischium is slightly shorter than the carpus, while the merus is shorter than the propodus; the dactyli of the three pairs are quite similar, extremely short and claw-like.

The *branchial formula* is:—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The endopod of the *pleopods* is as usual rather shorter than the exopod in the last four pairs and is provided with an appendix interna at its base. The outer *uropods* are slightly longer than the inner; both are longer than the telson (excluding spines); the outer pair are rather more than three times as long as broad and are setose along their outer margins.

Size.—The largest specimen examined measures 21 mm.; an ovigerous female is 18·5 mm. in length. Smith records an example of 27 mm.

Colour in life.—Transparent, with a thick sprinkling of pure red chromatophores on the carapace and abdomen, the colour being darkest on the rostrum. The gastric regions are visible through the carapace as a greenish mass. The eyes are black; the antennal and antennular flagella are quite transparent, but their peduncles and the antennal scale are dotted with red chromatophores. The outer maxillipedes are thickly strewn with red pigment spots. The two basal joints of each pereiopod are red; the chela of the first pair is outlined with a double row of red chromatophores (but is quite transparent in the centre), and there is a very narrow red band at the base of the chela of the second pair; all the remaining joints of the pereiopods are quite colourless and transparent.

The Irish specimens of *C. Gordoni* have added very considerably to our knowledge of the variability of the species. The diverse forms of the rostral armature are paralleled in the genera *Hippolyte* and *Spirontocaris*, but the variation in the length of the lateral process of the antennules is perhaps unusual. In the matter of the number of epipods present and the spinulation of the telson the specimens examined show no difference, although these features are by no means constant in some of the more variable members of the family.

It is worth noting that of the forty-five specimens in the collection only two are adult males.

General distribution.—Known in European waters from the North Sea (Metzger), Denmark (Meinert), Sweden (Goës), S. Norway to E. Finmark (Sars and Norman), Iceland (Hansen) and off the Scotch coasts from the Shetlands, Loch Fyne, Moray Firth and off Aberdeen (Norman and Scott). I have recently examined specimens collected by the *Huxley* on the N. side of the Bay of Biscay, which is the most southern locality in which the species has been found in the N.E. Atlantic. In the West Atlantic it has been frequently found off the American coast, north of Cape Cod (Smith).

Smith (1879) states that the species is only found on hard or rocky bottoms in fairly deep water, and Sars (1882) has found it frequently off the west coast of Norway in the region of the deep-sea corals.

Irish distribution.—There seems no ground for the belief that *C. Gordoni* is restricted to a rocky bottom round the Irish coasts, although it has occurred in such localities. Deep-sea corals (*Lophohelia*, etc.) have not often been found off the

west coast of Ireland; they seem to occur in deeper water than in the Norwegian fjords and on no occasion has *C. Gordoni* been found associated with them.

In the following records latitude and longitude are given only in the case of deep-water west coast localities.

Helga.

LXXVII.—29/6/'01.—*Porcupine Bank*, 53° 24′ N., 13° 36′ W. Soundings, 91 fathoms. Townet, 0–40 fathoms—Two, 13 and 14 mm.

LXXX.—2/7/'01.—20 miles N.W. by N. of Cleggan Head, Co. Galway. Soundings, 63 fathoms. Townet, 0–31 fathoms. —One, 12 mm.

M. L. LXI.—12/8/'01.—4 miles W.S.W. of High I., Co. Galway. Soundings, 54 fathoms. Townet, 0–54 fathoms. Temperature at 54 fathoms, 12·0° C.—One, 10·5 mm.

CXXI.—24/8/'01.—53° 52′ N., 11° 56′ W. 199 fathoms. Trawl. —Fifteen, 12·5–15 mm.

S. 66—5/8/'02.—9 miles off Clogher Head, Co. Louth, 21–22 fathoms. Trawl.—One, 13 mm.

A. 1.—14/8/'02.—20 miles W.N.W. of Cleggan Head, Co. Galway. 72½ fathoms. Dredge. Temperature at 70 fathoms, 9·7° C.—Six, 11–13 mm.

13/7/'03.—53° 36′ N., 11° 30′ W. 120 fathoms. Trawl—Six, 13–14 mm.

S.R. 44.—17/8/'03.—53° 35′ N., 11° 33′ W. 116½ fathoms. Trawl. Temperature at 115 fathoms 10·15° C.—Two, 14 mm.

W. 5.—23/3/'04.—3–5 miles S.W. of Gt. Skellig, Co. Kerry. 60–65 fathoms. Trawl. Temperature at 60 fathoms 7·45° C.— One, 14·5 mm.

S. 226.—23/6/'04.—34 miles E. of Clogher Head, Co. Louth. 36–38½ fathoms. Trawl.—One female, ovigerous, 18·5 mm.

S.R. 139—11/8/'04.—55° 0′ N., 10° 48′ W. Soundings, $\frac{\cdot}{1,000}$ fathoms. Triangle net, 0–1,000 fathoms. Surface temperature, 14·6° C. Temperature at 800 fathoms, 7·0° C.—Two, 14 and 14·5 mm.

S.R. 145.—23/8/'04.—53° 24′ 30″ N., 11° 38′ W. 112 fathoms. Trawl.—One, 16 mm.

S.R. 152—27/8/'04.—54° 7′ N., 11° 37′ W. Soundings, 220 fathoms. Triangle net, 0–200 fathoms—One, 14·5 mm.

S.R. 200—14/2/'05.—"*Rathlin Deep*," off Rathlin I., Co. Antrim. 125 fathoms. Dredge. Temperature at 113 fathoms, 7·85° C.—One, 21 mm.

S. 274—24/5/'05.—11 miles S. of St. John's Point, Co. Down. 32½–39 fathoms. Trawl—One, 16 mm.

R. 19.—2/2/'06.—18 miles S.E. by S. of Old Head of Kinsale, Co. Cork. 48 fathoms. Trawl—Two, 14 and 14·5 mm.

S. 457—15/10/'06.—19 miles W.S.W. of Calf of Man. 41–80 fathoms. Trawl. Temperature at 38 fathoms, 12·6° C., salinity, 34·04°/$_{oo}$—One.

In only six of the above instances were the specimens captured on hard and rough ground; in all the others they were found on or over a muddy or sandy bottom.

Although not hitherto recorded from Irish waters, *C. Gordoni* is widely distributed round the coast, as may be seen from the list of records. It is, on the whole, a decidedly scarce species and is usually found singly or in small numbers.

Vertical range.—This species, although in many cases found under circumstances which afford good evidence that it was inhabiting the bottom, has also been taken in midwater. It has been found off the Irish coast over soundings of 21 to more than 1,000 fathoms, but has not been proved to occur on the bottom at greater depths than 199 fathoms. In the Bay of Biscay it was trawled in as much as 246 fathoms, while in the West Atlantic it is known between 27 and 110 fathoms (Smith).

Genus **Leontocaris,** Stebbing.

Leontocaris, Stebbing, 1905.

Leontocaris lar, Kemp.

Pl. XVII, figs. 1–17.

Leontocaris lar, Kemp, 1906.

The *rostrum* (figs. 1 and 9) is a little longer than the carapace and projects beyond the apex of the antennal scale. It is quite straight, slightly ascendant and is furnished dorsally with nine or ten deeply cut teeth, the distal of which are smaller and more closely set than the proximal. There are also three or four teeth situated on the carapace behind the orbital notch: these decrease in size from before backwards. Ventrally the rostrum is furnished with from nine to thirteen closely set teeth, the posterior of which are the largest. The carapace is dorsally arched and the median carina is obsolete close behind the middle point; it is not much laterally compressed and is considerably less than twice as long as deep. Anteriorly it is produced as a rounded point below the orbit, while opposite the base of the antenna there is a sharp spine flanked with a short carina; this spine originates close behind the anterior margin. There is no supra-orbital spine. Anteriorly and basally the carapace is angular, but not produced to a spine.

The *abdominal somites* are all dorsally rounded; the third is not produced as a spine over the succeeding somite, and the sixth is about one and three-quarters the length of the fifth. The *telson* (fig. 17) is longer than the fifth and sixth somites

combined; it is not sulcate dorsally and is only very slightly narrowed to a broad rounded apex. It is provided with five pairs of dorso-lateral spinules and six terminal spines, of which the innermost pair is the longest.

The *eyes* are large and globose; the cornea is deeply pigmented and is much wider than the stalk. No ocellus is distinguishable. The *antennular peduncle* (fig. 13) is almost exactly the same as in the type species of the genus; the basal joint is much longer than the two following combined and bears at its base an acutely pointed lateral process reaching to almost half its length. In both sexes the outer flagellum is strongly setose and is stouter and rather longer than the inner. The peduncle of the *antenna* is not provided with a spine at its lower distal angle. The antennal scale (fig. 12) reaches fully to the apex of the antennular peduncle; it is scarcely at all narrowed distally and is rather less than three and a half times as long as wide. Externally it is almost straight and is provided with a series of stout forwardly directed spines, about seventeen in number, on its distal three-fifths. The most anterior of these spines is not longer than any others of the series and falls short of the produced lamellar portion of the scale. The basal joint of the flagellum reaches to more than half the length of the scale, the whole ramus being about half the entire length of the animal.

The *mandibles* (fig. 4) possess a small one-jointed palp, which in the specimen dissected showed no trace of setae. The incisor process is tipped with five teeth, while the molar bears a number of bristles and a few minute teeth at its apex. The *first maxilla* (fig. 5) has much the same outline as in *L. Paulsoni*; the outer lobe is fringed with setae on its external margin; the inner bears only two. The rounded basal lobe of the *second maxilla* (fig. 6) is obscurely notched distally; the two anterior lobes project much beyond it, the outer being wider than the inner. The endopod bears a single terminal seta; the exopod is long, setose and rounded at either end and is more concave internally and distally than in Stebbing's figure of *L. Paulsoni*. The *first maxillipede* (fig. 7) is very like that of the type species, but the lamellar portion of the exopod slopes away rather more sharply from its connection with the distal lash; the endopod is very narrow apically and the epipod is large and bilobed. The terminal joint of the *second maxillipede* (fig. 8) is very much shorter and broader than in *L. Paulsoni*. An irregularly shaped epipod is present at the base; distally this shows traces of breaking up into lamellae and possibly becomes a functional podobranch in some cases. The *third maxillipedes* are much swollen basally and reach almost to the apex of the antennal scale; they do not possess an exopod and the ultimate joint is rather more than one and a half times the length of the penultimate.

The *first pair of pereiopods* is not longer than the third maxillipedes. The ischium is more than half the length of the merus; the carpus is rather longer than the merus and is more than twice the length of the small and slender chela.

The *second pair* is asymmetrical; the limb of one side, the right in the type specimen, (fig. 2) is slender, and reaches beyond the apex of the antennal scale by the chela and distal joint of the carpus. The ischium[1] is a trifle shorter than the merus and the carpus is composed of four segments, of which the proximal is about three-quarters the length of the ischium and merus combined; the two succeeding segments are very short, about as long as broad, and are flexed so as to bring the distal joint—which is about twice the length of the two short ones—to a position at right-angles with the proximal carpal segment. The chela is slender and is rather more than half the length of the merus; the dactylus, as in the first pair, is short.

On the other side of the animal (the left in the type specimen) the leg of the second pair is of enormous length, being nearly as long as the entire animal, excluding the telson. It bears the huge and peculiar chela characteristic of the genus, and appears under normal circumstances to be carried flexed in two places—somewhat as shown in fig. 1, but with the joints overlying one another in lateral view. The ischium is half the length of the merus and the carpus, as in the leg of the same pair on the other side, is composed of four joints. The proximal joint is nearly as long as the merus and ischium combined and bears a stout tubercle distally on its dorsal edge; the three succeeding segments are very short and about as long as broad. The great chela is about one and a third times the length of the carapace and is more than three times as long as broad. It bears a close resemblance to that of the type species—figs. 10 and 11 will probably convey a better idea of its peculiar appearance than a long description. The superior margin of the propodus is very thin and reflected upwards and outwards, leaving a deep groove between its elevated edge and the thick lower portion. From an extra deep area of this groove a thin walled sausage-shaped structure rises; in one case this gives the appearance shown in fig. 10, but in no two specimens is it exactly alike. In one instance it seems to consist of an inflated membrane which rises above the level of the other parts of the chela (fig. 11); it is possible that this is the normal form of the structure, while in the other two specimens it is torn. On the lower side of this a row of small papillae may be seen and when the limb is completely flexed these papillae appear to come in contact with a similar row on the inferior margin of the merus (see fig. 1 and enlarged view in fig. 3). If these had been of a stouter build it would have seemed possible that they were provided to link the joints of this unwieldy limb together, when not in use, but their structure is so essentially weak that they could hardly serve this purpose.

The *third, fourth and fifth* pairs of pereiopods are of about equal length and are longer than the rostrum and carapace combined. The ischium is rather more than half the length

[1] Stebbing's figure of this limb in *L. Paulsoni* is perhaps erroneous in respect of the proportional lengths of the basus and ischium.

of the merus, while the carpus and propodus are about equal. The dactylus is short and claw-like and less than one-fifth the length of the propodus.

The *branchial formula* appears to differ from that of *L. Paulsoni* in the occurrence of an epipod on the second maxillipedes.

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	...	...	...	...	...	...
Arthrobranchiae, ...	...	...	1	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

In the female the endopod of the first pair of *pleopods* (fig. 15) is narrow; it is less than one-third the length of the exopod and bears no setae on its margins. In the male (fig. 14) the endopod is longer and wider, internally concave and beset with setae on its posterior margin; on the rounded proximal portion of its anterior edge it bears a few short but stout spines, while nearer the apex is a papilla furnished with minute hooks. In the remaining pairs of pleopods the endopod is only slightly shorter than the exopod and bears the usual appendix interna at its base.

Both *uropods* extend a trifle beyond the apex of the telson. The outer (fig. 16) is slightly longer than the inner and is about three and a half times as long as wide. It bears a series of spines (seventeen in the type specimen) on the distal two-thirds of its margin and thus bears in almost every feature an exceedingly close resemblance to the antennal scale.

Size.—The three specimens examined all measure about 21 mm. in length; Stebbing mentions a specimen of *L. Paulsoni* 46 mm. long.

Colour in life.—No notes were taken at the time the specimens were caught, but as far as recollection goes, they were ivory white with jet black eyes.

Only two species of this highly specialized genus are known. They may be readily distinguished thus :—

L. Paulsoni.	*L. lar.*
Rostrum with $6+\frac{2}{8}$ teeth.	Rostrum with $\frac{9 \text{ to } 10+3 \text{ to } 4}{9-13}$ teeth.
Third abdominal somite produced posteriorly as a dorsal spine.	Third abdominal somite not produced posteriorly.
Eyes smaller.	Eyes larger.
Terminal spine of outer margin of antennal scale reaching as far forward as lamellar portion.	Terminal spine of outer margin of antennal scale not reaching as far forward as lamellar portion.

L. Paulsoni—cont'd.	*L. lar*—cont'd.
No epipod at base of second maxillipedes.	An epipod at base of second maxillipedes.
Telson acutely pointed apically with a pair of terminal spines.	Telson broadly rounded apically with three pairs of terminal spines.

Leontocaris Paulsoni was found off the South African coast, 25 miles off Lion Head, in 131 and 136 fathoms.

Irish distribution.—*Leontocaris lar* has only been found at two stations. On each occasion the trawl brought up numerous specimens of *Antipatharia* and *Lophohelia*; it seems probable that the species is confined to areas where such Alcyonarians grow. The records are :—

Helga.

S.R. 223—12/5/'05.—53° 7′ N., 14° 50′ W. 500 fathoms. Trawl. —Two females, 21 mm.

S.R. 504—12/9/'07.—50° 42′ N., 11° 18′ W. 627–728 fathoms. Trawl—One male, 21 mm.

Vertical range.—500-627 fathoms.

Genus **Bythocaris,** G. O. Sars.

Of this genus only a single specimen, which has been determined as *Bythocaris gracilis*, has been found off the Irish coast. *B. gracilis* is very closely related to the common arctic form *B. Payeri*, which was taken by the *Knight Errant* expedition (Norman), and more recently by Dr. Wolfenden in the Färöe Channel.[1]

Bythocaris gracilis, Smith.

Pl. XVIII, figs. 1–3.

Bythocaris gracilis, Smith, 1887, Pl. xii, figs. 3 and 4.
Bythocaris gracilis, Hansen, 1908.

The solitary Irish example is a male measuring only 19 mm.; it nevertheless agrees fairly well with Smith's description and figures of the ovigerous female. From the closely

[1] The species inhabiting this district are almost wholly arctic in character, and it was very properly decided in 1890 that they could not be admitted to the British lists. It thus happens that *B. Payeri*, though found within five miles of the British area, will in all probability never be caught within it, except by the merest accident.

allied *B. Payeri* the species may be distinguished by the following characters :—

B. gracilis.	*B. Payeri.*
Median carina of carapace usually terminating anteriorly in a small tooth.	Median carina of carapace rarely terminating anteriorly in a tooth.
Supra-orbital spines more prominent.	Supra-orbital spines less prominent.
Eye longer, the greatest width of the cornea about half the greatest width of the antennal scale.	Eye shorter, the greatest width of the cornea about one-third the greatest width of the antennal scale.
Antennal scale longer than carapace.	Antennal scale not longer than carapace.
Antennal scale three times as long as wide.	Antennal scale not more than two and a half times as long as wide.

Of these characters the proportional size of the eye appears to be the most reliable. Figs. 1 and 4 represent dorsal views of the anterior portions of the Irish specimen of *B. gracilis* and of a young male example of *B. Payeri* (36 mm.) in which this distinction is clearly shown.

Although the Irish example bears a distinct appendix masculina on the inner branch of the second pair of pleopods, yet the small size of the specimen as compared with Smith's ovigerous females suggests that some of the features by which this individual can be distinguished from *B. Payeri* may be modified by further growth. Such are the concave external border of the antennal scale, the rudimentary condition of the finger-like process on the endopod of the first pair of pleopods (fig. 2) and the straight-sided telson with long spines on its rather broadly truncate apex (fig. 3). Smith figures the external margin of the antennal scales as straight in adult female *gracilis* and, when detailing the differences between that species and *Payeri*, makes no reference to the form of the telson—a feature which could scarcely have escaped notice had the distinctions been at all as great as is shown in figs. 3 and 6.

Size.—As stated above, the Irish specimen measures 19 mm. Smith's material consisted of two egg-laden females, one of which was 39 mm. in length. Ovigerous females of *B. Payeri* are usually found to have attained a length of 50 mm. or more.

Colour in life.—When freshly caught the body of the Irish specimen was perfectly clear and transparent, the red oral and purplish hepatic regions showing distinctly through the walls of the carapace. The sixth somite, telson and uropods were pale rose red, as were also the antennae and antennules. The eyes were brownish black, with a golden reflection. The third maxillipedes were red and all the pereiopods were very faintly tinged with the same colour.

General distribution.—The type specimens were found off the east coast of N. America, 35° 45′ N., 74° 31′ W., and 39° 35′ N., 71° 24′ W. (Smith). More recently it has been taken by the Danish-Ingolf Expedition in Davis Straits and near Iceland (Hansen).

Irish distribution.—The single record is as follows :—

Helga.

S.R. 497—10/9/'07.—51° 2′ N., 11° 36′ W. 775–795 fathoms. Trawl—One 19 mm.

Vertical range.—393 fathoms (Hansen) to 1,043 fathoms (Smith).

Family *ALPHEIDAE.*

Two genera, *Alpheus* and *Athanas*, are known from British and Irish waters :—

I. Rostrum very short; eyes wholly covered in dorsal view by the projecting anterior margin of the carapace; outer antennule uniramous; antennal scales reduced; no articulated process on the sixth somite at the base of the uropods, *Alpheus* (p. 120).

II. Rostrum comparatively long; eyes only partially covered in dorsal view by the projecting anterior margin of the carapace; outer antennule biramous for more than half its length; antennal scales well developed; an articulated process on the sixth somite at the base of the uropods, ... *Athanas* (p. 122).

The branchial formula of these two genera is expressed in the following table :—

— .	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	ep.	ep.	ep.	ep.	±ep.	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The epipod at the base of the penultimate pair of pereiopods is present in *Alpheus ruber* but absent in *Athanas nitescens.*

Genus **Alpheus,** Fabricius.

Two British species of this genus are known, only one of which has so far been found in Irish waters :—

I. Frontal portion of carapace evenly rounded from side to side and produced to a short spine in front of each eye, thus giving the anterior margin a tridentate appearance ; external margins of antennal scales slightly concave ; right and left chelae of the first pereiopods closely similar in size and shape, without longitudinal carinae and less than three times as long as wide, the dactylus articulating with the propodus by a curious lateral and oblique movement, ... *A. macrocheles.*

II. Frontal portion of carapace convex over each eye, the rostrum continued backwards as a separate elevation with a groove on either side, anterior margin rounded in front of eyes—not tridentate ; external margins of antennal scales very strongly concave ; right and left chelae of the first pereiopods very dissimilar in shape and size, the larger nearly four times as long as wide and with four longitudinal carinae, the dactylus articulating normally in both, . *A. ruber.*

Alpheus macrocheles (Hailstone) (Pl. XIX, figs. 3, 4) is not known in Irish waters. It is common in the Mediterranean and has been recorded from the English Channel from the neighbourhood of Hastings, Jersey, Plymouth and Dodman Point. The long and complicated synonymy of this species will be found in Norman and Scott's work (1906) on the crustacea of Devon and Cornwall[1].

Alpheus ruber, H. Milne-Edwards.

Pl. XIX, figs. 1, 2.

Alpheus ruber, Bell, 1853, fig. p. 271.
Alpheus ruber, Norman, 1868 (*ubi syn.*).

Colour in life.—The dorsal portions of the carapace and abdomen are bright red ; the black eyes showing through the semi-transparent frontal margins. The sides of the carapace, abdominal pleura and pleopods are ivory white. The antennal

[1] In addition, *Alpheus barbara,* Lockington, is, according to Coutière, probably a synonym of this species. *A. barbara* was found off the coast of California.

scales and antennules are pale red dorsally, paler still below. The last four joints of the first pair of pereiopods are red above, fading beneath to an ivory white; the remaining legs are white, sometimes tinged with red.

Size.—The largest specimen examined is a male measuring 43 mm.; the large right-hand chela of this individual is fully 31 mm. in length.

General distribution.—Mediterranean and Adriatic (Milne-Edwards, Heller, etc.), Algerian coast (Lucas), Bay of Biscay (Fischer). In the English Channel it is known from the coasts of Devon and Cornwall (Norman, etc.).

Coutière is of the opinion that *Alpheus Halesi*, Kirk, is probably a synonym of this species; if this is so, the horizontal range of *A. ruber* extends to New Zealand.

Irish distribution.—This species has only been found on a few isolated occasions in Irish waters, but its rarity is perhaps more apparent than real.

It was first discovered by Melville (1860) in 60 fathoms off the Arran Is., Co. Galway. In June, 1905, a second specimen was found in the same district; it was obtained by a sailing trawler in the North Sound, between Inishmore and the mainland. The remaining records are :—

Helga.

R. 10—3/5/'05.—15 miles off Mine Head, Co. Waterford. 41–42 fathoms. Trawl—One, 43 mm.

S. 361—20/2/'06.—13½ miles W.½S. of Chicken Rock, Isle of Man. 35½–36 fathoms. Trawl. Temperature at 35 fathoms 7·0° C., salinity 34·05°/$_{oo}$—One, 23 mm.

S. 560 and 561—24/10/'07.—12–15 miles W.S.W. of Chicken Rock, Isle of Man. 34½–42 fathoms. Trawl. Temperature at 30 fathoms 12·75° C., salinity 34·04°/$_{oo}$—Eighteen, 34–42 mm.

The trawling grounds off the east coast of Ireland have been fished again and again, but *Alpheus ruber* has only been found on the occasions mentioned above. Apart from the interest afforded by the occurrence of the species in comparatively large numbers at a single point in a large and apparently uniform area, the records are valuable as constituting the most northern limit of its known horizontal distribution.

In the Irish Sea the specimens were found on a bottom of soft mud, whereas the Waterford and Galway examples were taken on rough stony ground.

Vertical range.—*Alpheus ruber* is usually found in about 30 or 40 fathoms of water. It has been recorded from 61 fathoms in the Mediterranean (Adensamer).

Genus **Athanas,** Leach.

Athanas nitescens (Montagu).

Pl. XIX, fig. 5.

Athanas nitescens, Bell, 1853, fig., p. 281.
Athanas veloculus, Spence Bate, 1888, Pl. xcvi, fig. 1.

Colour in life.—Numerous large closely set red chromatophores are distributed over the carapace and abdomen. Dorsally a broad white stripe runs from the base of the rostrum to the apex of the telson, crossed at the base of the latter by a transverse red line; behind each eye there is a lenticular white patch. On the antennular and antennal peduncles are a few large red pigments spots; the flagella themselves are yellowish. The third maxillipedes are transparent, tinged with red at the base. The first three pairs of pereiopods are heavily banded with red, but the last two are transparent. The uropods are bright red.

No opportunity for observing the range of colour in this species was afforded. After long preservation in dilute formalin specimens often exhibit a rather marked blue coloration. This is probably a prominent characteristic of some individuals when living.

Size.—The largest specimen examined measures 20 mm.

General distribution.—*Athanas nitescens* is found commonly in the Mediterranean and Adriatic (Heller, etc.); it has been recorded from the Cape Verde Is. (Sp. Bate sub *A. veloculus*) and is well known on the west coast of France (Barrois, Fischer, etc.). The species has also been found in Denmark (Meinert), Sweden (Goës), and off the south and west coasts of Norway (Sars), but in these localities it seems to be very scarce. Pearson (1905) has examined specimens from Ceylon.

On the English coasts *A. nitescens* is known from Devon and Cornwall and from Cullercoats in Northumberland (Norman, Sp. Bate, etc.).

Irish distribution.—Like *Hippolyte prideauxiana* this species is in Irish waters essentially littoral, and consequently does not come within the scope of the operations of the *Helga*. On the west coast it is probably far from uncommon. It has been frequently found in Blacksod Bay, Co. Mayo, and in Bofin and Ballynakill Harbours, Co. Galway, and has also been taken near Roundstone and Oranmore. On the Co. Clare coast it has been recorded from Lahinch and Ballyvaughan, while two examples were found in February, 1908, at Valencia, Co. Kerry.

On the east coast of Ireland it is known from Larne Lough, Co. Antrim (Rankin) and from Kingstown and Killiney, Co. Dublin (Kinahan).

Vertical range.—Exclusively littoral on the west coast of Ireland, but frequently found in the Mediterranean between 20 and 30 fathoms.

Family *PROCESSIDAE.*

Genus **Processa,** Leach.

Nika, Bell, 1853.
Processa, Stebbing, 1905 (*ubi syn.*).

Bell recognized two British species of this genus, *Nika edulis*, Risso, and *N. Couchi*, Bell. As has been several times suggested, the latter of these is probably founded on an abnormal specimen of the former. *N. Couchi* has only twice been recorded; the type specimen was taken off the Cornwall coast and the capture of a second example is very briefly noticed by Patterson (1898) in an account of the Crustacea of Great Yarmouth: this specimen, like the type, has unfortunately been lost. *Nika edulis*, or as it should more correctly be called, *Processa canaliculata*, is a form which shows an exceedingly wide range of variation, and in the absence of a more detailed description the second species is best omitted from our lists.

Processa canaliculata, Leach.

Nika edulis, Bell, 1853, fig., p. 275.
Processa canaliculata, Stebbing, 1905 (*ubi syn.*)

Colour in life.—The carapace and abdomen are dull whitish with faint reddish pigmentation. This pigmentation is very pale on the carapace, but is more pronounced towards the posterior margin of each abdominal somite and over the base of each pleopod; on the telson and uropods it is still more evident. The eyes are black with reddish reflections. The antennular and antennal flagella are reddish, the scale of the latter being translucent. The two terminal joints of the outer maxillipedes are bright red; the remaining joints of this limb and also the first pair of pereiopods are faintly dotted with red; the other four pairs are quite pale. The gastric and cardiac regions are of a darkish red colour and show through the semi-translucent carapace.

Size.—The largest specimen examined is a female bearing eggs, 68 mm. in length. This individual was trawled in the Irish Sea; off the west coast the species does not seem to attain to such a large size. Very small ovigerous examples are found on both coasts; one of these measures only 28 mm.

The variation exhibited by this species is far greater than in any other Decapod known from British waters. Specimens taken in the Irish Sea do not as a rule differ widely

from one another, but in the west such a great diversity of form is apparent that if it were not for the long series of intermediate examples, the creation of at least two additional species would be justifiable.

Two large specimens selected at random from the Irish Sea material and from the west coast collections compare as follows :—

Irish Sea.	Bofin Harbour, Co. Galway.
♀ 67 mm.	♀ 45 mm.
Form slender, abdomen one-third as deep as long.	Form stout, abdomen one-half as deep as long.
Antennal scale one-half the length of the carapace and nearly six times as long as wide.	Antennal scale almost three-quarters as long as the carapace, and scarcely four times as long as wide.
Penultimate joint of antennular peduncle nearly twice the length of the ultimate.	Penultimate joint of antennular peduncle about one and a quarter times as long as the penultimate.
Third maxillipedes reaching beyond the apex of the antennal scale by little more than the ultimate joint.	Third maxillipedes reaching beyond the apex of the antennal scale by the whole of the two ultimate joints.
Fifth pereiopod reaching beyond the apex of the antennal scale by the dactylus only.	Fifth pereiopod reaching beyond the apex of the antennal scale by rather more than the propodus and dactylus.

In both these specimens the second pair of pereiopods are, as usual, of unequal length, but in other examples from the west coast a very remarkable degree of variation exists in this respect, for in many cases the long right-hand pereiopod is very considerably shortened, in some instances to such an extent that both right and left are exactly equal and do not reach beyond the antennal scale by more than the length of the chela.

The principal variations observed in the series of Irish specimens may be summarised thus :—

Form of carapace and abdomen stout or slender.

Eye scarcely wider than, or fully one and a half times as wide as, the greatest breadth of the antennal scale.

Rostrum falling slightly short of, or extending a little beyond the eye.

Antennal scale less than four to fully six times as long as wide and from one-half to three-quarters the length of the carapace.

Penultimate joint of antennular peduncle equal to, or fully twice the length of, the ultimate joint.

External maxillipede reaching beyond the apex of the antennal scale by one or by two of the terminal joints.

Second pereiopods equal or unequal; the right often quite twice the length of the left with about forty carpal joints, frequently shorter, with a corresponding reduction in the number of carpal joints, occasionally equal in length to the left with a minimum of eleven joints in the carpus. Left leg with eleven to twenty-one carpal joints.

Fifth pereiopod varying from slightly longer to considerably shorter than the fourth; reaching beyond the apex of the antennal scale by scarcely the length of the dactylus or by as much as the dactylus, propodus and part of the carpus.

The last three pairs of pereiopods comparatively stout or slender.

In respect of the size of the eye and proportional lengths of the rostrum, antennal scale, and joints of the antennular peduncle, a closely similar range of variation has been noticed by Miss Rathbun (1906) in specimens taken in American waters off the coasts of Florida and California. Among these examples some were found in which both pereiopods of the first pair possessed chelae. This very remarkable variation has not so far been met with in Irish waters.

In all the Irish specimens the telson is sulcate above and provided with six apical spines, of which the intermediate pair are the longest and strongest. Dorsally two pairs of spinules are usually found.

General distribution.—In European waters *Processa canaliculata* extends from S. Norway to the Mediterranean, including the Black Sea. It is well distributed round the English and Scotch coasts and in certain localities is often found abundantly. The species has also been recorded from Madeira (Stimpson), S. Africa (Stebbing), Ceylon (Pearson), Bermuda (Rankin), from N. Carolina to Trinidad (Rathbun), from San Diego, California, to the Gulf of Panama (Rathbun) and from Japan (Ortmann).

Irish distribution.—During the course of fishery investigations *P. canaliculata* has been constantly found off the east coast of Ireland. There is little variation in these specimens; all are of the slender form and correspond closely in character with the large female noticed above. In these waters the species appears to be most abundant between 20 and 40 fathoms; on several occasions it has been trawled in large numbers in the neighbourhood of Rockabill Lighthouse.

Off the south and west coasts the species seems to be widely

distributed; the records are, however, scanty and it is probable that it is much scarcer in these districts than in the Irish Sea. Among the preserved material from these coasts the greatest possible variation exists, but the forms which show the widest differences from those taken in the Irish Sea were nearly all found in Bofin and Ballynakill Harbours, Co. Galway. In these two localities the species was frequently caught during the period in which the marine laboratory was stationed there.

The other south and west coast records are :—

Helga.

CXVII.—23/8/'01.—36 miles W.N.W. of Cleggan Head, Co. Galway. 74½ fathoms. Dredge—One, 10 mm.

CXXI.—24/8/'01.—64 miles N.W.½W. of Cleggan Head, Co. Galway. 199 fathoms. Trawl—Seven, 11–14 mm.

W. 4—22/3/'04.—Dingle Bay, Co. Kerry. 35 fathoms. Trawl—One, 29 mm.

W. 6—23/3/'04.—7 miles S. by W. of Tearaght Lighthouse, Co. Kerry. 40–53 fathoms. Temperature at 45 fathoms 8·1° C. —Five, 32–46 mm.

S.R. 146—24/8/'04.—80 miles W.N.W. of Slyne Head, Co. Galway. 181 fathoms. Trawl. Temperature at 158 fathoms 9·52° C. —One, 11 mm.

R. 9—3/5/'05.—17½ miles S.W.½W. of Coningbeg Lightship, Co. Wexford. 40 fathoms. Trawl—One, 45 mm.

R. 10—3/5/'05.—15 miles off Mine Head, Co. Waterford. 41–42 fathoms. Trawl—Two, 22 and 31 mm.

S.R. 257—5/9/'05.—47 miles W.N.W. of Cleggan Head, Co. Galway. 105 fathoms. Large townet on bottom. Temperature at 100 fathoms 10·0° C.—One, broken.

W. 40—W. 47—8/9/'05.—Off Black Head, Galway Bay. 8–15 fathoms. Trawl. Bottom temperature 14·0–15·1° C.— Frequent in Rays' stomachs.

R. 15—1/11/'05.—9 miles S.W. of Coningbeg Lightship, Co. Wexford. 37½–41 fathoms. Trawl. Temperature at 30 fathoms, 12·2° C., salinity 35·21°/$_{oo}$—One, 20 mm.

W. 50—13/2/'06.—Blacksod Bay, Co. Mayo 4¾–5½ fathoms. Trawl. Temperature at 4½ fathoms 5·4° C.—One, 28 mm.

P. canaliculata was found by the Royal Irish Academy expedition of 1886 in Berehaven and Bantry Bay, Co. Cork, and the species has also been taken at Roundstone, Co. Galway, Valencia Harbour, Co. Kerry, and Cove, Co. Cork.

Vertical range.—Found off the Irish coast between 3 and 199 fathoms, but apparently of rare occurrence outside the 100 fathom line. Off the American coasts it ranges from shallow water to 111 fathoms (Rathbun), while in the Mediterranean it has been recorded from depths of 216 fathoms (Senna) and 326 fathoms (Adensamer).

Family *PALAEMONIDAE*.

The three British and Irish genera may be distinguished thus :—

I. Rostrum very short, unarmed; antennules biramous—the outer flagellum not split; second pair of pereiopods assymmetrical; [no palp on mandible]. Living in sponges, . *Typton*.

II. Rostrum well developed, bearing teeth above and below; antennules triramous—the outer flagellum split; second pair of pereiopods symmetrical. Free living.

A. Mandible with a two or three jointed palp, . *Leander* (pp. 128, 129).

B. Mandible without palp, . . *Palaemonetes* (p. 129).

The genus *Typton*, Costa, is very closely related to *Pontonia*, Latreille; many authors consider that the characters of these and of a few other allied genera entitle them to rank as a separate family, the Pontoniidae.

Of *Typton*, one species only, *T. spongicola*,[1] Costa, has been found within the British area, but it has not so far been observed in Irish waters. It has been recorded three times from the coasts of Devon and Cornwall (v. Norman and Scott, 1906), where it was found living within the sponges *Desmacidon* and *Homoeodictya*.

Of the genera *Leander* and *Palaemonetes*, four species, all of which were known to Bell, are found off the British coasts. Of these *Leander squilla* is certainly one of the commonest, yet it was not hitherto known that this abundant form differed from the two allied British species, *L. serratus* and *L. adspersus* in such an important character as the number of joints in the mandibular palp. Recently Dr. Calman, having had occasion to examine these species, discovered that in *L. squilla* only two segments are to be found in the palp, whereas three are present in *L. serratus* and *adspersus*. This most interesting information Dr. Calman has very kindly placed at my disposal—as may be seen from Pl. XX, figs. 2, a–c, I am able to testify to the accuracy of his observation.

On the following pages the principal characters of the British species of *Leander* and *Palaemonetes* are summarised in the form of a table.

[1] For synonymy consult Norman, 1868.

Leander serratus (p. 130).	*Leander adspersus* (p. 131).
Rostrum trending definitely upwards at apex, without chromatophores.	Rostrum hardly trending at all upwards at apex, the lower half thickly sprinkled with small dark chromatophores.
Rostrum armed dorsally with six to eight teeth,[1] which do not extend into the distal third; the posterior tooth situated on the carapace well behind the orbital notch, the second either immediately over the orbital notch or slightly behind it.	Rostrum armed dorsally with five to seven teeth[1], which extend well into the distal third; the posterior tooth situated on the carapace well behind the orbital notch, the second slightly in front of or immediately over the orbital notch.
Rostrum armed ventrally with five, less commonly with four, teeth.	Rostrum armed ventrally with three, rarely four, teeth.
Shorter ramus of the outer antennule fused to the longer for about one quarter its length. Shorter ramus reaching only about to the apex of rostrum.	Shorter ramus of the outer antennule fused to the longer for about one-third its length. Shorter ramus reaching beyond the apex of rostrum by more than three-quarters of its free length.
Antennal scale widest basally, its outer margin practically straight.	Antennal scale widest basally, its outer margin slightly convex.
Mandibular palp three-jointed.	*Mandibular palp three-jointed.*
First pair of pereiopods falling short of apex of antennal scale.	First pair of pereiopods reaching to, or extending a little beyond, apex of antennal scale.
Second pair of pereiopods reaching beyond apex of antennal scale by about one-third the length of the chela.	Second pair of pereiopods reaching beyond apex of antennal scale by nearly the whole length of the chela.
Chelae of second pair longer than carpus, with dactylus as long as, or at least three-quarters the length of, the palm; carpus considerably shorter than merus.	*Chelae of second pair longer than carpus, with dactylus more than three-quarters the length of the palm; carpus longer than merus.*

[1] Not counting the small distal tooth which is usually present, and which forms the upper portion of the bifid apex.

Leander squilla (p. 132).	*Palaemonetes varians* (p. 132).
Rostrum trending slightly upwards at apex, without chromatophores.	Rostrum practically straight, without chromatophores.
Rostrum armed dorsally with seven to ten teeth[1], which extend well into the distal third; two posterior teeth situated on the carapace well behind the orbital notch, the third tooth either immediately over the orbital notch or slightly behind it.	Rostrum armed dorsally with three to five teeth[1], which do not extend into the distal third; the posterior tooth situated on the carapace a little behind the orbital notch[2].
Rostrum armed ventrally with three, very rarely with two or four, teeth.	Rostrum armed ventrally with two teeth, less commonly with one.
Shorter ramus of outer antennule fused to the longer for about two-fifths its length. Both free rami and from one-third to two-thirds of the fused portion extending beyond the apex of rostrum.	Shorter ramus of outer antennule fused to the longer for nearly three-quarters its length. Both free rami and from two-thirds to the whole of the fused portion extending beyond the apex of rostrum.
Antennal scale widest basally, its outer margin slightly convex.	Antennal scale as wide distally as basally, its outer margin practically straight.
Mandibular palp two-jointed.	*Mandible without palp.*
First pair of pereiopods reaching to, or extending a little beyond, apex of antennal scale.	First pair of pereiopods falling short of, or extending a little beyond, apex of antennal scale.
Second pair of pereiopods reaching beyond apex of antennal scale by the whole length of the chela and usually by a portion of the carpus as well.	Second pair of pereiopods falling short of apex of antennal scale, or reaching beyond by as much as the length of the chela.
Chelae of second pair longer than carpus, with dactylus little more than half the length of the palm; carpus longer than merus.	*Chelae of second pair shorter than carpus, with dactylus rather less than two-thirds the length of the palm; carpus longer than merus.*

[1] Not counting the small distal tooth which is usually present, and which forms the upper portion of the bifid apex.

[2] Rostrum very rarely armed with one, two, six, or seven teeth dorsally, and wholly unarmed or with three teeth ventrally (v. Weldon 1892).

Certain genera of Palaemonidae such as *Palaemon, Palaemonella, Amphipalaemon, Palaemonetes* and *Leander* form such a homogeneous group that few reliable characters are available for their determination, and consequently the number of joints of which the mandibular palp is composed, or its total suppression, become indications of primary importance. The question therefore arises whether *squilla* and *serratus* should not properly be placed in different genera, even though the only character which can be found to justify such a view is afforded by the segmentation of the mandibular palp. As a precedent for such a course the genera *Palaemonella* and *Palaemon* might be cited, in which the chief and perhaps the only differential characteristic lies in this very detail of a two or three jointed palp. Nevertheless it seems best for the present to retain the three species under the genus *Leander*[1]. It is difficult to estimate the value of a single character of such a nature as this without a thorough investigation of all the genera of the family, and until this much needed work is undertaken the matter is best left untouched.

Bell distinguished the four British species from one another by characters drawn almost solely from the rostral dentition, and although it is true that all four can, as a rule, be determined by this feature alone, yet the considerable variation which exists renders it in practice less useful than others. From the table on the preceding pages it will be noticed that apart from the important question of the mandibular palps all four species can be determined by the characters afforded by the second pair of pereiopods.

Genus **Leander,** Desmarest.

Palaemon, Bell, 1853.

Leander serratus (Pennant)

Pl. XX, figs. 1, a-e.

Palaemon serratus, Bell, 1853, fig., p. 302.

The colouring in life of this and of the three succeeding species is extremely variable and doubtless depends largely on environment. The species are littoral in habit and have only rarely been found during the investigations of the *Helga*; it is therefore not possible to discuss their colouration in any adequate manner.

[1] The type of the genus *Leander* is *L. erraticus*, Desmarest, which Spence Bate (1888) quotes as a synonym of *L. natator* (Milne-Edwards). Stimpson (1860) cites *L. natator* as the type species, and Dr. Calman informs me that specimens in the British Museum labelled as this species possess a three-jointed palp on the mandible.

Size.—*L. serratus* is the largest of the three British species and frequently attains a length of 100 mm. or more.

General distribution.—*Leander serratus* has been recorded from the Danish and Dutch coasts (Meinert), from Belgium (van Beneden), from both north and west coasts of France (Milne-Edwards, Barrois, Fischer, etc.) and from the Mediterranean (Heller, etc.). It is found abundantly off the English coast, more particularly in the south; off the Scotch coast it is apparently very rare (Herdman, 1880, records *P. serratus*? from Lamlash Bay).

Irish distribution.—This species is abundant on most parts of the Irish coast. As at present understood its range extends as far north as Larne, Co. Antrim (Rankin), on the east coast and as far as Blacksod Bay, Co. Mayo, in the west. In the south-east, south and west it occurs plentifully and, although it has not as yet been noticed in the north, it is very probable that it will be found there in course of time.

Vertical range.—Essentially a littoral species.

Leander adspersus (Rathke).

Pl. XX, figs. 2, a–e.

Palaemon Leachi, Bell, 1853, fig., p. 307.
Palaemon Fabricii, Mortensen, 1897 (development).
Leander adspersus, Senna, 1903 (*ubi syn.*).

The pigment spots which Bell mentions on the lower blade of the rostrum (fig. 2a) afford a ready and certain means of separating this species from its allies when alive. The colouring is fairly permanent in weak formalin but disappears rapidly in spirit.

Size.—The largest specimen examined measures 65 mm.

Leander adspersus is by far the rarest of the three British and Irish species, but in Norway it is found in great abundance and is fished commercially with considerable profit.

General distribution.—*L. adspersus* is known from west and south Norway (Sars, Wollebaek, etc.), from Sweden (Goës), from Denmark (Meinert), from the Prussian coast (Zaddach), from the west coast of France (Fischer), in the Mediterranean and Adriatic (Heller, Adensamer, etc.) and in the Black Sea (Czerniavsky). In the English Channel it has been recorded from Poole Harbour (Bell) and Weymouth (W. Thompson) and has also been found in the Thames estuary.

Irish distribution. This species was first recorded from the Irish coast by Melville (1860) from Galway Bay. During the last two years it has frequently been found in the same district, near Oranmore, Co. Galway, where it occurs in company with *L. squilla* and *L. serratus*. The only other Irish

locality in which the species has been recognised is Bofin Harbour, Co. Galway, a few specimens being found among the samples of *Leander* preserved on the Marine Laboratory.

Vertical range.—*L. adspersus* is usually found in less than 5 fathoms of water. In the Mediterranean, however, it was taken on one occasion in a dredge fishing between depths of 87 and 197 fathoms (Senna, 1903).

Leander squilla (Linnaeus).

Pl. XX, figs. 3, a–e.

Palaemon squilla, Bell, 1853, fig., p. 305.
Leander squilla, Senna, 1903 (*ubi syn.*).

Size.—The largest specimen examined measures 60 mm., but it is probable that individuals frequently attain a greater length than this.

General distribution.—*L. squilla* is known from west and south Norway (Sars, Appellöf), from Sweden (Goës), from Denmark (Meinert), from the north and west coasts of France (Fischer, Barrois, etc.), in the Mediterranean and Adriatic (Heller, Senna, etc.) and in the Black Sea (Czerniavsky). It is also known from the Azores (Barrois), from Madeira (Dana), from the Canary Is. (Brullé) and from St. Vincent in the Cape Verde Is. (*fide* Senna). The species is found abundantly off the English coasts; it occurs also in Scotch waters, but seems to be rather scarce.

Irish distribution.—*Leander squilla* is of common occurrence in shallow water all round the Irish coast.

Vertical range.—In the British area this is an essentially littoral species, but in the Mediterranean it has been found in as much as 30 fathoms (Senna).

Genus **Palaemonetes,** Heller.

Palaemonetes varians (Leach).

Pl. XX, figs. 4, a–e.

Palaemon varians, Bell, 1853, fig., p. 309.
Anchistia migratoria, Heller, 1863, Pl. viii, fig. 20.
Palaemonetes varians, Weldon, 1892.
Palaemonetes varians, Norman and Scott, 1906 (*ubi syn.*).

The development of this species is very remarkable. In Northern Europe, where it is found close to the sea in water that is more or less brackish, the young are liberated in a late *zoea* stage. In Southern Europe *P. varians* occurs in perfectly fresh water and the development is greatly abbreviated, for the young emerge from the egg with all the limbs, except the uropods, fully formed (v. Mayer, 1881, and Boas, 1889),

Size.—The largest specimen examined measures 42 mm.

General distribution.—*P. varians* is known from Sweden (Goës), Denmark (Heller and Meinert), Friesland (Metzger), Belgium (van Beneden), and France (Milne-Edwards). In the Mediterranean and Adriatic it has been found in numerous localities, including Lakes Garda and Trasimene in Italy and L. Albafuera in Spain (Heller, etc.); it has been recorded from Egypt (Heller) and is known in the Black Sea (Czerniavsky).

This species is found rather commonly in suitable localities on the south coast of England, extending northwards on the east coast as far as Durham (Norman). I know of only one record from the Scotch coast—Firth of Clyde (Henderson, 1886).

Irish distribution.—*Palaemonetes varians* is probably not uncommon in Ireland; owing to its peculiar habitat it is doubtless often overlooked. It is known from the following localities:

Co. Antrim.—Glynn (Rankin).

Co. Down.—Belfast and Strangford Loughs (Bell on the authority of Thompson).

Co. Dublin.—In a slightly brackish pond at Sutton (S.W.K.). "Pools on Merrion Strand" and at Kingstown and Killiney (Kinahan).

Co. Wicklow.—In a pond of almost fresh water close to the sea at the mouth of the Vartry River.

Co. Wexford.—In ponds of almost fresh water close to the sea at Courtown.

In brackish ditches communicating with the mouth of Wexford Harbour, near Rosslare (S.W.K.).

Co. Cork.—In brackish ditches E. of Queenstown (S.W.K.).

Co. Kerry.—In ditches of almost fresh water at Darrynane (S.W.K.). Dingle and Ventry, "freshwater" (Dublin Museum).

Co. Mayo.—Lough Leam and adjacent ditches, brackish water (S.W.K.).

In Ireland this species is generally found in pools or ditches of almost fresh water, close to, but not directly communicating with the sea. It is usually taken in company with *Neomysis vulgaris*, on which it feeds freely, with the larvae of the dragon fly, *Ischnura elegans*, and with various species of Rhynchota, chiefly of the genera *Gerris* and *Corixa*. It is only in the southern part of its distribution that *P. varians* has been found at any great distance from the coast line (as in L. Garda and L. Trasimene). The species has never been recorded from any of the Irish lakes, and it does not seem likely that it occurs in them.

Family *CRANGONIDAE*.

The number of British and Irish species of Crangonidae has been nearly doubled since Bell in 1853 wrote his British Crustacea. Kinahan's treatment of the family eight years later is very inadequate and his figures are most misleading, while the other literature is much scattered. Short descriptions of each species are therefore given here, and these, taken in conjunction with the figures, should afford a ready means of determining the various forms.

The confusion which exists among the genera of this family must have struck the most casual observer, yet the question is in reality very simple, for the whole difficulty may be traced to the incorrect application of Guérin-Méneville's *Aegeon*. Such species as *echinulatus*, *trispinosus*, *sculptus*, *fasciatus*, *neglectus* and *bispinosus* have all at various times been referred both to it and to *Cheraphilus*, and some also, with less reason, to *Pontophilus*. An examination of *cataphractus*, the type species of *Aegeon*, at once shows that none of them should rightly be referred to that genus. *A. cataphractus* has deep sculpture and spinous ridges on both carapace and abdomen, the first pereiopod bears a setose exopod, the endopod of the last four pairs of pleopods is nearly as long as the exopod and bears an appendix interna at its base and the inferior apices of the branchiae point forwards, giving them a most characteristic C-shaped appearance, which may be at once seen on raising the gill cover. None of these features are present in the six species mentioned above, but the question still remains whether two genera may not be represented among them. In this connection Gurney's researches on laval Crangonidae (1903) are of great importance. He examined the larvae of eight species, and found them to fall naturally into three groups, which he thus defines :—

> "1.—*Vulgaris* and *Allmanni* : characterised by a one-jointed maxilla-palp and the absence of an exopodite on the second leg in the *mysis* stage.
>
> "2.—*Trispinosus*, *nanus* (=*bispinosus*), *echinulatus* and *fasciatus* ; characterised by their two-jointed maxilla-palp, possession of five pairs of exopodites in the *mysis* stage, form of the rostrum and arrangement (paired) of the abdominal spines.
>
> "3.—*Spinosus* and *norvegicus* : distinguished from the second group by their extremely elongate body form, shape of the rostrum, possession of a long median spine on the third abdominal segment, and by the form of the tail plate."

Group 1 is the genus *Crangon* and group 3 *Pontophilus*. Group 2 combines species which have been referred both to *Aegeon* and to *Cheraphilus*. Gurney therefore called it by the former name, which had the advantage of priority. This, as I have shown above, is due to a misconception of the characters

of *Aegeon*; the four species of group 2, to which *sculptus* may certainly be added, must therefore be referred to *Cheraphilus*, or rather to *Philocheras*, a name proposed by Stebbing (1900) to replace *Cheraphilus*, which at its institution by Kinahan contained *spinosus*, the type species of *Pontophilus*.

The deep water form *Lacazei* is now the only British and Irish species which can correctly be assigned to *Aegeon*, and the capture of Milne-Edwards' *Jacqueti* involves the inclusion of *Sclerocrangon* among our native genera of Crangonidae. Norman's solitary record of *Sabinea* brings the total number up to six, which may be separated thus :—

I. Second pereiopods chelate.

A. First pereiopods without an exopod; endopod of last four pairs of pleopods much less than half the length of the exopod, divided into two segments and without an appendix interna at the base.

i. Lateral process of antennules acutely pointed distally; second pereiopods with dactylus less than half the length of the propodus.

a. Carapace without strong sculpture; an arthrobranch usually present at base of third maxillipedes, . . . *Crangon* (p. 136).

b. Carapace with very strong sculpture; no arthrobranch at base of third maxillipedes, *Sclerocrangon* (p. 139).

ii. Lateral process of antennules distally truncate or rounded; second pereiopods with dactylus much more than half the length of the propodus, ... *Philocheras* (p. 143).

B. First pereiopods with (or without[1]) an exopod; endopod of last four pairs of pleopods nearly as long as exopod, composed of a single segment and with an appendix interna at the base.

i. Second pereiopods reaching at least to distal extremity of carpus of first pair; inferior apices of branchiae turned forwards, an arthrobranch at base of third maxillipedes, *Aegeon* (p. 155).

ii. Second pereiopods at most not reaching beyond distal extremity of merus of first pair, usually much shorter; inferior apices of branchiae turned backwards, no arthrobranch at base of third maxillipedes, . . *Pontophilus* (p. 159).

II. Second pereiopods simple, not chelate, . . *Sabinea*.

[1] This exopod is present in all the known British species.

Only a single specimen of *Sabinea* has so far been found within the British area. It was dredged by Norman in 1861 in the neighbourhood of the Shetland Isles, and was recorded by him as *S. septemcarinata* (Sabine).

In a recent paper (1908), Hansen expressed the opinion that the specimen is in reality an example of *S. Sarsi*, Smith, a species which extends much further south than the Arctic *S. septemcarinata*. Canon Norman presented his specimen to the British Museum and there, through the kindness of Dr. Calman, I was able to examine it. The specimen, which is unfortunately dry, is, as Hansen suggests, an example of *Sabinea Sarsi*, Smith.

Genus **Crangon**, Linnaeus.

Steiracrangon, Kinahan, 1861.

Rostrum depressed; carapace smooth, without longitudinal dentate carinae. *Eyes* present. Lateral process of *antennules* acutely pointed distally. First pair of *pereiopods* without exopod; second pair chelate, long and slender, reaching to tips of first pair, dactylus less than half the length of propodus, carpus considerably longer than ischium; dactylus of fourth and fifth pairs not laminar. Endopods of last four pairs of *pleopods* very much less than half the length of the exopod, divided into two segments and without appendix interna at base. Inferior apices of *branchiae* turned backwards. Formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	ep.	...	...	...	...	...
Arthrobranchiae, ...	...	...	1[1]	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The two British and Irish species of *Crangon* may be thus recognised :—

I. Sixth abdominal somite dorsally smooth, *C. vulgaris* (p. 137).

II. Sixth abdominal somite dorsally channelled and bicarinate, . . . *C. Allmanni* (p. 138).

[1] This arthrobranch is absent in *C. antarcticus*, Pfeffer, a species which Calman (1907) retains in the genus *Crangon*. Reliable information as to the presence or absence of this gill in the other species of the genus is necessary before a true estimate of the generic value of the character can be formed.

Crangon vulgaris, Linn.

Pl. XXI, figs. 1, a–d.

Crangon vulgaris, Bell, 1853, fig., p. 256.

Crangon vulgaris, Sars, 1890, Pl. 1, figs. 1–28 (development).

Crangon vulgaris, Ehrenbaum, 1900 (life-history).

Rostrum dorsally hollowed, rather broad at base, and tapering to an evenly rounded point. *Carapace* armed with three spines, one in the mid-dorsal line about one-third the distance from the rostrum to the posterior edge of the carapace, the others placed laterally and slightly in advance of the median spine. From the posterior edge of the orbit a narrow groove runs outwards and backwards, becoming obsolete at about the middle of the carapace and there is also a shallow depression between the orbital and antero-lateral angles. Posterior half of carapace unarmed, smooth, and rounded. *Abdominal somites* all rounded above, though occasionally the sixth is slightly flattened dorsally.

Basal joint of *antennular peduncle* longer than second and third combined and furnished below with a stout spine beset with hairs; lateral process acutely pointed and reaching distal end of joint; second joint about equal in length to third; outer antennular flagellum in the female not reaching the apex of the antennal scale. *Antennal scale* (fig. 1 b) straight along its outer border and terminating in a tooth which extends beyond the lamellar portion, much narrowed distally and about two and three-quarter times as long as broad. First *pereiopod* with the merus armed with a stout spine in the middle of its inner border.

Colour in life.—Uniform light or dark mottled grey, often with an almost black transverse band across the posterior portions of the fourth abdominal somite. The telson and uropods are also very frequently darker than the general colouring. As has been repeatedly noticed, this species is usually of a dark colour when found on a muddy bottom, whereas specimens living on sand are of a much lighter shade.

Size.—Large specimens attain a length of 70 mm. or more.

Crangon vulgaris is very largely fished off the English and Scotch coasts, but in Ireland it is very rarely, if ever, used for food.

General distribution.—N.E. Atlantic from the White Sea (Birula) and East Finmark (Norman) to the Mediterranean (both north and south shores); usually found in abundance. Kröyer has recorded the species from Iceland.

Crangon vulgaris has been recorded from the E. coast of N. America and from several localities in the Pacific, but these specimens are in all probability referable to *C. septemspinosa*, Say, an extremely closely allied form, which differs from *C. vulgaris* only in the shape of the antennal scale (v. Rathbun, 1904).

Irish distribution.—Abundant all round the coast, more especially on a sandy bottom.

Vertical range.—Common off the Irish coast in 0–10 fathoms, and more rarely found up to 20 fathoms; in the Christiania fjord it has occurred in 30 fathoms (G. O. Sars) and in the Brevik Fjord in 50–65 fathoms (Wollebaek). In the West Atlantic it has much the same range; Kingsley (1878) states that it is common in 70 fathoms.

Crangon Allmanni, Kinahan.

Crangon Allmanni, Kinahan, 1857.
Steiracrangon Allmanni, Kinahan, 1861, fig. III.
Crangon Allmanni, Sars, 1890, Pl. I, figs. 29–31 (development).
Crangon Allmanni, Wollebaek, 1908, Pl. VIII, figs. 1–50.

This species is very closely allied to *C. vulgaris*, but may be easily distinguished by the deep longitudinal groove and parallel carinae on the dorsal aspect of the sixth abdominal somite. The rostrum also is slightly narrower than in the preceding species and the outer antennular flagellum of the female reaches considerably beyond the apex of the antennal scale (v. Wollebaek, 1908).

Colour in life.—The carapace and abdomen are brownish grey, composed of thinly distributed brown, with occasional yellow chromatophores, frequently verging to a dark maroon tint on the telson and uropods. Occasionally the general colouring inclines to reddish. The eyes are greyish black. The pereiopods, more particularly the last two pairs and the propodus of the first pair, are dotted with red chromatophores. The gastric and cardiac regions are very dark and usually show conspicuously through the carapace.

Size.—The largest specimen examined, an ovigerous female, measures 58 mm.

Were it not for Sars' important contribution to the life history of this species, one would be inclined to follow Ortmann in regarding the characters of *C. Allmanni* as merely of subspecific value. Sars has, however, shown that the two forms are easily distinguishable at a very early stage. Larval *C. vulgaris* possess a strong backwardly directed spine on the third and a pair of lateral spines on the fifth abdominal somite. In larval *C. Allmanni* the spine on the third somite is obsolete and the pair on the fifth much shorter.

General distribution.—*C. Allmanni* is confined to the N.E. Atlantic and extends as far north as West Finmark, the Murman coast and the White Sea (Birula). It appears to occur plentifully over the whole of the North Sea and has been recorded from Sweden (Goës) and Iceland (G. O. Sars). It is found on both east and west coasts of England and Scotland and less commonly in the English Channel.

In August, 1906, large numbers of *C. Allmanni* were taken by the *Huxley* on the north side of the Bay of Biscay. This is the most southern point from which the species is known.

Irish distribution.—Abundant off the east coast; in the south it is apparently much scarcer, but has been taken in considerable numbers off Dungarvan, Co. Cork. It has not so far been observed in any west coast locality to the north of Co. Kerry, but it seems probable that it will be found there in the course of time. In the south-west it has been taken in Bantry, Ballinskelligs and Dingle Bays, and also in deeper water in the neighbourhood of the Fastnet Rock, the Skelligs and the Blasket Is.

Vertical range.—Found commonly in the Irish Sea in 20 to 73 fathoms, and less frequently between 10 and 20 fathoms. Off the west coast it has occurred between 30 and 84 fathoms. Metzger records this species from 6 fathoms in the Skagerrak and Cattegat, while on the N. side of the Bay of Biscay it has been found in as much as 146 fathoms.

Genus **Sclerocrangon**, G. O. Sars.

Rostrum either securiform, much compressed and expanded below, or spinose. *Carapace* strongly sculptured, carinate and dentate, antero-lateral angles large and laterally expanded. *Eyes* present. Lateral process of *antennules* acutely pointed distally. First pair of *pereiopods* without exopod; second pair very slender and minutely chelate, reaching at least to the middle of the propodus of the first pair, dactylus very much less than half the length of the propodus, carpus longer than ischium; dactylus of fourth and fifth pairs not laminar. Endopod of last four pairs of *pleopods* very much less than half the length of exopod, divided into two segments, and without appendix interna at base. Inferior apices of *branchiae* turned backwards. Formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	...	...	...	...	...	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

I have followed Smith and Faxon in placing Milne-Edwards' *Jacqueti* (=*Agassizi*) under *Sclerocrangon* and this I do not doubt to be correct even though it becomes rather difficult to frame a definition which will exclude the genus *Crangon*. Now that the arthrobranch on the third maxillipede is known to be absent in *Crangon antarcticus* and possibly also in other species of that genus, the sculpture of the carapace (a most unsatisfactory character in Crangonidae) is almost the only feature available. The reduction of *Sclerocrangon* to the rank of a sub-genus, as suggested by Ortmann, will perhaps solve the difficulty, but further investigation may show that the sternal spines of the male and the greatly abbreviated metamorphosis (v. Sars, 1890, and Wollebaek, 1907) afford satisfactory indications of its generic validity.

Two groups of species are comprised in this genus; one contains such forms as *boreas*, *salebrosus*, *atrox*, and *ferox*, while the other includes *Jacqueti*, *munita*, *procax* and other allied species.[1] This second group, although properly regarded as belonging to *Sclerocrangon*, is nevertheless much more closely allied to *Crangon* than the first.

Sclerocrangon Jacqueti (A. Milne-Edwards).

Pl. XXII, figs. 7–10.

Pontophilus Jacqueti, A. Milne-Edwards, 1881.
Pontophilus Jacqueti, A. Milne-Edwards, 1882.
Ceraphilus Agassizi, Smith, 1882, Pl. VII, figs. 4–5a.
Pontophilus Jacqueti, A. Milne-Edwards, 1883, Pl. 40.
Ceraphilus Agassizi, Smith, 1885.
Sclerocrangon Agassizi, Smith, 1887.

The *rostrum* consists of an acutely pointed spine, which trends upwards and is concealed when viewed from above by the long anterior median spine of the carapace; it is rather short and does not reach the tips of the eyes. The *carapace* is rather broad; both it and the abdomen are covered with a short and very sparse pubescence. The outer orbital angle is defined by a sharp spine about as long as the rostrum, but considerably shorter than that which terminates the broadly expanded lateral angles. A median dorsal carina extends the whole length of the carapace; the prominent anterior spine overhangs the rostrum, reaching beyond its apex and a second stout forwardly directed spine is situated on the cardiac region; between these two a small tubercle is usually present. On each side of the median carina is found a gastric spine, and below this a strong hepatic spine supported by two carinae, one of which runs backwards to the posterior edge of the carapace, while the other is less pronounced, leading downwards

1 Miss Rathbun (1904) has described several very closely allied species belonging to this group under the genus *Crangon*.

and backwards and disappearing on the branchial region. From the orbital spine a strong carina runs backwards, fading away between the gastric and hepatic spines, and from the antero-lateral spine, another, even more sharply defined, extends towards the branchial region, becoming obsolete below the hepatic spine. Behind the posterior median spine a faint transverse ridge is situated, reaching downwards on each side to the upper hepatic carina. In the male the two dorsal spines of the carapace are usually conspicuously longer than in the female.

The *abdominal somites* are rather broad; the first three are smooth and rounded above in the female, while in the male they often show traces of dorsal carination. On the fourth and fifth somites the dorsal carina is conspicuous in the male, but in the female it is not so pronounced and is sometimes quite obsolete. The sixth somite bears four longitudinal carinae; posteriorly the margin is produced to a sharp spine on either side of the telson and laterally as an acute angle outside the bases of the uropods. The pleura of the first three somites are pointed below.

The *antennular peduncle* (fig. 9) reaches to rather more than two-thirds the length of the antennal scale; the second joint is considerably longer than the third and both together are shorter than the basal segment. The lateral process reaches to the distal end of the basal segment; it is pointed anteriorly and is much longer than broad. The *antennal scale* is about two and half times as long as broad; its outer edge is slightly concave and is produced to a stout apical spine which extends a little beyond the distal end of the lamellar portion. The basal joint of the flagellum reaches to about three-quarters the length of the scale.[1]

The *outer maxillipedes* are slender, reaching considerably beyond the antennal scale. The first three pairs of *pereiopods* are practically glabrous, bearing only a very few setae. The second pair (fig. 10) is very slender, reaching beyond the middle of the propodus of the first pair; the dactylus is scarcely one-fifth the length of the propodus and the carpus and merus are about equal in length, each being a little longer than the ischium. The third pair is very slender and rather longer than the second. The fourth and fifth pairs are much stouter than the two preceding; the former is longer than the latter and about equal in length to the third.

The *telson* is longer than the uropods; it is broadly sulcate dorsally and tapers to a sharp point. It is armed with two or three pairs of dorso-lateral spinules and its inferior margins are strongly ciliated. The outer *uropods* are slightly shorter than the inner and are from two to three times as long as broad.

In the male there are four thoracic and five abdominal sternal spines; these are absent in the female. As has been already stated by Faxon (1895), the second pleopod of the male

[1] In this respect Milne-Edwards' figure is quite erroneous.

differs from Sars' original description of the genus in having the inner branch simple.

Only a single male example of this species, 23 mm. in length, has as yet been found in the East Atlantic. In this specimen the antennular flagella do not differ markedly in length or thickness from those of the female. Smith (1882) states that in the male the flagella are twice as long as the peduncle, with the outer ramus longer and very much stouter than the inner, or than the outer flagellum of the female.

Size.—One of the specimens recorded from the West Atlantic was as much as 72 mm. in length. Ovigerous females from the British and Irish area measure only 30–33 mm.

Colour in life.—The carapace is of a rather faint dull purple grey colour; this is darkest dorsally and anteriorly, becoming paler laterally. Posteriorly the carapace shows a faint mottling of red—on the abdominal somites are larger patches of rather faint purple grey and red; the pleura of the first and fifth somites are unpigmented, those of the second, third and fourth show at the posterior basal angles a large grey patch surrounded with red. The pleura of the sixth somite are grey; the telson is unpigmented and transparent.

The eyes are reddish, with grey stalks. The antennular peduncle and antennal scale are purplish grey with reddish mottling; the flagella are transparent, with the exception of the inner ramus of the antennule, which is basally of a reddish colour. The ante-penultimate joint of the outer maxillipede is purplish grey and the propodus of the first pair of pereiopods is mottled with the same colour. All the other joints of the outer maxillipedes and pereiopods are transparent, with the exception of the basus of the fourth pair of the latter, which bears a red spot. The pleopods are unpigmented, but there are faint reddish markings in the centre of each uropod.

General distribution.—*Sclerocrangon Jacqueti* was first found in the East Atlantic by the *Travailleur*, and has since then been dredged on several occasions off the East Coast of the United States between Charleston and Cape Cod.

Although hitherto unrecorded, this species was taken within the British area by both *Porcupine* and *Triton* expeditions near North Rona. The localities are :—

Porcupine.

August, 1869.—59° 34′ N., 7° 18′ W., 542 fathoms, bottom temperature 6·5° C.—One, small (in Mus. Norm.).

Triton.

St. 10, 1882.—59° 40′ N., 7° 21′ W., 516 fathoms, bottom temperature 7·8–8·1° C.—Four ovigerous females, 30–33 mm. (in Mus. Norm.).

Irish distribution.—This species has been found off the west coast of Ireland on the following occasions :—

Helga.

S.R. 353—6/8/'06.—50° 38′ N., 11° 32′ W., 250–542 fathoms. Trawl. Temperature at 500 fathoms 8·58° C., salinity 35·46°/$_{oo}$.—Two, 35 and 21 mm.

S.R. 477—28/8/'07.—51° 15′ N., 11° 47′ W., 707–710 fathoms. Trawl. Temperature at 700 fathoms 7·19° C.—One, 23 mm.

Vertical range.—Smith records specimens from depths of 440 and 950 fathoms.

Genus **Philocheras**, Stebbing.

Cheraphilus, Kinahan, 1861 (*partim*).
Philocheras, Stebbing, 1900.

Rostrum depressed; carapace with or without longitudinal dentate carinae. *Eyes* present. Lateral process of *antennule* subquadrate or rounded, never distally acuminate. First pair of pereiopods without exopod; second pair chelate, not particularly slender, reaching slightly beyond carpus of first pair, dactylus much more than half the length of propodus, carpus equal to or rather shorter than ischium; dactylus of fourth and fifth pairs not laminar. Endopod of last four pairs of *pleopods* very much less than half the length of the exopod, composed of two segments, without appendix interna at base. Inferior apices of branchiae turned backwards. Formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	ep.	±ep.	...	...	...	...	...
Arthrobranchiae, ...	...	...	1	...	...	...	...	...
Pleurobranchiae, ...	...	...	...	1	1	1	1	1

The following table will serve to discriminate the six British and Irish species of *Philocheras*.

I. Apex of rostrum rounded or triangular.

A. Carapace with three spines in the median line, *P. echinulatus* (p. 144).

B. Carapace with one or two spines in the median line.

i. Carapace with one median and a pair of lateral spines, the median being somewhat in advance of the lateral, . *P. trispinosus* (p. 146).

ii. Carapace with one median spine, behind which is a second small tubercle-like spine (occasionally obsolete).

a. Numerous minute tubercles arranged in longitudinal series on either side of the median line, . . . *P. bispinosus* (p. 152).

b. No tubercles on either side of the median line, . . *P. bispinosus*, v. *neglectus* (p. 153).

II. Apex of rostrum squarely truncate or emarginate.

A. Apex of rostrum squarely truncate; only one spine on median line of carapace; abdomen smooth and unsculptured; antennal scale with only the usual distal spine on its outer edge, ... *P. fasciatus* (p. 151).

B. Apex of rostrum emarginate; several spines on median line of carapace; abdomen strongly sculptured; antennal scale with a stout spine at about the middle of its outer edge, *P. sculptus* (p. 148).

Philocheras echinulatus (M. Sars).

Pl. XXI, figs. 7, a–d.

Crangon echinulatus, M. Sars, 1861.
Crangon serratus, Norman, 1862.
Cheraphilus echinulatus, G. O. Sars, 1882.
Cheraphilus echinulatus, G. O. Sars, 1890, Pl. II, figs. 1–21 (development).

Rostrum dorsally hollowed and rather broad at base, tapering to a finely rounded point. *Carapace* with antero-lateral angles produced to a sharp point, armed with five longitudinal dentate carinae, one median and two pairs of lateral. Median carina armed with three stout equidistant spines; first lateral with six spines, of which the second and third are rather widely separated from each other, the sixth close to the posterior margin and sometimes obsolete. Between the first lateral and the median carinae another row of teeth is frequently present on each side; they are very small and three or four in number; the second and third are on a line with the first two median spines, while the third is situated behind the posterior median spine and from it a carina runs towards the posterior margin. Third lateral row consisting of a well-marked carina which extends from close behind the orbital angle to the hinder edge of the carapace; it is furnished with two stout spines on its anterior third, in front of which another very small tooth is often present.

First two *abdominal somites* dorsally smooth; third and fourth carinate on their posterior half, the former often only

very feebly so; fifth sharply carinate; sixth dorsally channelled and bicarinate. On close examination the carinae of the fourth and fifth somites are seen to consist of a pair of fine ridges which meet posteriorly. *Telson* dorsally sulcate, and slightly longer than outer uropods.

Basal joint of *antennular peduncle* longer than second and third combined, its lateral process quadrate in outline, reaching distal end of segment; second joint longer than third. *Antennal scale* (fig. 7 b) concave along its outer border, much narrowed distally and three times as long as broad; apical spine long, projecting far beyond the lamellar portion of scale.

In this form, as in all the other species of *Philocheras*, the chela of the second pair of pereiopods (fig. 7 d), although of comparatively large size, is weak and probably of but little service to the animal. The dactylus is much more than half the length of the propodus, but the inner margins of the claw are almost parallel and their apices are not provided with ungues.

Size.—The largest specimen examined measures 38 mm.; Scott (1902) records an example of 45 mm.

Colour in life.—The carapace and abdomen are dorsally of a somewhat greenish tinge, due to the admixture of lemon yellow and sienna brown chromatophores; laterally there are numerous, large, dark maroon chromatophores along the inferior margins of the carapace and on the abdominal pleura. The telson is coloured with a mixed pigmentation of lemon yellow, sienna, and maroon. The eyes are greenish black. The antennal scale and antennules are sparsely mottled with yellow and sienna brown. The outer maxillipedes are spotted with maroon, with a few clear red chromatophores distally. The first and second pereiopods are maroon, the former with a few red spots at the terminal end of the propodus. In the last three pairs of pereiopods the ischium is maroon; in the third pair the remaining joints are transparent, while in the other two there are red chromatophores on the merus and carpus. The pleopods are maroon, faintly tipped with red.

Some specimens are very sparsely pigmented; in these all trace of the red pigment is frequently absent, while the lateral maroon markings are very faint.

General distribution.—This species is not particularly common; it is known from the western and southern coasts of Norway, the North Sea, off the coasts of Scotland and on the N. side of the Bay of Biscay.

Irish distribution.—On the east coast trawling grounds *P. echinulatus* is not infrequently found, but it has not so far been observed off the south coast. Off the west coast it has been taken on the following occasions:—

Helga.

CXXI.—24/8/'01.—53° 52′ N., 11° 56′ W. 199 fathoms. Trawl. Many, 9·5—29 mm.

CXXI.—13/7/'03.—53° 34′ N., 11° 29′ W. 120 fathoms. Trawl—Twenty-nine, 10–17 mm., and one ♀ ovigerous, 27 mm.
S.R. 85—5/2/'04.—51° 44′ N., 10° 43′ W. 72–75 fathoms. Trawl—One, 28 mm.
W. 7—24/3/'04.—51° 49′ N., 11° 8′ W. 100 fathoms. Trawl. Temperature at 100 fathoms, 9·8° C.—Two, ♀ ovigerous, 21 and 28 mm.
S.R. 107—9/5/'04.—53° 37′ N., 11° 33′ W. 121 fathoms. Trawl. Temperature at 116 fathoms, 9·3° C.—Two, 24 mm.
S.R. 145—23/8/'04.—53° 24′ 30″ N., 11° 38′ W. 112 fathoms. Trawl—One, 25 mm.
S.R. 150—25/8/'04.—53° 54′ N., 12° 19′ W. 220 fathoms. Trawl. Temperature at 186 fathoms, 9·45° C.—One, 29 mm.
S.R. 165—3/11/'04.—52° 6′ N., 11° 44′ W. 244 fathoms. Dredge Temperature at 230 fathoms, 10·4° C., salinity 35·61°/$_{oo}$—Five, 21–28 mm.
S.R. 321—1/5/'06.—50° 58′ N., 11° 17′ W. 208-480 fathoms. Trawl—One, 26 mm.
S.R. 338—13/5/'06.—51° 28′ 30″ N., 11° 39′ W. 291-330 fathoms. Trawl.—One, 26 mm.
S.R. 351—5/8/'06.—50° 19′ 30″ N., 11° 6′ W. 230–250 fathoms Trawl—Sixteen, 12–16 mm.
S.R. 362—9/8/'06.—51° 34′ 30″ N., 11° 27′ W. 145–160 fathoms Trawl. Temperature at 150 fathoms, 10·05° C., salinity 35·37°/$_{oo}$—Thirty-seven, 10–17 mm.

There is only one previous record of the occurrence of *P. echinulatus* off the west coast of Ireland; a single specimen was found by the *Fingal* in 175 fathoms, 34 miles off Achill Head, Co. Mayo.

Vertical range.—30 to 291 fathoms. Most authors give 50 to 60 fathoms as the normal depth. Off the east coast of Ireland it has occurred in 30 fathoms, and, as may be seen from the above records from the west coast, it has been taken on one occasion (S.R. 338) in at least 291 fathoms. This constitutes a considerable increase in the known bathymetric range of the species, the previous greatest depth being 218 fathoms (Appellöf, 1906).

Philocheras trispinosus (Hailstone).

Pl. XXI, figs. 2, a and b.

Pontophilus trispinosus, Hailstone, 1835.
Crangon trispinosus, Bell, 1853, fig., p. 265.
Cheraphilus trispinosus, Kinahan, 1861, fig. v.
Aegeon trispinosus, Norman and Scott, 1906.

Rostrum broad, dorsally hollowed, its apex bluntly triangular; carapace broad, furnished with three spines, one median and a pair of lateral. The median spine is situated on the

anterior third of the carapace; the lateral spines are slightly posterior to it[1] and are continued backwards for a short distance as carinae. The posterior half of the carapace is smooth and rounded, with the exception of a groove which runs obliquely upwards and backwards behind the lateral carinae. *Abdominal somites* rather broad, all evenly rounded above; *telson* somewhat sulcate dorsally.

Basal joint of *antennular peduncle* about as long as second and third combined, the subquadrate lateral process reaching somewhat beyond the end of the segment; second joint considerably longer and wider than the third. *Antennal scale* (fig. 2 b) with its outer margin slightly convex, less than two and a quarter times as long as wide, the apical spine falling short of the sharply angled distal end of the lamellar portion.

Size.—Up to about 27 mm.

Colour in life.—The carapace and abdomen are mottled with golden yellow, sienna and umber brown chromatophores; usually the yellow and sienna are dorsal and the umber lateral. The sienna colouring is sometimes absent and in some specimens the yellow predominates to a very large extent, giving the whole animal a beautiful golden appearance. In other specimens both yellow and sienna are only faintly perceptible, the carapace and abdomen being semi-translucent, with umber brown speckling. The eyes are greyish black. The eyestalks, antennules and antennal scales show umber brown or brown and yellow chromatophores; the flagella are sometimes marked with red. The distal joints of the outer maxillipedes and first pereiopods are also marked with umber brown and yellow pigment spots, the latter being of large size; the second and third pereiopods are colourless, while the last two pairs show brown and yellow markings on the merus and carpus and sometimes also on the ischium. The pleopods, telson and uropods follow the general colouring of the abdomen.

General distribution.—*P. trispinosus* is not uncommon in many parts of the North Sea and English Channel and extends south to Gironde (Fischer), the Azores (Barrois) and to Marseilles (Gourret), but is apparently known in the Mediterranean only from the last locality. It has been recorded from the east coast of Scotland (Scott), from the west coast (Patience, Firth of Clyde) and from the Shetlands (Norman), but is not known on the Scandinavian shores.

Irish distribution.—First taken in Irish waters off Skerries, Co. Dublin. During the course of fishery investigations *P. trispinosus* has been found very frequently near the Kish and Burford Banks, off the mouth of Dublin Bay, in 10–12 fathoms

[1] By this character *P. trispinosus* is very readily distinguished from young *Crangon vulgaris*, to which it bears a superficial resemblance.

of water and has also been found in the Bay itself. The other records are :—

Helga.

S. 337—30/11/'05.—4 miles N.E. of Howth Head, Co. Dublin. 13–17 fathoms. Trawl. Temperature at 16 fathoms 7·7° C.—Three.

S. 350—5/12/'05.—1½ miles N.E. of Clogher Head, Co. Dublin. 10 fathoms. Trawl. Temperature at 9 fathoms, 8·8° C.—Four.

W. 50—13/2/'06.—Blacksod Bay, Co. Mayo. 4½–5½ fathoms. Trawl. Temperature at 4 fathoms, 5·4° C.—One.

W. 58—10/9/'06 —Off Minard, Dingle Bay, Co. Kerry. 10 fathoms. Trawl—Twenty-one.

S. 466—17/10/'06.—2 miles E. of Drogheda, Co. Louth. 8–10 fathoms. Trawl—One.

S. 493—19/2/'07.—1½ miles E. of Drogheda, Co. Louth. 5½–8 fathoms. Trawl—Three.

Also found in small numbers at Ballynakill and Bofin Harbours, Co. Galway.

In addition to these, the species has been recorded from Port Magee and Lough Kay, off Valencia Island (Walker), and there are specimens in the Dublin Museum from Seapoint, Co. Dublin and from Smerwick, Dingle and Roundstone Harbours.

Vertical range.—Littoral to 22 fathoms (Metzger).

Philocheras sculptus (Bell).

Pl. XXI, figs. 6, a and b.

Crangon sculptus, Bell, 1853, fig., p. 263.
Aegeon sculptus, Kinahan, 1861, fig. 9.
Crangon sculptus, Heller, 1863, Pl. VIII, fig. 14.

Rostrum much broader at apex than at base, dorsally hollowed and apically emarginate.

Carapace with a distinct median carina and two pairs of indistinct lateral carinae, the median bearing two stout spines, one close behind the rostrum and the other situated about one-third the length of the carapace from the posterior edge. In addition to these there are also in the median line two much smaller spines or tubercles, one placed between the two large spines and the other behind the posterior spine. First lateral carina of carapace represented by short obscure ridges, usually five in number, which are not produced anteriorly in the form of spines; second lateral carina consisting of two ridges, the foremost of which is prominent, sharply carinate, and produced anteriorly to a spine which is slightly in advance of the foremost spine of the median line. There are also four

short ridges, the foremost of which is very obscure, on the posterior part of the carapace between the first and second lateral carinae. The whole carapace is covered with a short and close pubescence.

Abdominal somites all strongly sculptured laterally and dorsally, the raised portion being glabrous and the depressions pubescent; pleura of the first four bluntly pointed below. First two somites dorsally rounded; third, fourth and fifth sharply carinate, sixth bicarinate. The carinae of the third, fourth and fifth somites, when closely examined, show faint traces of bicarination, this, however, is not so pronounced as is the case with *P. echinulatus*. Inner *uropod* considerably longer than the outer and about equal in length to the deeply grooved telson.

Basal joint of *antennular peduncle* longer than second and third combined, its distal end reaching somewhat beyond the anterior portion of the subquadrate lateral process; second joint about equal in length to third. *Antennal scale* (fig. 6 b) about two and a half times as long as broad, its outer edge slightly concave and bearing at about its middle a stout spine, in this feature differing from all other European and perhaps from all known Crangonidae. The apical spine reaches beyond the lamella of the scale. Merus of first *pereiopods* not furnished at its outer distal edge with the spine which is present in all other members of the genus.

Colour in life.—Extremely variable. Gosse (1853, p. 155) gives a close description of two forms. In one specimen noticed on the *Helga* the carapace and oral appendages were pale yellowish buff, with a minute blue spot in the mid-dorsal line of the former near the posterior edge. The first four abdominal somites were umber brown with whitish mottling, verging to maroon laterally, and with a few pale sienna spots; the last two somites and the telson were pale, with very faint sienna markings. Another specimen was of a general brick-red colour, with minute darker dots; others had an umber brown carapace with a whitish abdomen, some possessing in addition a transverse umber band across the proximal portion of the fifth abdominal somite; others again were uniform umber brown, with the exception of the sixth abdominal somite and the telson, which were whitish. One example showed a type of coloration closely resembling that of *P. trispinosus*, the carapace and abdomen being very pale mottled grey, verging to a dark maroon laterally.

Size.—The largest specimen observed measures 24 mm.

General distribution.—*P. sculptus* has been recorded from the Adriatic (Heller), Finistere (Barrois), Guernsey (Norman) and off the coasts of Devon and Cornwall (Bell, Norman, etc.). Off the west coast of Scotland it is known from the Minch and Lamlash Bay (Norman) and from the Firth of Clyde (Patience).

Irish distribution.—This species is by no means common in Irish waters, but has been taken in some numbers in one or two localities. Kinahan mentions it as not uncommon off Bray, Co. Wicklow, and he also found specimens off the Gobbins, near Belfast. Melville has recorded it from the Arran Is., Co. Galway. Other records are :—

Helga.

S. 82—30/7/'02. 2 miles off Dalkey, Co. Dublin. 14–15 fathoms. Trawl—One female, ovigerous, 19 mm.

S.R. 96—3/5/'04. 70 miles S.W. of Fastnet, Co. Cork. 82 fathoms. Bottom townet—One, 24 mm.

S.R. 182—28/1/'05. 2½ miles off Bray Head, Co. Wicklow. 15 fathoms. Townet. Temperature at 13 fathoms, 7·62° C., salinity 34·43°/$_{oo}$. One, 18 mm.

R. 8. 3/5/'05. 16½ miles S. W. of Coningbeg Lightship, off Co. Wexford. 40 fathoms. Trawl. Temperature at 38 fathoms, 8·9° C., 15–19 mm., several ovigerous females.

R. 9—3/5/'05. 17½ miles S.W. of Coningbeg Lightship, off Co. Wexford. 40 fathoms. Trawl. Twelve, 14–17 mm.

W. 47—9/9/'05.—Off Black Head, Co. Galway. 7–10 fathoms. Trawl. Temperature at 8 fathoms, 14·8° C. One, 11 mm.

R. 17—1/2/'06.—13½ miles S.S.W. of Hook Point, Co. Wexford. 40 fathoms. Trawl. Temperature at 39 fathoms, 8·6° C. Five, 10-20 mm.

R. 26—16/8/'06.—1½ miles S. of Helvick Head, Co. Waterford, 14½–16 fathoms. Trawl. Temperature at 15 fathoms. 11·3° C. Two, 18 mm.

R. 29—17/8/'06.—15 miles S.E. of Mine Head, Co. Waterford. 40–42 fathoms. Trawl. Temperature at 38 fathoms, 9·6° C., salinity 34·74°/$_{oo}$. One, ovigerous female, 22 mm.

S. 530—3/5/'07.—Off Kingstown, Dublin Bay. 4½–6½ fathoms. Trawl. Two ovigerous females, 16–18 mm.

In Ballynakill Harbour, Co. Galway, the species is very scarce; only three specimens were found during four years.

Vertical range.—Usually found between 5 and 40 fathoms; the 82-fathom record (S.R. 96) constitutes, I believe, a considerable increase in the known bathymetric distribution of the species.[1]

[1] The specimen recorded from 300 fathoms, off the S.W. Coast of Ireland as *Aegeon sculptus* (Calman, 1896, p. 3), is to be referred to *Aegeon Lacazei.*

Philocheras fasciatus (Risso).

Pl. XXI, figs. 3, a and b.

Crangon fasciatus, Bell, 1853, fig., p. 259.
Aegeon fasciatus, Kinahan, 1861, fig. VIII.
Crangon fasciatus, Heller, 1863, Pl. VII, fig. 10.
Crangon fasciatus, Norman, 1887.

Rostrum very broad, dorsally hollowed, and abruptly truncate at apex. *Carapace* with a single median spine in the anterior third; from this spine a carina runs backwards, becoming obsolete before reaching the posterior edge. On either side of the middle line are two lobe-like folds, the outer of which reaches further forwards than the inner; anteriorly these lobes are well-defined and rounded. From the orbital spine a carina runs backwards and outwards and meets a third lateral lobe which is more pointed; inferiorly this lobe is defined by a groove, which runs towards the branchial region, and superiorly by another groove which runs backwards past the posterior ends of the two inner lobes, becoming obsolete near the middle line on the cardiac region.

Abdominal somites dorsally smooth and rounded; occasionally very faint traces of dorsal carination are discernible on the fourth and fifth. *Telson* dorsally sulcate and shorter than both inner and outer uropods.

Basal joint of *antennular peduncle* about as long as second and third combined, its lateral process distally rounded and reaching to the end of the segment; second joint longer than third. *Antennal scale* (fig. 3 b) only about twice as long as broad, its outer edge convex; the short apical tooth does not surpass the distal end of the lamella.

The joints of the second *pereiopods* are proportionately much wider in this than in the other species of the genus.

Size.—The largest specimen examined measures 19 mm.

Colour in life.—The carapace and abdomen are, as a rule, whitish, the latter having two transverse dark umber brown bands, one across the fourth somite and the other across the posterior half of the sixth somite, telson, and uropods. In some specimens the carapace is dark umber brown, in others the posterior of the two abdominal bands is missing; forms occur very rarely in which all trace of the brown pigment is missing.

It should be noticed that the striking brown banding in this species also occurs in *P. bispinosus* v. *neglectus* and in some forms of *P. sculptus*. The colour of these smaller Crangonidae is extremely variable, and cannot be considered of any value for systematic purposes.

General distribution.—*P. fasciatus* has been recorded by various authorities from the Adriatic and Mediterranean and is also known from the Azores (Barrois), Gironde (Fischer), the Channel Is. (Norman), the Scilly Is. (Vallentin), from

the coasts of Devon and Cornwall (Bell, Norman, etc.), Norfolk (Patterson) and Northumberland (Norman). Off the Scotch coast it is rare; Firth of Forth (Scott), Firth of Clyde (Patience).

Irish distribution.—Off the Irish coast this species is widely distributed, but not common anywhere. It has been recorded from Sandycove, Co. Dublin; in the Strangford and Belfast districts from Portaferry, Donaghadee, Ballyholme Bay and off the Gobbins (Kinahan), and from Larne Lough (Rankin). On the west coast Melville found it off the Arran Is., Co. Galway.

The species was found not uncommonly in Ballynakill and Bofin harbours, Co. Galway; in Valencia harbour, Co. Kerry, Miss M. Delap has found a single specimen near Glanleam, and it has also occurred in small numbers in Blacksod Bay.

Vertical range.—Littoral to 30 fathoms (Heller). Off the Irish coast the species has not been taken in more than 15 fathoms.

Philocheras bispinosus (Hailstone and Westwood).

Pl. XXI, figs. 4, a and b.

Pontophilus bispinosus, Hailstone and Westwood, 1835, p. 271, fig. 30.
Crangon nanus, Kröyer, 1842.
Crangon bispinosus, Bell, 1853, fig., p. 268.
Cheraphilus bispinosus, Kinahan, 1861, fig. IV.
Aegeon nanus, Norman and Scott, 1906.

Rostrum short, dorsally hollowed, apex rounded. *Carapace* with two spines in the median line, one in the anterior third and one further back in the posterior third, the latter often reduced to a mere tubercle. On either side are numerous minute tubercles arranged in a more or less longitudinal series; of these, one row is more pronounced than the rest and consists of about fourteen tubercles forming a rather wavy line from close behind the orbit to the posterior margin of the carapace. The line is interrupted at about its middle by a groove which runs backwards and upwards, becoming obsolete before it reaches the median line of the carapace behind the posterior dorsal spine or tubercle.

Abdominal somites smooth and dorsally rounded, with the exception of the fifth and sixth, on which very obscure tubercles in longitudinal series may usually be observed. Telson sulcate above, about as long as the outer uropod.

Basal joint of *antennular peduncle* about as long as second and third combined, its subquadrate lateral process not quite reaching the distal end of the segment; second joint longer than third. *Antennal scale* (fig. 4 b) rather narrower than in the preceding species—slightly more than two and a half times

as long as wide; outer margin straight or slightly concave, the apical spine not exceeding the lamellar portion of the scale.

Colour in life.—Pale mottled grey or reddish, with darker mottling along the inferior edges of the carapace, pleura, and pleopods. Another form observed was of a dark mottled grey, still darker laterally with whitish patches on the dorsal aspect of the carapace, third, fourth and sixth abdominal somites, and at the apex of the antennal scale.

I am indebted to Mr. Alexander Patience for a specimen from the Firth of Clyde which shows a type of coloration closely resembling that of the var. *neglectus*; the carapace is of a reddish chestnut colour, a band of the same tint being found across the fourth and fifth abdominal somites and another across the telson and uropods. This type of coloration seems to be very rare, but it furnishes an additional proof of what I have stated above—that colour is of the very slightest systematic importance among the species of the genus.

Size.—This species attains a length of about 20 mm. Scott (1902) mentions ovigerous females of only 11 mm.

The characteristic row of tubercles on either side of the carapace are best seen if the superficial moisture from the specimen is absorbed with blotting-paper before examination.

The Irish examples of *P. bispinosus* appear to belong to a race in which the tuberculation of the carapace is comparatively weakly developed. In no case is this feature as strongly pronounced as it is in certain specimens from the Norwegian coast. The latter individuals, which are in Canon Norman's museum, represent an extreme type, the whole of the carapace and part also of the abdomen being covered with large and prominent spinules.

General distribution.—*P. bispinosus* is very common in the N.E. Atlantic; it extends from the Lofoten Is., N. of the Arctic Circle, to the English Channel, but is not known from Iceland. Barrois (1888) has recorded the species from the Azores.

Irish distribution.—Abundant all round the Irish coast.

Vertical range.—Occurring at all depths in the Irish Sea and off the west coast descending to as much as 200 fathoms.

Philocheras bispinosus, var. **neglectus** (G. O. Sars).

Pl. XXI, figs. 5, a and b.

Cheraphilus neglectus, G. O. Sars, 1882, Pl. 1, fig. 7.
Crangon neglectus, Norman, 1887.
Cheraphilus neglectus, Hansen, 1908.

This form has been found off the Irish coast on only one occasion and the specimens which were then obtained were so

evidently distinct from any Irish examples of *P. bispinosus* that, notwithstanding Appellöf's statements (1906, p. 180), I was convinced that two well-defined species were represented; but recently, after a close examination of a very large number of specimens from Canon Norman's museum, I have been forced to alter my views on the subject. From the examples collected by Canon Norman it is easy to select a series showing every possible intermediate form between *P. bispinosus* and *neglectus*.

Typical specimens of the var. *neglectus* are characterized by the perfectly smooth carapace without trace of tuberculation on the dorso-lateral ridges or elsewhere; under a high power the general surface is seen to be very finely reticulate with numerous minute depressions and punctures. The posterior spine in the median line of the carapace is reduced to an obscure tubercle or is wholly obsolete. The rostrum is slightly more rounded at the apex than in *P. bispinosus* and the grooves on the carapace are rather less distinct.

The colour in life of the Irish specimens, which are in every feature typical of the var. *neglectus*, is as follows :—The carapace is uniformly pale, pale with a sprinkling of brown dots, or uniform dark chestnut brown. The abdomen is pale, with a transverse chestnut brown band across the fourth somite; the pleura and pleopods show dark mottling. On the telson and uropods there is a narrow transverse brown band consisting only of a pair of chromatophores on the telson and one on each of the uropods.

The brown banding cannot be considered at all satisfactory as a specific character. It is wholly absent in two recent well-marked examples of the var. *neglectus* which were caught in the Bay of Biscay and, as already stated, similar colouring frequently prevails in *P. fasciatus* and *P. sculptus* and has once been observed (v. p. 153) in a typical *bispinosus*.

Practically all the specimens which Canon Norman has so kindly permitted me to examine showed a certain amount of surface spinulation; in the case of the better marked examples of the var. *neglectus* this was, of course, exceedingly obscure, but certainly no individual was found to possess as smooth a carapace as the Irish specimens.

In course of time it will perhaps be found that the relationship between *P. bispinosus* and *neglectus* is somewhat of the same nature as that which seems to exist between *Spirontocaris spinus* and *S. Lilljeborgi*, and that the two forms are quite distinct in certain areas, while in others they occur in company with intermediate forms.

Size.—Three of the Irish specimens are ovigerous females, and are $13\frac{1}{2}$, 14 and 15 mm. in length; the fourth specimen is a male, and measures 14 mm. Scott (1902) records a specimen of 18 mm.

General distribution.—This rare form was first described by Sars from the west coast of Norway. It has been four times recorded from the coasts of Scotland: by Norman (1887)

from Loch Tarbert and from the Shetlands,[1] by Scott (1902) from the Firth of Forth, and by Patience (1908) from the Firth of Clyde. It is known also from the S. coast of Iceland (Hansen) and has been found on the N. side of the Bay of Biscay (Kemp).

Irish distribution.[2]—Only on one occasion has this form been found off the Irish coast :—

Helga.

R.S.—3/5/'05.—16½ miles S.W. of Coningbeg Lightship, off Co. Wexford. 40 fathoms. Trawl. Temperature at 38 fathoms, 8·9° C., salinity 35·03°/$_{oo}$—Four, 13½—15 mm., three ♀ ovigerous.

Vertical range.—Off Norway this species has been found between 2 and 6 fathoms and on the Scotch coast between 8 and 10 fathoms. Hansen records it from 20–45 fathoms in the neighbourhood of Iceland and it has occurred in 75 fathoms in the Bay of Biscay (Kemp).

Genus **Aegeon**, Guérin Méneville.

Egeon, Risso, 1816.
Pontocaris, Spence Bate, 1888.

Rostrum depressed; longitudinal dentate carinae on both *carapace* and *abdomen*. *Eyes* present. Lateral process of *antennules* distally pointed. First pair of *pereiopods* with a setose exopod; second pair chelate, reaching slightly beyond carpus of, or nearly as long as, first pair, dactylus about one-third the length of propodus, carpus shorter than ischium; dactylus of fourth and fifth pairs not laminar. Endopod of last four pairs of *pleopods* only slightly shorter than exopod, one-jointed and with appendix interna at base. Inferior apices of *branchiae* turned forwards, giving the whole gill a characteristic C-shaped appearance. Formula :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1 + ep.	...	...	...	...	...	...
Arthrobranchiae, ...	...	...	1	...	...	...	...	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

[1] I am indebted to Canon Norman for the information that these Shetland specimens, which he recorded in 1869 as *Crangon fasciatus*, are in reality (as he suggested in 1887) examples of *neglectus*.

[2] Mr. A. O. Walker has very kindly allowed me to examine the specimens recorded by him from Valencia (1898, p. 163) as *Crangon neglectus*. These specimens, three in number, are of extremely small size, ca. 7 mm.; they, however, show distinct traces of lateral tubercles, and I strongly suspect that they are only young specimens of typical *P. bispinosus*.

Aegeon Lacazei (Gourret).

Pl. XXII, figs. 1–5.

Crangon Lacazei, Gourret, 1888, Pl. XII, figs. 19–23; Pl. XIII, figs. 1–10.
Aegeon Brendani, Kemp, 1906.

The *rostrum* is short, depressed, and about half the length of the eyestalks; it is very deeply emarginate apically and provided near the base with a pair of small, semi-obsolete lateral spinules. The *carapace* is very strongly convex, deeper than broad, and furnished with seven dentate carinae, of which the three lateral pairs are curved in dorsal view. The spine at the outer edge of the orbit is but little longer than the rostrum, but the antero-lateral angle is very strongly pronounced and reaches considerably beyond the eyes. The median carina of the carapace bears four strong forwardly directed teeth, of which the third is the largest; the first lateral row consists of six teeth which decrease in size from before backwards, the hindmost, however, not being reduced to mere spinules as in the case of *A. cataphractus*. The second lateral carina terminates anteriorly in the antero-lateral angle; it is interrupted in its anterior third by a depression which runs from the back of the orbit towards the branchial region. In front of this depression the carina is represented by a single spine; another spine, which is situated immediately behind the sharp antero-lateral angle, appears more properly to belong to the third lateral row. Posterior to the depression the carina is divided into six or seven teeth; the anterior of these is sharp, but the others are semi-obsolete and in most specimens are little more than nicks in the carina. The third lateral carina, which runs close to the inferior margin of the carapace, consists of a stout anterior spine (mentioned above), behind which is a row of very obscure spinules which very frequently are scarcely perceptible.

The *abdominal somites* are all finely and sharply sculptured. The first somite bears a pair of dorsal carinae which are produced anteriorly to sharp forwardly directed teeth; outside these is a short interrupted carina, bearing two small but sharp teeth, which continues the curve of the first lateral carina of the carapace; the second lateral carina is also continued on to this somite, where it is represented by several blunt elevations. The second somite bears in its middle a stout forwardly directed dorsal spine. The third and fourth somites are each furnished with three dorsal carinae, of which the two outer are posteriorly divergent. The fifth and sixth somites are armed with a pair of dorsal carinae, outside of which traces of a second pair are visible; the median pair of the fifth are slightly divergent posteriorly; those of the sixth are parallel, notched so as to show two pairs of backwardly directed spines, and posteriorly carried back beyond the edge

of the somite to form a pair of sharp spines on either side of the telson. The sixth somite is about one and a half times the length of the fifth. The lateral portions of all the somites are occupied by obscure elevations and depressions; in the male the pleura are bluntly pointed below, but more rounded in the female.

The *telson* is not quite one and a half times the length of the sixth somite, but is somewhat longer than the inner uropod, slightly sulcate dorsally, and terminates in an acute point, which, in perfect specimens, is provided with a few long setae; dorso-laterally it is furnished with one or two very minute pairs of spinules.

The *eyes* are short and widest distally; the cornea, which is black, occupies only a comparatively small area at the apex of the stalk.

The peduncle of the *inner antennae* reaches more than half the length of the antennal scale; the lateral process is apically pointed and scarcely reaches to the distal end of the basal segment, the second joint is rather longer than the third. In the female the two flagella are of about equal thickness, the inner, which is longer than the outer, being somewhat shorter than the peduncle. In the male (fig. 3) the inner flagellum is quite twice the length of the peduncle, while the outer is shorter and greatly thickened basally.

The *antennal scale* (fig. 4) is almost twice as long as wide; its outer edge is very definitely concave and the apical spine projects beyond the lamellar portion.

The *oral appendages* do not appear to differ in any important particular from those of *A. cataphractus*, but are provided with finer and less dense fringes of setae. In both species the podobranch at the base of the second maxillipede is practically rudimentary, consisting only of a few simple plates.

The *pereiopods* also bear the closest resemblance to those of *A. cataphractus*; as a whole they are rather more slender and a trifle longer than in that species and the setae are finer and less numerous. The small exopod at the base of the first pair of pereiopods is rather densely clothed with fine setae. In the second pair the propodus, carpus, and merus are all nearly the same length and each shorter than the ischium. The third pair is longer and more slender than the fourth and fifth which are of about equal length.

The first five *abdominal sterna* are each furnished with a small median tubercle which is far less conspicuous than the stout spine present in *cataphractus*.

The inner *uropod* is narrow, about six times as long as broad, and is much longer than the outer, which is little more than three and a half times as long as broad.

Size.—The largest specimen is a female measuring 32 mm.

Through the good offices of M. Penot I have been able to compare the Irish specimens, which were recently described as *A. Brendani*, with authentic examples of *A. Lacazei* from

the Gulf of Marseilles. There is no doubt that *A. Brendani* is a synonym of the species found by Gourret, though this is by no means evident from his description and figures.

Aegeon Lacazei may be readily distinguished from all other known species of the genus (with the possible exception of *A. Habereri*, Doflein) by the comparatively narrow antennal scale with concave outer edge. Doflein (1902) describes the antennal scale of his *A. Habereri* from East Asiatic waters as oval, but in a rather rough figure the outer edge appears to be concave. Miss Rathbun (1906) when recording specimens of this form from Hawaiian waters, does not allude to the shape of the antennal scale, but mentions that the median carina of the carapace is five-toothed in the female and that the outer antennular flagellum of the female is not more than half as thick as the inner. These characteristics are certainly not present in *A. Lacazei*.

In addition to the shape of the antennal scale, *A. Lacazei* may be distinguished from *A. cataphractus*, the common Mediterranean form, by its more slender build and fine sculpturing, by the number of teeth on the second lateral carina of the carapace and by the greater length of the sixth abdominal somite (in *A. cataphractus* the fifth and sixth somites are of much the same length).

General distribution.—Until quite recently this species was known only from the Gulf of Marseilles, where the type specimens were found. In addition to the Irish examples I have examined a number of individuals caught by the *Huxley* on the N. side of the Bay of Biscay.

Irish distribution.—All the specimens were found in deep water off the south-west of Ireland. The records are :—

Helga.

S.R. 165—3/11/'04.—52° 6′ N., 11° 44′ W., 244 fathoms. Trawl. Temperature at 230 fathoms 10·4° C., salinity 35·61°/$_{oo}$ —Two, 14 mm.

S.R. 171—5/11/'04.—52° 7′ N., 11° 58′ W., 337 fathoms. Trawl. —Six[1], 23–32 mm.

S.R. 188—3/2/'05.—51° 53′ N., 11° 59′ W., 320–372 fathoms. Trawl. Temperature at 300 fathoms 10·12° C., salinity 35·50°/$_{oo}$ —One, 24 mm.

S.R. 321—1/5/'06.—50° 58′ N., 11° 17′ W., 208–480 fathoms. Trawl.—One, 16 mm.

S.R. 330—9/5/'06.—51° 16′ N., 11° 37′ W., 374–415 fathoms. Traw Temperature at 400 fathoms 9·55° C., salinity 35·33°/$_{o}$° —One, 17 mm.

S.R. 362—9/8/'06.—51° 34′ 30″ N., 11° 27′ W., 145–160 fathoms. Trawl. Temperature at 150 fathoms 10·05° C., salinity 35·37°/$_{oo}$—One, 24 mm.

[1] The type specimen is a female measuring 32 mm.

The Dublin Museum contains a single specimen of this species taken by the *Lord Bandon* expedition in 1886. It was found in lat. 51° 11′ N., long. 11° 31′ W., at a depth of 325 fathoms.

Vertical range.—Found off the Irish coast in 160–374 fathoms and in the Bay of Biscay in 240–246 fathoms.

Gourret states that the type specimens were found between 38 and 44 fathoms. This record is very remarkable and is not improbably based on error. There is reason to believe that the specimens were caught by a local fisherman and came from deeper water than Gourret supposed.

Genus **Pontophilus,** Leach.

Rostrum depressed; *carapace* usually with longitudinal dentate carinae. *Eyes* present. First pair of *pereiopods* with, or without, a small exopod; second pair slender, chelate, and very short—rarely reaching distal extremity of merus of first pair, carpus very much shorter than ischium; dactyli of fourth and fifth pairs not laminar. Endopod of last four pairs of *pleopods* only slightly shorter than exopod, composed of a single segment and with an appendix interna at base. Inferior apices of *branchiae* turned backwards; formula :—

—	VII.	VIII	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1 + ep.	±ep.[1]	...	...	...	...	...
Arthrobranchiae, ...	...	...	...	...	...	...	...	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

Alcock (1901) has stated that the absence of an exopod on the first pair of pereiopods is characteristic of *Pontophilus;* this exopod is, however, present in *P. spinosus*, the type species of the genus, and also in *P. norvegicus*.

The two British and Irish species of *Pontophilus* may be separated thus :—

I. First lateral carina of carapace armed with three teeth, the second with two teeth, *P. spinosus* (p. 160).

II. First lateral carina of carapace armed with two teeth, the second with only one, *P. norvegicus* (p. 162).

[1] This epipod when present is rudimentary.

Pontophilus spinosus (Leach).

Pl. XXI, figs. 8, a–d.

Crangon spinosus, Bell, 1853, fig., p. 261.
Cheraphilus spinosus, Kinahan, 1861, fig. VII.[1]
Crangon spinosus, Heller, 1863, Pl. VII, fig. 16.
Pontophilus spinosus, M. Sars, 1868, Pl. II, figs. 38–45; Pl. III, figs. 46, 47.
Pontophilus spinosus, G. O. Sars, 1890, Pl. III, figs. 1–20 (development).

Rostrum short, slightly hollowed dorsally, broad at base, tapering rapidly to a narrow rounded apex, and bearing at about its middle a small short spinule on either side. *Carapace* broad, with five longitudinal dentate carinae; the median with three stout teeth and frequently with one or two minute spinules in addition in front of the most anterior. First lateral carina also bearing three stout teeth, second lateral with two on its anterior half. Antero-lateral angle flanked by a short carina which rapidly becomes obsolete, vanishing completely on the branchial region.

First four *abdominal somites* very faintly carinate dorsally; fifth with two pairs of posteriorly divergent carinae; sixth with two pairs of parallel carinae, the outer pair usually very obscure. *Telson* dorsally sulcate and rather longer than the inner uropod.

Basal joint of *antennular peduncle* very slightly longer than second and third combined, furnished in the middle of its inferior margin with a stout forwardly directed spine; lateral process acutely pointed and reaching slightly beyond distal end of segment. Second joint longer than third and almost as broad as long. *Antennal scale* (fig. 8 b) in adult specimens not quite two and a half times as long as wide; outer edge somewhat convex proximally and slightly concave distally, apically produced to a sharp spine reaching beyond the distal end of the lamellar portion of the scale.

Colour in life.—Large specimens show a very striking type of coloration. The carapace and abdomen are mottled reddish brown. Dorsally the carapace has a prominent bluish white patch extending from the base of the rostrum to the second median spine and bounded laterally by the first lateral carina. Similar bluish white patches are present on the abdominal somites, telson and uropods. A pair of dorso-lateral patches are present on the first somite, there is a prominent transverse band on the posterior edge of the third somite, a broad band extends across the base of the telson and uropods, and there is also a spot of the same colour at the apex of the outer uropods. The eyes are greyish. The outer maxillipedes,

[1] The spinulation of the carapace in this figure is quite imaginary.

pereiopods, and pleopods are thickly spotted with red, the antennal scale and antennules being more sparsely dotted with the same colour.

Size.—The largest specimen examined is 52 mm. in length. Off the Irish coast this species appears to grow to a large size only in comparatively shallow water (60 fathoms or less).

Very small specimens, of from 10 to 15 mm., from deep water off the west coast, invariably possess the two small additional teeth in front of the median anterior tooth; the rostrum is deeply hollowed above and in side view arched, with its lateral spines much more pronounced than in large specimens; the antennal scale also is narrower, externally slightly concave, its apical spine not reaching beyond the lamellar portion.

A curious variation in the armature of the carapace occurs in the case of an example 10·5 mm. in length from 74 fathoms, 30 miles W.N.W. of Cleggan Tower, Co. Galway. Here the posterior tooth of the median line and the middle tooth of the first lateral are entirely missing. In all other respects, however, this specimen bears the closest resemblance to the small forms mentioned above, so that I have no hesitation in regarding it merely as an abnormal example of *P. spinosus*.

General distribution.—*Pontophilus spinosus* is known from south and west Norway as far north as lat. 62° 35′ (Sars, Norman, etc.), S. of Iceland (Hansen), Sweden (Goës), Denmark (Meinert) and generally throughout the North Sea. It has been recorded from the Bay of Biscay (Caullery) and has been repeatedly found in the Mediterranean and Adriatic (Senna, Heller, etc.).

Off the English and Scotch coasts this species is moderately common, extending from the extreme south as far north as the Shetland Is.

Irish distribution.—Not uncommon on the east coast trawling grounds outside the 20-fathom line, and equally plentiful off the south and west coasts.

Vertical range.—Found off the east coast in 10 to 73 fathoms; in the west the species has been trawled in as much as 244 fathoms. In the Mediterranean *P. spinosus* occurs in much deeper water, Adensamer records it from 664 fathoms and Senna from 863 fathoms.

Pontophilus norvegicus (M. Sars).

Pl. XXI, figs. 9, a and b.

Crangon norvegicus, M. Sars, 1861.

Pontophilus norvegicus, M. Sars, 1863, Pl. I, figs. 1–25; Pl. II, figs. 17–37.

Pontophilus norvegicus, G. O. Sars, 1890, Pl. IV, figs. 1–20 (development).

Pontophilus norvegicus, Wollebaek, 1900, Pl. I, fig. 2.

Rostrum narrower and relatively rather longer than in the preceding species, slightly hollowed dorsally, terminating in an acute point, and armed at about its middle with a pair of small lateral spinules. *Carapace* with five longitudinal dentate carinae; the median armed with three stout teeth, in front of which a small tubercle is occasionally found, first lateral carina with two teeth on its anterior half; second lateral with only one tooth placed in advance of the median anterior tooth. A short carina extends backwards from the antero-lateral angle as in the last species.

First four *abdominal somites* dorsally smooth and rounded; the fifth with very faint traces of posteriorly divergent carinae, sixth bicarinate. *Telson* dorsally sulcate, rather shorter than inner uropods.

Eyes considerably larger than in *P. spinosus*. Basal joint of *antennular peduncle* much longer than second and third combined, the second joint longer than broad; otherwise similar to the preceding species. *Antennal scale* (fig. 9 b) not narrowed distally, nearly three times as long as wide, its outer edge concave and furnished with an apical spine which does not exceed the lamellar portion of the scale.

In this species as well as in *P. spinosus* the fingers of the chelae of the second pair of legs meet only at the tips and bear ungues, that of the fixed finger being longer than that of the dactylus. The whole hand agrees almost exactly with the description and figures given by Stebbing (1905) for *P. gracilis*.

Colour in life.—The carapace and abdomen are dorsally of a pale and dull reddish brown colour, often having a mottled appearance owing to certain small areas being less thickly pigmented than the rest. The red-brown colouring is darkest on the posterior portions of the last three abdominal somites. Anteriorly the carapace is semi-transparent, the black gastric regions showing through the walls. Laterally a few sparse umber brown chromatophores are mixed with those of reddish brown on both carapace and abdomen, while on the former there are also two conspicuous bands of pure white which run obliquely upwards and backwards from the posterior margin. Traces of this white colouring may also be observed on the pleura of the first two abdominal somites.

The eyes are dull black with golden brown reflections. The antennal scale is mottled with many dark brown and with a few red chromatophores; the apical spine is orange as are also all three pairs of flagella. The outer maxillipedes are pigmented with dark umber brown. The first pair of pereiopods are of a rather redder tone; the second and third pairs are brownish red basally with transparent terminal joints; in the fourth and fifth pairs the dactylus is colourless, the propodus, carpus, merus, coxa and basus are reddish brown, while the ischium is transparent with a few white chromatophores. The pleopods, uropods and telson are dull mottled reddish brown. In an ovigerous female the eggs were a pale wood-brown colour.

Size.—P. norvegicus is known to attain a length of 64 mm. (Ohlin); but an ovigerous female from the Irish coast measured only 38 mm.

As in the case of *P. spinosus* small specimens possess a relatively longer rostrum than in the adult and the small additional tooth is always present in front of the median anterior spine.

In a few small specimens (from S.R. 364) the posterior spines of the median and of the first lateral carina are missing, while other examples taken at the same time exhibit the normal spinulation. This variation is similar in character to that described above in the case of *P. spinosus;* the very small size of the specimens suggests the phenomenon is possibly due to immaturity.

General distribution.—Pontophilus norvegicus is known from Spitzbergen (Ohlin), Iceland (Hansen), E. Finmark to S. Norway (Norman and Sars), Sweden (Goës), Denmark (Meinert), and from the Bay of Biscay (Caullery). The species has been found off Greenland and in Davis Straits (Hansen), and has been taken off the east coast of America from Nova Scotia to Long Island (Smith).

Irish distribution.—P. norvegicus has been found on many occasions off the west and south-west coasts of Ireland. Outside the 300-fathom line it is by far the commonest Decapod met with. The species is doubtless abundant at suitable depths over the whole of the N.E. Atlantic from the Bay of Biscay northwards.

The Irish records are :—

Helga.

CXXI.—24/8/'01.—53° 52′ N., 11° 56′ W., 199 fathoms. Trawl—One, 15 mm.

S.R. 152—27/8/'04.—54° 7′ N., 11° 37′ W., 220 fathoms. Trawl—Fragments.

S.R. 164—3/11/'04.—52° 6′ N., 12° 0′ 30″ W., 375 fathoms. Dredge. Temperature at 350 fathoms 9·78° C., salinity 35·70°/$_{oo}$—One, 45 mm.

S.R. 171—5/11/'04.—52° 7′ N., 11° 58′ W., 337 fathoms. Trawl—Thirteen, 18–46 mm.

S.R. 172—5/11/'04.—52° 2′ N., 12° 8′ W., 454 fathoms. Tarwl—Nine, 19–43 mm.

S.R. 188—3/2/'05.—51° 53′ N., 11° 59′ W., 320–372 fathoms. Trawl. Temperature at 300 fathoms, 10·12° C., salinity 35·50°/$_{oo}$—Thirty-one, 22–53 mm., including several ovigerous females.

S.R. 212—6/5/'05.—51° 54′ N., 11° 57′ W., 375–411 fathoms. Trawl. Temperature at 350 fathoms 9·82° C., salinity 35·28°/$_{oo}$—Six.

S.R 327—8/5/'06.—51° 41′ N., 12° 17′ W., 550–800 fathoms. Trawl. Temperature at 500 fathoms 9·22° C., salinity 35·16°/$_{oo}$—Six, 41–52 mm.

S.R. 331—9/5/'06.—51° 12′ N., 11° 55′ W., 610–680 fathoms. Trawl—Eight, 22–24 mm.

S.R. 353—6/8/'06.—50° 39′ N., 11° 32′ W., 250–542 fathoms. Trawl. Temperature at 500 fathoms 8·58° C., salinity 35·46°/$_{oo}$—Many, 14–51 mm.

S.R. 359—8/8/'06.—52° 0′ N., 12° 6′ W., 465–492 fathoms. Trawl. Temperature at 475 fathoms 9·04° C., salinity 35·37°/$_{oo}$—Five, 12·5–45 mm.

S.R. 363—10/8/'06.—51° 22′ N., 12° 0′ W., 695–720 fathoms. Trawl—Three, 30–46 mm.

S.R. 364—10/8/'06.—51° 23′ 30″ N., 11° 47′ W., 620–695 fathoms. Trawl. Temperature at 600 fathoms 7·92° C., salinity 35·37°/$_{oo}$—Nine, 11–12·5 mm.

S.R. 387–·7/11/'06.—51° 47′ N., 12° 12′ W., 530–535 fathoms. Trawl. Temperature at 500 fathoms 9·13° C., salinity 35·39°/$_{oo}$—One.

S.R. 397—2/2/'07.—51° 46′ N., 12° 6′ W., 549–646 fathoms. Trawl. Temperature at 500 fathoms 8·71° C., salinity 35·57°/$_{oo}$—Two, 21 and 23 mm.

S.R. 398—2/2/'07.—51° 45′ N., 12° 2′ 30″ W., 547–549 fathoms. Trawl—One ovigerous female, 39 mm.

S.R. 400—5/2/'07.—51° 18′ N., 11° 50′ W., 525–600 fathoms. Trawl—Ten, several ovigerous females.

S.R. 440—16/5/'07.—51° 45′ N., 11° 49′ W., 350–389 fathoms. Trawl. Temperature at 300 fathoms 9·93° C., salinity 35·46°/$_{oo}$—One.

S.R. 447—18/5/'07.—50° 20′ N., 10° 57′ W., 221–343 fathoms. Trawl. Temperature at 300 fathoms 9·87° C., salinity 35·48°/$_{oo}$—Twenty-eight, 23–31 mm.

S.R. 448—18/5/'07.—50° 21′ N., 11° 0′ W., 343–346 fathoms. Trawl—Seven, 25–44 mm.

S.R. 477—28/8/'07.—51° 15′ N., 11° 47′ W., 707–710 fathoms Trawl. Temperature at 700 fathoms 7·19° C.—Six.

S.R. 482—29/8/'07.—51° 16′ N., 11° 26′ W., 368 fathoms. Eel-trawl—Four.

S.R. 484—30/8/'07.—51° 35′ N., 11° 57′ W., 602–610 fathoms. Trawl. Temperature at 550 fathoms 8·34° C., salinity 35·32°/$_{o}$—One.

S.R. 486—3/9/'07.—51° 37′ N., 11° 59′ W., 600–660 fathoms. Trawl—One, 41 mm.

S.R. 487—3/9/'07.—51° 36′ N., 11° 57′ W., 540–660 fathoms Trawl. Temperature at 500 fathoms 8·65° C., salinity 35·35°/$_{oo}$—Seventeen, 14–53 mm.

S.R. 489—4/9/'07.—51° 35′ N. 11° 55′ W., 720 fathoms. Trawl —Several.

S.R. 490—7/9/'07.—51° 57′ 30″ N., 12° 7′ W., 470–491 fathoms. Trawl. Temperature at 480 fathoms 8·68° C.—Nine, 37–61 mm.

S.R. 491—7/9/'07.—51° 57′ 30″ N., 12° 13′ W., 491–520 fathoms. Trawl. Temperature at 500 fathoms 8·53° C., salinity 35·44°/$_{oo}$—Nineteen, 37–65 mm.

S.R. 493—8/9/'07.—51° 58′ N., 12° 25′ W., 533–570 fathoms. Trawl—Thirteen, 36–57 mm.

S.R. 494—3/9/'07.—51° 59′ N., 12° 32′ W., 550–570 fathoms. Trawl—Twenty-nine, 13–58 mm.

S.R. 495—8/9/'07.—52° 0′ N., 13° 10′ W., 346–400 fathoms. Prawn trawl—Two, 48 and 55 mm.

S.R. 496—8/9/'07.—51° 54′ N., 12° 54′ W., 473–500 fathoms. Trawl—One, small.

S.R. 497—10/9/'07.—51° 2′ N., 11° 36′ W., 775–795 fathoms. Trawl —One.

S.R. 499—11/9/'07.—50° 55′ N., 11° 29′ W., 666–778 fathoms Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·41°/$_{oo}$—Six, 13–30 mm.

S.R. 501—11/9/'07.—50° 49′ N., 11° 22′ W., 447–625 fathoms. Prawn trawl—Four.

S.R. 502—11/9/'07.—50° 46′ N., 11° 21′ W., 447–515 fathoms Trawl. Temperature at 500 fathoms 8·8° C., salinity 35·37°/$_{oo}$—Twenty-six, 14–57 mm.

S.R. 504—12/9/'07.—50° 42′ N., 11° 18′ W., 627–728 fathoms. Trawl—Fifteen, 11–49 mm.

S.R. 505—12/9/'07.—50° 39′ N., 11° 14′ W., 464–627 fathoms. Trawl—Twelve, 32–49 mm.

S.R. 506—12/9/'07.—50° 34′ N., 11° 19′ W., 661–672 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·53°/$_{oo}$—Twenty-one, 12–61 mm.

This abundant species has only once previously been recorded from British waters—by Norman (1894) in a distribution table of the Crustacea of Norway. The locality is :—

Porcupine.

St. 47—August, 1869.—59° 34′ N., 7° 18′ W., 542 fathoms, bottom temperature 6·5° C.—One.

Vertical range.—As will be seen from the above records *P. norvegicus* is found off the Irish coast between 199 and 775 fathoms. Smith mentions it from 101 fathoms off the east coast of N. America; off the Swedish coast it has been found

in only 80 to 90 fathoms (Goës, *fide* Ohlin), while Sars has recorded it from 30 fathoms off the Norwegian coast. The species does not seem to have been hitherto caught in as much as 775 fathoms.

Tribe STENOPIDEA.

Family *STENOPIDAE.*

Genus **Richardina,** A. Milne-Edwards.

Richardina spinicincta, A. Milne-Edwards.

Pl. XXIII, figs. 1–10.

Richardina spinicincta, A. Milne-Edwards, 1881.
Richardina spinicincta, A. Milne-Edwards, 1882.
Richardina spinicincta, A. Milne-Edwards, 1883, Pl. 41.

The *rostrum* is strongly compressed and about half as long as the carapace measured in the mid-dorsal line. Dorsally it is armed with from nine to eleven evenly spaced teeth, behind which a small blunt tubercle is usually found situated on the carapace; ventrally the rostrum is provided with from two to five teeth on its distal half. The *carapace* is broad and only slightly compressed; at about its middle there is a prominent transverse cincture of procumbent spines, about thirty in number, which extends downwards on either side for rather more than half its depth, an additional spine being present in front of the most inferior of the series. Behind the base of the rostrum there is a second transverse row of forwardly-directed spines; these are six or eight in number and are interrupted in the mid-dorsal line by a carina which runs backwards from the rostrum, becoming obsolete shortly before it reaches the posterior series of spines. The anterior margin of the carapace is produced and rounded below the orbital notch; there is a small spine above the base of the antennae and a number of spinules on the rounded inferior angle.

The *abdominal somites* are all smooth and evenly rounded dorsally; the first somite is not overlapped by the pleura of the second. There is a minute spinule on the posterior margins of the fourth and fifth somites above the acutely pointed inferior angle, while on the proximal part of the sixth, near the lower margin, there is a pair of stout spines. The *telson* (fig. 10) is about the same length as the inner and outer uropods and is deeply sulcate in the mid-dorsal line, the convex portions on either side being strongly spinose.[1] There is a single very strong lateral spine on either side at about the middle, and

[1] The arrangement of the dorsal spines seems to be subject to considerable variation. In fig. 10 (which illustrates the only perfect telson observed) it will be noticed that they are not even placed symmetrically.

from this onwards to the apex the margins are clothed with long setae. The apex is rounded with a minute central point and a blunt spine marking each outer angle; it bears eight long setae and a few short hairs.

The *eye* (fig. 3) is short; the corneal area is indistinctly marked off from the stalk; it only shows the very faintest traces of facets, and is entirely devoid of black pigment. The stalk is considerably wider than the cornea and bears seven strong spines, two on the outer side and five on the inner superior aspect.

The *antennular peduncle* reaches about to the apex of the rostrum. The proximal joint is much longer than the two following combined; it bears at its base a short forwardly directed lateral process. The second joint is almost twice the length of the third and is furnished with three spines, two on the inner and one on the outer aspect. In the female the flagella are very long and of about equal thickness; the outer and lower ramus is the longer. The basal joints of the *antennae* are spinose below. The antennal scale (fig. 2) reaches beyond the rostrum by almost one-half its length and is almost three and a half times as long as wide. The outer edge is strongly concave and bears from two to five teeth[1] in addition to that which forms its distal termination. The lamellar portion is narrowed anteriorly and slopes away rather rapidly from the apical spine. The flagellum is much longer than the entire length of the animal.

The *mandibles* (fig. 4) bear a curved three-jointed palp; the incisor and molar processes are only separated from one another by a groove. The characters of the two pairs of maxillae and the first two maxillipedes are shown in figs. 6–8. The *third maxillipedes* are seven-jointed, and when stretched forwards reach beyond the middle of the antennal scale. The exopod is long, reaching beyond the distal end of the ischium, and the merus is provided with a double row of spines on its outer and inferior aspect. All the joints are strongly setose ventrally.

The first three pairs of *pereiopods* are chelate, the third pair being very much the longest. The *first pair* reaches slightly beyond the apex of the antennal scale; the carpus is a little longer than the merus and the chela is about three-fifths the length of the carpus. The *second pair* reaches beyond the antennal scale by the whole chela and nearly one-third of the carpus; the merus is three-quarters the length of the ischium and the chela is half as long again as that of the first pair. The legs of the *third pair* are equal and symmetrical (thus sharply contrasting with *R. spongicola*, Alcock and Anderson, in which one is immensely bigger than the other); they are stouter than any of the others and reach beyond the antennal scale by the chela and four-fifths of the carpus. The merus is only slightly longer than the carpus and the large chela is

[1] Milne-Edwards (1883) does not figure any spines on the outer margin of the antennal scale. Although these are present in all three Irish examples, it is quite possible that they are sometimes missing.

fully one and a quarter times the length of the former. The number and arrangement of the spinules on the dorsal and ventral aspects of the merus, carpus and propodus seems to be subject to considerable variation. The *fourth* and *fifth pairs* of legs are about equal in length, each being slightly shorter than the third. The merus is a little shorter than the carpus and about one-third longer than the propodus. The carpus and propodus are subdivided into several rather obscure joints; in both pairs the carpus is composed of five joints and the propodus of four. The dactylus is simple and acutely-pointed and more than one-third of the propodus in length.

The *branchial formula* is :—

—	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Podobranchiae, ...	ep.	1 + ep.	ep.	ep.	ep.	ep.	ep.	...
Arthrobranchiae, ...	...	1	2	2	2	2	2	...
Pleurobranchiae, ...	...	...	1	1	1	1	1	1

There is a small rounded setose lobe immediately above the base of the last pair of pereiopods.

The first pair of *pleopods* are uniramous in the female; the rest are biramous, with both inner and outer branches broadly lanceolate. The outer *uropod* (fig. 9) is about twice as long as wide; it is broadly rounded at the apex and bears four or five spines on its outer margin. The lamella is stiffened by two longitudinal parallel ribs. The inner uropod is rather less than three times as long as wide and has only a single longitudinal rib.

The eggs of this species are very large, measuring approximately 2 mm. by 1·5 mm. in longer and shorter diameter.

Size.—The largest specimen examined measures about 21·5 mm.

Colour in life.—The carapace is very pale red, almost transparent, with numerous red chromatophores on its posterior half; the hepatic region is yellowish and shows faintly through the cephalothoracic walls. The first five abdominal somites are pale rose red; the sixth somite, telson, and uropods are transparent. The rostrum and eyestalk are rather thickly dotted with minute red chromatophores; the corneal area is pale orange and very strongly refractive. The antennules, antennae, third maxillipedes, pereiopods and pleopods are all transparent; the mandibles, maxillae and first two maxillipedes are deep red. The eggs, when first extruded, are deep black in colour, but change immediately to a salmon pink when placed in spirit.

The larvae enclosed within eggs attached to one of the specimens are in a very advanced condition and are apparently

almost ready to emerge. From an examination of these it appears that the young are liberated in a very advanced state of development, as might be expected in the case of a species bearing such large eggs. In these larvae all the pereiopods and pleopods are present, although the uropods are not yet free; the telson is deeply bifurcate much as in Spence Bate's figure of the protozoea of *Spongicola venusta* (1888, Pl. XXIX, fig. 2).

General distribution.—The type and the only previously recorded specimen of this species was dredged by the *Travailleur* in 1880 in the Bay of Biscay. A closely allied, but apparently distinct, form, *Richardina Fredericii*, has been found by the *Puritan* expedition in the Mediterranean (Lo Bianco, 1903).

Irish distribution.—Three specimens of *Richardina spinicincta* have been found off the Irish coast :—

Helga.

S.R. 331—9/5/'06.—51° 12′ N., 11° 56′ W., 610–680 fathoms. Trawl—One ovigerous female, 21·5 mm.

S.R. 364—10/8/'06.—51° 24′ N., 11° 47′ W., 620–695 fathoms. Trawl. Temperature at 600 fathoms 7·92° C., salinity 35·37°/$_{oo}$—One, 16 mm.

S.R. 506—12/9/'07.—50° 34′ N., 11° 19′ W., 661–672 fathoms. Trawl. Temperature at 600 fathoms 8·22° C., salinity 35·53°/$_{oo}$—One ovigerous female, 20 mm.

It seems probable that the genus *Richardina*, like other genera of Stenopidae, is definitely associated with sponges. *R. spongicola* was found in Indian waters in *Hyalonema Masoni*. None of the examples of *R. spinicincta* were actually found in sponges, but the Hexactinellid, *Pheronema Grayi*, was taken in large numbers in the first haul, S.R. 331, and less abundantly at S.R. 506.

Vertical range.—661–672 fathoms.

ADDENDUM.

Glyphocrangon longirostris (Smith).

While this paper was in press, a single specimen of the genus *Glyphocrangon* was obtained by the ss. *Helga* off the W. coast of Ireland. Hitherto no representative of the family Glyphocrangonidae has been recorded from British and Irish waters.

The specimen is unfortunately only about half grown ; it measures 40 mm. in length and was caught at Station S.R. 851, lat. 50° 47·5′ N., long. 11° 43′ W., 900 fathoms. It agrees in almost every detail with Smith's original description of *Glyphocrangon* (=*Rhachocaris*) *longirostris* (1882, p. 51, pl. v, fig. 1, pl. vi, fig. 1) drawn up from a specimen 54 mm. in length and also with Faxon's remarks (1895, p. 143) on the same individual.

When freshly caught the animal was ivory-white in colour with a suffusion of pink on the rostrum, the anterior part of the carapace, the oral appendages and the first pair of pereiopods. The corneal area of the eyes was pale orange without a trace of black pigment. According to Smith's amended description (1886), drawn up from specimens 99–107 mm. in length, the eyes in full-grown examples are "dark colored as in the other species."

In the Irish specimen now recorded arthrobranchs appear to be absent from the bases of the first two pairs of pereiopods, in accordance with Alcock's definition of the subgenus *Plastocrangon* though not with MacGilchrist's account of *G. longirostris*[1] (?) from the Indian Ocean.

Apart from the record just mentioned, considered doubtful by the author, only eight specimens of *G. longirostris* are known ; four of these were found off the east coast of the United States between lat. 31° 41′ and 39° 35′ N., 1043–1073 fathoms (Smith), and four off the S. African coast between 660 and 800 fathoms (Stebbing).

[1] *Ann. Mag. Nat. Hist.* (7), xv, 1905, p. 239.

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Fig. 4.—Sixth abdominal somite and basal joints of uropods, seen from below, ... × 6.
Fig. 5.—Lateral view of a larva measuring 10·2 mm., ... × 8.
Fig. 6.—Outline of egg to the same scale, ... × 8.
Fig. 7.—Telson of the larva, 10·2 mm. in length, ... × 9·5.
Fig. 8.—Antennal scale and antenna, } of the same specimen. × 21.
Fig. 9.—Third maxillipede, } of the same specimen. × 19.
Fig.10.—Second maxillipede, } of the same specimen. × 19.
Fig.11.—First maxillipede, } of the same specimen. × 19.
Fig.12.—Second maxilla, } of the same specimen. × 19.
Fig.13.—Lateral view of a post-larval specimen measuring 12·7 mm., ... × 7.
Fig.14.—Telson of the same specimen, ... × 32·5.
Fig.15.—Lateral view of a post-larval specimen, measuring 15·8 mm., ... × 6·5.

[*The black spots represent photophores.*]

PLATE VII.

Ephyrina Hoskyni, Wood-Mason.

Fig. 1.—Lateral view of the Irish specimen, ... × 2·5
Fig. 2.—Mandible.
Fig. 3.—First maxilla.
Fig. 4.—Second maxilla.
Fig. 5.—First maxillipede.
Fig. 6.—Second maxillipede.

Ephyrina Benedicti, Smith.

Fig. 7.—Rostrum and eye of the Irish specimen, ... × 15.

Plate VIII.

Hymenodora glacialis (Buchholz).

Fig. 1.—Lateral view of an ovigerous female, after G. O. Sars, ... × 2.
Fig. 2.—Second maxilla of an adult specimen, ... × 5.
Fig. 3.—First maxillipede of an adult specimen, ... × 5.

Plate IX.

Nematocarcinus ensifer (Smith), var. *exilis*, Spence Bate.

Fig. 1.—Lateral view of a female, ... × 2.
Fig. 2.—Outline of antennal scale of an adult, ... × 3.
Fig. 3.—Outline of antennal scale of a specimen 36 mm. in length, ... × 6.
Fig. 4.—Endopod and exopod of first pleopod of female, × 7.
Fig. 5.—Endopod and exopod of first pleopod of male, ... × 7.
Fig. 6.—Endopod of second pleopod of male, ... × 7.
Fig. 7.—Telson, ... × 8.
Fig. 8.—Apex of telson more highly magnified.
Fig. 9.—Zoea just emerged from egg, ... × 28.
Fig. 10.—Telson of zoea, ... × 28.

Plate X.

Bresilia atlantica, Calman.

Fig. 1.—Dorsal view of cephalic region of a female 23 mm. in length, ... × 12.
Fig. 2.—Rostrum of another female, ... × 21·5.
Fig. 3.—Rostrum of the male specimen, ... × 26.
Fig. 4.—Second maxillipede, ... × 16.
Fig. 5.—Chela of first pereiopod, ... × 12.
Fig. 6.—Endopod of second pleopod of male, ... × 26.
Fig. 7.—Endopod of first pleopod of male, ... × 31.

Pandalus Montagui, Leach.

Fig. 8.—Rostrum of an abnormal specimen, ... × 6·5.

Plate XI.

Pandalus propinquus, G. O. Sars.

Fig. 1.—Dorsal view of the cephalic region of a specimen from shallow water measuring 53 mm., ... × 2·5.
Fig. 2.—Carapace and rostrum of the same specimen, lateral view, ... × 2·5.
Fig. 3.—Dorsal view of the cephalic region of a specimen from deep water measuring 57 mm., ... × 2·5.
Fig. 4.—Carapace and rostrum of the same specimen, lateral view, ... × 2·5.

Plate XII

Plesionika martia, A. Milne-Edwards.

Fig. 1.—Lateral view of an ovigerous female, ... × 1.
Fig. 2.—Second maxilla.
Fig. 3.—Endopod of first pleopod of male, ... × 4·5.
Fig. 4.—Endopod of first pleopod of female, ... × 4·5.

Plate XIII.

Hippolyte varians, Leach.

Fig. 1.—Lateral view of a female, ... × 8.
Fig. 2.—Mandible, ... × 25.
Fig. 3.—First maxilla, ... × 25.
Fig. 4.—Second maxilla, ... × 25.
Fig. 5.—First maxillipede, ... × 25.
Fig. 6.—Second maxillipede, ... × 25.
Fig. 7.—Outline of antennal scale, ... × 9·5.

Hippolyte prideauxiana, Leach.

Fig. 8.—Outline of antennal scale, ... × 7.
Fig. 9.—Lateral view of a female, ... × 5.
Fig. 10.—Rostrum of another specimen, ... × 8.

Plate XIV.

Spirontocaris spinus (Sowerby).

Fig. 9.—Lateral view of the Irish specimen, ... × 7.

Spirontocaris spinus var. *Lilljeborgi* (Danielssen).

Fig. 1.—Lateral view of the Irish specimen, ... × 7·5.
Fig. 3.—Rostrum of another specimen, ... × 6·5.
Fig. 4.—Second pereiopod, ... × 7·5.
Fig. 5.—Outline of antennal scale, ... × 10.
Fig. 6.—Mandible, ... × 20.
Fig. 7.—First maxilla, ... × 20.
Fig. 8.—Second maxilla, ... × 20.
Fig. 9.—First maxillipede, ... × 20.
Fig. 10.—Second maxillipede, ... × 20.

Plate XV.

Spirontocaris Cranchi (Leach).

Fig. 1.—Endopod of first pleopod of a young male, ... × 48.
Fig. 2.—First pleopod of a female, ... × 17.
Fig. 3.—Rostrum, typical form, ... × 11.
Fig. 4.—Rostrum, abnormal form, ... × 11.
Fig. 5.—Second pereiopod, ... × 7.

Spirontocaris pusiola (Kröyer).

Fig. 6.—Lateral view of a female, ... × 6.
Fig. 7.—Endopod of first pleopod of an adult male, ... × 33.
Fig. 8.—First pleopod of a female, ... × 19.

Plate XVI.

Caridion Gordoni, Spence Bate.

Fig. 1.—Lateral view of an ovigerous female, ... × 5·5.
Fig. 2.—Rostrum of a specimen 21 mm. in length, .. × 8·5.
Figs. 3, 4.—Rostra of two smaller specimens, ... × 8·5.
Fig. 5.—Outline of antennal scale, ... × 16·5

PLATE XVI.—*continued.*

Fig. 6.—Basal joint of antennular peduncle, ... × 19·5.
Fig. 7.—Second maxillipede, ... × 19·5.
Fig. 8.—First maxillipede, ... × 19·5.
Fig. 9.—Second maxilla, ... × 19·5.
Fig. 10.—First maxilla, ... × 19·5.
Fig. 11.—Mandible, ... × 19·5.
Fig. 12.—Apex of telson, ... × 19·5.

PLATE XVII.

Leontocaris lar, Kemp.

Fig. 1.—Lateral view of the type specimen, a female, ... × 8·5.
Fig. 2.—Second pereiopod, right side,... ... ... × 13·5.
Fig. 3.—Papillae from hinder margin of merus of second pereiopod, left side, ... × 9·5.
Fig. 4.—Mandible, ... × 21.
Fig. 5.—First maxilla, ... × 21.
Fig. 6.—Second maxilla, ... × 22.
Fig. 7.—First maxillipede, ... × 21.
Fig. 8.—Second maxillipede, ... × 21.
Fig. 9.—Rostrum of another specimen, a male, ... × 17.
Fig. 10.—Chela of second pereiopod, left side, viewed dorsally, ... × 20·5.
Fig. 11.—Chela of second pereiopod, left side, viewed laterally, ... × 20·5.
Fig. 12.—Antennal scale and basal joints of antenna, ... × 22.
Fig. 13.—Antennule, ... × 22.
Fig. 14.—First pleopod of male, ... × 21.
Fig. 15.—First pleopod of female, ... × 21.
Fig. 16.—Outer uropod, ... × 22.
Fig. 17.—Telson, ... × 18

PLATE XVIII.

Bythocaris gracilis, Smith.

Fig. 1.—Dorsal view of the cephalic region of the Irish specimen, a male, ... × 10·5.
Fig. 2.—First pleopod of the same specimen, ... × 28.
Fig. 3.—Telson of the same specimen (with apex further enlarged), ... × 15.

Bythocaris Payeri (Heller).

Fig. 4.—Dorsal view of the cephalic region of a young male, ... × 4.
Fig. 5.—First pleopod of male, ... × 5·5.
Fig. 6.—Telson, ... × 7.

PLATE XIX.

Alpheus ruber, H. Milne-Edwards.

Fig. 1.—Lateral view of a male, ... × 3·5.
Fig. 2.—Dorsal view of cephalic region of a female, ... × 6.

Alpheus macrocheles (Hailstone).

Fig. 3.—Chela of first pereiopod, right side, ... × 4.
Fig. 4.—Dorsal view of cephalic region of a female, ... × 6.

Athanas nitescens (Montagu).

Fig. 5.—Lateral view of a female, ... × 9.

PLATE XX.

Figs. 1, a—e.—*Leander serratus* (Pennant).
Figs. 2, a—e.—*Leander adspersus* (Rathke).
Figs. 3, a—e.—*Leander squilla* (Leach).
Figs. 4, a—e.—*Palaemonetes varians* (Leach).
a. Rostrum.
b. Mandible.
c. Outline of antennal scale.
d. Basal portion of outer antennal flagellum.
e. Second pereiopod.

PLATE XXI.

Figs. 1, a—d.—*Crangon vulgaris* (Linnaeus).
Figs. 2, a & b.—*Philocheras trispinosus* (Hailstone).
Figs. 3, a & b.—*Philocheras fasciatus* (Risso).
Figs. 4, a & b.—*Philocheras bispinosus* (Hailstone).
Figs. 5, a & b.—*Philocheras bispinosus* var. *neglectus*[1] (G. O. Sars).
Figs. 6, a & b.—*Philocheras sculptus* (Bell).
Figs. 7, a—d.—*Philocheras echinulatus* (M. Sars).
Figs. 8, a—d.—*Pontophilus spinosus* (Leach).
Figs. 9, a & b.—*Pontophilus norvegicus* (M. Sars).
a. Carapace seen from above.
b. Outline of antennal scale.
c. Endopod and exopod of third pleopod.
d. First and second pereiopods.

PLATE XXII.

Aegeon Lacazei (Gourret).

Fig. 1.—Dorsal view of the type specimen, a female, ... × 4.
Fig. 2.—Lateral view of carapace of the same specimen, ... × 5.
Fig. 3.—Antennule of a male.
Fig. 4.—Outline of antennal scale, ... × 16·5.
Fig. 5.—First and second pereiopods, ... × 6·5.

Aegeon cataphractus (H. Milne-Edwards).

Fig. 6.—Outline of antennal scale, ... × 14.

Sclerocrangon Jacqueti (A. Milne-Edwards).

Fig. 7.—Dorsal view of a female, ... × 4.
Fig. 8.—Lateral view of carapace of the same specimen, ... × 4.
Fig. 9.—Antennule.
Fig. 10.—First and second pereiopods, ... × 6·5.

[1] *Philocheras neglectus* on plate.

Plate XXIII.

Richardina spinicincta, A. Milne-Edwards.

Fig. 1.—Lateral view of an ovigerous female (telson broken), × 7·5.
Fig. 2.—Antennal scale, ... × 16·5.
Fig. 3.—Right eye seen from above, ... × 37·5.
Fig. 4.—Mandible, ... × 22.
Fig. 5.—First maxilla, ... × 22.
Fig. 6.—Second maxilla, ... × 22.
Fig. 7.—First maxillipede, ... × 22.
Fig. 8.—Second maxillipede, ... × 22.
Fig. 9.—Inner and outer uropods, ... × 19·5.
Fig. 10.—Telson of another specimen, ... × 21.

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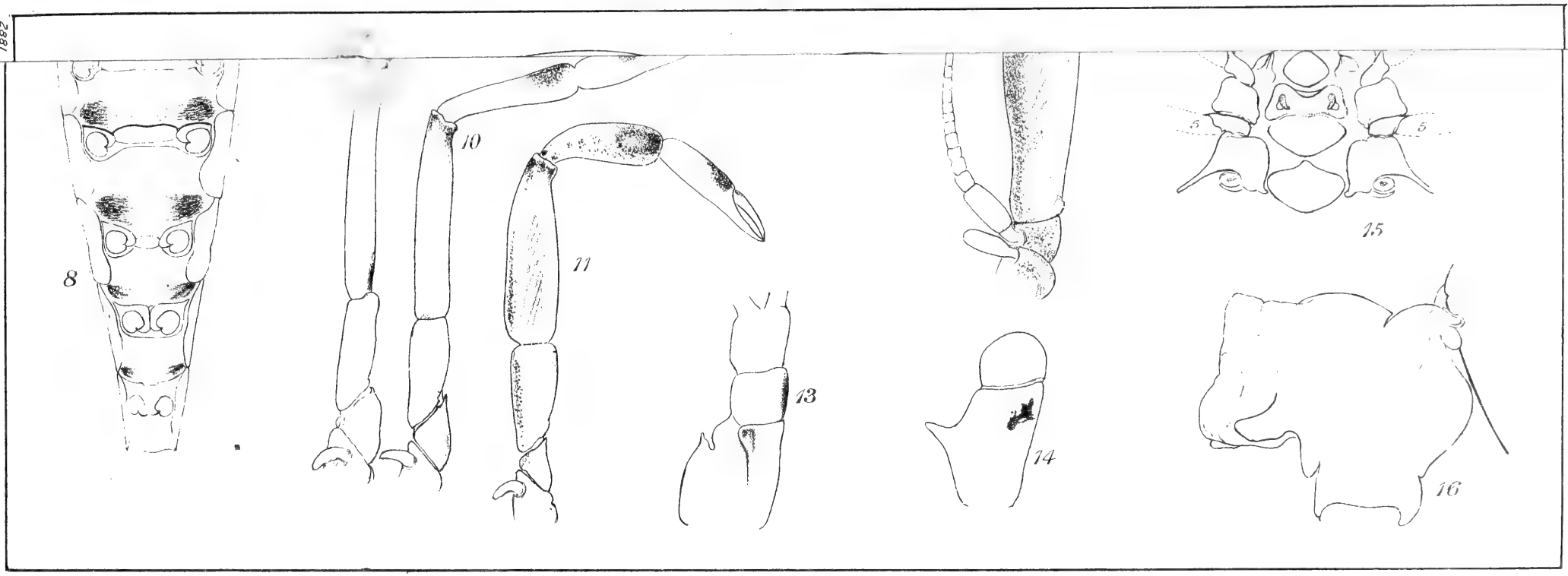

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Amalopenaeus elegans.

S.W.K. del

Solenocera siphonocera.

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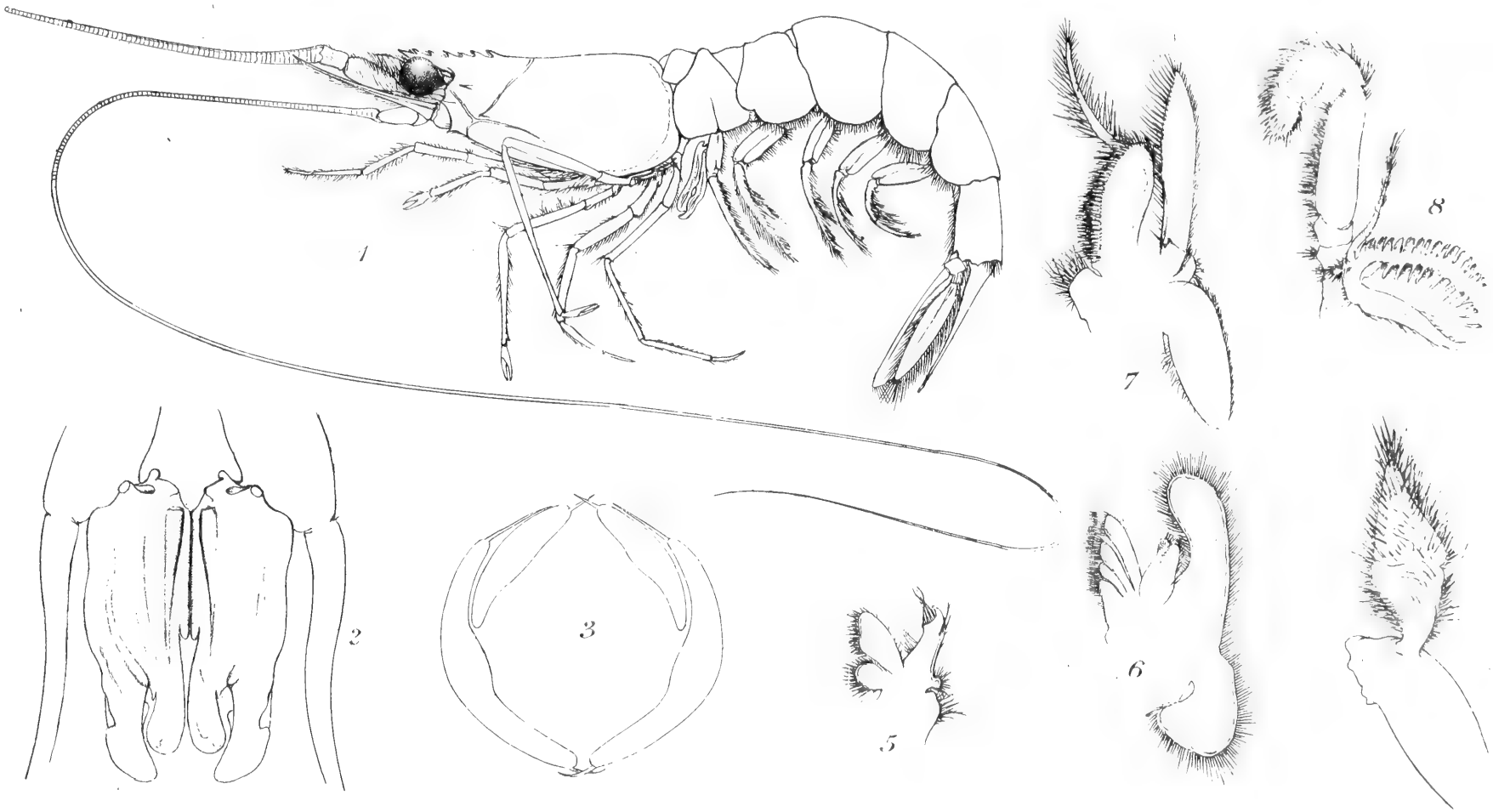
Amalopenaeus elegans.



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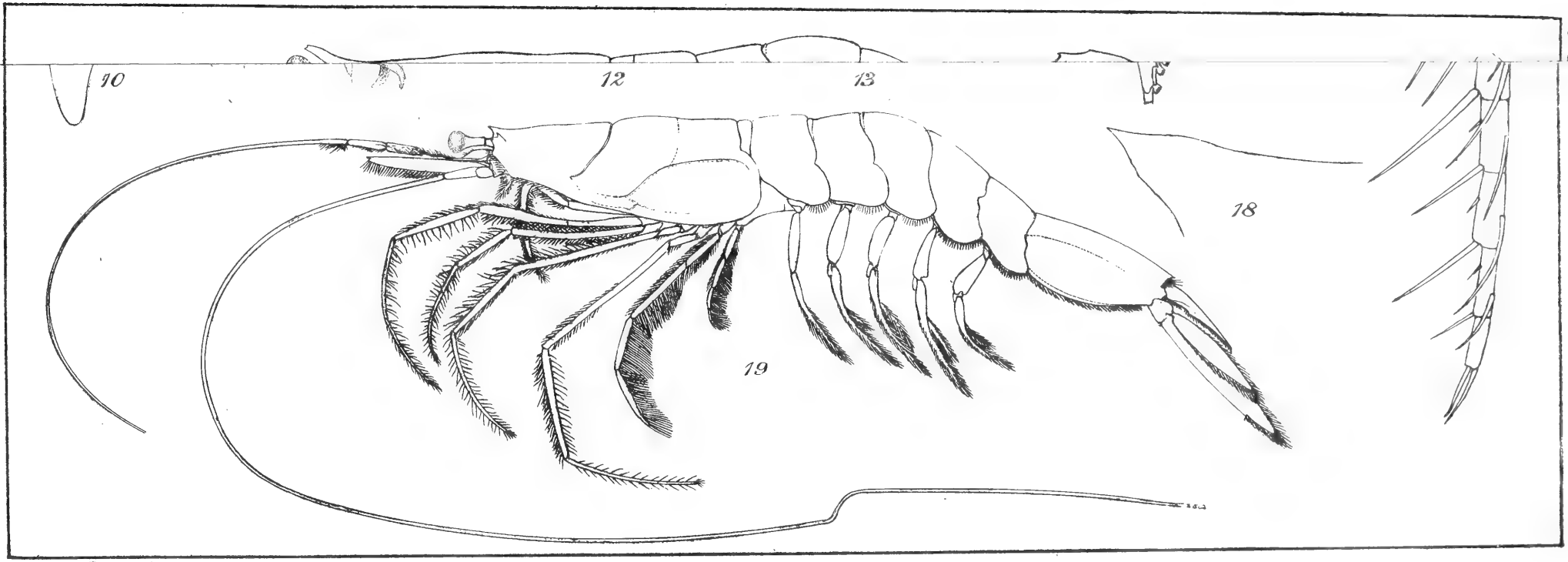
Solenocera siphonocera.



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Figs. 1–12, Sergestes robustus.
Figs. 13–19, Sergestes arcticus.

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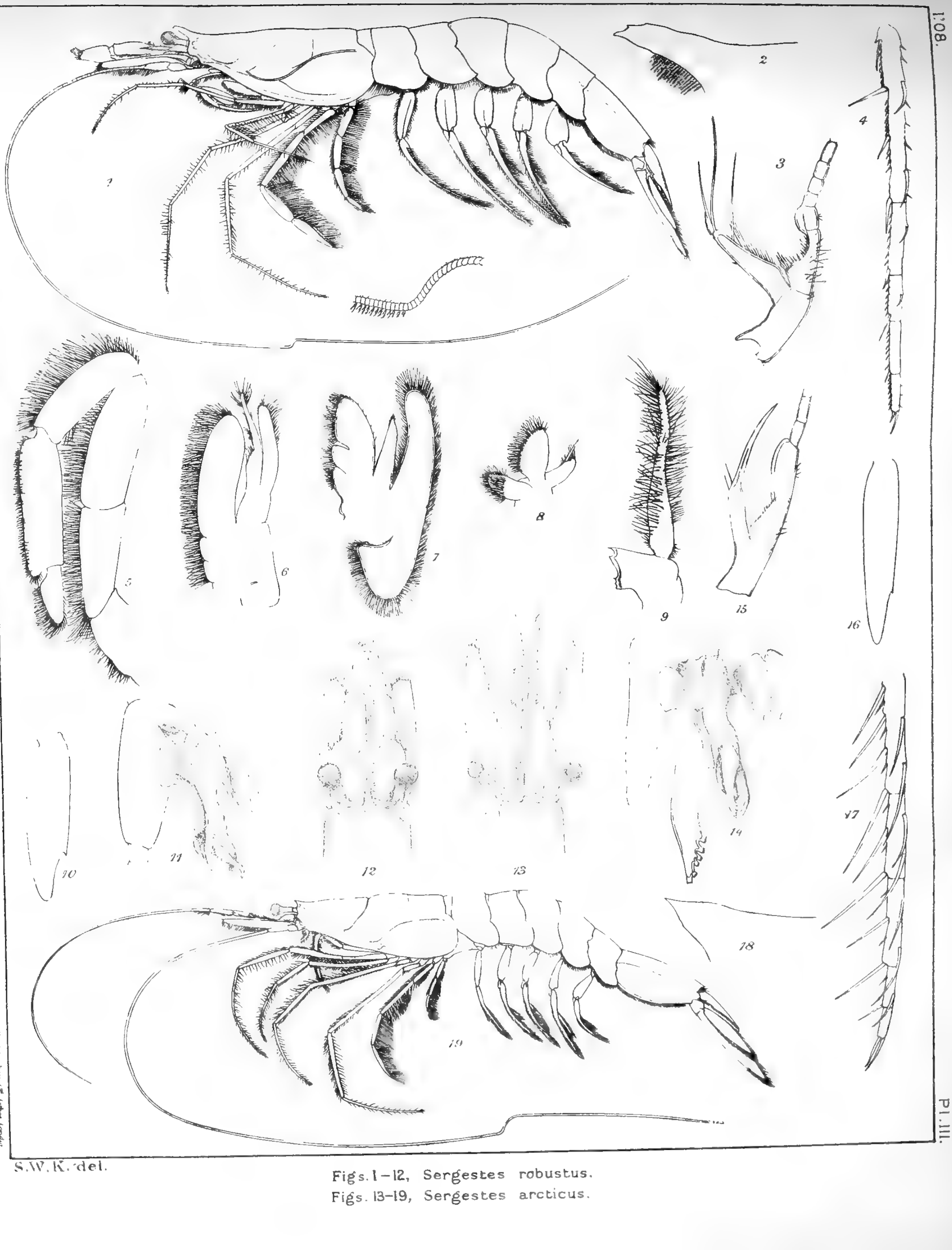
Parapasiphaë sulcatifrons.



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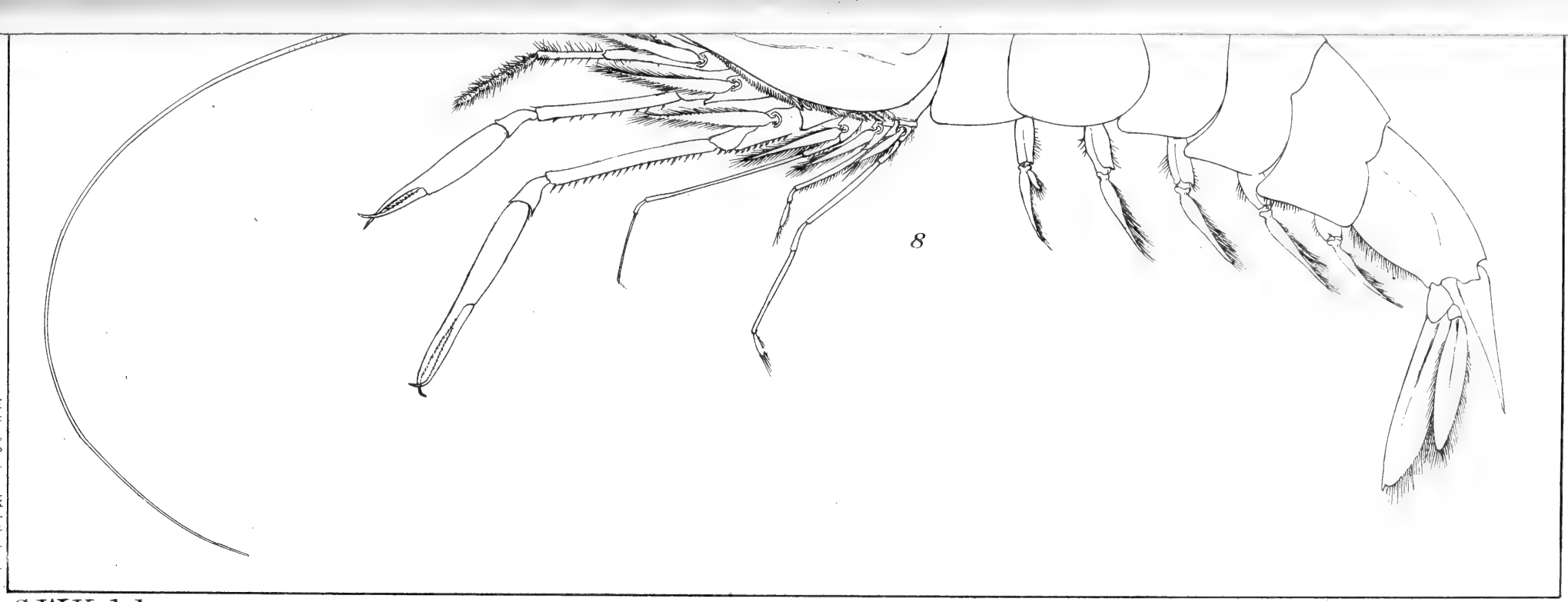
Figs. 1–12, Sergestes robustus.
Figs. 13–19, Sergestes arcticus.



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Figs. 1–7, Pasiphaë princeps. Figs. 8–11, Pasiphaë tarda.
Fig. 12, Pasiphaë sivado.

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Parapasiphaë sulcatifrons.

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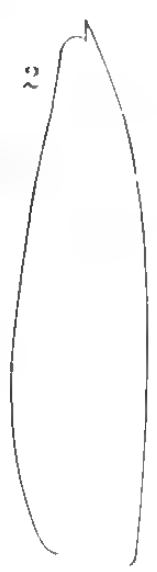
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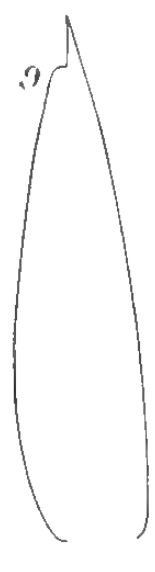
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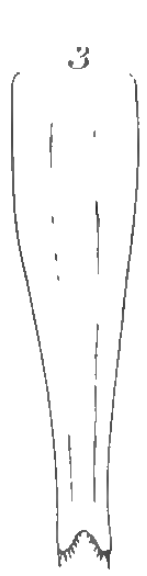
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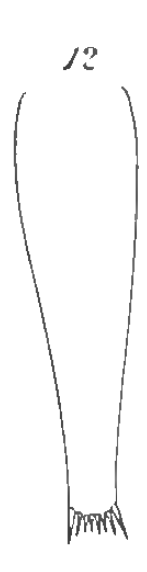
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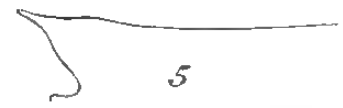
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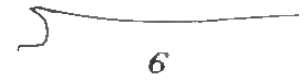
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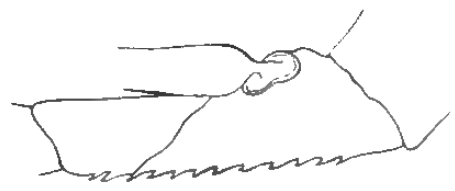
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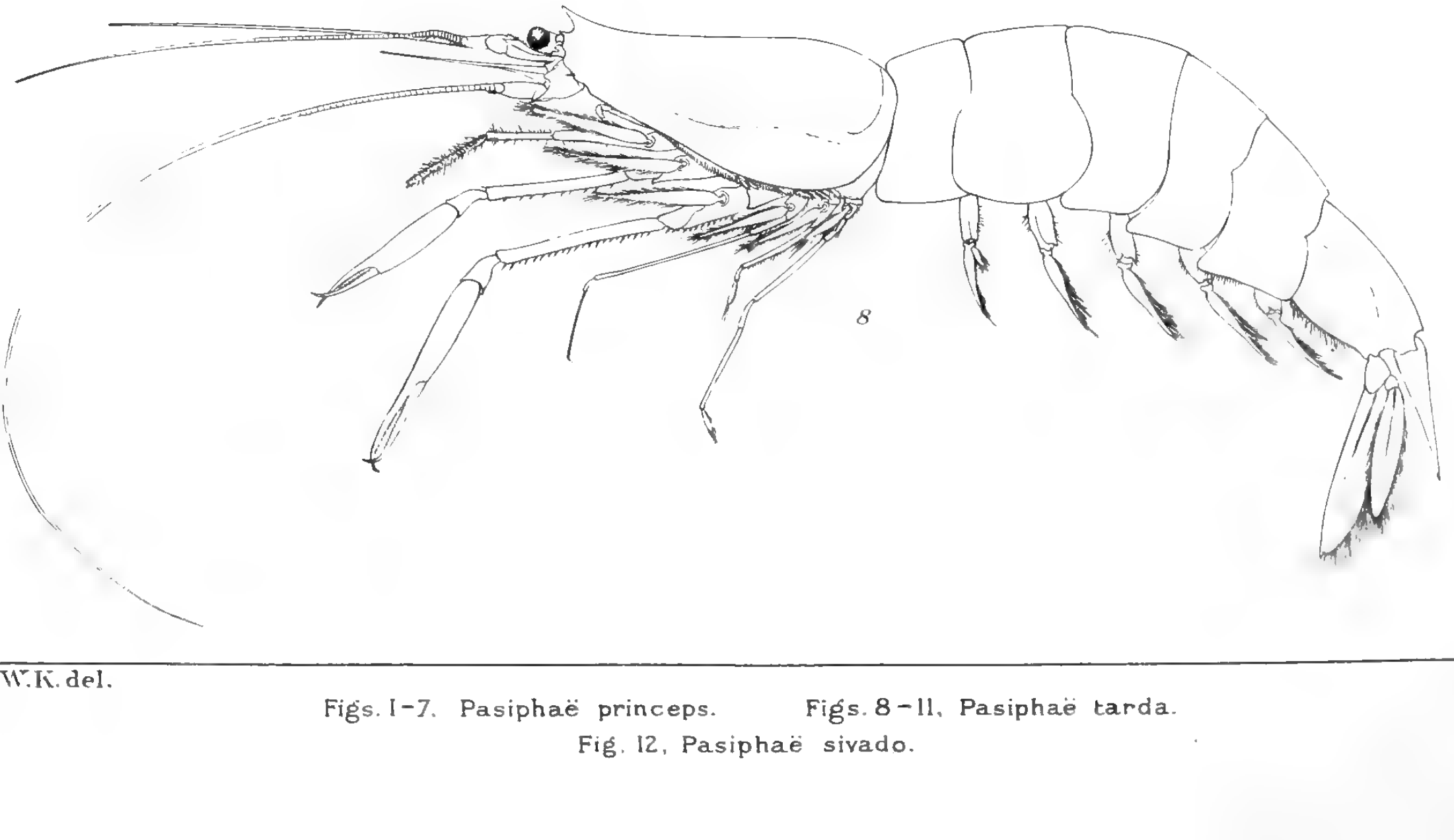
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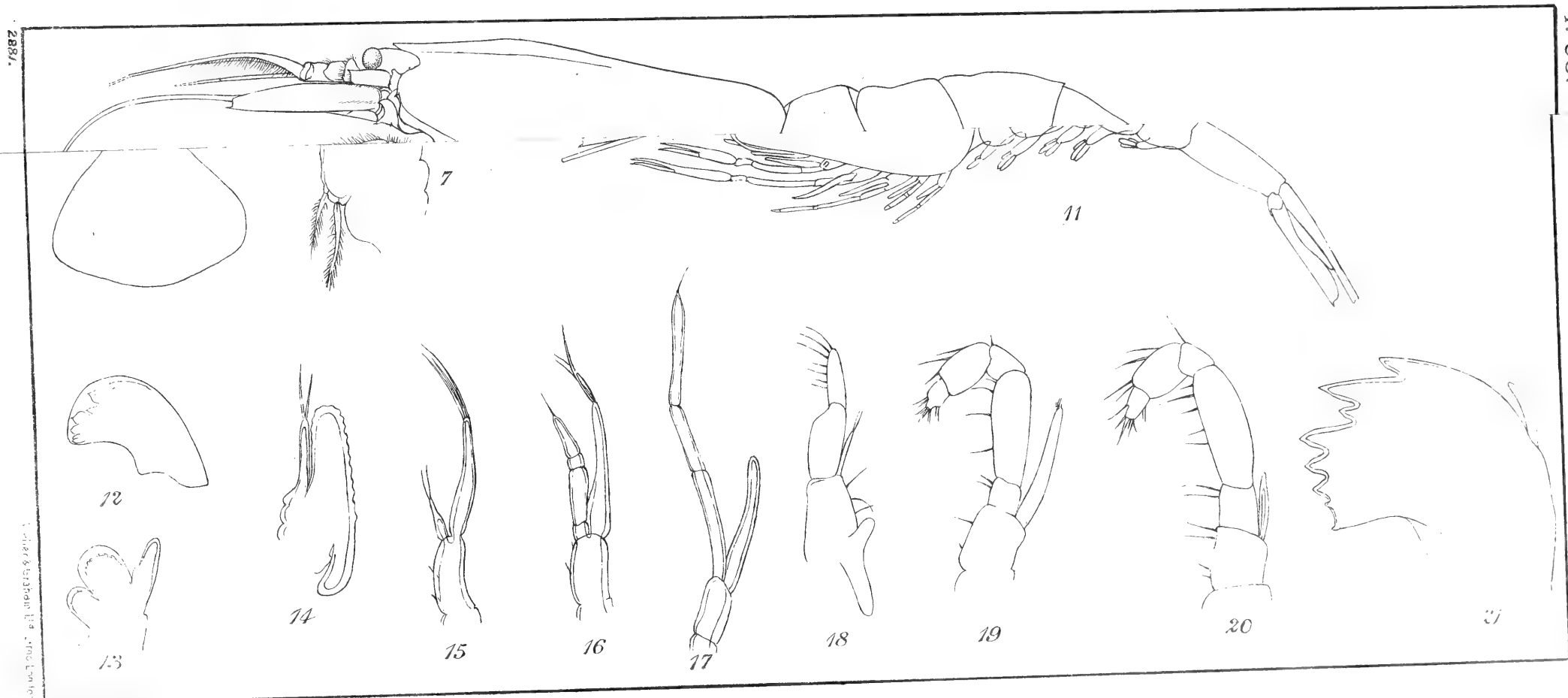
Figs. 1–7. Pasiphaë princeps. Figs. 8–11, Pasiphaë tarda.
Fig. 12, Pasiphaë sivado.



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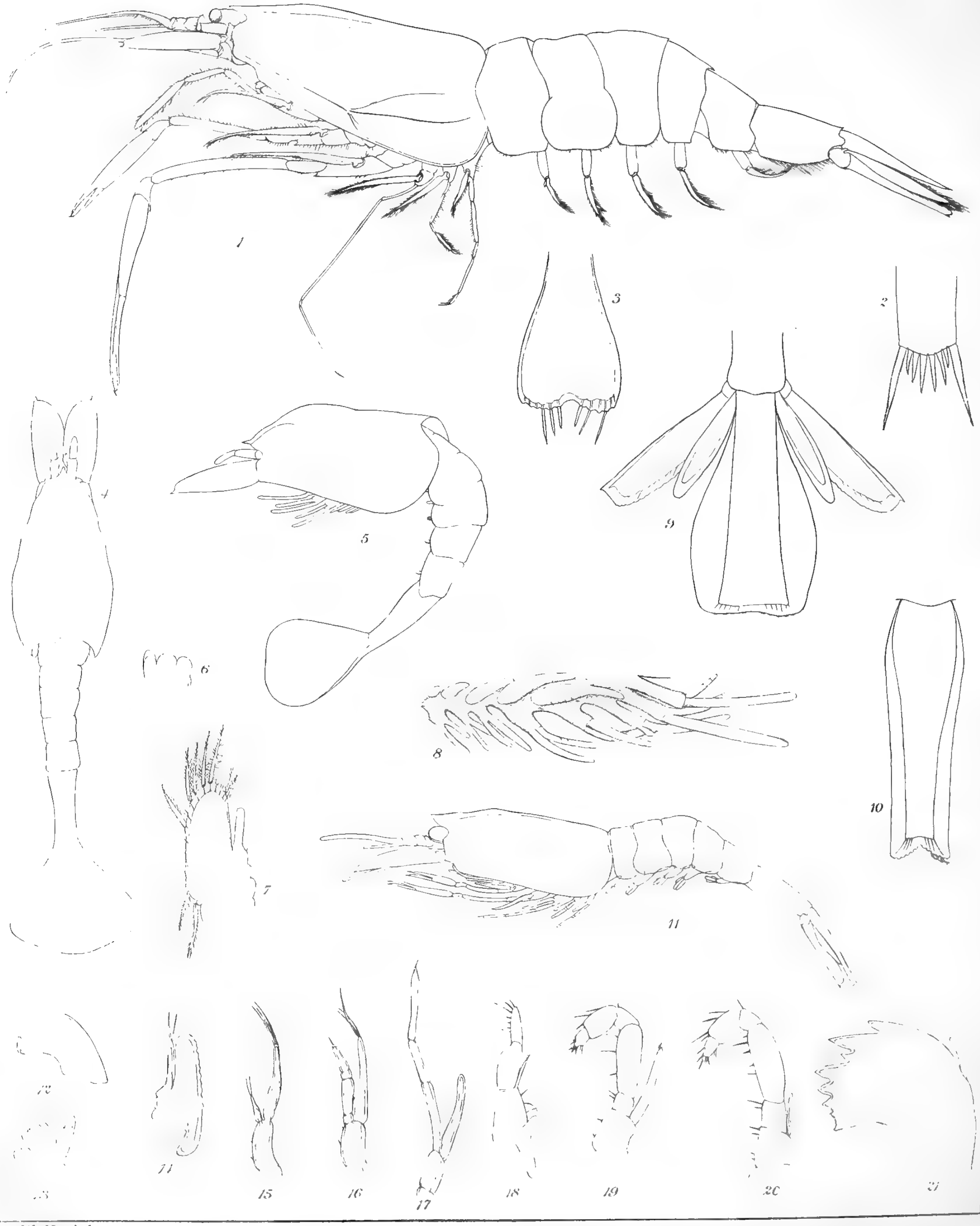
Parapasiphaë sulcatifrons.



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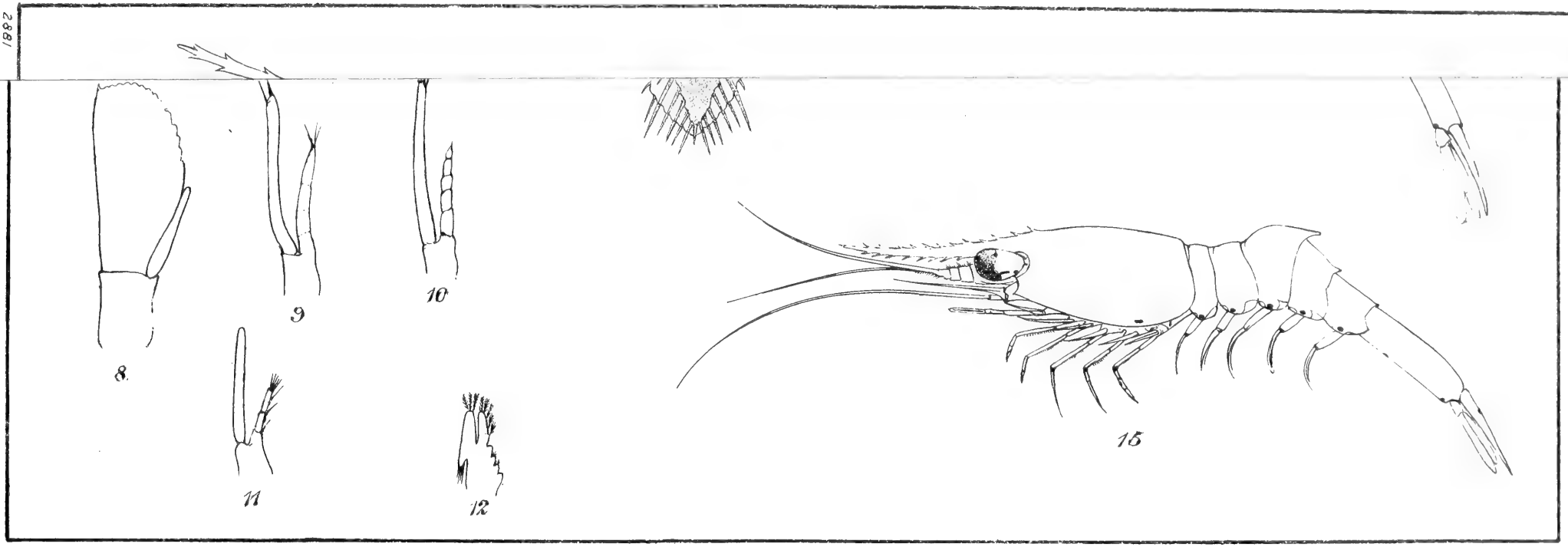
Parapasiphaë sulcatifrons.



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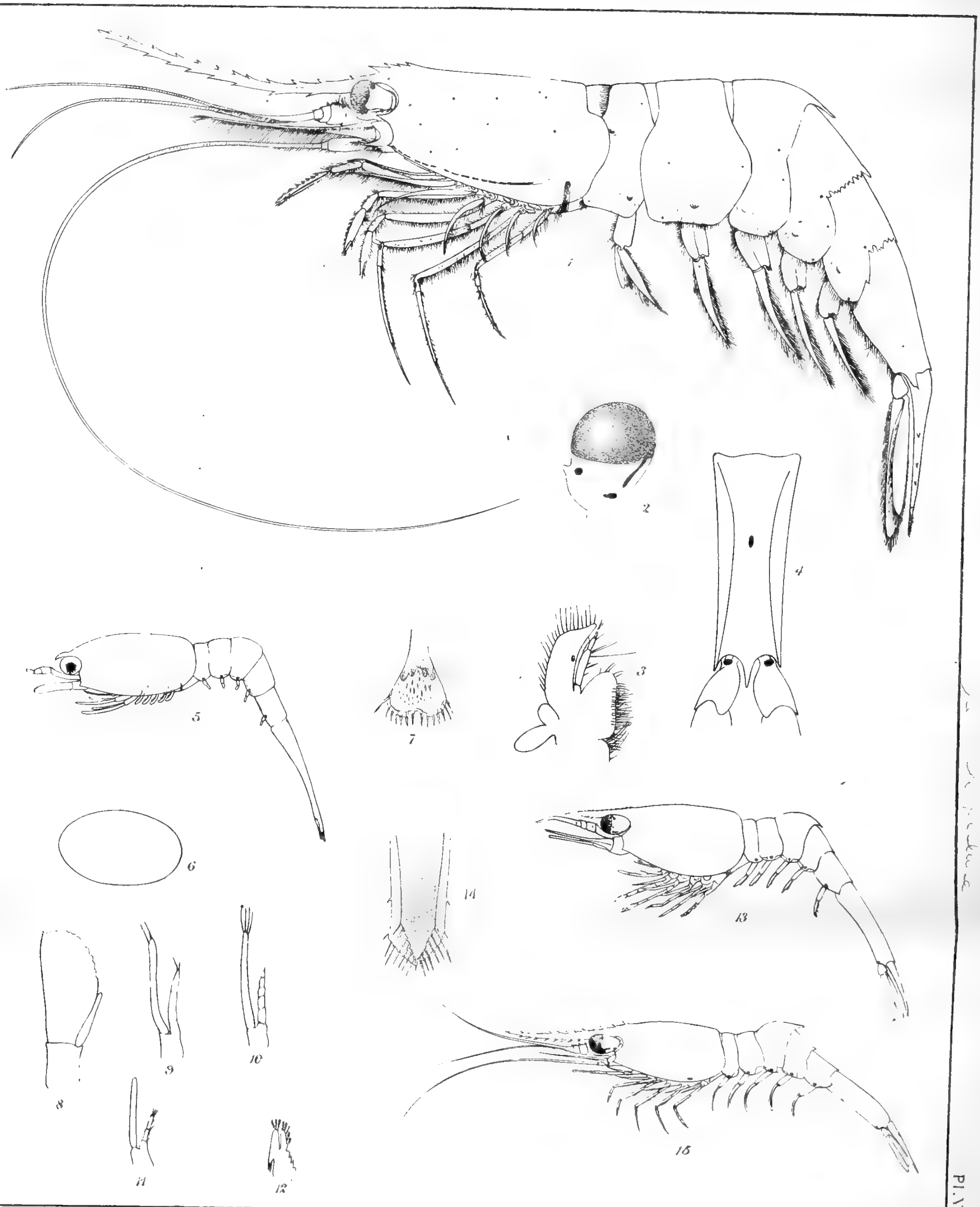
Acanthephyra debilis.

Hymenodora glacialis



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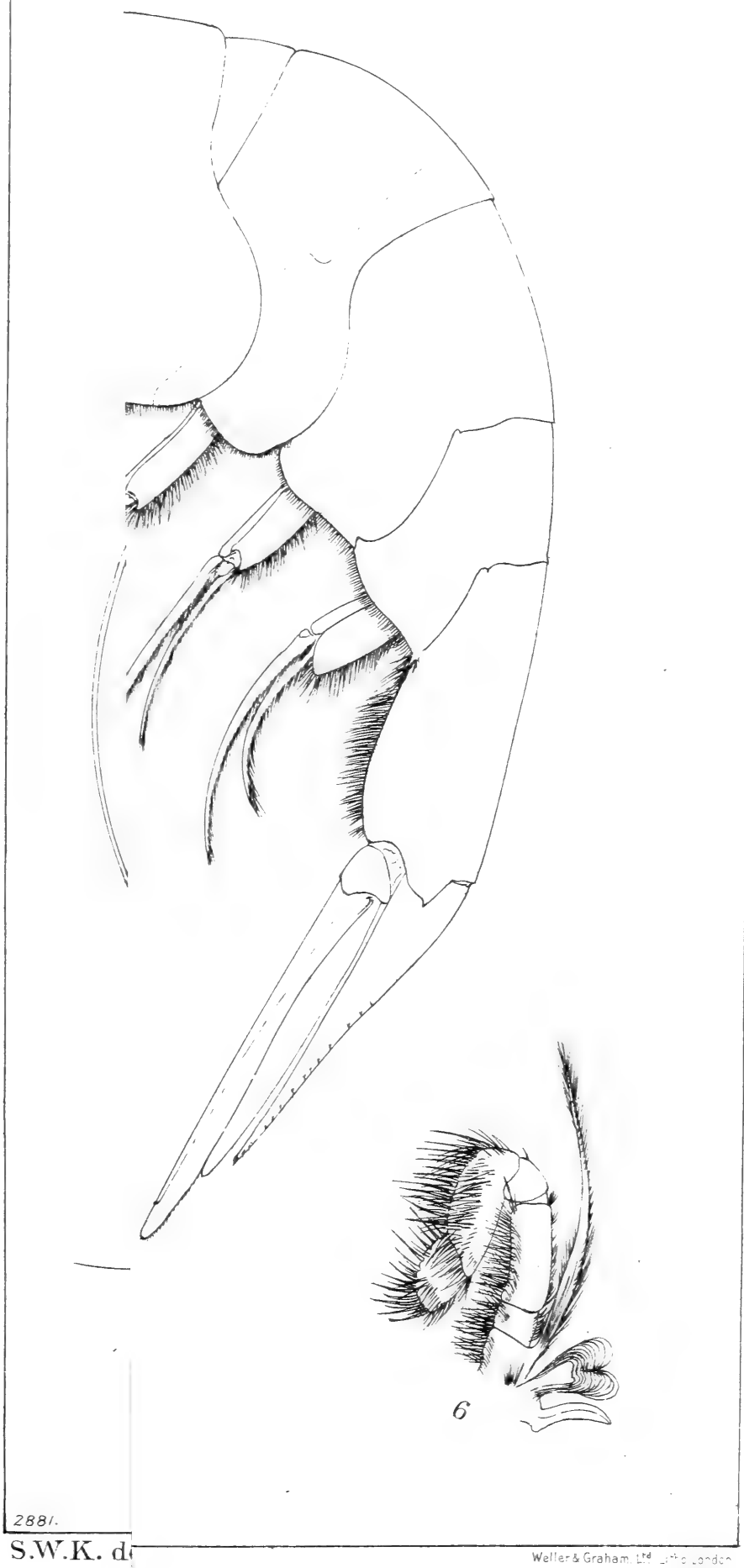
Acanthephyra debilis.



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III.

Hymenodora glacialis

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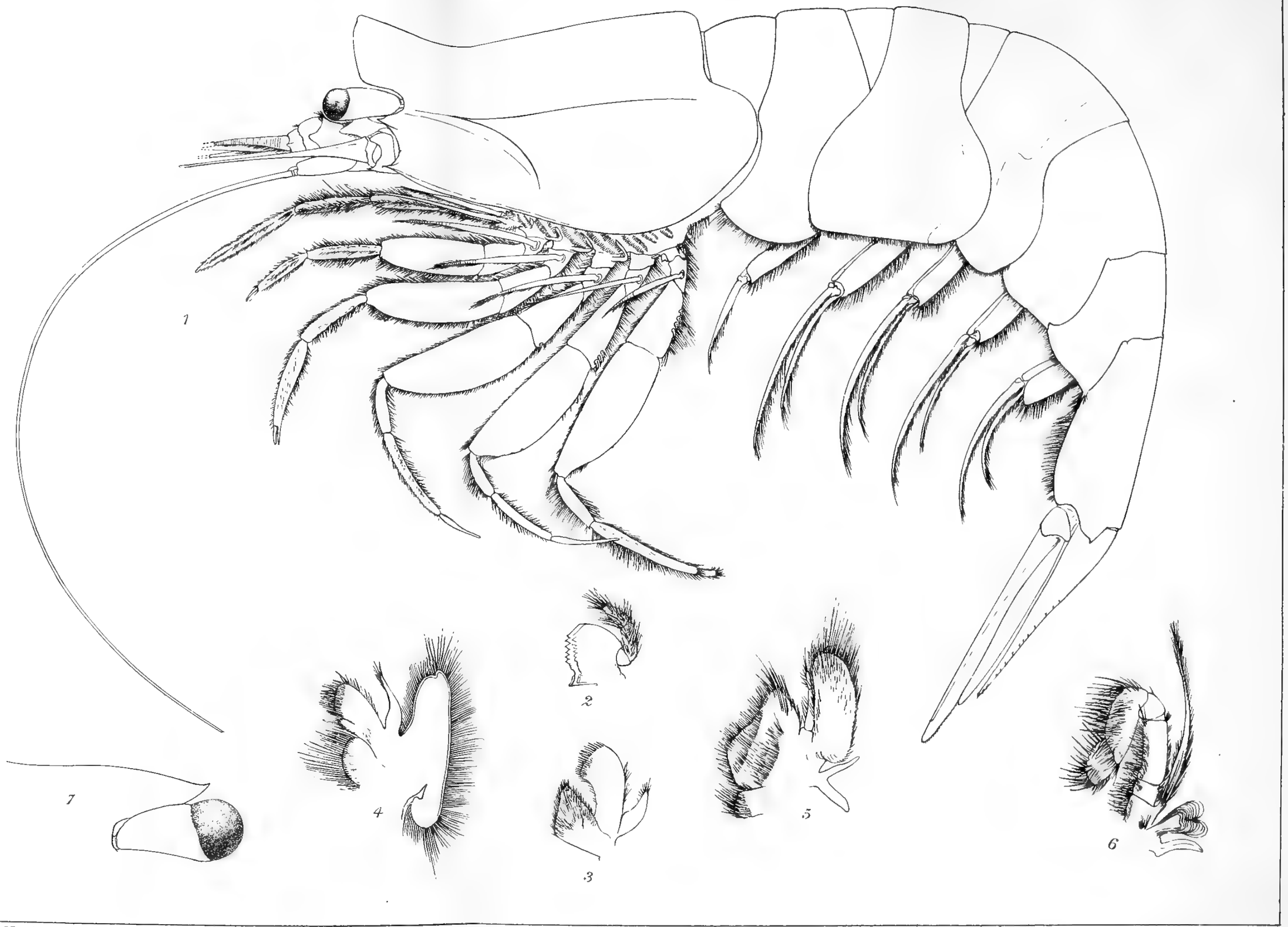

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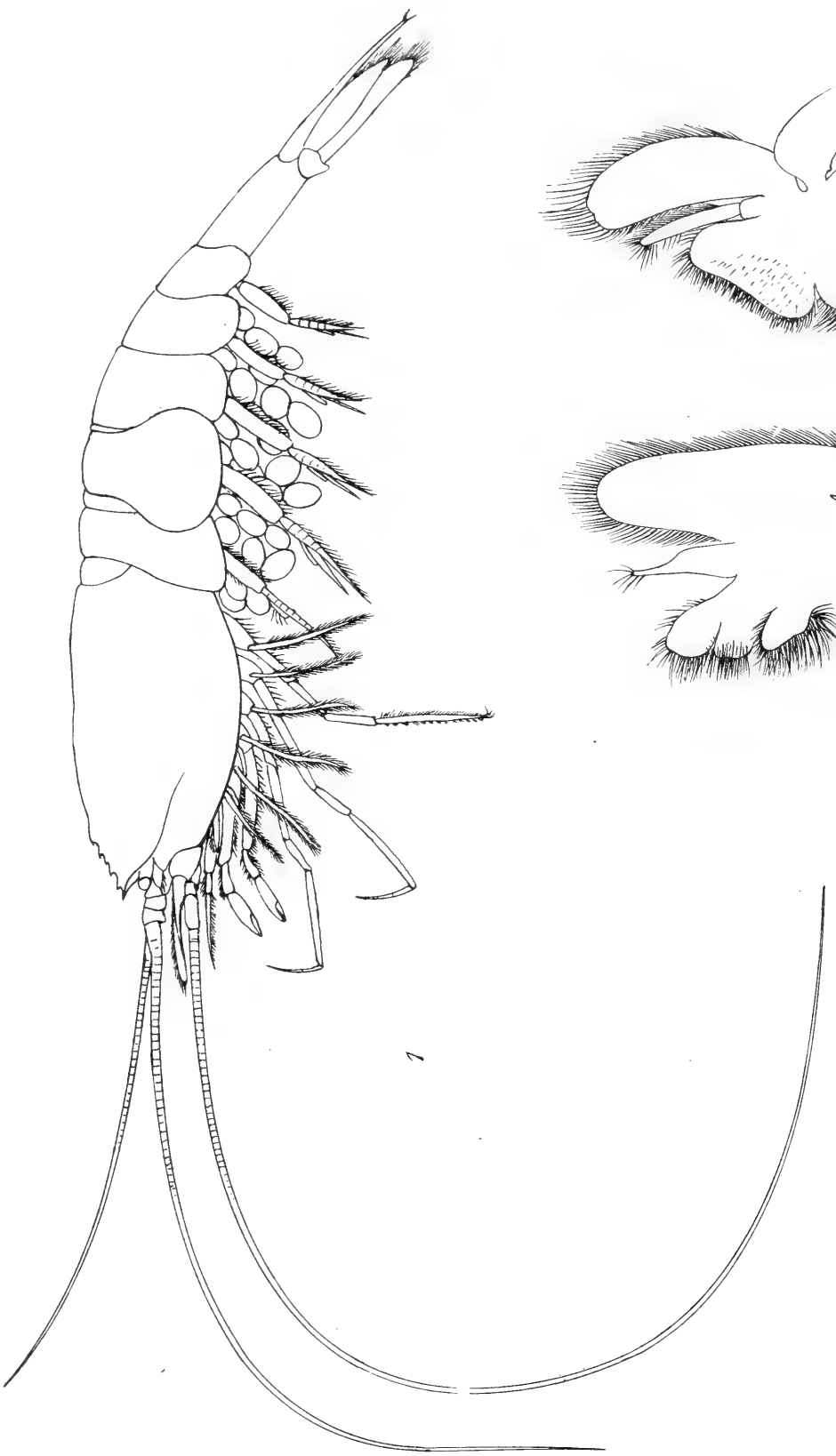
Figs. 1-6. Ephyrina Hoskyni. Fig. 7, Ephyrina Benedicti.



Hymenodora glacialis.

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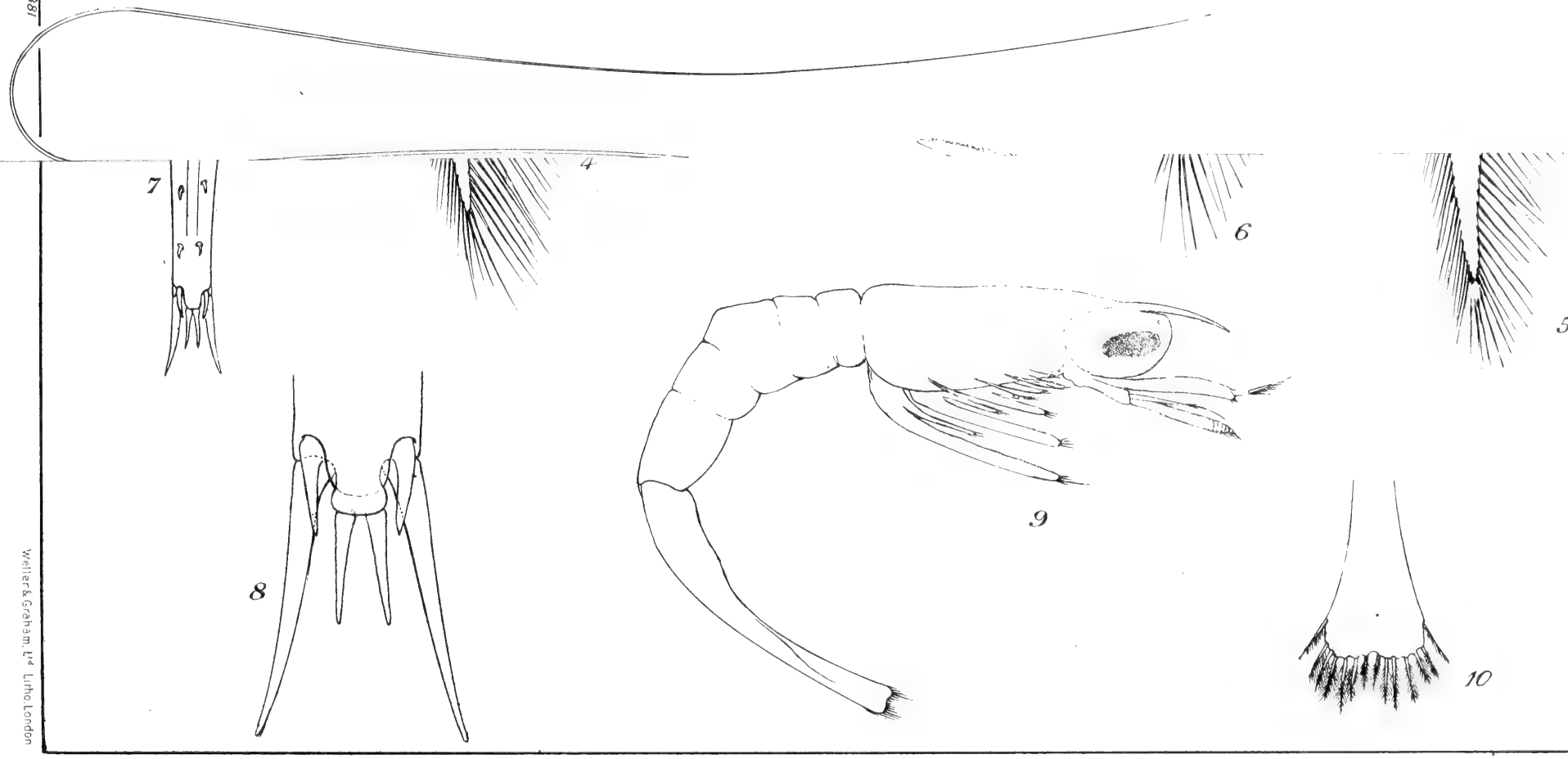

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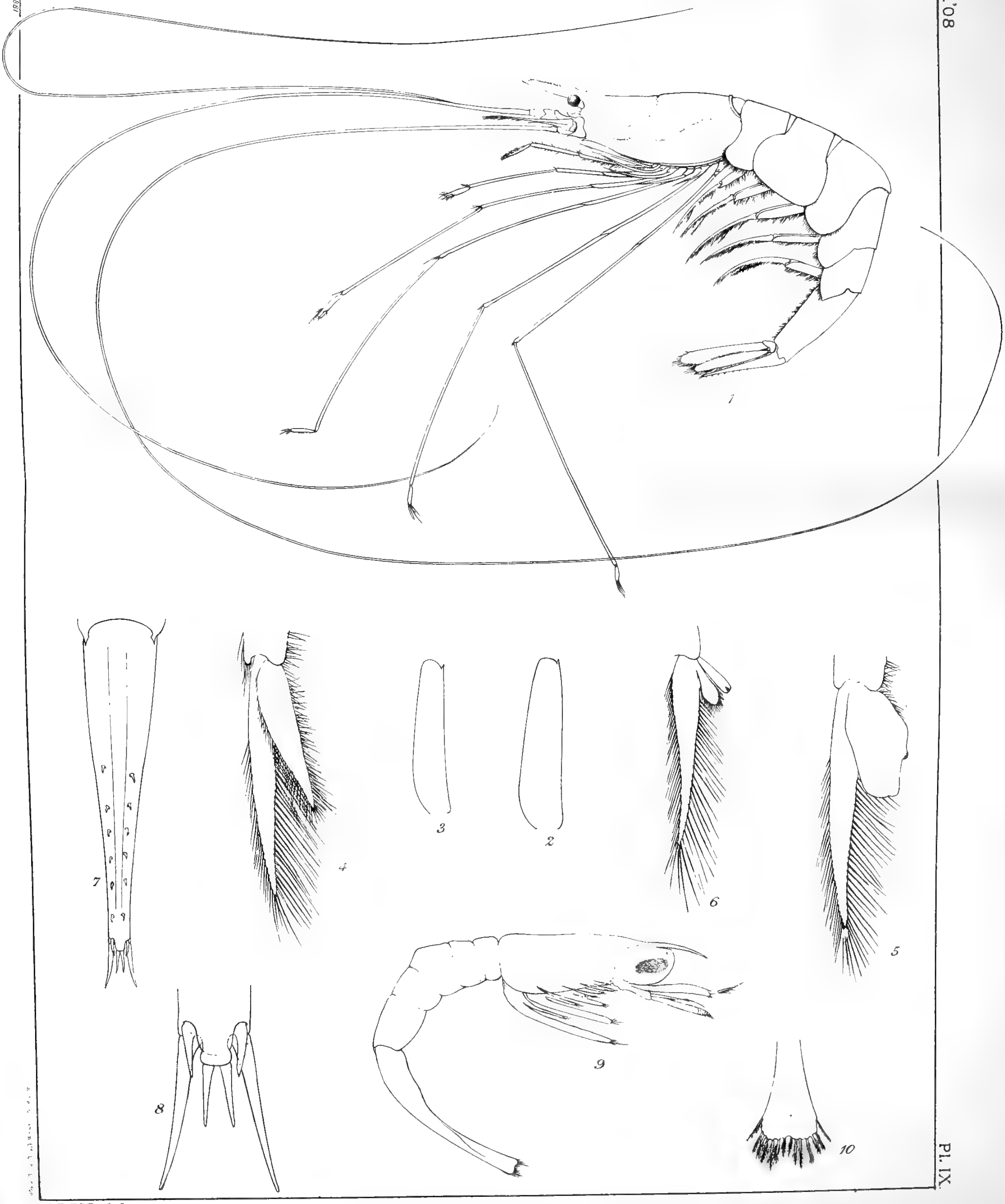
Nematocarcinus ensifer. var. exilis.



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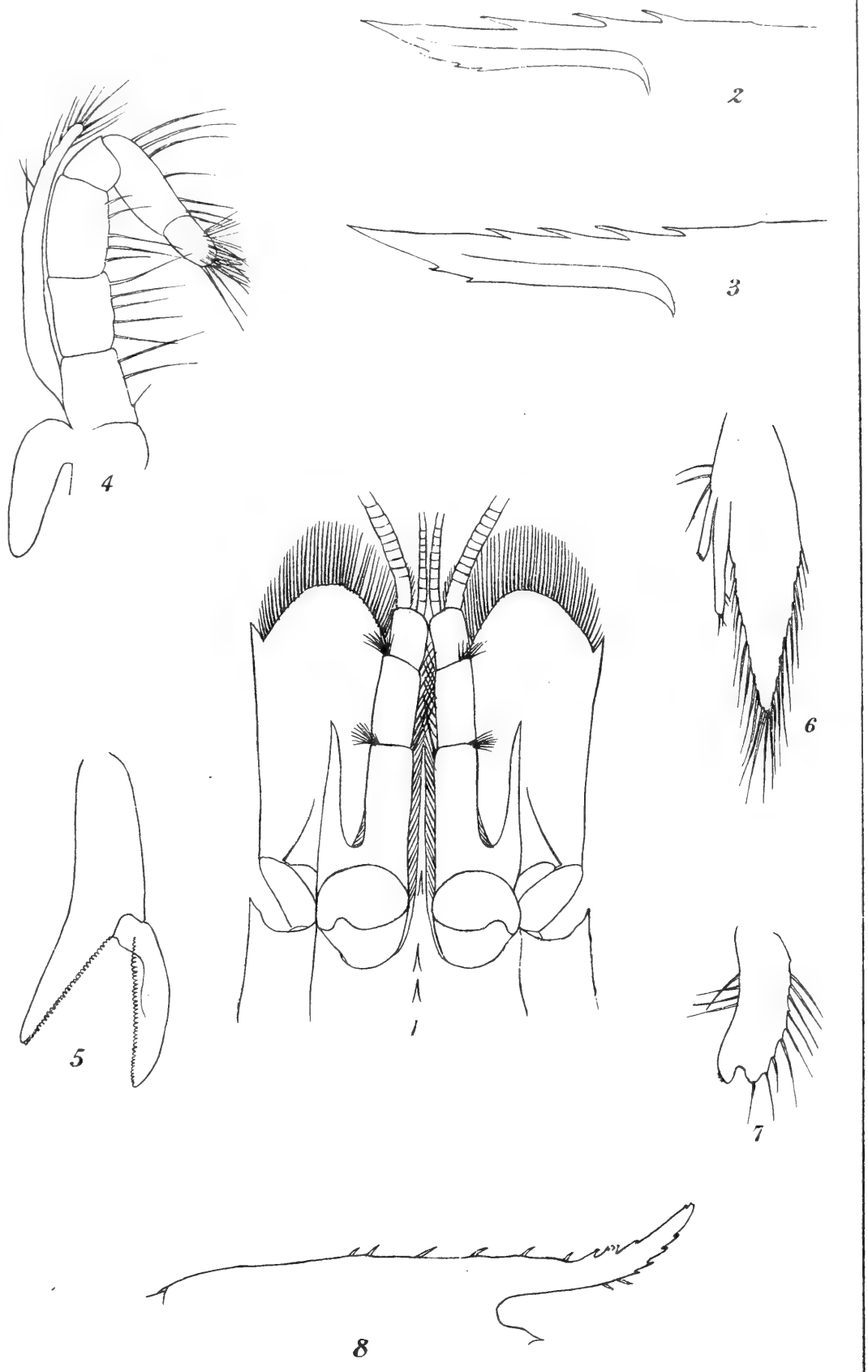
Nematocarcinus ensifer. var. exilis.



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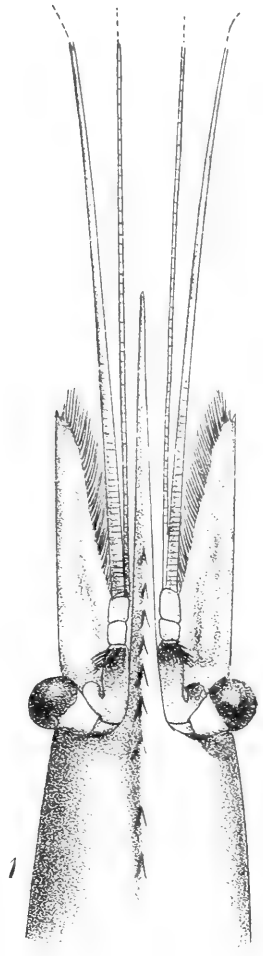
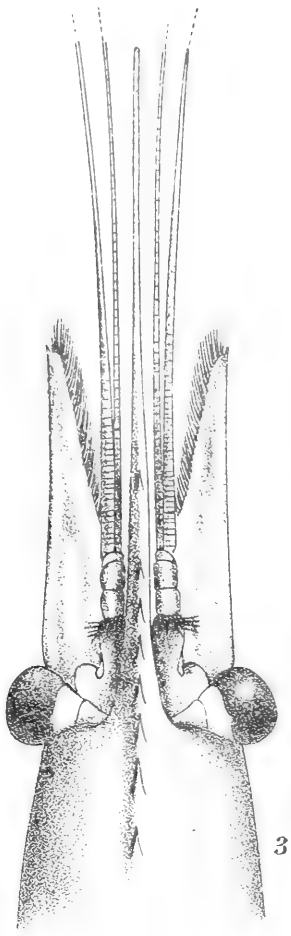
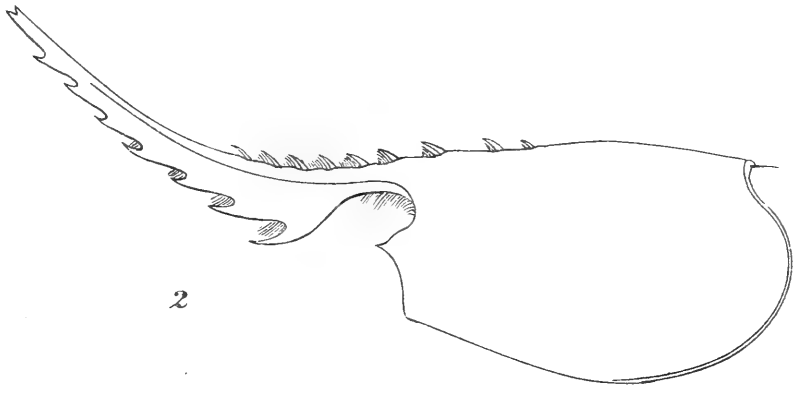
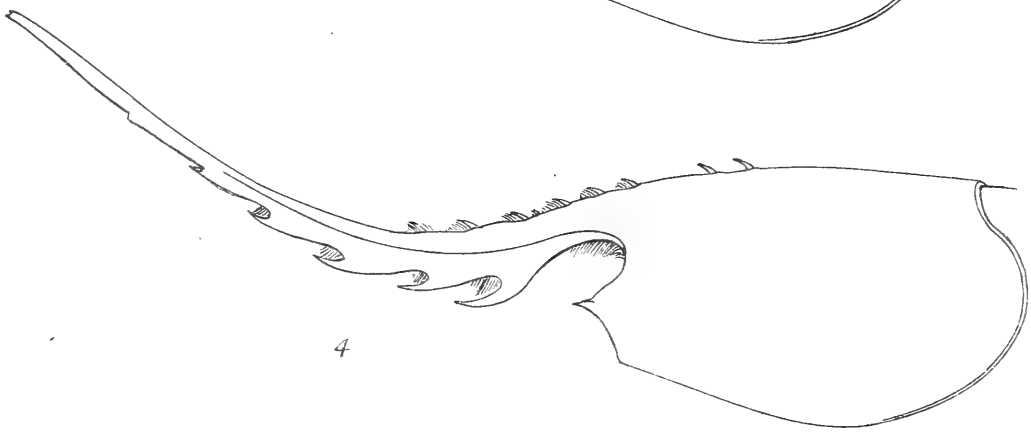
Figs. 1-7, Bresilia atlantica.
Fig. 8, Pandalus Montagui.









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Pandalus propinquus.

Plesionika martia.

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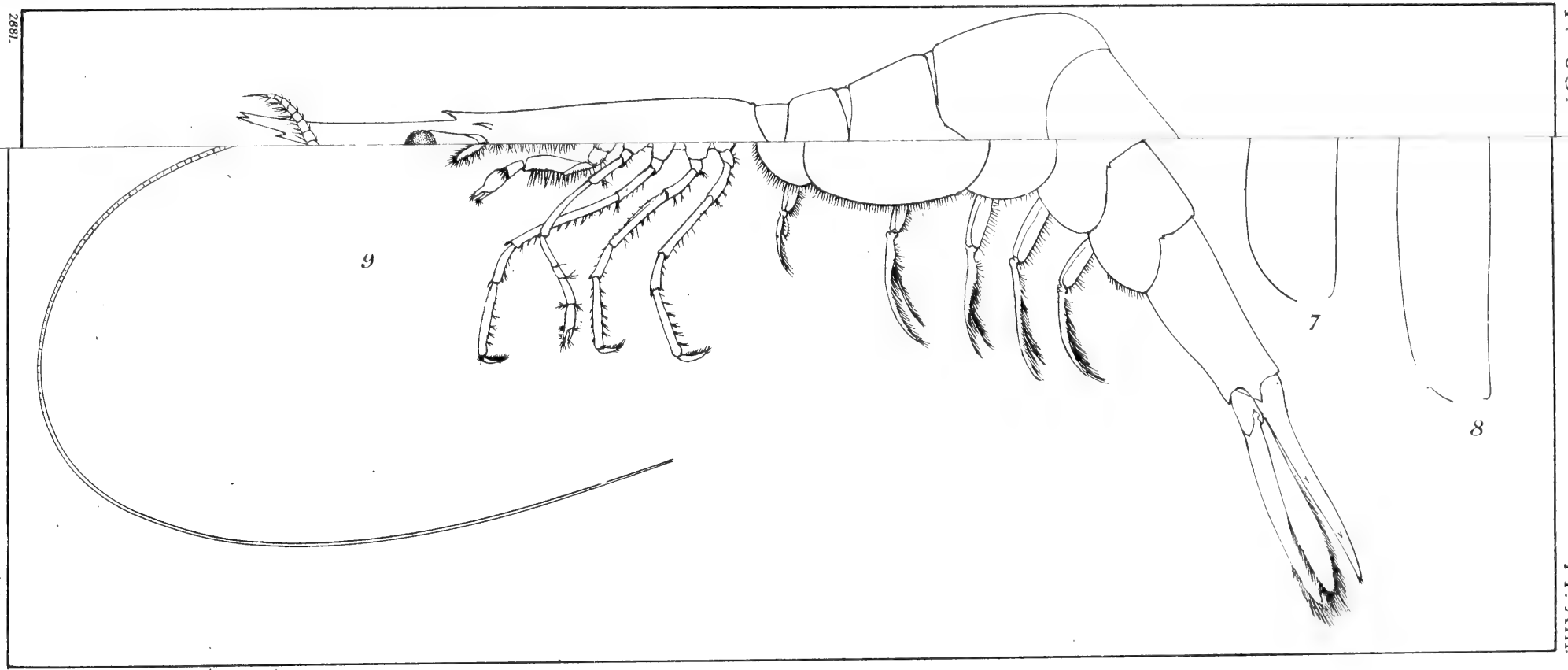

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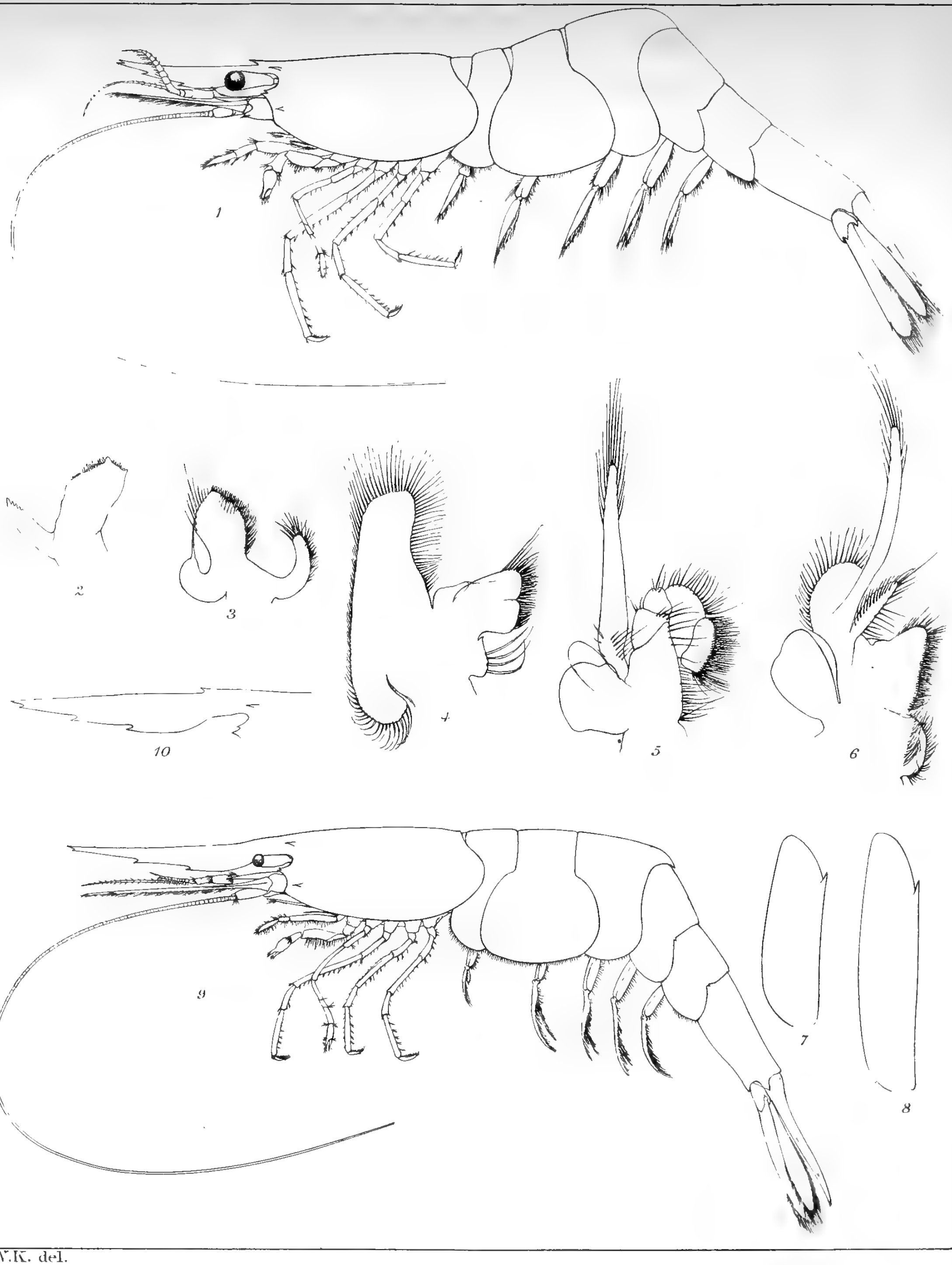
Figs. 1-7, Hippolyte varians.
Figs. 8-10, Hippolyte prideauxiana.



S.W.K. del.

Figs. 1-7. Hippolyte varians.
Figs. 8-10. Hippolyte prideauxiana.

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Fig. 1, Spirontocaris spina.
Figs. 2–10, Spirontocaris spina, var. Lilljeborgi.

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Fig. 1, Spirontocaris spina.
Figs. 2–10, Spirontocaris spina, var. Lilljeborgi.

Figs. 1-5, Spirontocaris Cranchi.
Figs. 6-8, Spirontocaris pusiola.

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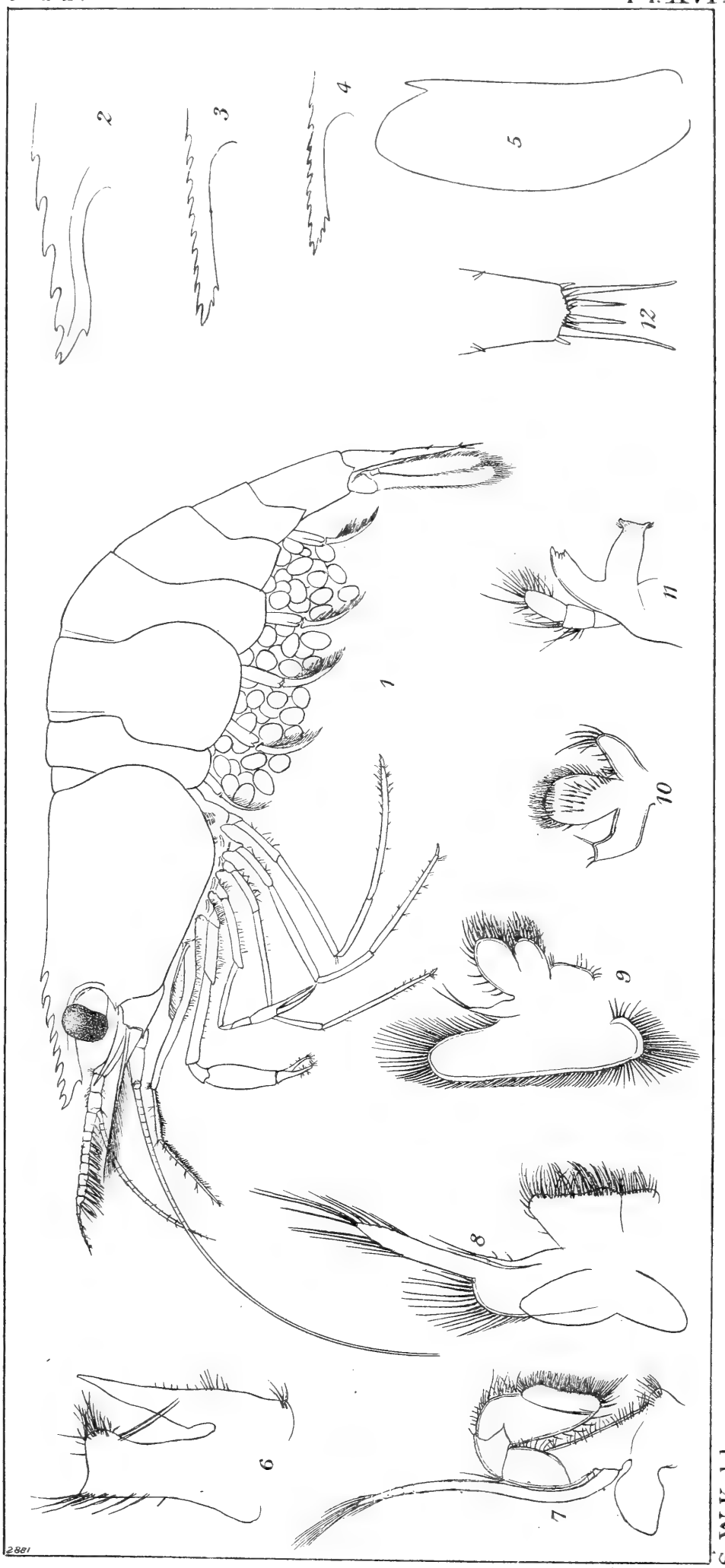

Caridion Gordoni.

S. W. K. del.

2881

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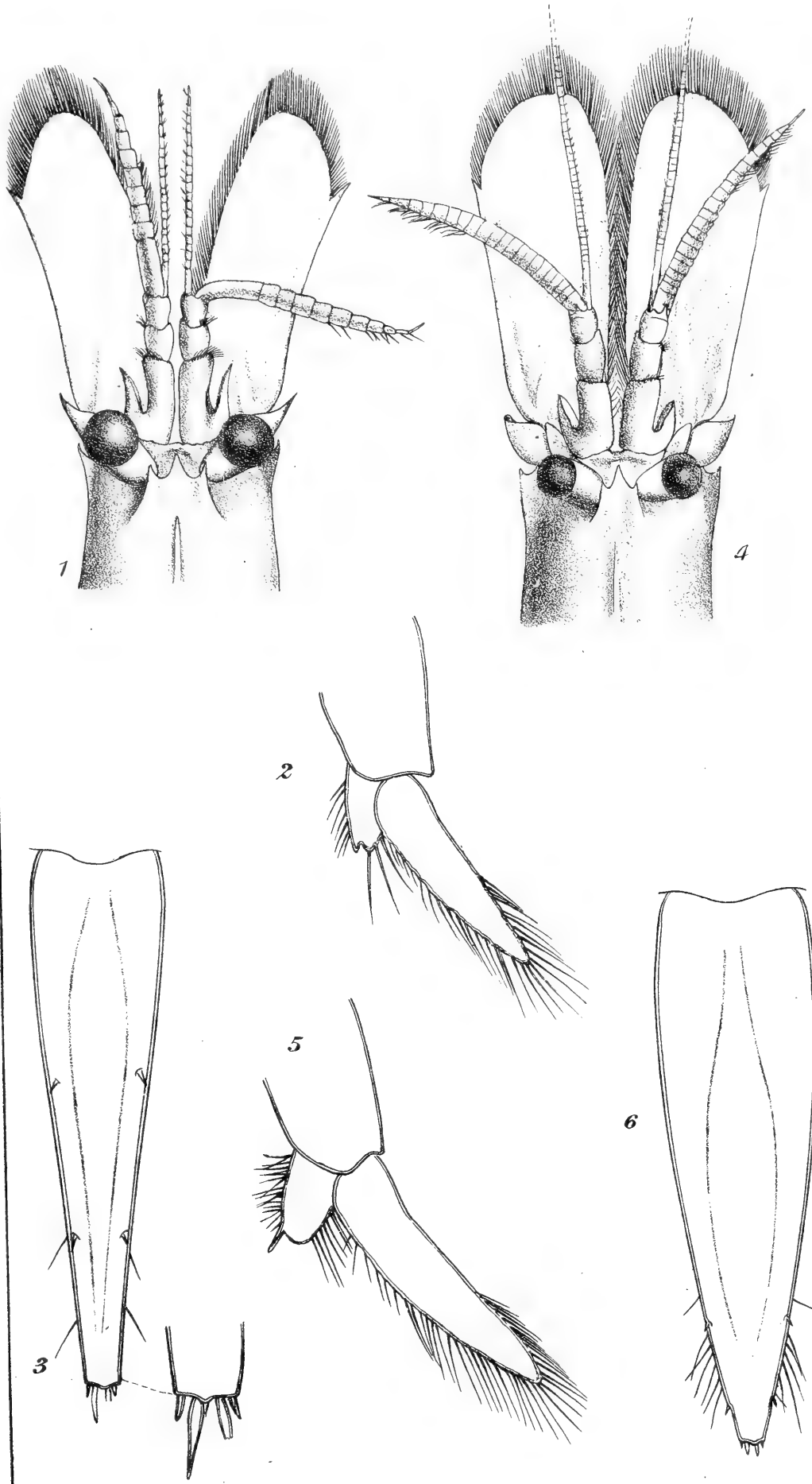
Leontocaris lar.

S.W.K. del.

PI. XVII.

Leontocaris lar.

S.W.K. del.



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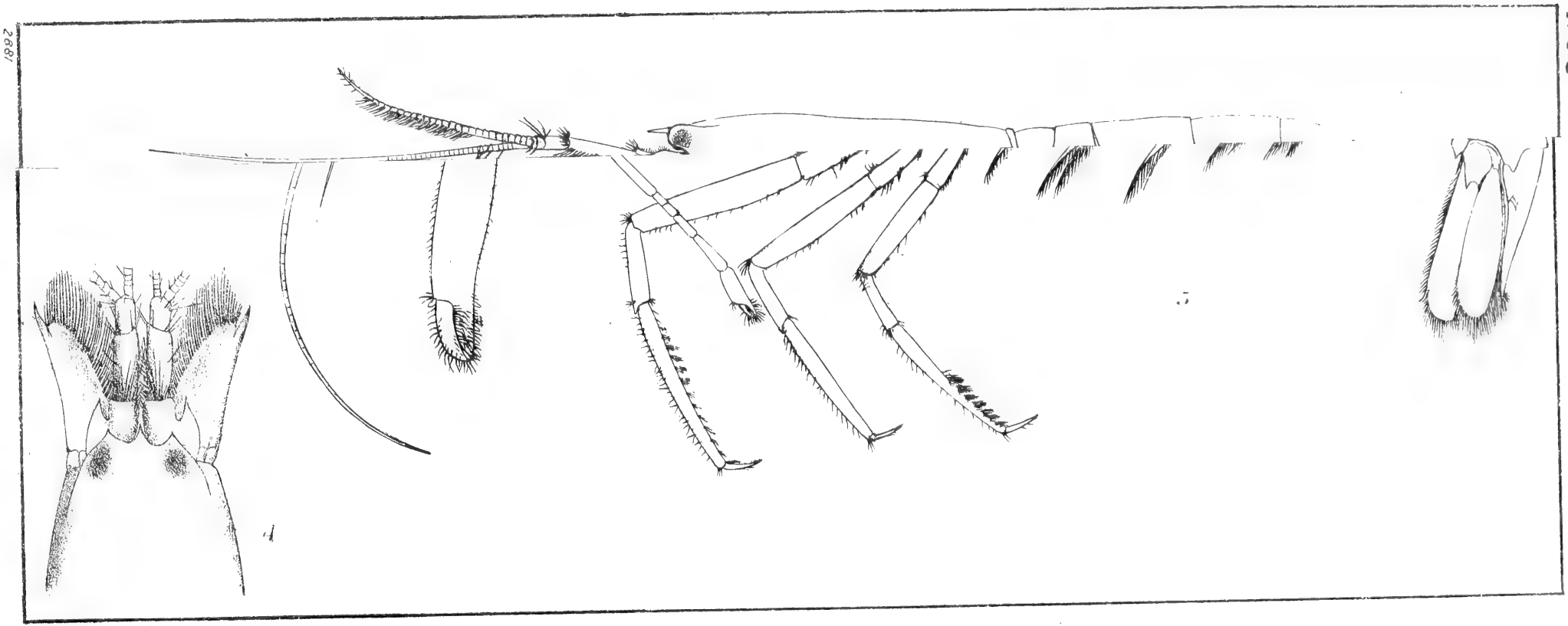
S.W.K. del.

Figs. 1 - 3, Bythocaris gracilis.
Figs. 4 - 6, Bythocaris Payeri.



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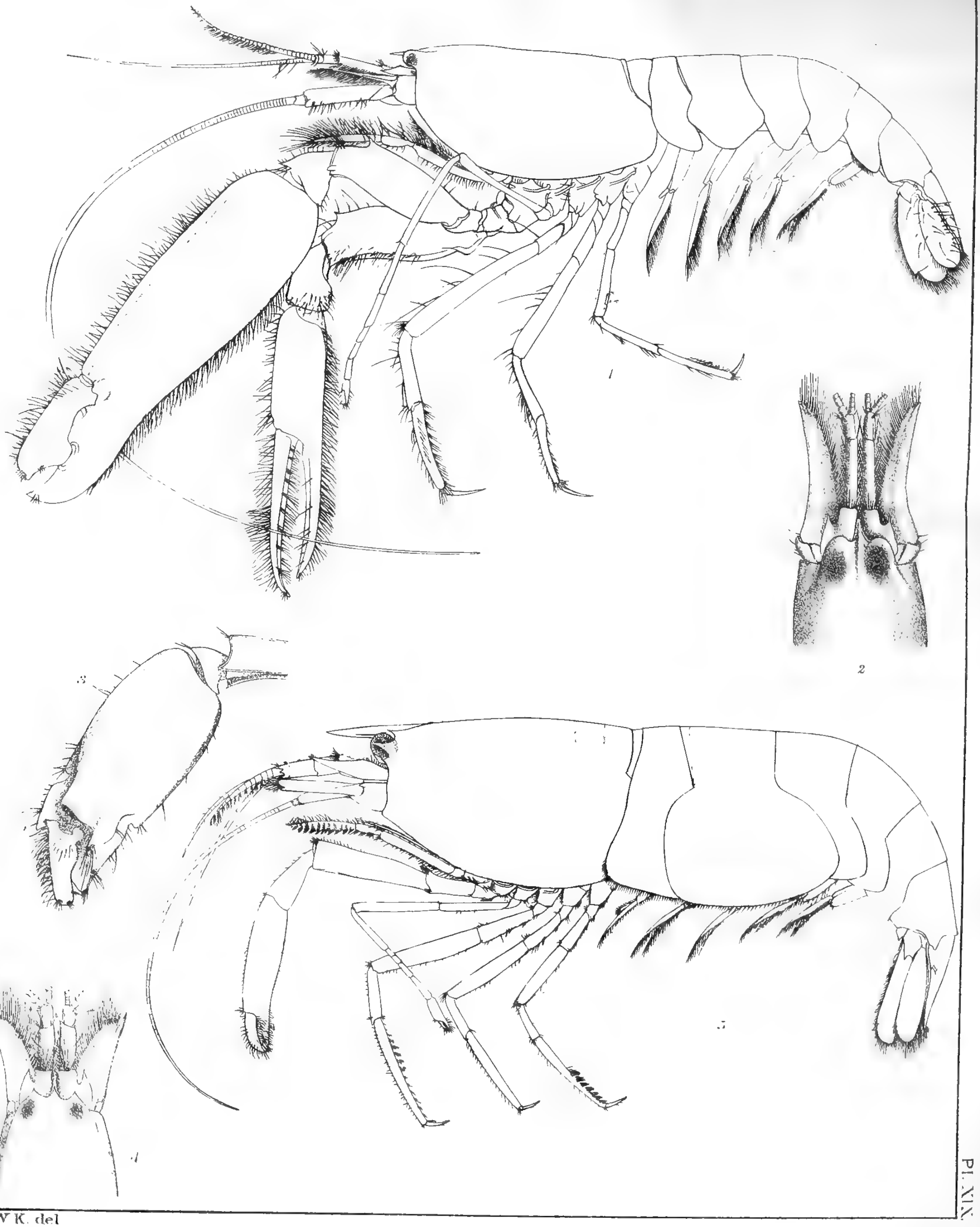
Figs. 1, 2, Alpheus ruber. Figs. 3, 4, Alpheus macrocheles.
Fig. 5, Athanas nitescens.



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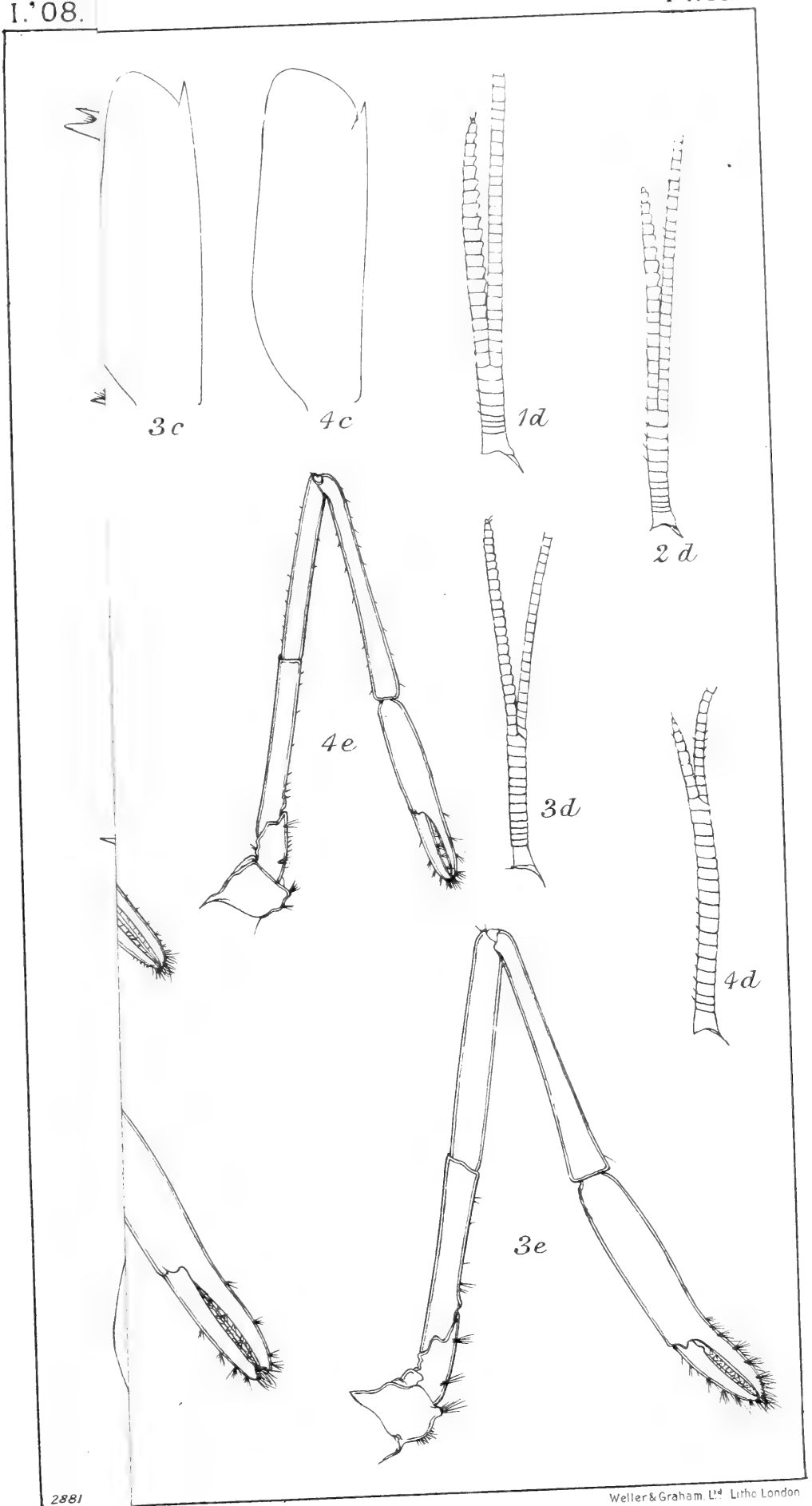
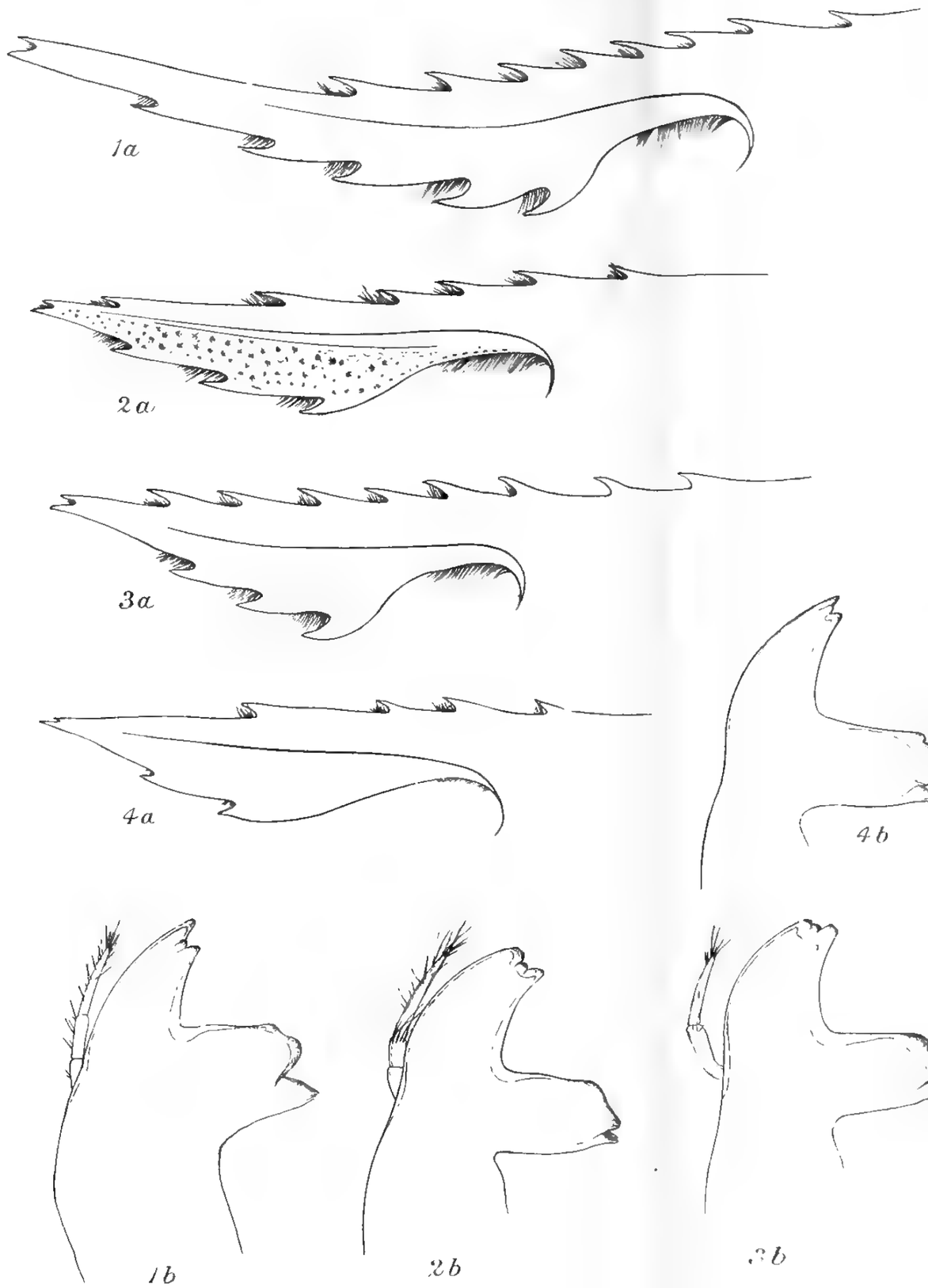
Figs. 1, 2, Alpheus ruber. Figs. 3, 4, Alpheus macrocheles.
Fig. 5. Athanas nitescens.

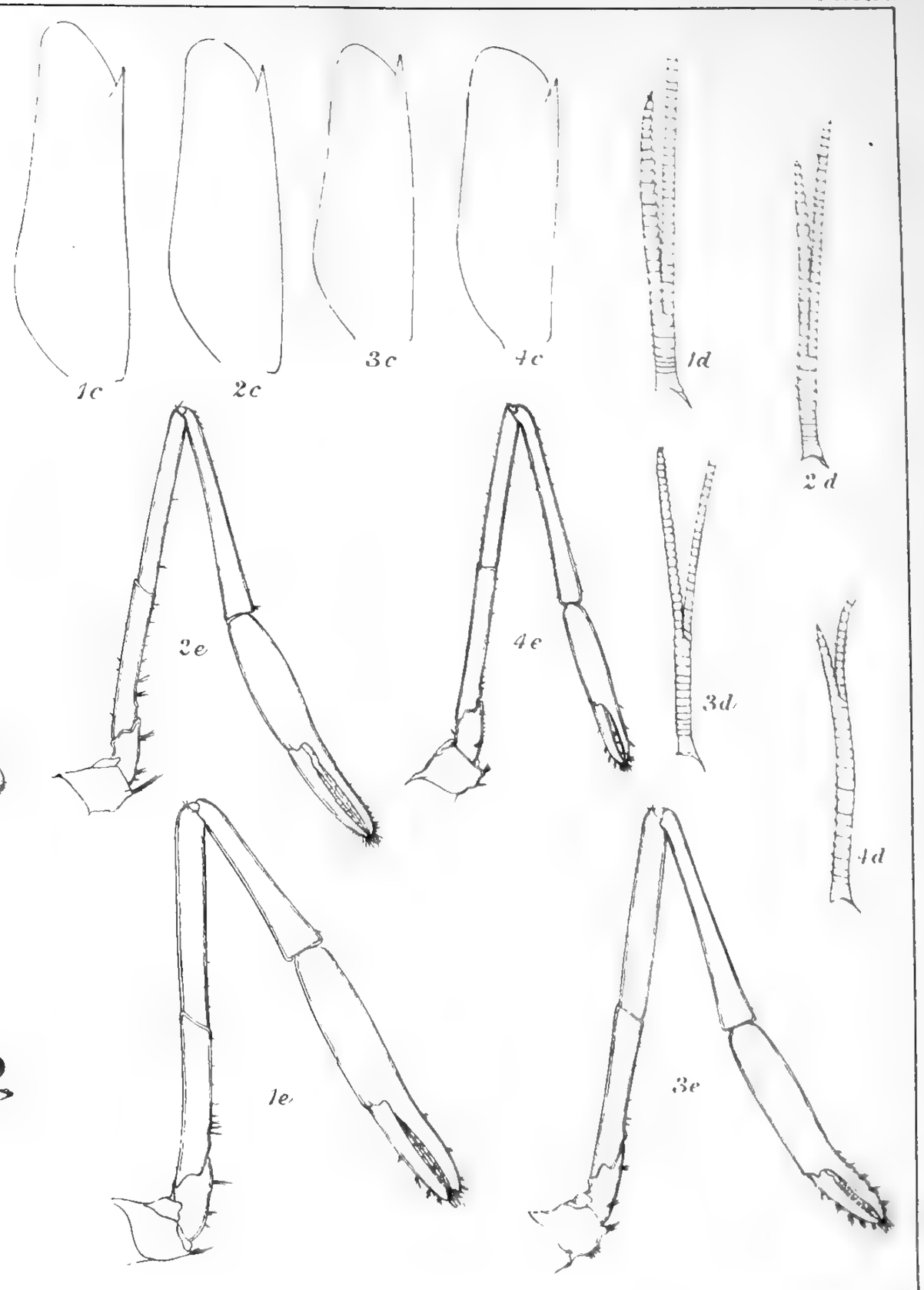


S.W.K.

adspersus.

etes varians.





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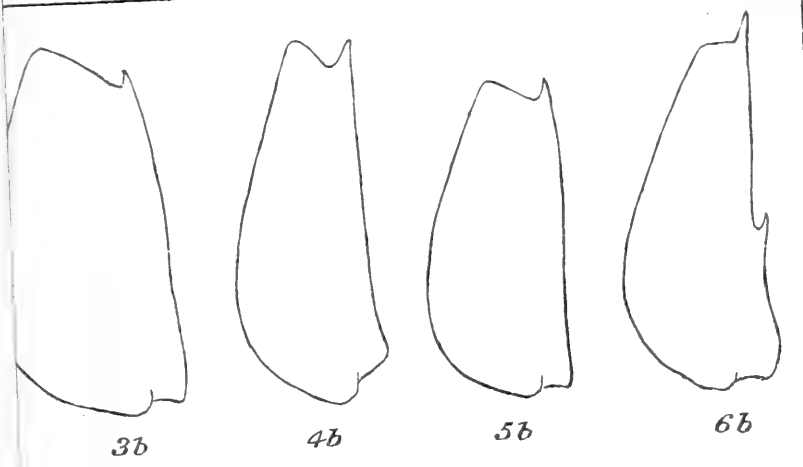
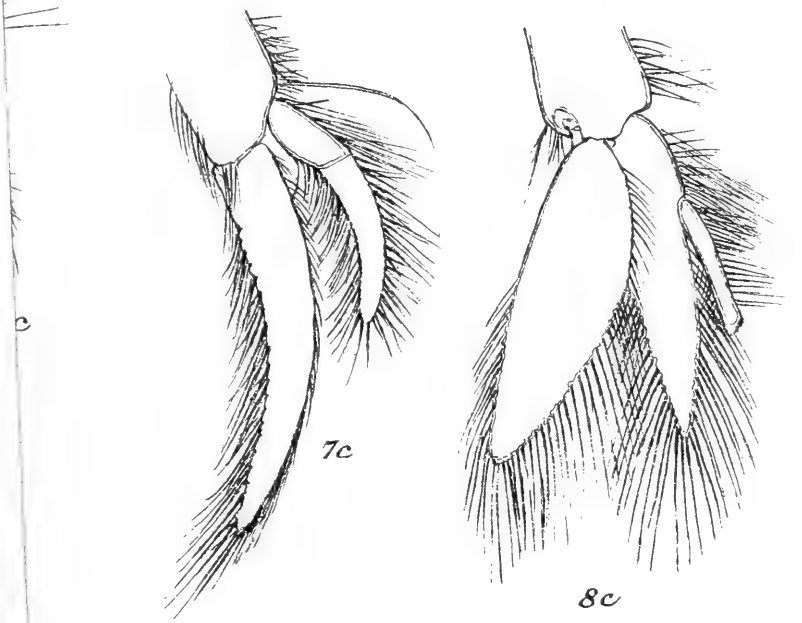
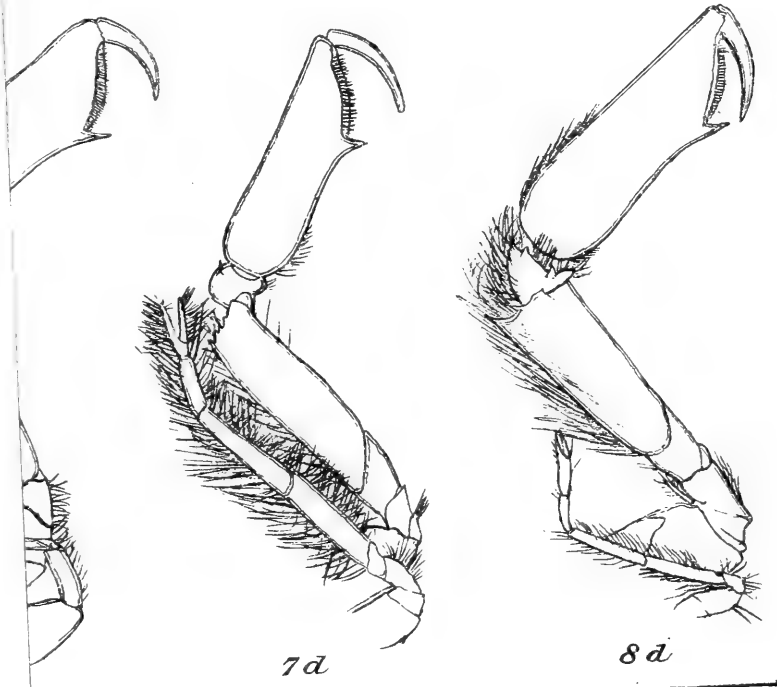
Figs. 1 *a–e*, Leander serratus.
Figs. 3 *a–e*, Leander squilla.

Figs. 2 *a–e*, Leander adspersus.
Figs. 4 *a–e*, Palaemonetes varians.







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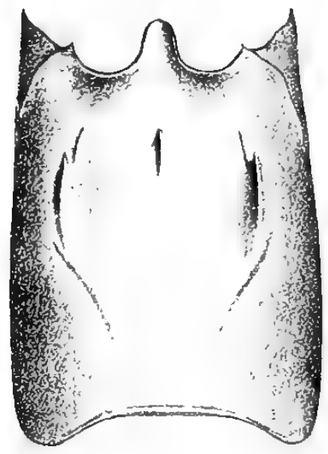
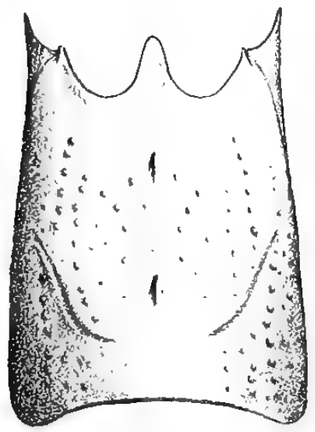
b, Philocheras fasciatus.
b, Philocheras sculptus.
b, Pontophilus norvegicus.


1a


2a


3a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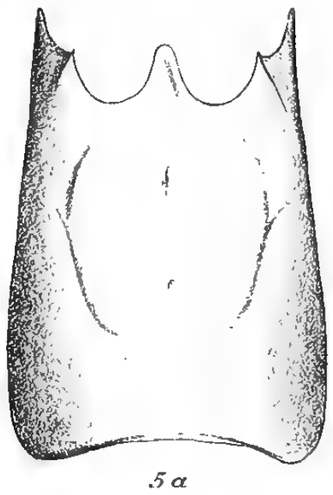
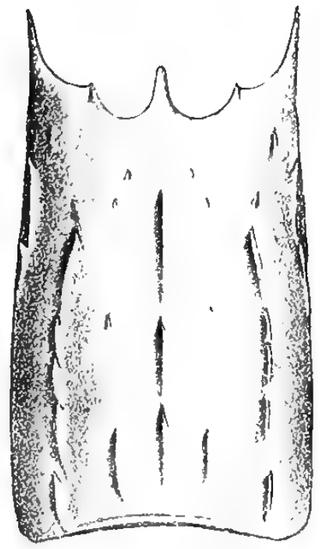

5a


6a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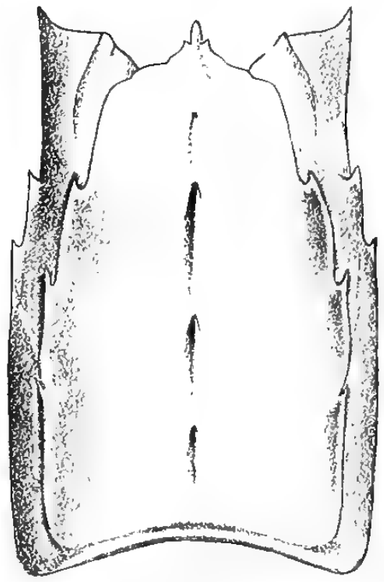
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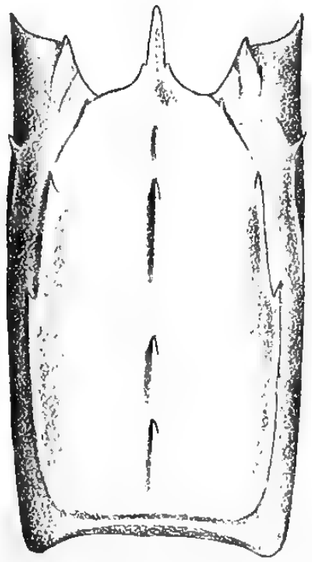
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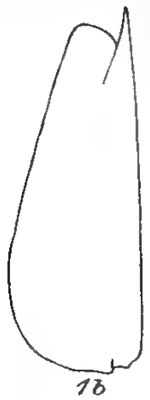

1b


2b

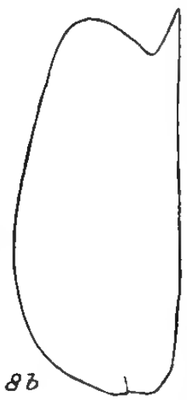

3b


4b


5b


6b


7b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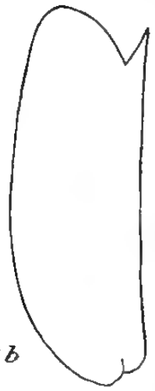
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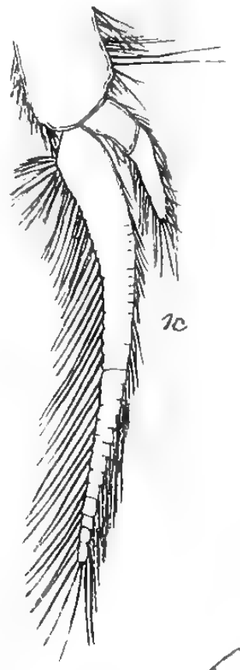
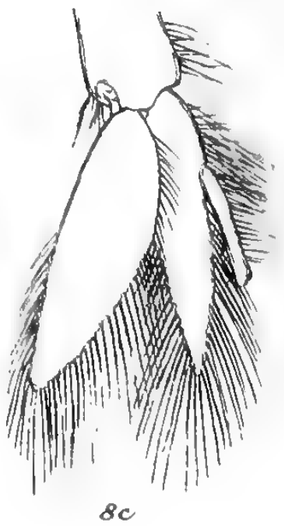

1c


7c


8c


1d


7d


8d

S.W.K. del.

Fig. 1. *a–d*, Crangon vulgaris.
Fig. 4. *a–b*, Philocheras bispinosus.
Fig. 7. *a–d*, Philocheras echinulatus.

Fig. 2 *a–b*, Philocheras trispinosus.
Fig. 5 *a–b*, Philocheras neglectus.
Fig. 8 *a–d*, Pontophilus spinosus.

Fig. 3 *a–b*, Philocheras fasciatus.
Fig. 6 *a–b*, Philocheras sculptus.
Fig. 9 *a–b*, Pontophilus norvegicus.

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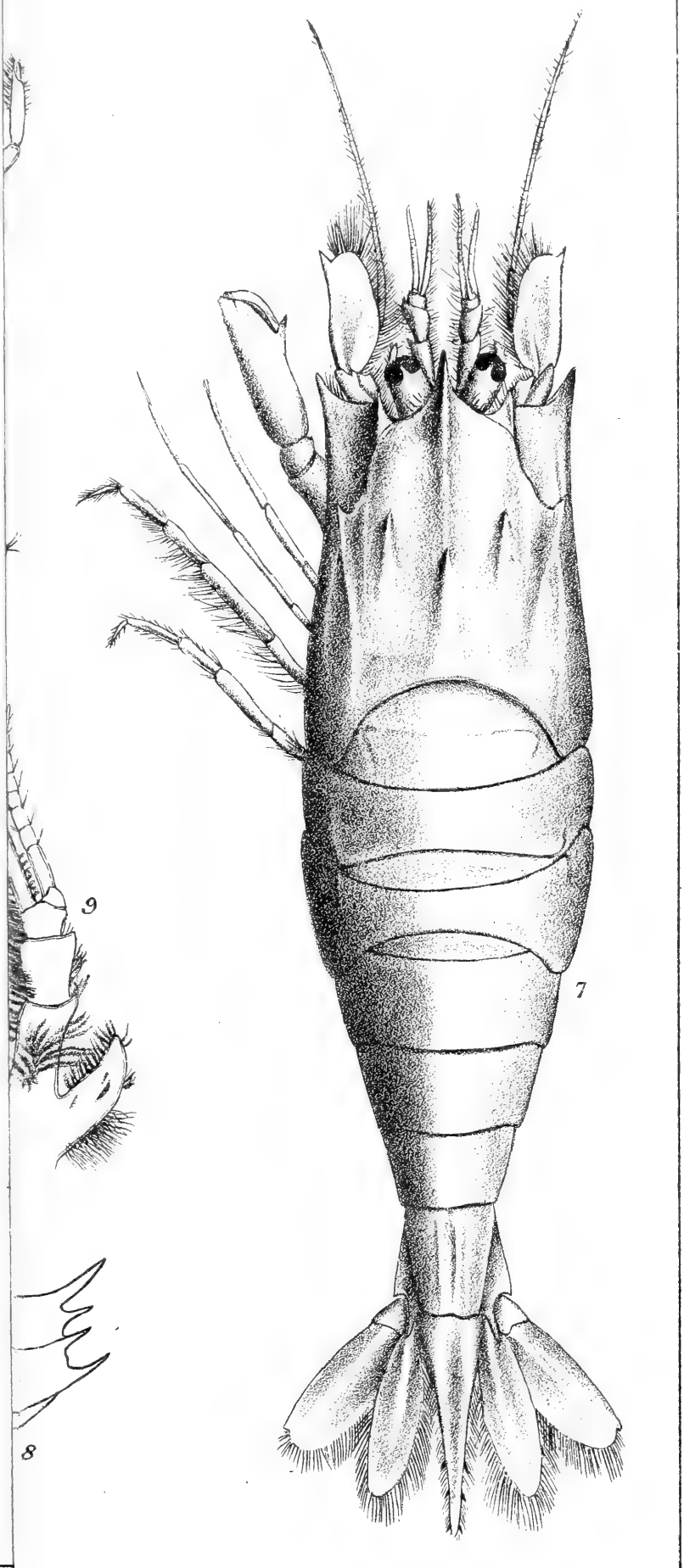

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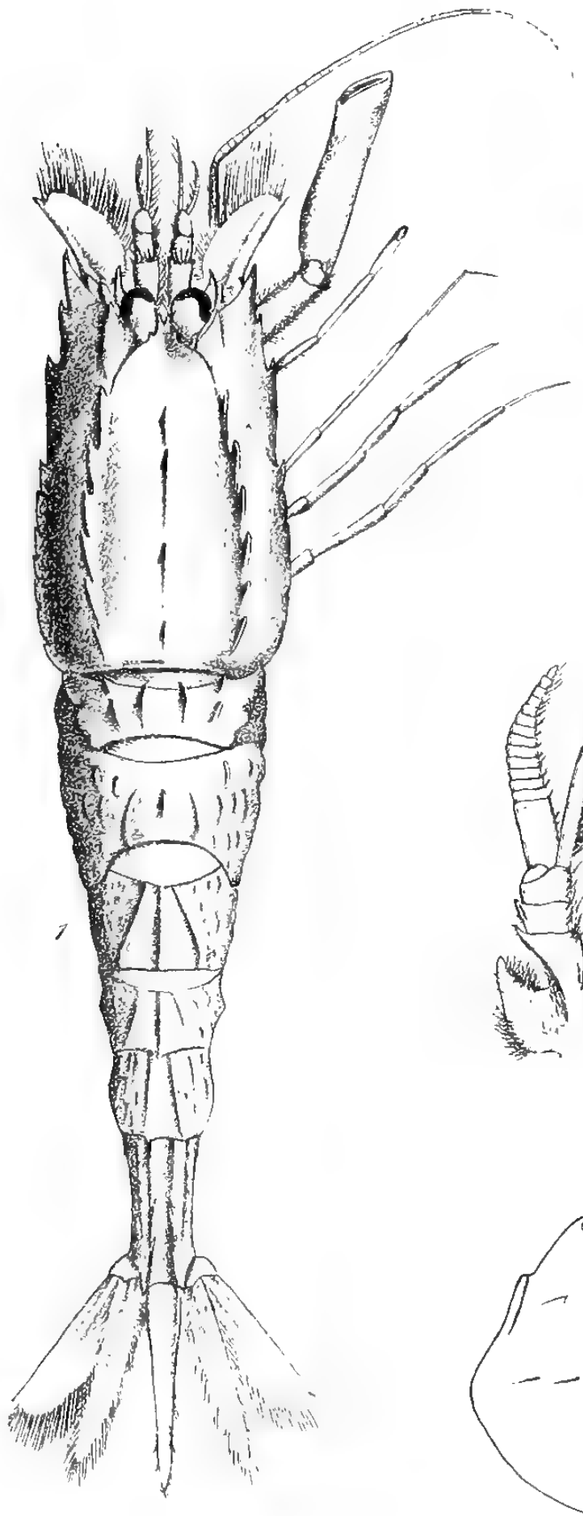
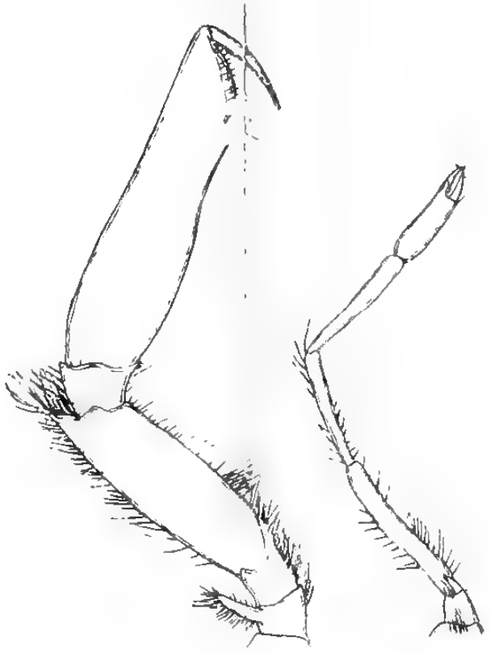
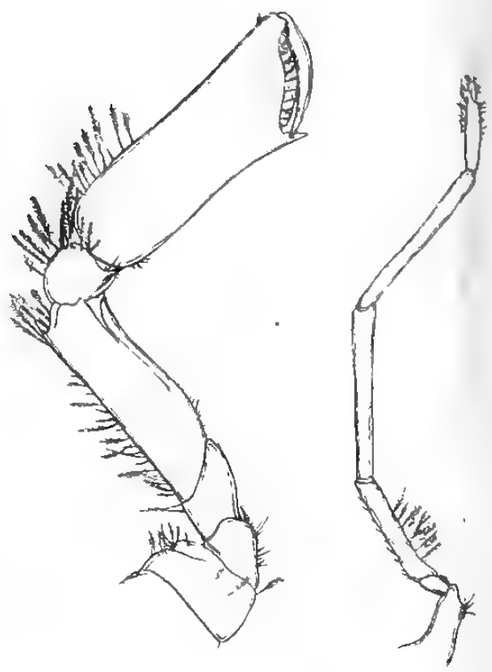
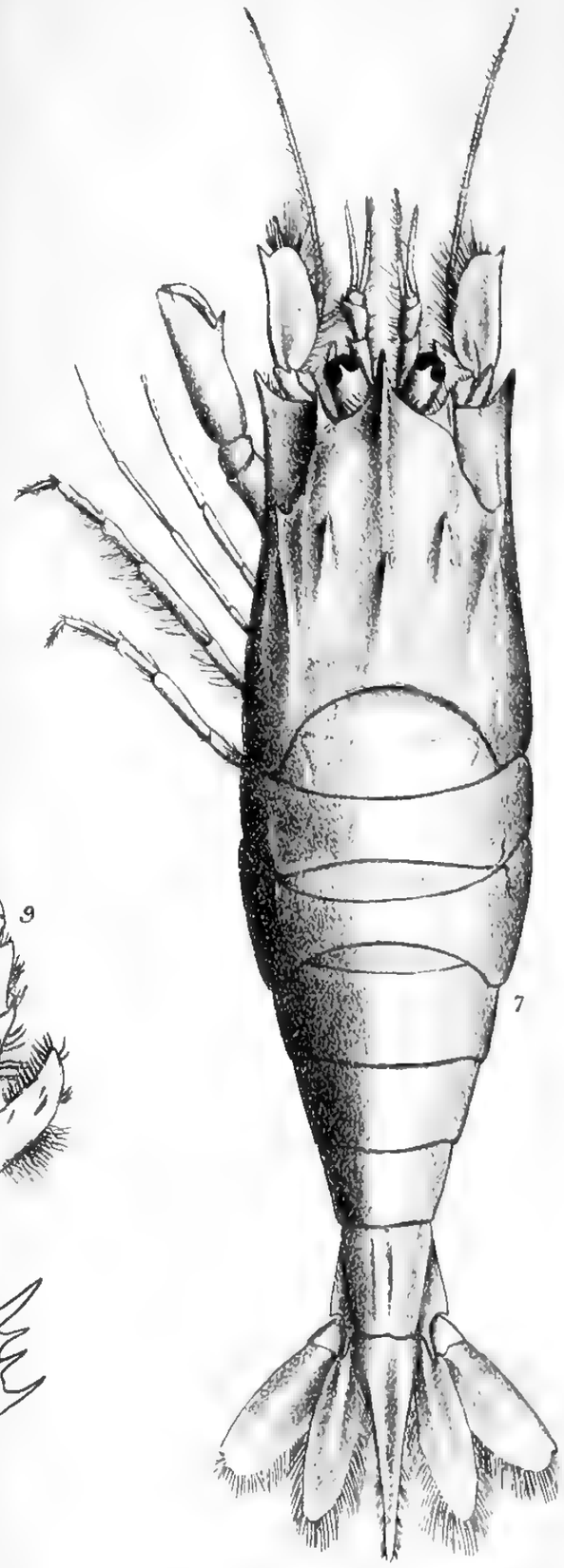
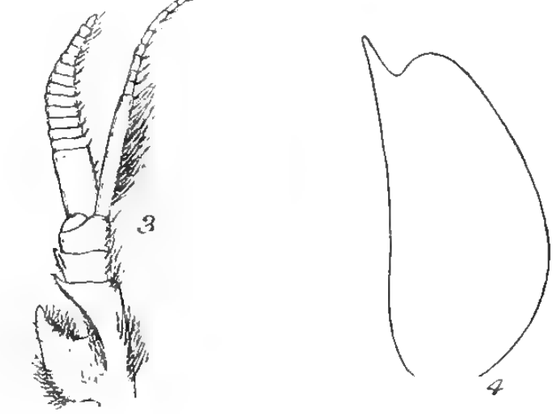
Sprocrangon Jacqueti.

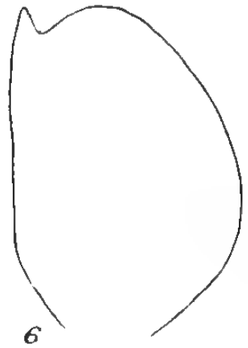


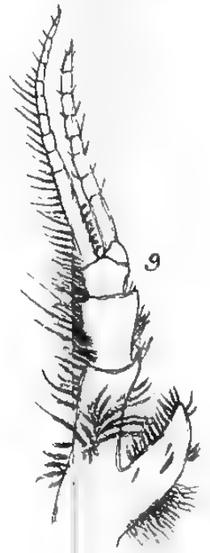


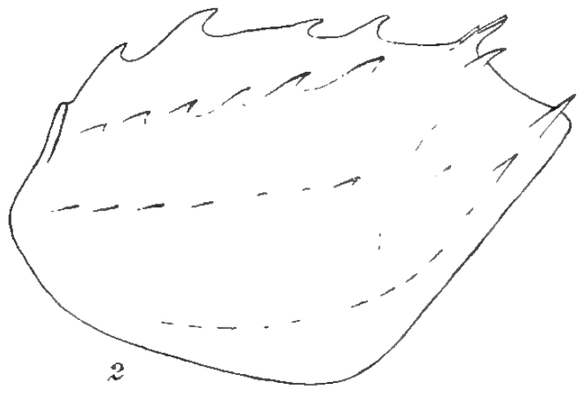


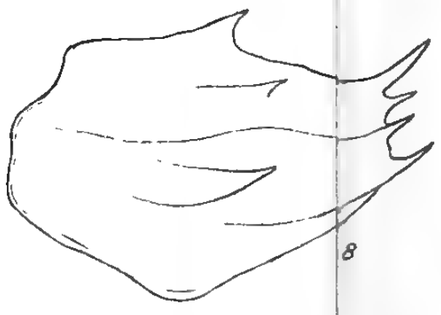












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Figs. 1–5, Aegeon Lacazei. Fig. 6, Aegeon cataphractus. Figs. 7–10, Sclerocrangon Jacqueti.

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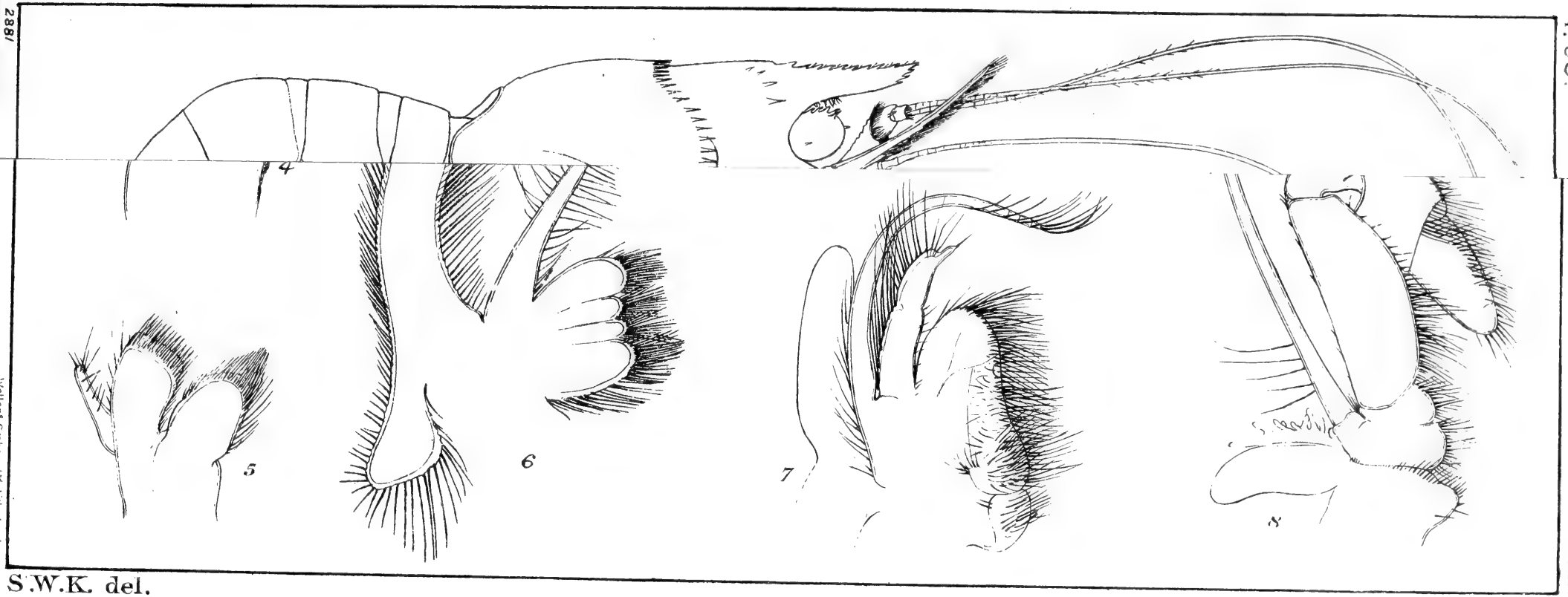

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S.W.K. del.

Richardina spinicincta

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2

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4

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6

7

8

9

10

S.W.K. del.

Richardina spinicincta

Fisheries, Ireland, Sci. Invest., 1908.

I.—Kemp, S. W.,—The Decapoda Natantia of the Coasts of Ireland, pp. 190, pl. 23. [1910]

II.—Ashworth, J. H.,—Polychaeta of the Coasts of Ireland. I.—Arenicolidae and Scalibregmidae, pp. 4. [1909].

III.—Southern, R.,—Polychaeta of the Coasts of Ireland. II.—Pelagic Phyllodocidae, pp. 11, pl. 3. [1909].

IV.—Holt, E. W. L., and L. W. Byrne,—Third Report on the Fishes of the Atlantic Slope. The Holocephali or Chimaeras, pp. 26, pl. 4. [1910].