

## North Pacific.

<i>Sergestes præcollis.</i>		<i>Sergestes ventridentatus.</i>
<i>Sergestes spiniventralis.</i>		<i>Sergestes utrinquedens.</i>
<i>Sciacaris telsonis.</i>		

STATION 267. August 28, 1875; lat. 9° 28' N., long. 150° 49' W.; south of the Sandwich Islands. Tow-net at 2000 fathoms.

*Gennadas parvus* (1).

STATION 270. September 4, 1875; lat. 2° 34' N., long. 149° 9' W.; surface temperature, 79°·5. Surface.

<i>Lucifer typus.</i>		<i>Lucifer reynaudii.</i>
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South Pacific, north of Low Archipelago; September 1875.

<i>Sergestes rinkii.</i>		<i>Sergestes oculatus.</i>
<i>Caricyphus gibberosus.</i>		

STATION 272. September 8, 1875; lat. 3° 48' S., long. 152° 56' W.; north of the Low Archipelago; depth, 2600 fathoms; bottom, Radiolarian ooze; bottom temperature, 35°·1. Trawled.

*Benthesicymus crenatus* (1 ♀).

Between Honolulu and the Low Islands, September 12, 1875.

*Sergestes armatus.*

STATION 276. September 16, 1875; lat. 13° 28' S., long. 149° 30' W.; near the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, 35°·1. Trawled.

<i>Aristeus armatus</i> (1 ♀).		<i>Benthesicymus crenatus</i> (2 ♀).
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STATION 279C. October 2, 1875; lat. 17° 29' 11" S., long. 149° 34' 32" W.; near Tahiti; depth, 680 fathoms; bottom, volcanic mud. Trawled.

*Alpheus spiniger* (1 ♀).

## Tahiti.

<i>Panulirus penicillatus</i> (1).		<i>Bithynis lar</i> (5 ♂). Fresh-water.
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STATION 281. October 6, 1875; lat. 22° 21' S., long. 150° 17' W.; depth, 2385 fathoms; bottom, red clay; bottom temperature, 34°·9. Trawled.

*Haliporus curvirostris* (1)

South Pacific; lat. 24° S., long. 148° W.

*Sergestes fermerinkii*.

STATION 285. October 14, 1875; lat. 32° 36' S., long. 137° 43' W.; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°. Trawled.

*Haliporus curvirostris* (1 ♀).

*Bentheocaris exuens* (1).

*Benthesicymus brasiliensis* (1 ♀).

*Acantheephyra longidens* (1 ♂).

STATION 289. October 23, 1875; lat. 39° 41' S., long. 131° 23' W.; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8. Trawled.

*Hepomadus inermis* (1).

*Gennadas parvus* (1 ♂).

South-west Pacific.

*Sergestes junceus*.

STATION 295. November 5, 1875; lat. 38° 7' S., long. 94° 4' W.; depth, 1500 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·3. Trawled.

*Sergestes longicollus* (1).

STATION 298. November 17, 1875; lat. 34° 7' S., long. 73° 56' W.; depth, 2225 fathoms; bottom, blue mud; bottom temperature, 35°·6. Trawled.

*Willemasia leptodactyla* (♀).

Between Valparaiso and Juan Fernandez. Tow-net at 200 fathoms.

*Sergestes nasidentatus*.

STATION 300. December 17, 1875; lat. 33° 42' S., long. 78° 18' W.; off Valparaiso; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Trawled.

*Pentacheles lævis* (1 ♀).

*Sergestes profundus* (1).

*Willemasia leptodactyla* (1 ♂).

*Glyphocrangon rimapes* (2 ♀).

*Nematocarcinus proximatus* (3 ♀).

STATION 302. December 28, 1875; lat.  $42^{\circ} 43' S.$ , long.  $82^{\circ} 11' W.$ ; depth, 1450 fathoms; bottom, Globigerina ooze; bottom temperature,  $35^{\circ} 6.$  Trawled.

*Nematocarcinus proximatus* (3 ♂ ♀).

STATION 304. December 31, 1875; lat.  $46^{\circ} 53' 15'' S.$ , long.  $75^{\circ} 12' 0'' W.$ ; Port Otway, Patagonia; depth, 45 fathoms; bottom, green sand. Dredged.

*Nothocaris spiniserratus* (8).

STATION 305A. January 1, 1876; lat.  $47^{\circ} 48' 30'' S.$ , long.  $74^{\circ} 47' 0'' W.$ ; Messier Channel; depth, 125 fathoms; bottom, blue mud. Trawled.

*Campylonotus semistriatus* (6 ♀ ♂).

STATION 305B. January 1, 1876; lat.  $47^{\circ} 48' S.$ , long.  $74^{\circ} 46' W.$ ; Messier Channel; depth, 160 fathoms; bottom, blue mud. Trawled.

*Stereomastis suhmi*.

STATION 306A. January 2, 1876; lat.  $48^{\circ} 27' S.$ , lat.  $74^{\circ} 30' W.$ ; Messier Channel; depth, 345 fathoms; bottom, blue mud; bottom temperature,  $46^{\circ}$ . Trawled.

*Campylonotus semistriatus* (3 ♂).

STATION 307. January 4, 1876; lat.  $49^{\circ} 24' 30'' S.$ , long.  $74^{\circ} 23' 30'' W.$ ; off Port Grappler; depth, 140 fathoms; bottom, blue mud. Trawled.

*Campylonotus semistriatus* (40 ♀ ♂).

STATION 308. January 5, 1876; lat.  $50^{\circ} 8' 30'' S.$ , long.  $74^{\circ} 41' 0'' W.$ ; off Tom Bay; depth, 175 fathoms; bottom, blue mud. Trawled.

*Campylonotus semistriatus* (9 ♀ ♂). | *Campylonotus vagans* (1 ♀).

STATION 309. January 8, 1876; lat.  $50^{\circ} 56' S.$ , long.  $74^{\circ} 15' W.$ ; Puerto Bueno; depth, 40 fathoms; bottom, blue mud; bottom temperature,  $47^{\circ}$ .

*Campylonotus semistriatus* (3 ♀).

STATION 310. January 10, 1876; lat.  $51^{\circ} 27' 30'' S.$ , long.  $74^{\circ} 3' 0'' W.$ ; Sarmiento Channel; depth, 400 fathoms; bottom, blue mud; bottom temperature,  $46^{\circ} 5.$  Trawled.

*Acanthephyra carinata* (1 ♂). | *Acanthephyra approxima* (1).

*Campylonotus semistriatus* (6 ♀ ♂).

STATION 311. January 11, 1876; lat. 52° 45' 30" S., long. 73° 46' 0" W.; off Port Churruca; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°. Trawled.

*Stereomastis suhmi* (9). | *Campylonotus semistriatus* (4 ♀ ♂).  
*Pasiphæa acutifrons* (1).

STATION 315. January 26, 1876; lat. 51° 40' S., long. 57° 50' W.; Port William; depth, 12 fathoms; bottom, sand, gravel. Dredged.

*Nauticaris marionis* (1 ♂).

STATION 318. February 11, 1876; lat. 42° 32' S., long. 56° 29' W.; depth, 2040 fathoms; bottom, blue mud; bottom temperature, 33°·7. Trawled.

*Acanthephyra sica* (1). | *Acanthephyra brachytelsonis* (4 ♀ ♂).  
*Hymenodora mollicutis* (1 ♀).

STATION 320. February 14, 1876; lat. 37° 17' S., long. 53° 52' W.; off Monte Video; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Trawled.

*Sergestes atlanticus* (1). | *Pandalopsis amplus* (6 ♂ ♀).

STATION 321. February 25, 1876; lat. 35° 2' S., long. 55° 15' W.; off Monte Video; depth, 13 fathoms; bottom, mud. Trawled.

*Pleoticus mulleri* (30 ♂). | *Artemesia longinaris* (39 ♀ ♂).

STATION 323. February 28, 1876; lat. 35° 39' S., long. 50° 47' W.; off Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, 33°·1. Trawled.

*Aristeus armatus* (1 ♂). | *Benthesicymus brasiliensis* (4 ♀ ♂).

STATION 325. March 2, 1876; lat. 36° 44' S., long. 46° 16' W.; depth, 2650 fathoms; bottom, blue mud; bottom temperature, 32°·7. Trawled.

*Hemipenæus speciosus* (♂ ♀ 2).

STATION 331. March 9, 1876; lat. 37° 47' S., long. 30° 20' W.; depth, 1715 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Trawled.

*Glyphocrangon rimapes* (1 ♀).

STATION 347. April 7, 1876; lat.  $0^{\circ} 15' S.$ , long.  $14^{\circ} 25' W.$ ; surface temperature,  $82^{\circ}$ .  
Surface.

*Sergestes diapontius.*

North Atlantic, April 1876. Surface.

*Sergestes longirostris.*

STATION 352. April 13, 1876; lat.  $10^{\circ} 55' N.$ , long.  $17^{\circ} 46' W.$ ; surface temperature,  $77^{\circ} \cdot 7$ . Surface.

*Platysaccus crenatus.*

STATION 354. May 6, 1876; lat.  $32^{\circ} 41' N.$ , long.  $36^{\circ} 6' W.$ ; depth, 1675 fathoms; surface temperature,  $70^{\circ}$ . Surface.

*Sergestes atlanticus* (1).

*Sergestes longispinus.*

*Sergestes semiarmis* (1).

*Acanthephyra purpurea* (1 ♀).

## BATHYMETRICAL DISTRIBUTION.

TABLE SHOWING THE DEPTH IN FATHOMS AT WHICH THE SPECIES OF EACH GENUS WERE OBTAINED.

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Trichobranchiata.							
Aberrantia.							
Pylochelidæ.							
<i>Cheiroplatea</i> , . . . .	.	.	1				
Thalassinidæ.							
<i>Thalassina</i> , . . . .	1						
Callianassidæ.							
<i>Callianassa</i> , . . . .	.	.	1				
<i>Cheramus</i> , . . . .	1	.	1				
<i>Scallasis</i> , . . . .	1						
Axiidæ.							
<i>Paraxius</i> , . . . .	.	.	.	.	1		
<i>Eiconaxius</i> , . . . .	.	.	1	2			
Thaumastocheleidæ.							
<i>Thaumastocheles</i> , . . . .	.	.	1				
Normalia.							
Synaxiden.							
Scyllaridæ.							
<i>Ibaccus</i> , . . . .	1	.	3				
<i>Thenus</i> , . . . .	1						
<i>Arctus</i> , . . . .	1	2	1				
Palinuridæ.							
<i>Panulirus</i> , . . . .	1	.	1				
<i>Palinosyrtus</i> , . . . .	1	.	1				
<i>Phyllosoma</i> , . . . .	3						
Eryonidæ.							
<i>Eryoneicus</i> , . . . .	.	.	.	.	1		
<i>Polycheles</i> , . . . .	.	.	2	1	1		
<i>Pentacheles</i> , . . . .	.	.	1	3	2		
<i>Stereomastis</i> , . . . .	.	.	1	1			
<i>Willemasia</i> , . . . .	.	.	.	.	1	1	
Homaridæ.							
<i>Phoberus</i> , . . . .	.	.	.	1			
<i>Nephropsis</i> , . . . .	.	.	.	2			
<i>Nephrops</i> , . . . .	.	1	1				
Astacidæ.							
<i>Astacopsis</i> , . . . .	{	3 (fresh-water)					

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Stenopidæ.							
<i>Stenopus</i> , . . .	1						
<i>Spongicola</i> , . . .	.	1					
Dendrobranchiata.							
Normalia.							
Penæidea.							
Penæidæ.							
<i>Penæus</i> , . . .	10	3	4	.	2	1	
<i>Pleoticus</i> , . . .	2	.	1				
<i>Artemesia</i> , . . .	1						
<i>Haliporus</i> , . . .	.	.	2	2	1	2	
<i>Sicyonia</i> , . . .	2	.	1				
<i>Hemipenæus</i> , . . .	.	.	3	2	1	2	
<i>Aristeus</i> , . . .	.	.	1	.	1	1	
<i>Hepomadus</i> , . . .	.	.	.	.	1	1	
<i>Peteinura</i> , . . .	1						
<i>Benthesicymus</i> , . . .	.	.	2	1	5	2	1
<i>Gennadas</i> , . . .	1	.	1	1	2	1	1
Sergestidæ.							
<i>Petalidium</i> , . . .	.	.	.	.	1	1	
<i>Sergestes</i> , . . .	27	.	3	4	1	2	
<i>Elaphocaris</i> , . . .	1						
<i>Platysaccus</i> , . . .	1						
<i>Acanthosoma</i> , . . .	5						
<i>Mastigopus</i> , . . .	5						
<i>Sciacaris</i> , . . .	2						
<i>Lucifer</i> , . . .	2	1					
Phyllobranchiata.							
Aberrantia.							
<i>Zoontocaris</i> , . . .	2	.					
<i>Sestertius</i> , . . .	1						
Normalia.							
Crangonidea.							
Crangonidæ.							
<i>Crangon</i> , . . .	2						
<i>Pontophilus</i> , . . .	.	.	1	.	1	2	
<i>Sabinea</i> , . . .	.	1					
<i>Pontocaris</i> , . . .	1	.	1				
Polycarpidea.							
Nikidæ.							
<i>Glyphocrangon</i> , . . .	.	.	2	2	4		
<i>Nika</i> , . . .	1						
Alpheidæ.							
<i>Athanas</i> , . . .	1						
<i>Parathanas</i> , . . .	1	1					
<i>Cheirothrix</i> , . . .	1						
<i>Alpheus</i> , . . .	16	2	.	.	.	1 (?)	
<i>Betæus</i> , . . .	2						
<i>Paralpheus</i> , . . .	1						
<i>Symalpheus</i> , . . .	1						
Hippolytidæ.							
<i>Platybema</i> , . . .	.	.	.	1			
<i>Latreutes</i> , . . .	3						

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
<i>Hippolytidae—continued.</i>							
<i>Hippolyte</i> , . . . . .	1	1					
<i>Spirontocaris</i> , . . . . .	.	1					
<i>Nauticaris</i> , . . . . .	2	2	1				
<i>Hetairus</i> , . . . . .	.	3					
<i>Chorismus</i> , . . . . .	.	.	1				
<i>Merhippolyte</i> , . . . . .	.	.	1	1			
<i>Amphiplectus</i> , . . . . .	.	.	1				
<i>Pandalidae.</i>							
<i>Heterocarpus</i> , . . . . .	.	.	4	1			
<i>Plesionika</i> , . . . . .	.	.	5	1	1		
<i>Nothocaris</i> , . . . . .	2	1	2				
<i>Pandalus</i> , . . . . .	.	1	2				
<i>Pandalopsis</i> , . . . . .	.	.	.	1			
<i>Chlorotocus</i> , . . . . .	.	.	1				
<i>Dorodotes</i> , . . . . .	1	.	.	.	1		
<i>Monocarpidea.</i>							
<i>Thalassocaridae.</i>							
<i>Thalassocaris</i> , . . . . .	1						
<i>Diaphoropus</i> , . . . . .	2						
<i>Kyptocaris</i> , . . . . .	1						
<i>Atyidae.</i>							
<i>Atya</i> , . . . . .	3						
<i>Caridina</i> , . . . . .	1						
<i>Pontoniidae.</i>							
<i>Pontonia</i> , . . . . .	(?) 1						
<i>Caricyphidae.</i>							
<i>Caricyphus</i> , . . . . .	5						
<i>Rhomaleocaris</i> , . . . . .	1						
<i>Aneboecaris</i> , . . . . .	1						
<i>Acanthephyridae.</i>							
<i>Bentheocaris</i> , . . . . .	.	.	.	.	1	1	
<i>Acanthephyra</i> , . . . . .	.	.	7	5	4	6	
<i>Systellaspis</i> , . . . . .	.	.	1				
<i>Oplophorus</i> , . . . . .	.	.	.	3	1		
<i>Campylonotus</i> , . . . . .	1	.	3				
<i>Palæmonidae.</i>							
<i>Palæmon</i> , . . . . .	2						
<i>Palæmonella</i> , . . . . .	.	.	1				
<i>Bithynis</i> , . . . . .	2 (fresh-water)						
<i>Brachycarpus</i> , . . . . .	2						
<i>Nematocarcinidae.</i>							
<i>Nematocarcinus</i> , . . . . .	1	.	2	7	7	1	
<i>Stochasmus</i> , . . . . .	.	.	.	.	1		
<i>Tropiocaridae.</i>							
<i>Notostomus</i> , . . . . .	.	.	.	2	2	2	
<i>Tropiocaris</i> , . . . . .	.	.	.	.	1	1	
<i>Hymenolora</i> , . . . . .	.	.	.	1	3	3	
<i>Stylodactylidae.</i>							
<i>Stylodactylus</i> , . . . . .	.	.	1	2			
<i>Pasiphæidae.</i>							
<i>Leptochela</i> , . . . . .	3						



	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
<i>Pasiphæidæ</i> — <i>continued</i> .							
<i>Pasiphæa</i> , . . .	.	.	2	2	1		
<i>Orphanæa</i> , . . .	.	.	.	.			
<i>Oodeopidæ</i> .							
<i>Oodeopus</i> , . . .	7						
<i>Haplopodea</i> .							
<i>Hectarthropidæ</i> .							
<i>Proctetes</i> , . . .	.	.		1			
<i>Icotopus</i> , . . .	1						
<i>Hectarthropus</i> , . . .	4						
<i>Eretmocariss</i> , . . .	4						
<i>Amphion</i> , . . .	2						

## GENERAL OBSERVATIONS.

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The classification of the Macrura into three separate divisions, according to the structural character of one of their most important and essential organs, will be found convenient in the study of this order in relation to its distribution both in time and space.

Each division is apparently of equal importance both in relation to size and structure, but however much they may correspond in certain anatomical details which are characteristic of the separate divisions, or may approximate to one another in general form, yet they are essentially distinct in affinity, both in their development and descent. Independent of the character of the branchiæ, the Trichobranchiata, Dendrobranchiata, and Phyllobranchiata are separated generally from each other by the form of the carapace, the appendages of the pereion, the plan of the rhipidura, and the stage at which the embryo quits the ovum.

In the Dendrobranchiata the brephalos is supposed to exist in the Nauplius condition, from positive evidence in the genus *Lucifer*; and from negative evidence of all the other genera this is supposed to obtain universally throughout the division.

In the Phyllobranchiata the brephalos, so far as it has been observed, is a Zoea, excepting in the case of a few genera in which closely allied forms vary, such as *Alpheus* and *Homaralpheus*, *Acanthephyra* and *Systellaspis*, and *Crangon*, in which it appears that the only separation beyond specific character is that of this variation in the stage of the brephalos.

In the Trichobranchiata the brephalos is in the Megalopa condition, of which *Phyllosoma* is an immature stage; this is universal in the division, excepting in the genus *Stenopus*. According to their branchial structure both *Stenopus* and *Spongicola* belong to the Trichobranchiata, while the appearance of their carapace resembles that of the Phyllobranchiata, and the structure of their legs corresponds with that of the Dendrobranchiata; whereas in the manner of their development, the brephalos of *Stenopus* appears to be a Megalopa, approaching in form that of the Trichobranchiata, while that of *Spongicola* is a Zoea, approaching that of the Phyllobranchiata.

In the Dendrobranchiata *Lucifer* is the only genus the development of which has been accurately determined, although the negative evidence arising from the absence of the attachment of ova in all known genera is suggestive of their being fertilised as in *Lucifer*, and hatched also in the Nauplius stage.

In the Phyllobranchiata the brephalos quits the ovum as a Zoea, but to this rule there are exceptions, and these may exist in nearly allied species, as in *Alpheus* and *Homaralpheus*, which are generically separated on the physiological grounds that *Alpheus* has the brephalos hatched in the form of a Zoea and *Homaralpheus* in the form of a Megalopa. Similar reasons suggested the separation of *Systellaspis* from *Acanthephyra* and *Crangon arctus* from *Crangon vulgaris*. Now if we turn to the genus *Oplophorus*, which Milne-Edwards has ranged among the Penæidea—chiefly it appears from its having a series of large basephyses attached to the legs—there is nothing in its general form excepting the non-chelate character of the third pair of pereiopoda which prevents it from being considered a long-spined congener of *Sicyonia*,

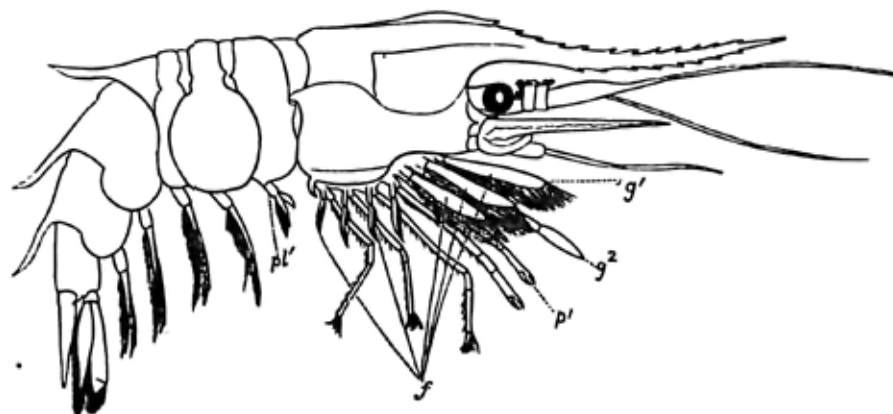


FIG. XVI.—*Oplophorus typus*, from a drawing by the late Dr. R. von Willemoes Subm. *g*<sup>1</sup>, first gnathopod; *g*<sup>2</sup>, second gnathopod; *p*<sup>1</sup>, first pereopod; *f*, basephyses; *pl*<sup>1</sup>, first pleopod.

which it approximately resembles, yet we know that they differ in the manner of their development and in the structure of their respiratory organs, and therefore are widely separated in their genealogical history.

If therefore we utilise our observations on the external form of these recent Crustacea we may be able to read much of their internal structure and organisation, and determine the true relation of the fossil forms to their recent congeners. And I believe that I am near to the truth in asserting that nearly all, if not all, the Macrurous forms that are found in the earliest geological formations belong to the Trichobranchiata, either Normal or Aberrant.

There are some genera which have only been deciphered from such very distorted or injured fragments that it is impossible as yet to determine their perfect structure; such is the case with *Palæocrangon* (?) *socialis*, Salter, and of *Gilocrangon*, Ritchie, of which

Mr. Salter says—"It is, I should think, doubtful, judging by the figures, if it be a crustacean at all."<sup>1</sup>

The genus *Palæocarabus*—of which the species *Palæocarabus russellianus*, being the best preserved, may be accepted as the type—is very near the Astacidea with its short and stunted scaphocerite; but *Anthropalæmon*, of which the species *Anthropalæmon frosartii* appears to be the most perfect in preservation, has no scaphocerite, nor can this be due to its want of preservation, inasmuch as the peduncle of the second antennæ is well preserved and minutely figured by the late Mr. J. W. Salter.<sup>2</sup>

Among the specimens of the Challenger collection, I found in one of the bottles a dismembered specimen of a deep-sea genus belonging to the Galatheidæ, that so closely resembled the fossil *Anthropalæmon* that it might I think be accepted as belonging to the same genus. The fossil specimen is recorded from the "slaty band" of the black-band ironstone of the Carboniferous limestone of Lanarkshire. The genus *Pemphix*, von Meyer, appears to possess all the characters of a Galathæan; while the genera *Glyphæa* and *Scapheus* approach the Callianassidæ, to which family the genus *Megacherus* appears also to belong.

The genus *Clytia*, as restored by Reuss, except for the accidental additions of a somite too many to the pleon, is suggestive of the genus *Phoberus*, A. Milne-Edwards, in which the appendages are a little more robust than is seen in the Challenger species, *Phoberus tenuimanus*; and the genus *Thaumastocheles* has its prototype in the recently discovered *Stenocheles* of the Chalk formation of Bavaria.

Münster's species of *Palinurella pygmæa* from the White Jura bears a near resemblance to a young specimen of *Palinurus* of the recent seas, of which the common Rock or Spiny Lobster (*Palinurus vulgaris*) may be considered as the type. It is generally called the "Crawfish" by the Cornish fishermen, and is very plentiful all round the shores of Europe, being very abundant at the entrance to the English Channel. It appears to be essentially a northern and southern form. It is represented in the South Indian Ocean by *Palinurus edwardsii*, which ranges from the Cape of Good Hope to New Zealand, by *Palinurus trigonus* in Japan, *Palinurus frontalis* on the coast of South America, and by *Palinurus longimanus* from the Antilles. Besides these species which are only separated from each other by small differences that have only been appreciated by the minute observations of modern research, there are a large number of allied forms, which are more widely separated in organisation, but which may readily be determined by having the flagella attached to the first pair of antennæ very much longer and more slender than in those already referred to. These were placed by the late Dr. Gray of the British Museum under the generic name of *Panulirus*.

<sup>1</sup> *Quart. Journ. Geol. Soc.*, vol. xvii. p. 533, 1861.

<sup>2</sup> *Quart. Journ. Geol. Soc.*, vol. xvii. p. 531, figs. 1, 2, 1861.

The localities of this latter genus appear to be more numerous within the warmer or tropical latitudes, as may be seen from the accompanying table :—

<i>Panulirus americanus</i> , Lamarck, . . . . .	Antilles.
„ <i>dazipus</i> , Latreille, . . . . .	India.
„ <i>dugessii</i> , de Haan, . . . . .	Japan.
„ <i>fasciatus</i> (Fabricius), . . . . .	Indian Ocean.
„ <i>guttatus</i> , Latreille, . . . . .	Antilles.
„ <i>interruptus</i> , Randall, . . . . .	California.
„ <i>japonicus</i> (de Haan), . . . . .	Japan.
„ <i>longipes</i> , A. Milne-Edwards, . . . . .	Antilles.
„ <i>ornatus</i> (Milne-Edwards), . . . . .	Hong-Kong.
„ <i>penicillatus</i> , Milne-Edwards, . . . . .	Tahiti.
„ <i>speciosus</i> , Milne-Edwards, . . . . .	Pacific.
„ <i>sulcatus</i> (Lamarck), . . . . .	India.

Of these localities, Japan, that is about 40° N. lat., is the most northerly range, whereas the species of *Palinurus* in which the flagella of the first pair of antennæ are short have been taken, with the exception of the little known species *Palinurus longimanus*, south of the Cape of Good Hope or north of the latitude of the Japanese Islands.

In passing to a consideration of the closely allied genera of Scyllaridæ it is necessary to notice the ancient form of *Cancerinos claviger*, Münster, found in the White Jura of Bavaria, which possesses much of the character of the Scyllaridæ, but has the outer pair of antennæ multiarticulate as in the Palinuridæ, but reduced in length to about that of the carapace, and has the flagellum increased in diameter to a greater degree than that of the peduncle, as if it were in anticipation of assuming the broad flat uniarticulate condition of the Scyllaridæ. The body of the animal itself is apparently broader and more depressed dorsally than in the Palinuridæ. This genus leads us on to the Scyllaridæ, of which the earliest form appears to have been found in *Thenops scyllariformis*, Bell, of the London Clay.

This family in the recent seas is remarkable for the broad and foliaceous character of the flagellum of the second pair of antennæ, which, instead of being multiarticulate, consists of a broad and uniarticulate disc-like plate.

Most of our recent species are inhabitants of the warmer zones. *Ibaccus peronii* has been taken as far south as Australia, but all the other species appear to be inhabitants of the tropical regions. One species of the genus *Scyllarus* has been taken as far north as Japan, or in latitude 40°, and the closely allied form *Arctus* has been found as far north as lat. 50°, it being common on the French coast, and on the islands at the entrance to the English Channel, and it has occasionally been found as far north as the shore of Cornwall and Devon, and sometimes has even been taken in Plymouth Sound.

The general distribution is shown in the following table :—

<i>Ibaccus brevipes</i> ,	.	.	.	New Guinea.
„ <i>pares</i> ,	.	.	.	Antilles.
„ <i>peronii</i> ,	.	.	.	Australia.
„ <i>verdi</i> ,	.	.	.	Cape Verde Islands.
<i>Thenus orientalis</i> ,	.	.	.	Seychelles Islands and the Indian Ocean.
<i>Arctus immaturus</i> ,	.	.	.	Cape Verde Islands.
„ <i>orientalis</i> ,	.	.	.	Philippine Islands.
„ <i>pygmæus</i> ,	.	.	.	Canary Islands.
„ <i>rugosus</i> ,	.	.	.	India.
„ <i>sordidus</i> ,	.	.	.	Hong Kong.
„ <i>tuberculatus</i> ,	.	.	.	New Guinea.
„ <i>ursus</i> ,	.	.	.	Europe.
<i>Scyllarus æquinoctialis</i> ,	.	.	.	Antilles.
„ <i>latus</i> ,	.	.	.	Canary Islands.
„ <i>sculptus</i> ,	.	.	.	.
„ <i>squamosus</i> ,	.	.	.	Antilles.

Numerous species of the genus *Eryon* have been found in the Lias of England, Normandy, and the Upper White Jura of Bavaria. This family is numerously represented in our recent fauna, the whole of the species being inhabitants of the deeper parts of the ocean; generally preferring to dwell where the bottom is mostly covered by *Globigerina* ooze, excepting in the case of the genus *Stereomastis*, which lives on a muddy bottom in the narrow channels between the mainland and the numerous islands on the western coast of Patagonia, at a depth of 200 to 600 fathoms. Species of the recent genus *Willemæsia* are to be found in Mid, North, and South Atlantic, as well as in Mid Pacific, at a depth of about 2000 fathoms, while *Pentacheles* and *Polycheles* are met with at from 100 to 1000 fathoms in channels among the Polynesian Islands, as well as in the West Indies, whilst another representative form, *Eryoneicus*, exists among the Cape Verde Islands.

The genus *Hoploparia* of the Green Sand and London Clay, appears to be represented in our recent Homaridæ; so much so that *Hoploparia longimana* from Lyme Regis corresponds so closely with *Nephropsis rosea* as to appear to be only a smoothly rostrated species of the same genus, and both bear a near resemblance to a young *Homarus*, from which they differ in having no scaphocerite and smaller ophthalmopoda.

Different species of *Nephropsis* have been found in the North Atlantic, the West Indies, the South Atlantic, and the Celebes Seas, all of which possess the remarkable feature in common with the fossil form of having no scaphocerite, and the ophthalmopoda are also reduced to a rudimentary condition.

The consideration of these species gradually leads to that of another family of no very different structural character, but with very distinct surroundings. Instead of inhabiting the deeper recesses of the sea, the group *Astacidea* inhabits the fresh-water

streams and lakes of the continents and larger islands of both the northern and southern hemispheres.

The northern genera differ in the number of their branchiæ from those of the southern, which also exhibit evidence of a divergence in descent.

Those of Europe and America possess evidence of a closer consanguinity, but are generically separated by the numerical distinction of the branchial plumes; whilst those of Eastern Europe and Western Asia differ only in specific value very considerably from those of Western Europe, those of Eastern Europe differ in external form but slightly from those of Eastern America.

Those that inhabit the rivers of South America differ in external appearance from those of the northern continent, but bear a corresponding resemblance to those that inhabit the rivers of Australia, while these latter differ widely both in appearance and structure from the New Zealand forms. The solitary species of the only genus of Madagascar differs structurally from, but corresponds externally with, those that belong to Australia.

In all the northern forms the outer margin of the dactylos is either straight or incurved, whereas in the southern genera the same part is always arched or curved outwards. It is but a small distinction, but it is one that is invariably capable of determining the northern from the southern species, and it is interesting to notice that a fossil species was recently found in the Eocene formation of North America that possesses this congenital feature peculiar to the northern forms; a circumstance that demonstrates the long and persistent character in the history of this feature.

The several species have been arranged in accordance with their general form and the number of their branchiæ into the following genera:—

*Astacus* in Europe and Asia.

*Astucoides* in Madagascar.

*Astacopsis* in Australia.

*Cambarus* in North and East America.

*Cherops* in Tasmania.

*Engæus* in Tasmania.

*Paranephrops* in New Zealand.

*Parastacus* in Australia and South America.

In looking back through past ages it would appear that the earliest macrurous forms are those that have been obtained from the coal measures of Shropshire and Glasgow, and if the illustrations given be anatomically correct, the structure of *Palæocarabus* corresponds with a Crustacean that belongs to the Trichobranchiata. The short and stunted form of the scaphocerite of the second pair of antennæ is such as is seen to exist in the Astacidea of recent periods, but the restoration of the specimen of *Palæocarabus russellianus*, as given in Salter's paper,<sup>1</sup> shows that the rostrum is long and laterally compressed, contrary to its character in the Astacidea, or in fact in any of the Trichobranchiata, excepting those of the family Stenopidæ.

<sup>1</sup> *Quart. Journ. Geol. Soc.*, vol. xix. p. 520, figs. 1, 2.

The Dendrobranchiata have a few representatives in the ancient seas. *Penæus speciosus*, Münster, from the White Jura of Bavaria, is closely allied to the recent deep-sea genus *Gennadas*; and *Dusa monocera* bears a miniature resemblance to *Penæus monodon* of the Indian Ocean. The form of *Aeger* as restored in Salter and Woodward's Chart of Fossil Crustacea is evidently supposed by them to be of the same genus, and *Blaculea sieboldi* may belong to *Penæus* also.

The recent genera that belong to this division, with the exception of the Sergestidæ, are mostly pelagic in their habits. In Japan the species *Penæus canaliculatus* is of considerable size and is used as an article of food, a circumstance that would argue for its frequenting water sufficiently shallow to be within the reach of ordinary fishermen, but, in the record given, it is probable that many specimens are those of wanderers from the deeper waters of their ordinary localities. Only one specimen of *Gennadas* is stated to have been captured within 50 fathoms of the surface, while others have been taken beyond 3000 fathoms, and it is this deep-sea species that corresponds most nearly with *Penæus speciosus*, Münster; while *Dusa monoceros* of the same geological horizon bears a tolerable resemblance to *Penæus monodon*, which is an inhabitant of less than 30 fathoms. With the exception of a few species, such as *Petalidium*, that have been dredged, almost all the Sergestidæ have been taken within 50 fathoms of the surface, and none of these have been recorded as having been found in a fossil condition.

The division Phyllobranchiata is still more feebly represented. *Tropifer lævis*, Gould,<sup>1</sup> appears to me to approximate more nearly to the genus *Pontocaris* of the Crangonidæ than, as supposed by the author, to the genus *Nephrops* or *Scyllarus*, in consequence of the lateral position of the ophthalmopoda. The absence of any rostrum, and the presence of the ophthalmopoda as short and spherical bodies at the outer angles of the frontal margin of the carapace, bear comparison with *Pontocaris*, the carapace of which is longitudinally traversed by carina, and transversely divided by a cervical fossa. In the fossil specimen the ophthalmopoda are at the extreme fronto-lateral angles of the carapace, while in *Pontocaris pinnata* (Pl. XCI. fig. 1) the fronto-lateral angles project on the outer side of them, but in the younger forms of Crustacea the ophthalmopoda are more in accordance with the condition seen in the fossil specimen.

*Urodella agassizii*, Oppel, from the Upper White Jura of Bavaria, may find its congener in the genus *Crangon* of recent times, but the pereopoda are not sufficiently figured in clear detail for a fixed opinion to be given.

The common Shrimp that so abundantly frequents the shores of Europe, lives generally where the sand is fine and most abundant. They swim about in the shallow water that precedes the incoming tidal wave, or when at rest sink to the bottom and partially bury themselves in the sand, first by wriggling out a depression with their legs and bodies,

<sup>1</sup> *Proc. Zool. Soc. Lond.*, vol. xiii. p. 360, fig. 1.



and then by dragging the sand over their backs by the aid of their long antennæ until they are covered, all but their eyes, which appear above the sand, and suit well the tint of their surroundings. The speckled grey of their surface is common to all the specimens that dwell in shallow water, but often migrants may be found in deeper water, in which the change of colour at first provokes the belief in a distinction of more importance, since with the loss of the speckled appearance they also possess a more slender form, that may be induced through an increase of restless activity in a search for food and from the lessened necessity for hiding from passing dangers.

On the Japanese coast, in the narrow channels that separate the islands, specimens have been taken at from 10 to 12 fathoms, that so closely resemble our European species that we are not able to determine any constant feature of distinction; and in fact the Japanese species more closely resemble those of the shallow waters of our bays than do the specimens taken from deeper water in the same locality.

Not only do we find our common Shrimp, *Crangon vulgaris*, in the seas of Japan, but we also meet with it on the eastern coast of North America, whilst on the western shores as far south as Mexico there is found a species that Dr. Stimpson named *Crangon nigricauda* from its having the sixth somite of the pleon black in colour, but most other observers agree, from a close analytical examination, that it is not distinct from our European species.

Thus it would appear that this familiar form may be found common perhaps to all the sandy shores of the entire northern hemisphere.

According to the observation of specimens brought home by the Challenger the several species of *Nematocarcinus* only differ from one another in the relative length of the projecting rostrum, the numerical value of their dental ornamentation, and the comparative length of their legs, which are found to extend over a considerable space.

The species extend geographically from the line of the southern icy sea-board to the latitude of Japan in the northern hemisphere, and along the line of the Australasian Archipelago from Celebes to the Kermadec Islands, to which I may add that they have been taken in the West Indies by the "Blake" Expedition, and in the Atlantic during the cruise of the "Travailleur."

In all the habitats recorded, the sea-bottom consists of a Diatomaceous or Globigerina ooze, with the exception of the neighbourhood of the Kermadec Islands, where it is recorded as being rocky, although at a short distance off the island a muddy bottom exists.

In the track from south to north, that is from the South Indian Ocean, a great line of current has its course over the area occupied by these animals, running up the eastern coast of Australia, and turning westward among the islands of the Archipelago of New Guinea, Celebes, and the Philippine Islands, turning northward and travelling along the eastern shores of Asia, till it sweeps eastward along the shore of Japan.

These long-legged Prawns (*Nematocarcinus*) are essentially free-swimming forms, that probably pass their lives in mid-water, at an average depth of 1000 fathoms. The largest number of specimens at the largest number of stations have been taken between 500 and 2000 fathoms, while at one station there were fifteen specimens taken at 28 fathoms in the shallow waters of the Arafura Sea. In every instance of their capture the trawl was used, although in some instances the dredge was employed also, and it is probable that they only occasionally come into contact with the sea-bottom, and the greatest depth at which they have been taken is 2150 fathoms off the Celebes Islands, or about two miles from the surface. The second deepest range is south of Japan, at a depth of 1875 fathoms, or about one mile and one-eighth. Off Juan Fernandez in the Pacific, specimens were taken at two stations at an average depth of one mile.

In this genus there are several species which depart from each other in characters apparently so unimportant that it is difficult to fix on any salient points of sufficient importance to determine specific features. Thus *Nematocarcinus longicarpus*, *Nematocarcinus parvidentatus*, *Nematocarcinus paucidentatus*, and *Nematocarcinus serratus* are chiefly determinable by the form and number of the teeth on the rostrum, which bear a relation to one another as to number and position on the upper and lower margin, as shown below:—

<i>Nematocarcinus parvidentatus</i> ,	Japan,	$\frac{24}{0}$
„ <i>paucidentatus</i> ,	Fiji,	$\frac{9}{1}$
„ <i>serratus</i> ,	New Zealand,	$\frac{30}{0}$
„ <i>tenuipes</i> ,	Japan, Admiralty Islands,	$\frac{20}{1}$

Again, if we turn to another group which is remarkable for having a long rostrum, and for being larger when adult, we find that the external variations are but small and apparently unimportant beyond the numerical value of the teeth on the rostrum, which may be tabulated as follows:—

<i>Nematocarcinus altus</i> ,	Philippines,	$\frac{15}{2}$
„ <i>lanceopes</i> ,	Antarctic,	$\frac{26}{8}$
„ <i>longirostris</i> ,	Japan,	$\frac{40}{5}$
„ <i>proximatus</i> ,	Marion Island, Valparaiso, Arafura Sea, Japan,	$\frac{34}{1}$

These four species have been taken at very distant localities. *Nematocarcinus longirostris* was found only on the south coast of Japan, *Nematocarcinus altus* only near the island of Celebes, and *Nematocarcinus proximatus* at two stations off the western

coast of South America, also off Marion Island in the South Indian Ocean, in the Arafura Sea, and near Japan.

It appears to me difficult to believe that these are not merely variations of one and the same species, and that if they were compelled to reside under similar local conditions, the unimportant specific distinctions would be bridged by many intermediate forms.

Although separated widely in space the conditions under which these species exist may in some respects approximate to each other. Thus the temperature at which they have severally been recorded to live off Japan and the western coast of South America do not differ widely, being  $41^{\circ}1$  in the former and  $35^{\circ}5$  in the latter. Although *Nematocarcinus altus* was taken at a still greater depth off the north-west coast of the island of Celebes, and near to land, at a depth of 2150 fathoms, with a temperature of  $38^{\circ}9$ , that is at a temperature that is more commonly recorded at the depth of 600 fathoms.

If we compare the specific characters of one group with those of the other, we shall find but little difference beyond the number of teeth on the rostrum. Closer examination with others will show that these teeth are generally smaller and more crowded in the first and less so in the second where the rostral process is longer.

All these distinctions are but slight in relation to the physical conditions which appear to lead to the true features of specific character.

No specimen of this genus has so far as we know been found fossil.

The fresh-water genus *Atya* is very remarkable, both for its peculiarity of form and for the distant localities in which it has been found.

The American naturalist Randal described a small specimen which was taken in the rivers or ponds of the island of Hawaii, under the name of *Atyoida*, and another species, but very closely resembling it, was taken by the late Dr. Stimpson in the island of Tahiti, whence numerous specimens were brought home in the Challenger collection. A third has been taken in the rivers of Mexico by Saussure, and, lastly, from the river *Potimerim* in South America.

The older known species that have longer been associated with the genus are eight in number, and are found in localities here tabulated:—

<i>Atya armata</i> , . . . . .	New Zealand.
„ <i>margaritacea</i> , . . . . .	New Caledonia.
„ <i>occidentalis</i> , . . . . .	Mexico and West Indies.
„ <i>pipilles</i> , . . . . .	New Zealand.
„ <i>robusta</i> , . . . . .	New Caledonia.
„ <i>scabra</i> , . . . . .	Mexico and West Indies.
„ <i>spinipes</i> , . . . . .	New Zealand.
„ <i>sulcatipes</i> , . . . . .	Cape Verde Islands

Associated with *Atya sulcatipes* was a specimen of *Atya (Atyoida) serrata*, and a

damaged specimen of what I have described as *Caridina typus*, Milne-Edwards, but which I am much inclined to think from its immature condition is the young of the *Atya sulcatipes* that exists in the same locality.

In form these animals have a very peculiar feature in the articulation of the heavy chelate joint of the first two pairs of pereopoda, which has been described at pp. 6 and 7 of this Report and by Dr. Fritz Müller.<sup>1</sup> When the hand is opened, according to Fritz Müller, the hairs upon the margin of the fingers spread like a fan, gather and retain fine mud; when the hand is closed these hairs close round the mud and compress it into a pellet which is passed into the mouth, and so the animal lives on the small organic substances that exist in the mud, which it collects with great rapidity.

These animals, of which the male is smaller than the female, as is frequently the case when they are not provided with offensive weapons, are only known to inhabit fresh water, and singular to relate, although they are inhabitants of distant localities, several of which are oceanic islands, yet all the species bear so close an affinity of form that it is difficult to determine one from the other by any permanent character.

The question naturally arises how, so far asunder as the habitats of these animals are, can they be brought to live without any intermediate connecting influence as far as we can determine?

Mr. Darwin, in his book on Earthworms, says that in every bit of land or distant island worms are found in the soil; considering that they are land and air-breathing animals, it is a matter of curious interest to determine how they get where they are.

M. A. Certes, in the Comptes rendus, says that having taken carefully collected sediment from which he evaporated the water, he three years afterwards treated the residue with boiled and filtered rain-water. All care having been taken to keep out germs from the air, after two months a *Nauplius*-like form was detected which later on took the form of *Artemia salina*. M. Certes points out that in cases of this kind death was only apparent, and that organic conditions and nutritive changes do not cease entirely. Thus it appears that it is quite possible for wading birds to be the means of carrying mud containing either animals or ova to a considerable distance and so transferring species to a great distance from one locality to another.

One of the most abundant in specific forms is the genus *Alpheus*, including those subgenera that are separated more for the convenience of classification than from any distinguishing point of more than specific value, *Paralpheus*, *Synalpheus*, *Cheirothryx*, and *Betæus*. These contain about eighty different species, and with the exception of a single instance they have all been taken within 52 fathoms from the surface. They are mostly recorded from muddy bottoms, but they are frequently found sheltered among Corallines and masses of Sponges. From their frequently being found in ooze and muddy bottoms I am inclined to believe that they burrow more decidedly than is the

<sup>1</sup> *Kosmos*, vol. ix. pp. 117-124, 1881.

habit of our common Shrimp, for which purpose the ophthalmopods have become protected by the frontal margin of the carapace.

They are mostly inhabitants of the warmer seas, abounding in tropical and subtropical regions, becoming scarce in the temperate, and gradually disappearing towards the subarctic regions. One specimen alone of *Betæus truncatus* is recorded by Dana from Cape Horn, where it was dredged in 10 fathoms of water, with which exception none of the family has been observed further south than New Zealand (50° S. lat.), or further north than the English Channel (52° N. lat.).

It is essentially a sublittoral form, for the instances of its being found beyond 20 fathoms are few, and these are suggestive of doubt, inasmuch as *Alpheus avarus* is recorded in our collection as being taken off Tongatabu at a depth of 18 fathoms, and in Mid-Pacific at 2675 fathoms, south of Japan.

I am not aware that any species of this or the allied genera has been found fossil.

The family of the Pasiphæidæ is but poorly represented in the Challenger collection, there being only three genera, *Pasiphæa*, *Orphania*, which are deep-sea forms, and *Leptochela*, which, if found at the bottom, lives within 50 fathoms of the surface. It is interesting to compare these species with a fossil form that has been much discussed among geologists, but it appears to me that if the interpretation of *Pygocephalus huxleyi* of Woodward<sup>1</sup> be correct, there can be little doubt that it is closely allied to the genus *Pasiphæa*, and that it differs from *Pasiphæa cristata* (Pl. CXLI. fig. 1) in little that cannot be considered as of merely specific importance.

<sup>1</sup> *Trans. Geol. Soc. Glasgow*, vol. ii. fig. 2, p. 243.

## DESCRIPTIONS OF GENERA AND SPECIES.

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### Suborder **MACRURA.**

THIS section of the order Decapoda in the Crustacea may be generally defined by the following external characters:—

The animal is elongated and compressed. The carapace is less than half the length of the animal, and is anteriorly produced in the median line and covers the ophthalmic somite.

The ophthalmopoda are not enclosed within orbits, and rest in a hollow in the upper surface of the first joint of the peduncle of the antennæ.

The first pair of antennæ is elongated, and not planted in fossettes.

The second pair is considerably elongated, and carries a foliaceous appendage attached to the second joint.

The second pair of gnathopoda is elongated and pediform.

The pereopoda have seven distinct joints, of which the coxa articulates with the pereion.

The pleopoda consist of biramose appendages, of which the anterior pair varies from the succeeding, and the posterior is associated with the telson and helps to form the great caudal fan or rhipidura, which is the only feature that is invariably constant and common to all families of the suborder.

Variations both in the structure and in the relative importance of parts occur in most organs, in some to a considerable extent, but the passage from one modification to another clearly demonstrates that such changes are of specific or generic value only. This is well shown in some species of *Pentacheles*, where some have the branchial lash (mastigobranchia) large, others small, and in some it is wanting altogether, and this variation occurs in specimens which differ little in external appearance, and which were procured in some instances from the same locality.

One of the most conspicuous variations of structure, and most convenient for examination, is to be found in the branchial appendages. In some genera these organs are developed as a series of leaf-like plates, in others they exist as feather-like plumes of slender cylinders, and again they are found to divide into a series of tree-like branches,

while in others they are absent from the pereion, or attached to the pleon also; consequently nearly every carcinologist who has attempted to construct a natural classification has made use of characters founded upon the branchial apparatus.

The broad division in the general structure of the branchial organs has long been recognised, and its full value appreciated. Dana<sup>1</sup> says, "The branchial system is one from which we should particularly expect important distinctions and valuable characteristics of the highest significance, and such distinctions exist. They are at the basis of some of the primary subdivisions, as exhibited in the systems of Milne-Edwards, and to a large extent also in the system of De Haan."

It is, however, very remarkable that, with this full conviction and desire, Dana has not utilised his observations beyond those of previous writers, who divided the Decapod Crustacea into two groups,—one having the branchiæ protected by a carapace, the other having them uncovered and pendent. Dana's terms of "Eubranchiata" and "Anomobranchiata" are synonymous with "branchies cachées" and "branchiogastres," the first and second orders of the Malacostraca of Latreille's earlier classification, and the Decapoda and Stomapoda of his later.

The system of De Haan is based on the arrangement of the branchiæ to such an extent as to divide the Macrura into two portions, separating those in which the organs consist of a series of long cylindrical filaments from others in which the structure is foliaceous, consisting of a series of leaf-like plates.

But De Haan appears to have appreciated the numerical value of the branchial character rather than the position of the plumes in relation to the general structure of the animal.

The great object of a natural systematic arrangement is to determine the internal structure by external evidence, without which it appears to me no classification can be perfect, especially in the future, when extinct forms must be studied in their relation to existing species, and this can only be done in the Crustacea through the preservation and knowledge of the harder or external parts.

The classification of Latreille separates the Macrurous Crustacea, in which the branchiæ are attached to the anterior limbs, and protected by the carapace, from those which have the branchiæ attached to the posterior limbs, or unprotected; that is, those in which the branchiæ belong to the pereion from those in which they are attached to the pleon, or absent.

This general arrangement has been adopted by Milne-Edwards and Dana with scarcely a variation in the general outline, and the subdivisions of their classifications also closely correspond. Thus the "Astacini" of Latreille agree closely with the "Astaciens" of Milne-Edwards, and the two tribes, Thalassinidea and Astacidea of Dana, correspond respectively with two divisions of the "Astacina" of De Haan.

<sup>1</sup> United States Explor. Expedition, vol. i. p. 61.

In the following table (pp. 4, 5) I have brought together, in one general scheme, an outline of the several classifications that have been adopted by the more distinguished carcinologists, so far as they relate to the Macrurous Crustacea.

It is interesting to observe how closely these different systems correspond as to their general conclusions, the chief points of distinction being with regard to those genera which, while they resemble one group in external form, approach some other group in some important structural character.

The arrangement of Latreille agrees closely with that of De Haan, even to the introduction of the phyllobranchiate families of the Paguridæ and Porcellanidæ among the anomurous forms.

The classification of Milne-Edwards differs in separating the Eryonidæ, Scyllaridæ, and Palinuridæ from the Astacidea, where all other authors, excepting Heller, place them, and in grouping them along with the Galatheidæ.

Dana differs from the others in the exclusion of the Galatheidæ and allied families from the Macrura altogether, and in forming a sub-tribe to receive *Penæus* and its allied genera, among which he includes *Stenopus*.

The more recent system proposed by Professor Huxley is almost identical with that of Latreille, as given in Cuvier's *Règne Animal*, 2nd ed., vol. iv., 1829, and quoted by Milne-Edwards in his *Hist. des Crust.*, t. i. p. 217, differing only in the removal of the family of the Penæidæ from among the Salicoques, where all preceding authors, excepting Dana, have placed it, and transferring the same to range with the Trichobranchiata, a section that corresponds with that of the "Homards" of Latreille, and is synonymous with the three divisions—Astaciens, Thalassiniens, and Cuirassés of Milne-Edwards—and with the *Astacina* of De Haan. It, moreover, corresponds with the Astacidea, Thalassinidea, and Penæidea of Dana, and with the Loricata, Astacidea, and Thalassinidæ of Heller, whose classification is identical with that of Milne-Edwards, excepting in the terms selected for the names of the separate groups.

It would thus appear that the various systems of classification have failed to receive acceptance by each successive naturalist, from the circumstance that the several tribes or groups have received their distinguishing title from the most prominent or distinctive animal in its respective group or tribe, a circumstance that must render a nomenclature very liable to be changed with any variation of individual thought, dependent upon the opportunity of study, as well as with the increase of knowledge through extension of research.

The nomenclature recently suggested by Professor Huxley, being based upon the structural character of the branchiæ, appears not to be open to this defect.

He has proposed that the Macrura be divided into three groups,—the Trichobranchiata, the Phyllobranchiata, and the Abranchiata.

*Trichobranchiata* are those that have the branchial plumes made up of long



TABLE SHOWING THE VARIOUS SYSTEMS OF CLASSIFICATION ALREADY PROPOSED.

<p>LATREILLE, . . . . . 1831.</p>	<p>Order I. DECAPODA. Family II. MACROURUS.</p> <p>Section 1. Section 2. Section 3.</p> <p>(9) Caridea. (10) Coleopoda.<sup>1</sup> <i>Palæmon.</i> <i>Cryptopus.</i></p>	<p>Order II. STOMAPODA.</p> <p>Family I. CARIDIODES. Family II. UNIPELTATA. Family III. BIPELTATA.</p> <p><i>Thysanopoda.</i> <i>Squilla.</i> <i>Phyllosoma.</i></p>	
<p>MILNE-EDWARDS, 1837.</p>	<p>Division I.</p> <p>Subdivision 1. (1) Notopterygia. <i>Albana.</i></p> <p>(2) Hippidea. <i>Hippa.</i></p> <p>(3) Pagurii. <i>Pagurus.</i></p> <p>Subdivision 2. (4) Scyllaridea. <i>Scyllarus.</i></p> <p>(5) Palinurii. <i>Palinurus.</i></p> <p>Subdivision 3. (6) Galathinae. <i>Galathea.</i></p> <p>Subdivision 4. (7) Thalassinidea. <i>Thalassinia.</i></p> <p>(8) Astacini. <i>Astacus.</i></p>	<p>Division II.</p>	
<p>DE HAAN, 1850.</p>	<p>ANOMALA.</p> <p>Galathea. <i>Galathea.</i></p> <p>Porcellanidea. <i>Porcellanidea.</i></p> <p>Hippidea. <i>Hippidea.</i></p> <p>Paguroidea. <i>Paguroidea.</i></p> <p>Lithodaeceae. <i>Lithodaeceae.</i></p> <p><i>Homarus.</i> <i>Thalassinia.</i></p> <p><i>Nephrops.</i> <i>Gebi.</i></p> <p><i>Astacus.</i> <i>Callinectes.</i></p> <p><i>Azza.</i> <i>Callinectes.</i></p> <p><i>Laomedea.</i></p>	<p>DECAPODES.</p> <p>MACROURUS.</p> <p>FOURISSURES. <i>Cryptobranchiides.</i></p> <p>Gastrobranchiides. <i>Gastrobranchiides.</i></p> <p>ASTACIENS. <i>Astacus.</i></p> <p><i>Homarus.</i></p> <p><i>Nephrops.</i></p> <p>SALICOQUES. <i>Crangonidea.</i></p> <p>Alpheidea. <i>Alpheidea.</i></p> <p>Palæmonidea. <i>Palæmonidea.</i></p> <p>Penæidea. <i>Penæidea.</i></p> <p><i>Stenopus.</i> <i>Opyrops.</i></p> <p><i>Penaeus.</i> <i>Parapenaeus.</i></p> <p><i>Sicyonia.</i> <i>Sergestes.</i></p> <p><i>Ephyrus.</i> <i>Actæa.</i></p>	<p>STOMAPODES.</p> <p>CARIDIODES. <i>Myisidea.</i></p> <p>Leuciferiens. <i>Leuciferiens.</i></p> <p>BICURASSÉS. <i>Phyllosoma.</i></p> <p><i>Anphion.</i></p> <p>UNICURASSÉS. <i>Erethrina.</i></p> <p>Squillidea. <i>Squillidea.</i></p>
<p>DE HAAN, 1850.</p>	<p>ASTACINA.</p> <p>Scyllaroides. <i>Scyllaroides.</i></p> <p>Palinuridea. <i>Palinuridea.</i></p> <p>Eryonidea. <i>Eryonidea.</i></p> <p>Astacoides. <i>Astacoides.</i></p> <p><i>Homarus.</i> <i>Thalassinia.</i></p> <p><i>Nephrops.</i> <i>Gebi.</i></p> <p><i>Astacus.</i> <i>Callinectes.</i></p> <p><i>Azza.</i> <i>Callinectes.</i></p> <p><i>Laomedea.</i></p>	<p>CARIDES.</p> <p>Palæmonidea. <i>Palæmonidea.</i></p> <p>Alpheidea. <i>Alpheidea.</i></p> <p>Crangonidea. <i>Crangonidea.</i></p> <p>Alyidea. <i>Alyidea.</i></p> <p>Penseidea. <i>Penseidea.</i></p> <p><i>Penæus.</i> <i>Sicyonia.</i></p> <p><i>Stenopus.</i> <i>Sergestes.</i></p> <p><i>Spongycola.</i> <i>Purpuridea.</i></p>	<p>STOMAPODA.</p> <p>Unipeltata. <i>Squilla.</i></p> <p><i>Erechthidea.</i></p> <p>Caridina. <i>Myisidea.</i></p> <p><i>Leuciferidea.</i></p> <p><i>Anphionidea.</i></p> <p>Bipeltata. <i>Phyllosoma.</i></p>

ANOMOBRANCHIATA.

- Squillae. Mysidea.
- Mysidae.
- Euphausiidae.
- Leuciferidae.

EUBRANCHIATA.

- THALASSINIDEA.
  - Gebidae.
  - Callinassidae.
  - Thalassinidae.
- ASTACIDEA.
  - Scyllaridae.
  - Palinuridae.
  - Eryonidae.
  - Astacidae.
- CARIDEA.
  - Crangonidae.
  - Atyidae.
  - Palaeomonidae.
  - Possiphonidae.
- PENAEIDEA.
  - Peneidae.
  - Sergestidae.
  - Eucopidae.

ANOMOBRANCHIATA.

- Mysis.
- Squilla.
- Gonodactylus.

CARIDEA.

- Crangon.
- Lyca.
- Gnathophylla.
- Cerithia.
- Troglocaris.
- Ephyr.
- Pasiphæa.
- Pandalus.
- Pontonia.
- Anchistia.
- Typion.
- Antononeca.
- Palæmon.
- Alpheus.
- Hippolyte.
- Yerbitus.
- Sicyonia.
- Penæus.
- Stenopus.

ASTACIDEA.

- Polychætes.
- Asacus.
- Homarus.
- Nephrops.

THALASSINIDEA.

- Gebia.
- Callinassa.
- Gallinaxis.

LORICATA.

- Galathea.
- Munida.
- Scyllarus.
- Pseudibaculus.
- Palinurus.

Family I.  
CARIDEA.  
Subfamilies.

- (1) Peneiæ.
- (2) Palæmoninæ.
- (3) Alpheinæ.
- (4) Atyinæ.
- (5) Pasiphæinæ.
- (6) Crangoninæ.
- (7) Gnathophyllinæ.

Family II.  
CARIDEA.  
Subfamilies.

Family III.  
ASTACIDEA.

Family IV.  
PALINURIDE.  
Subfamilies.

- (1) Scyllarinæ.
- (2) Palinurine.

Family V.  
GALATHEIDE.

Family VI.  
THALASSINIDE.

Family VII.  
PAGURIDE.  
Subfamilies.

- (1) Pagurine.
- (2) Birgide.

Family VIII.  
HIPPIDA.

ABRANCHIATA.

- MYSIDA.

PHYLLOBRANCHIATA.

- CARCINOMORPHA.
- CARCINOMORPHA.

TRICHOBRANCHIATA.

- ANOMOMORPHA.
  - Thalassinidae.
  - Axiidae.
- CARCINOMORPHA.
  - Palinuridae.
  - Parastacidae.
  - Potomobiidae.
  - Homaridae.
- CARCINOMORPHA.
  - Peneidae.
  - Stenopidae.
  - Euphausiidae.

"The tribe of the Schizopoda having been found (by the recent observations of M. Milne-Edwards) to be reduced to the single genus *Cryptopus*, and this offering certain characters which distinguish it from the *Satiscopes*, I have retained it in its isolation, but changed the name of the tribe and given to it one more appropriate to the particular character of the genus, that of *Colepodes*, because the carapace serves as a sheath for the feet."—Latreille, Cours d'Entomologie, p. 385.

DANA,  
1852.

HELLER,  
1863.

CLAUS,  
1860.

HUXLEY,  
1863.

cylindrical filaments; *Phyllobranchiata* are those that have the plumes formed by a series of foliaceous plates; *Abranchiata* are those that have no such branchial plumes attached to the pereion.

As most of the genera that belong to this last division possess branchiæ attached to some part or other, the term appears to be misleading.

The Galatheidæ and allied families that author separates from the rest of the Trichobranchiata, and ranges under the head *Anomomorpha*, which, except for the exclusion of the Paguridæ and the Porcellanidæ, neither of which are trichobranchiate, coincides with the *Anomaux* of Latreille and the *Anomala* of De Haan.

The Penæidæ, through the Stenopidæ, are supposed to lead from the trichobranchiate form to the phyllobranchiate.

Observation on the structure of the branchiæ of the Penæidæ, however evolved, demonstrates the character of a plume that belongs to a group in which the development is essentially distinct. Although I think we shall be able to show that the branchiæ of the Penæidea as well as those of the phyllobranchiate division have their origin in the trichobranchiate form, I shall, for the convenience of a general classification, range in a separate division those Crustacea in which the branches of the various plumes divide and subdivide in an aborescent manner; the more so as those Macrura that possess this kind of structure form a well-marked natural group.

In this Report I therefore follow Dana in placing the Penæidea in a separate division, as they do not belong either to the Phyllobranchiata or to the Trichobranchiata. I therefore classify them under the head of *Dendrobranchiata*, which corresponds closely with the Penæidea of Dana; while the Squillidæ, Mysidæ, &c., that is, the Schizopoda originally, and later the Stomapoda of Latreille, Edwards, and De Haan, will be arranged under the head of *Anomobranchiata*, which term was first used by Dana, and afterwards by Heller. It has, therefore, priority of date, and is less liable to misconception than the term *Abranchiata*.

The following classification of the Macrura—for much of the arrangement of which I am indebted to the experience of all previous carcinologists, and which is based to a large extent on the development and external evidence of the internal structure—will, I think, be found to approximate the conditions required for a natural classification:—

Suborder **MACRURA.**

TRICHOBRANCHIATA.

DENDROBRANCHIATA.

PHYLLOBRANCHIATA.

ANOMOBRANCHIATA.

## Division TRICHOBRANCHIATA.

The Trichobranchiata may conveniently be divided into two well-defined groups, one containing those genera in which the most typical characteristics of the order are persistent, the other containing those that depart from them more or less distinctly, both as to the character and arrangement of the branchiæ as well as in possessing some variation in the plan of the external structure and development. The former of these may readily be designated by the term *NORMALIA*, being those of the most typical condition, and the latter by that of *ABERRANTIA*, or those that depart more or less distinctly from the perfect character.

## Group ABERRANTIA.

Group.	Family.	Brephalos.
ABERRANTIA.	GALATHÆIDÆ.	{ <i>Galathea.</i> <i>Munida.</i> <i>Æglea.</i> <i>Grimothea.</i> } Zoea.
	PYLOCHELIDÆ.	{ <i>Cheiroplatea.</i> <i>Pomatocheles.</i> <i>Pylocheles.</i> } Zoea ?
	THALASSINIDÆ.	<i>Thalassina.</i>
	CALLIANASSIDÆ.	{ <i>Callianassa.</i> <i>Cheramus.</i> <i>Scallasis.</i> <i>Tripæa.</i> <i>Calliadina.</i> <i>Gobia.</i> }
	AXIIDÆ.	{ <i>Azius.</i> <i>Paraxius.</i> <i>Eiconaxius.</i> } Megalopa.
	THAUMASTOCHELIDÆ.	{ <i>Thaumastocheles.</i> <i>Calliazus.</i> <i>Calocaris.</i> }

Cephalon having the carapace short and compressed, with little or no rostrum. Pereion having the posterior somite articulated with the preceding. Pleon having the somites long, and not overlapping each other; coxal plates but feebly developed, with the post-inferior angles generally rounded. Ophthalmopoda small; antennæ having the peduncles long. Pereiopoda more or less chelate, first pair longest, posterior pair having a tendency to separate from the preceding, and directed backwards. Pleopoda long, biramose, variable. Rhipidura strong, powerful, variable.

This group may be separated into two divisions,—first, in which the animal is dorso-ventrally compressed; second, in which the animal is laterally compressed.

The first division corresponds only with the tribe Galatheides of Milne-Edwards's Division, *Macrura Cuirassés*, and part of the *Loricata* of Heller.

The second division corresponds with the tribe *Macrura Fouissures* or *Thalassiens* of Milne-Edwards, *Thalassinidea* of Dana, and *Thalassinidæ* of Heller, and contains several families, which, while they have a character that is common to all, yet possess features that are extremely at variance with one another in very closely affiliated forms.

Their structural relations assimilate them to the *Anomura*, and where they depart from that resemblance, they do so by approaching the condition of immature forms. The genus *Pomatocheles*, like the *Paguridæ*, inhabits molluscos shells, and possesses all the external characters of an Anomurous Crustacean, and *Pylocheles* was taken dwelling in the hollow of a mass of indurated sand. These facts induce the belief that *Cheiroplatea* may also reside in some dwelling-place of its own selection. In this latter genus we see a close resemblance in the cephalic appendages to those of the Anomurous form in the genus *Cenobita*, whereas the rest of the animal approximates to the character of the immature stage of *Pagurus* described by Milne-Edwards under the name of *Glaucothoë*, with the exception that, while *Glaucothoë* exhibits evidence of a tendency to bilateral variation, *Cheiroplatea*, *Pylocheles*, and *Pomatocheles* are perfectly symmetrical. The same remarks may also be applied with perhaps less force to the genus *Thalassina*, which approximates to *Pagurus*, as the previous genera resemble *Cenobita*. The branchiæ are variable in this group, but with a tendency, more or less complete, to the trichobranchiate condition; in some genera, as in *Thalassina*, they are both foliaceous and filamentous; in some filamentous and cylindrical, as in *Cheiroplatea*; in others filamentous and compressed, or flattened, as in *Eiconaxius*, with a tendency, where the pressure is less complete, to return to the cylindrical condition.

*Callianassa* retains all the external features of an Anomurous Crustacean, but is modified from the younger form which approaches the Macrurous type; this is most constantly exhibited in the tendency of the posterior two pairs of periopoda to undergo a variation from the original simplicity and normal use.

All carcinologists following Milne-Edwards classify the genus *Callianidea* not only in a separate family but also in a distinct group, forming the tribe of the Gastriobranchides of Milne-Edwards, the legion *Thalassinidea anomobranchiata* of Dana. It has been established on the strength of Milne-Edwards's description of *Callianidea*, and Guérin's description of *Isæa* (*Callianisea*, Milne-Edwards; *Callisea*, Dana), but which (from an examination of specimens lent to me by Dr. Carte of the Dublin Museum) I am inclined to place in the same family as *Callianassa*. The two genera resemble each other very closely in all points except the formation of the pleopoda. Those of the second pair in *Callianassa* are biramose; the inner branch slender, the outer of extreme

tenuity. Those of the three following pairs are also biramose, but the inner branch is short and broad; the outer is long and wide, being bent over the inner; the margins are smooth, inflected, and fringed with a delicate ciliary growth. In *Callianidea* the second pleopoda resemble those of the three succeeding pairs. They are biramose and foliaceous; the margins, instead of being fringed with small hairs or cilia, have these modified into soft and flexible articulated membranous filaments. These, it is assumed, are true branchial appendages; but whether they fulfil the function of aeration of the tissues or not, it appears to me that in classification they can only be regarded as finely modified hairs, and, consequently, are only of generic import. The genus *Isæa* of Guérin, which Milne-Edwards changed into *Callianisea*, because Guérin's name had previously been in use, and which has again been changed by Dana into *Callisea*, to prevent the confusion likely to ensue from the resemblance between *Callianassa* and *Callianisea*, appears to me to have been founded upon a damaged specimen of *Callianidea*. The character assigned as a distinctive feature was the presence of only one branch attached to each pleopod; but the imperfect condition of the specimen examined induced Milne-Edwards to suggest that this arrangement was the result of an accident. The only distinction between *Callianidea* and *Callianisea* of Milne-Edwards (the latter being *Isæa* of Guérin), rests upon the author's statement that the pleopoda are furnished with a great number of little branches grouped together. Or, to use his own words: "garnie d'un grand nombre de ramuscules en form de grappe," which Milne-Edwards supposes to mean that the ramuscules were inserted together directly on the base of the pleopoda.

An examination of the structure of the pleopoda in *Callianidea*, which is incorrectly figured by Milne-Edwards,<sup>1</sup> shows that the ramuscules are massed together, forming a bundle attached to the margin of the base of the inner branch of the pleopoda, not to the peduncle, as suggested by Milne-Edwards.

The branchiæ of *Callianassa* and *Callianidea* resemble each other, and appear to form a transition between the trichobranchiate and phyllobranchiate types. They consist of long and narrow filaments, which are closely packed and laterally compressed, they are arranged in two longitudinal rows, and differ from those of *Cheiroplatea* in being more numerous, and are consequently compressed instead of being cylindrical.

The genus *Axius*, while still retaining some of the features, more especially in external aspect, of the Thalassinidæ, exhibits a character that approximates its species to those that belong to the family of Astacidæ.

For example, the podobranchiæ are present, being attached to several of the pereopoda, and, according to my observation, in *Paraxius* and *Eiconaxius* the mastigobranchiæ are present to an equal degree, and form a consistent feature in leading us gradually to the family Thaumastochelidæ, in which all the branchiæ and their mastigobranchial

<sup>1</sup> Hist. Nat. des Crust., pl. xxv. bis, fig. 14.

accompaniments are developed as effectively as in the most highly-organised apparatus of any genus in the families of the NORMALIA.

It appears, therefore, taking into consideration the external features in connection with the branchial characters, that the following is the natural classification :—

#### Group ABERRANTIA.

Pereion short, posterior somite loosely articulated with the preceding; pleon long, somites increasing in size posteriorly, not overlapping each other dorsally; first pair of pereipoda more or less imperfectly chelate; posterior pair short, more or less abnormal; branchiæ variable in number and form.

##### Division I.

##### Family GALATHEIDÆ.

Pereion broad and dorsally depressed; carapace anteriorly produced into a rostrum; first pair of antennæ with flagella short, second pair without a scaphocerite; second pair of gnathopoda pediform; first pair of pereipoda chelate, subequal; second, third, and fourth simple, robust; posterior pair enfeebled; pleon broad and depressed; somites short and slightly overlapping each other; rhipidura equilateral and foliaceous. In development the brephalus takes the form of a zoea. Genera *Galathea*, *Munida*, *Grimothea*.

This family will be reported on by Prof. J. R. Henderson, M.B., F.L.S., in another volume of this series.

##### Division II.

##### Family PYLOCHELIDÆ.

First pair of antennæ with flagella short; second pair with scaphocerite; first pair of pereipoda chelate, symmetrical; rhipidura rigid; telson transversely divided; branchiæ filamentous, in two rows, cylindrical; mastigobranchiæ and podobranchiæ wanting. Genera *Cheiroplatea*, *Pomatocheles*, *Pylocheles*.

##### Family THALASSINIDÆ.

First pair of pereipoda subchelate, unequal; branchiæ filamentous and foliaceous; rhipidura rigid; mastigobranchiæ and podobranchiæ rudimentary. Genus *Thalassina*.

##### Family CALLIANASSIDÆ.

First pair of antennæ with flagella long, second without a scaphocerite; first pair of pereipoda asymmetrical, unequal; rhipidura foliaceous; branchiæ filamentous, compressed.

(A) Podobranchiæ and mastigobranchiæ wanting; second pair of pleopoda unlike the third and following pairs. Genera *Callianassa*, *Cheramus*, *Scallasis*, *Trypæa*.

(B) Podobranchiæ wanting; mastigobranchiæ present; second pair of pleopoda like the following pairs. Genus *Callianidea*.

(C) First pair of pereipoda subchelate; rhipidura foliaceous; branchiæ like *Callianassa*; second pair of pleopoda like the following pairs. Genus *Gebia*.

##### Family AXIIDÆ.

First pair of pereipoda chelate, subsymmetrical, unequal; branchiæ filamentous, cylindrical, and compressed; podobranchiæ and mastigobranchiæ present. Genera *Axius*, *Paraxius*, *Eiconæius*.

## Family THAUMASTOCHELIDÆ.

First pair of antennæ with flagella long, second with scaphocerite; first pair of pereiopoda unequal, chelate, large; second symmetrical, chelate, small; rhipidura foliaceous; branchiæ filamentous cylindrical; podobranchiæ and mastigobranchiæ present. Genera *Thaumastocheles*, *Callocaris*.

## Family PYLOCHELIDÆ.

The carapace has no rostrum, and its lateral walls are compressed and very deep. The eyes stand on peduncles of moderate length. The first pair of antennæ terminates in two short flagella, and the second supports a small scaphocerite. The mandibles carry a synhipod. The first pair of pereiopoda is subequal, chelate. Second and third pairs long and slender, each terminating in a long styliform dactylos. Fourth and fifth pairs are short, and terminate in a small, and more or less rudimentary dactylos. Rhipidura with the branches rigid and tapering; outer larger than the inner. Telson rigid anteriorly, and flexile posteriorly.

The respiratory apparatus is trichobranchiate. The filaments are long, slender, and cylindrical. The podobranchial plumes and mastigobranchial plates are wanting throughout all the appendages of the pereion, that is, from the first pair of gnathopoda to the posterior pair of pereiopoda.

This family is established to receive the genera *Pomatocheles*, Miers, *Pylocheles*, A. Milne-Edwards, and *Cheiroplatea*.

The name is derived from that given to a genus by A. Milne-Edwards, and includes all those paguriform Anomura that are trichobranchiate.

*Cheiroplatea*,<sup>1</sup> n. gen.

Carapace having deep lateral membranous walls, produced anteriorly in advance of the dorsal frontal margin.

Ophthalmopoda broadest at the base, and tapering gradually to the apex.

First pair of antennæ having the peduncular joints long, each capable of being folded upon the preceding, and terminating in two slender flagella that are longer than the third joint of the peduncle.

Second pair of antennæ having a strong and small scaphocerite attached to the peduncle.

Mandibles carrying a triarticulate synhipod.

Second pair of gnathopoda imperfectly chelate, and carrying a basephysis.

First pair of pereiopoda with the two limbs correspondingly equal, being large and well developed, having the anterior or upper surface of the carpos and propodos

<sup>1</sup> χείρ, hand; πλατύς, flat; this name was chosen and the plate printed before I became aware that the somewhat similar name *Chiroplatys* had been previously used by Kirby for a genus of Diptera.



flattened and bent at an angle with the other joints, by which peculiar feature in the animal the name of the genus is suggested.

The second and third pairs of pereopoda terminate in a long and strong dactylos.

The fourth and fifth pairs are shorter than the two previous, and terminate in a small and rudimentary dactylos.

The pleopoda are slender, except those of the sixth pair, which are robust and strong, form part of the rhipidura, and terminate in points partially covered with a pavement of spiculiform spines.

The telson is divided into an anterior and a posterior portion by an articulation, the alimentary canal terminating at the posterior extremity of the anterior division.

This genus corresponds somewhat nearly with *Polycheles* of A. Milne-Edwards<sup>1</sup> and *Pomatocheles* of Miers,<sup>2</sup> from both of which it differs in the form of the ocular peduncle, the length of the first pair of antennæ, and the general aspect of the animal.

*Cheiroplatea cenobita*, n. sp. (Pl. I. fig. 1).

Carapace without a rostral tooth, having the lateral walls deep and membranous. Pleon half as long again as the carapace. Telson quadrate, articulated with a terminal plate.

First pair of antennæ nearly as long as the carapace, each terminating in two small flagella. Second pair scarcely longer than the first, having a scaphocerite with serrate margin; the second joint of the peduncle armed with a serrate tooth.

First pair of pereopoda chelate; anterior and upper surface of the carpos and propodos flattened; carpos fringed with a crenate transverse crest; propodos inverted downwards and backwards. Second and third pairs of pereopoda long and slender. Fourth and fifth short, and terminating in a rudimentary dactylos; propodos of the fifth pair having the surface furnished with a pavement of obtuse spicules. Lateral branches of the rhipidura pointed and covered with a pavement of blunt spicules.

Length (female) 25 mm. (1 inch).

*Habitat*.—Station 194, September 29, 1874; lat. 4° 34' S., long. 129° 57' 30" E.; between the Arrou Islands and Banda; depth, 200 fathoms; bottom, volcanic mud.

Viewed dorsally, the carapace is nearly circular, having no projecting rostrum, but a slight prominence between the eyes. The latero-frontal angles are produced anteriorly a little beyond the line of the rostral point. The gastric is well defined from the hepatic and frontal regions; the branchial is also separated from the hepatic, but not distinctly from the cardiac region. The lateral walls of the carapace, which are visible only when

<sup>1</sup> Blake Expedition Crustacea, *Bull. Mus. Comp. Zool.*, vol. viii. p. 38.

<sup>2</sup> Edw. J. Miers, On a Collection of Crustacea made by Capt. H. C. St. John, R.N., in the Corean and Japanese Seas, part i. *Podophthalmia*, *Proc. Zool. Soc. Lond.*, January 14, p. 18, 1879.

the animal is viewed laterally, are membranous from a little below the line which defines the branchial from the hepatic region, and extend posteriorly beyond the line of the posterior margin of the dorsal surface of the carapace.

The pleon is longer than the carapace by about one half, but as the posterior portion is generally folded beneath the body it looks shorter. The first somite is short and triangular, having the broadest part situated posteriorly. It is nearly hidden beneath the carapace, and does not support any coxal plates. The five anterior somites are subequal in length, and rather broader than long. They are quadrate in their dorsal aspect, and have a distinct line of demarcation separating the body of the somite from the lateral or coxal plates, which are rounded at the anterior and posterior angles: they have a longitudinal line of depression near the middle of each, and the margins are fringed with delicate cilia. The sixth somite is also quadrate, and rather longer than the fifth, it supports the coxal plates at the posterior angles, where they support a freely-articulating joint that carries a pair of unequal branches. The seventh somite or telson is divided into an anterior and a posterior portion by a free-moving joint near the middle. The anterior portion is undoubtedly homologous with the somite, and the posterior with its appendages, since the alimentary canal debouches at the posterior margin of the anterior division.

The ophthalmopoda consist each of a sharp-pointed ophthalmus situated at the extremity of a large broad-based peduncle that gradually narrows to the apex; the peduncle is movable, but not to any very large extent, and is situated in a slight excavation in the frontal margin of the carapace; from the inferior margin of the eye the metope falls perpendicularly, and on the outer side of it, immediately below and outside the eye, is the first pair of antennæ, which consists of three peduncular joints; the first or coxal is very long, reaching as far again as the distal extremity of the eye; in its length it curves downwards, and has the upper surface longitudinally excavated to receive the second joint when folded back: on each side of the excavation is a strong tooth—one on the outer side near the base, the other on the inner side at the distal extremity; the second joint is about the same length as the first, but somewhat more slender; it is nearly cylindrical in shape, and when folded back falls into the longitudinal hollow of the first joint, the two spines acting apparently as guides to its position; the third joint is shorter than the second, and is also cylindrical; and when the antenna is folded up it is directed forwards. At the extremity of this third joint are situated two slender flagella; the primary branch is the longer and more robust, being about twice the length of the third joint of the peduncle; the secondary branch is about half the length of the primary.

The second pair of antennæ is implanted immediately outside the first. The first joint supports a phymacerite that is curved inwards and downwards, impinging at its extremity, which is serrate, against a small tubercle situated on the outer edge of the

metope; the second joint is produced at the distal external angle into a strong spine-like process, which is deeply serrate on the outer margin; within this is implanted a movable appendage, which resembles very much the spine-like process already described; like it, it is serrate, but not so deeply, on the outer margin; it articulates with the second joint, and is homologous with the scaphocerite; the fourth joint is short but longer than the two preceding; the fifth is very long and cylindrical, supporting at its extremity a slender flagellum less conspicuously multiarticulated than the primary flagellum of the first pair.

The mandibles consist of a pair of strong, externally convex blades, the anterior and upper portions of which articulate with the lower and outer angles of the metope, above which, on the anterior margin, articulates a three-jointed synsiphon, the first joint of which is short and subcylindrical, the second, long and triangular, of which one angle is attached to the extremity of the first joint, another extends upwards and forwards so as to fill the upper portion of the aperture of the mouth, and the third angle supports the third or last joint of the appendage, which is long and tapering, and falls within the mandible; it appears to be hairless, and lies folded between the epistoma and the mandible.

The first pair of siagnopoda appears<sup>1</sup> to consist each of two flat branches—one slender, rigid, and curved, terminating with a fringe of cilia, the other short and membranous, with five or six cilia attached.

The second pair of siagnopoda is foliaceous and five-branched, four of which are fringed with closely-packed cilia: the fifth is long, slender, flagellum-like, free from cilia, and outside it is a large squamiform plate, copiously fringed with long delicate hairs.

The third pair of siagnopoda consists of two single-branched, two-jointed appendages. The basal joint is strong, and produced into a lobe internally; the second or distal joint tapers gradually (the outer margin convex, the inner concave) to the apex. The inner margin is thickly fringed with strong cilia, which increase in length towards the apex.

The two pairs of gnathopoda are subpediform, and carry each a long secondary ramus (basephysis) which corresponds in form more with the Macrurous than the Anomurous type of Crustacea. The first pair is small, subpediform, and consists of seven joints; the second or basal joint supports a long basephysis; the next three succeeding joints are subequal and tolerably robust; the sixth, or propodos, is short and tapers to the apex from its base; and the seventh, or dactylos, is unguiculate. The three terminal joints are copiously fringed with long and strong cilia. The basephysis is comparatively very long, extending considerably beyond that of the primary branch of the gnathopod, which generally lies curved downwards, while the basephysis extends outwards and upwards.

The second pair of gnathopoda is much longer than the first, and likewise

<sup>1</sup> I say "appears," because the appendage was broken, the two portions being asunder; and there is but a solitary specimen in the collection.

consists of seven joints, and is formed on the same general type. The basal joint is short and irregular, and carries a long branch consisting of three joints, which is generally at right angles with the gnathopod, and lies parallel with that of the first pair, and stands upright by the side of the mouth. The first joint of this branch is long and cylindrical; the second is more slender, and lies generally at right angles with the first; and the third consists of a multiarticulate flagellum fringed with long slender hairs. The third joint (ischium) is long and angular (the internal margin has on the interior angle a strong projecting process, and has one strong spine a little beyond the centre); the fourth joint is about half the length of the third, is angular, and is armed with three teeth or spines on the inner margin; the fifth joint is scarcely longer than the fourth, and increases in diameter towards the distal extremity, where the outer angle supports a small brush of long hairs: the propodos, or sixth joint, increases in diameter towards the extremity, where the inner angle is produced into a polliciform lobe, and is tipped with a brush of long and strong hairs: the outer distal angle also has a small brush of cilia; the dactylos, or seventh joint, scarcely reaches beyond the extremity of the corresponding process of the propodos, against which it impinges and forms a cheliform extremity—a character, in my experience, that is unique among the higher Crustacea. Such a chela exists in some of the Edriophthalmous Crustacea, but, as far as I am aware, the form has not been previously observed in the Podophthalmia.

The next pair of appendages is the first of the pereiopoda. It is a large and powerful pair of organs, the peculiarity of which lies in the formation of the carpos and propodos: the limb, as far as the carpos, is laterally compressed and directed forwards, when it is suddenly compressed transversely, and abruptly bent downwards at an acute angle: the anterior or upper surface of the reflexed portion of the carpos, as well as that of the propodos and dactylos, is compressed flat. The outer margin is curved and the inner straight, so that when the right and left limb are brought together they, being of equal size, form a nearly oval plane, the upper or carpal portion of which is fringed with a row of equidistant comb-like dentations. The dactylos is sharply pointed, and impinges closely against the pollex, which it overlaps at the extremity.

The second pair of pereiopoda is of the normal form, and consists of seven joints, of which the carpos, propodos, and dactylos are subequal in length.

The third pair resembles the second both in size and form, and in the female carries the vulvæ in the form of a large circular opening on the posterior surface of the coxa. The coxa of these two pairs of legs approach each other more closely than those of the two following pairs, which are smaller and wider apart.

The fourth pair terminates in a small sharp dactylos which is considerably and suddenly smaller than the propodos. The fifth or last pair of pereiopoda has the distal extremity of the propodos enlarged and covered with a thick pavement of small tubercular spiculi-form points.

There are five pairs of pleopoda: four consist of small and slender biramose appendages, which support the ova in the female; the fifth is strong, stiff, and sharp-pointed, and helps to form the rhipidura.

*Observations.*—The object of the peculiar formation of the first pair of pereopoda is very difficult to discover, except it be that of forming an operculum, so as to protect the entrance, should the animal reside in a shell or enclosure of any kind; the arms are incapable of being directed in an extended position, and therefore cannot be advanced to grasp any object beyond the extremity of the antennæ. The two succeeding pairs are long and slender, but the last two—the penultimate and ultimate pairs of pereopoda—possess the Anomurous character of being very much shorter, and have the dactylos in the penultimate almost rudimentary in size. In the ultimate pair the propodos is paved over with a number of closely-packed spiculiform points of nearly equal size, which increase somewhat toward the extremity—among which it is difficult to determine the dactylos. These features in the pereopoda are strongly suggestive of an approximation to the Anomurous form; but an examination of the branchial appendages reveals a character that approximates to the Macrura, more especially to those belonging to the family of the Thalassinidæ. In *Birgus*, *Pagurus*, *Cenobita*, &c., to which *Cheiroplatea* approximates most nearly in form, the respiratory organs are phyllobranchiate in character; in this genus they are trichobranchiate, the filaments being cylindrical and arranged in two longitudinal rows, bearing a resemblance to those of the Astacidea, from which they differ in the absence of the podobranchial and mastigobranchial series of the appendages, which form important features in the respiratory organs of the latter. As a whole the arrangement of the several branchial plumes corresponds more nearly with those species that are generally grouped with the family Thalassinidæ than with those that belong to the Astacidæ.

The mastigobranchia is absent from all the pereopoda and from both the gnathopoda, and so are the podobranchiæ. Two arthrobranchial plumes are present on each of the pereopoda and one on each of the gnathopoda; and the pleurobranchiæ exist in connection with the three posterior somites of the pereion, as shown in the following table:—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	1	1	1
Arthrobranchiæ,	.	.	.	.	1	1	2	2	2	2	...
Podobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
					h	i	k	l	m	n	o

The plumes are generally small, and increase in size posteriorly. Of the three pleurobranchiæ, the last is the only plume attached to the posterior somite; whereas the penultimate and ultimate somites, besides a pleurobranchia, carry an anterior and posterior arthrobranchial plume. But the somites which support the anterior two pairs

of pereopoda have no pleurobranchiæ, but carry an anterior and posterior arthrobranchial plume attached to the pleurocoxal articulation.

The gnathopoda, both first and second, have only a single arthrobranchial plume; but whether they support a small mastigobranchia I have not been able to determine, from a desire not to dismember too largely a unique specimen of an interesting character.

The pleopoda are small and delicate appendages, each consisting of one long and one very short filamentous branch, fringed with long cilia, to which the ova are attached by thread-like fibres. The ova are very large and not very numerous, numbering about twenty in our specimen. Unfortunately these were in too immature a condition to enable me to determine the form and character of the future brephalos, or the stage at which the young are hatched.

The external plates of the rhipidura (or sixth pair of pleopoda) are Anomurous in character, but Macrurous in so far as that the appendages on the two sides are symmetrical.

The telson is peculiar, and instead of terminating as a single-jointed plate, there is a well-defined separation into an anterior and a posterior part by a joint-like line of division; the former has its coxa-marginal lobes, and the termination of the alimentary canal corresponds with its posterior margin, whereas the posterior division articulates with the former, and exists only as a movable plate.

The entire animal suggests its being in an intermediate stage, and bears a considerable generic resemblance to *Glaucothoë* of Milne-Edwards. But this latter has been shown (Brit. Assoc. Report, 1869) to be an intermediate form between the brephalos and the adult *Pagurus*. *Cheiroplatea*, like *Glaucothoë*, not only carries five pairs of pleopoda, but has the posterior pair equilaterally developed. It has, moreover, the dorsal surface of the pleon protected by Crustaceous plates, all of which *Glaucothoë* loses when, with increasing age, it fulfils the habits of its kind—takes to itself the shell of a dead Mollusc, and so passes from a Macrurous to an Anomurous condition.

*Cheiroplatea* appears in its adult condition to represent an intermediate link between *Cenobita* and the trichobranchiate Macrura. But the remarkable feature appears to be that its nearest allies in the Anomurous group belong to the phyllobranchiate condition of Crustacea. It has an appearance strongly suggestive of its being allied to a *Pagurus* that had failed to obtain a molluscous shell for itself, and had consequently retained some of the Macrurous characters of its youthful condition.

Its general appearance is not that of a swimming animal; we may consequently feel assured that it was brought up by the dredge from the bottom, which was about half a mile from the surface of the ocean, south of New Guinea. In this case the temperature of the bottom is not recorded. It was taken associated with *Eiconaxius acutifrons* and a species of *Ophlophorus*.

The arrangement and form of the chelæ induce me to believe that the little creature inhabited some abode where the flattened claws afforded an efficient operculum. This

idea is supported by a closely analogous form taken in the West Indies during the "Blake" expedition under the superintendence of Professor Agassiz, and named by Professor Alphonse Milne-Edwards *Pylocheles agassizii*.

#### Family THALASSINIDÆ.

Carapace produced anteriorly to a point in advance of the frontal margin; dorsally flattened. Eyes small; ophthalmopoda cylindrical. First pair of antennæ having the flagella long; second pair without a scaphocerite.

First pair of pereopoda unequal, imperfectly chelate, the pollex being shorter than the dactylos.

The four following pairs of pereopoda not chelate, terminating in a long dactylos; outer rami of the rhipidura without diæresis, slender, rigid, pointed. Telson without diæresis, rigid, obtuse, pointed. Branchiæ complex, trichobranchiate at the base, and phyllobranchiate on the exterior of each plume.

This family corresponds with Dana's, and contains, so far as research has yet proved, only a single genus.

#### *Thalassina*, Latreille.

*Geographical Distribution*.—A very fine specimen of one species of this genus, measuring 225 mm. in length, was procured at Kandavu, one of the Fiji Islands. It has been preserved in a bottle with fresh water prawns, and, not being labelled as coming from any station, was, I presume, procured from the natives, and not dredged. Milne-Edwards records it from the coast of Chili, while Desmarest states that it comes from the Indian seas. Heller, in the voyage of the Russian frigate "Novara," obtained it from the Nicobar Isles. Although the localities recorded are not numerous, they are sufficient to show the very wide area over which the animal is distributed, and if, as I am strongly induced to believe from the description given by Heller in the work quoted, *Thalassina maxima* is only a smooth variety of *Thalassina scorpionoides*, and the little *Thalassina gracilis* of Dana only the young of this same species, then we shall find that the geographical distribution extends from Singapore to Sydney, and across the Pacific and Indian Oceans. Even if these two specimens be distinct, their separation is not great, for the young, when only an inch and a half long, as is that of *Thalassina gracilis*, if not identical, must closely approximate to it in form; while *Thalassina maxima* appears to be only a less pronounced specimen of the typical species. A genus that is represented by a single species, the distribution of which is so very wide, would, we should presume, have structural conditions decidedly favourable to natural acclimatisation.

*Thalassina scorpionoides*, Latreille (Pls. III., IV.).*Thalassina scorpionoides*, Latr., Gen. Ins. et Crust., tom. i.*Cancer anomalus*, Herbst., tom iii. tab. 62.*Thalassina scorpionoides*, Leach, Zool. Misc., vol. iii. p. 28, tab. 130; Desmarest, Consider. des Crustacés, p. 203, pl. xxxv. figs. 1, 2 *a, b, c*; Milne-Edwards, Hist. des Crust., tom ii. p. 316; Atlas du Règne anim. de Cuvier, Crustacés, pl. xlvi. fig. 1; Heller, Russ. frigate "Novara," p. 93.*Habitat.*—Kandavu, Fiji Islands. One specimen.

Length, 225 mm. (9 inches).

The eyes are small, movable, and subconical in shape. Deposited in an imperfect orbit, formed by the obliquely directed inferior surface of the rostrum, on the inner side; by two teeth, one on the upper and outer angle being the anterior extremity of a short, smooth ridge or crest; the second, a smaller tooth, immediately beneath it; and on the lower side by an excavation in the upper surface of the inner antennæ, where a fringe of posteriorly directed hairs, coterminous with others that are anteriorly directed from the side of the rostrum, as well as from the upper external circuit of the orbit, forms a blepharis that surrounds and protects the eye.

The first pair of antennæ has the inner surface of the first joint compressed and flattened against that of the opposite side, the other surfaces slightly converging, and directed upwards; the second joint is much smaller and also directed upwards, the upper surface being slightly concave, and, with that of the first joint, forms a hollowed floor on which the eye rests; the upper surface of the first or coxal joint is perforated by an elongated triangular foramen or slit, the entrance to the auditory chamber, which is protected by a dense mass of ciliated hairs, also continuous within the auditory passage.

The auditory apparatus consists of a large calcareo-membranous chamber, attached to the upper wall of the antenna. Around the orifice that opens into it, within the chamber, there is a curved row of closely-planted delicately-ciliated hairs, each of which is attached to the base by a flexible membranous articulation, from which it proceeds flattened and tolerably broad for more than half its length, when it narrows rapidly and becomes ciliated, the cilia being short and fine; the hairs extend nearly if not quite across the auditory chamber, the floor of which is covered with small points, while the cavity contains much angular calcareous sand. This I found mostly gathered into a compact mass, but most probably when the animal was in a living condition it was not so, being then kept in a state of motion by the aid of the long slender ciliated hairs that have just been described. The auditory chamber occupies about two-thirds of the cavity of the first joint of the antenna.

The second pair of antennæ is in the same horizontal line with the first, immediately outside, being separated by a very narrow septum or calcified ridge. The five joints' of which the peduncle is formed are separately defined, and this enables us to demonstrate



the parts which exist in those genera where the calcification has more or less obliterated the means of identifying the several joints. There is no scaphocerite. The phymacerite is produced to a large lobe, but the closing membrane is rather small, and is situated in the first or coxal joint. The third joint supports a fasciculus of finely ciliated hairs, and the flagellum is formed of short articuli, each of which supports a few stiff hairs of the same length as the articulus.

The siagon or mandible is a tolerably strong, powerful organ, the psalisiform margin of which is denticulated, and produced in a continuous curve until it unites with the molar prominence, which is only a more strongly pronounced denticulation. The apophysis is long, and the synaphipod is two-jointed; both joints are short, robust, subequal, hairy, the second articulating with the first at a right angle and terminating in an obtuse point, and resting generally in the cavity between the incisive and molar denticulations.

The first pair of siagnopoda has three branches. The outer is cylindrical, curved at the extremity, and clean and smooth except for a few hairs on the anterior margin, which closely press upon the mandible. The central lobe is foliaceous and expanded at the extremity, bat-shaped, fringed with short spinous hairs on the inner margin, and with long ones on the extremity and distal portion of the posterior margin. The inner lobe is also foliaceous, very wide, short, and fringed at the inner margin with numerous closely packed hairs.

The second pair of siagnopoda consists of five foliaceous plates of great tenuity, and a long mastigobranchial appendage. Generally it resembles that of *Astacus* except in the form of the mastigobranchia, which in this genus is very narrow and produced to a considerable length, and fringed at the extremity with very long hairs, furnished with a series of minute, short, stiff cilia, spirally arranged; for some distance from the base these small cilia point posteriorly, or towards the base of the hair, and for the rest, which is more than half the length of the hair, they point anteriorly, or towards the apex or distal extremity, which terminates in a slightly curved blunt point—the cilia gradually dying out as they advance. The foliaceous plates are broad, short, thickly ciliated at the margins, and the mastigobranchia extends to a considerable distance within, so that the hairs on the extremity reach to quite half the length of the chamber, and are the only appendages that are capable of action on the branchiæ.

The third pair of siagnopoda is derived from the type seen in *Astacus*. It consists of an equally long and broad basal joint, fringed on the inner margin with a fur of cilia, and at the extremity with three foliaceous branches, of which the inner is broad and furred all over, while the other two are slender and fringed with rather long hairs towards the extremity only.

The first pair of gnathopoda appears to be only six-jointed, and a comparison of the several joints homotypically with those of the second pair suggests that the meros and ischium are united together to form one long straight joint, the carpos

and propodos are short and form a rigid curve, and terminate in a short flat spatuliform dactylos that is distally fringed with stiff spines. The coxa supports an imperfect or rudimentary forked mastigobranchia, tipped with long hairs, and a podobranchial plume made up of trichobranchial filaments and phyllobranchial plates longitudinally implanted on the stem. The basis carries an ecephysis that is as long as the gnathopod.

The second pair of gnathopoda has seven joints, the meros and ischium being distinct and continuous; both, but more especially the ischium, are longitudinally grooved or excavated, forming a hollow in which lies closely impacted, when at rest, the first long joint of the basecephysis; the carpos is long and curved, the propodos straight, and the dactylos long and straight, fringed on both the upper and under margins with long hairs, as also on the under or inner side of the propodos, ischium, and meros. The basecephysis is about two-thirds the length of the gnathopod, and is fringed with long hairs. The coxa supports a short, slightly curved, rigid mastigobranchia, fringed on the lower margin with short hairs and tipped with long ones at the extremity; from the base of the mastigobranchia arises a well-developed podobranchial plume; the lower and basal portion of the posterior or inferior side consists of a series of trichobranchiate filaments, and on the anterior portion, near the distal extremity of the same side, are several phyllobranchial plates. On the coxa near the podobranchial articulation is a single bunch or fasciculus of long hairs.

The first pair of pereiopoda consists of six articulated joints, the basis and ischium being fused together, leaving a distinct line of union defining the unused articulation between the two joints. The right is much larger than the left, and the coxa supports a short, curved, stiff, almost rudimentary, mastigobranchial process, thickly fringed with a fur of short hairs along the lower margin, and tipped with long hairs that are serrate along the sides; from the base of the mastigobranchia arises a well-developed podobranchial plume, consisting of trichobranchial filaments attached to the stem from the base to the extremity on the under side, and three phyllobranchiate plates at the distal extremity on the upper side, not far from the articulation of which, on the coxa, stand two well-formed fasciculi of long hairs, fringed with minute, sharp, short cilia, similar to those pointed out by Professor Huxley as existing in the genus *Astacus*. These two fasciculi are distinct from each other, well defined, and the hairs are as long as the podobranchial plume. The left differs from the right in size but resembles it in form, and is imperfectly chelate. The dactylos is long, arched, diagonally compressed, and reaches considerably beyond the extremity of the short, sharp pollex of the propodos: it is fringed with hairs upon the outer margin and with short blunt truncated denticulations on the inner, and only at the base impinges against the anterior serrated margin of the pollex: the propodos is quadrate, nearly as broad as long, compressed and slightly rounded both on the inner and outer surfaces, flattened on the upper, and fringed with strong hairs on the upper and lower margin; the carpos is short and triangular in

form, articulating with the meros at its extremity, and bending at a right angle with it. The meros is long and broad, flat on the inner and rounded on the outer side; lower margin straight, and armed with fine teeth and numerous long hairs; upper margin convex, and fringed with coarse strong teeth; articulates with the ischium by an oblique joint with lateral movement. The ischium is triangular, long and denticulated on the lower side, except near the distal extremity, where it is fringed with long hairs; the outer margin is represented only by a point at which the articulation of this joint meets the meros on one side and the coxa on the other, the basis being short and fused with the ischium. The coxa is stout and robust, and supports a short, stiff mastigobranchia, similar to, but a little longer than, that on the first pair of pereopoda, and a well-developed podobranchial plume, at the base of which stand two fasciculi of branchial hairs.

The second, third, and fourth pairs of pereopoda resemble each other. The dactylos is curved in a reverse direction from the common plan; it is straight for some distance, and the apex terminates in an outward and forward curve. The posterior margin is fringed with hairs; the anterior surface has two lines of elevation or crests, the inner or the one nearest the body is thickly fringed with hair, the outer is armed with a row of strong teeth, which terminates in the apex or unguis. This joint is not capable of being bent at more than right angles with the propodos: the propodos is subcylindrical, longer than broad, the upper margin is wide and armed with tufts of hair; the carpos is long, nearly as long again as the propodos, gradually narrowing from the distal to the nearer or meral articulation; meros long, laterally compressed, the anterior and posterior margins parallel and serrato-denticulated; ischium and basis fused together, about half the length of the meros, denticulated on the posterior, and mostly on the anterior margin; coxa large, quadrate. In the female those of the third pair approach each other, and are perforate near the interno-posterior angle for the vulva, near which the coxa articulates with the ventral surface of the pereion, whereas in the fourth pair the articulation is near the centre of the posterior margin of the coxa, instead of at the inner angle; the two limbs are distant from each other, being attached to wider ventral plates. In both these pairs of pereopoda the coxa supports a short mastigobranchial appendage, of which the posterior is the longer. Both are fringed with short hairs along the lower margin, and tipped with long ones at the extremity.

The fifth pair of pereopoda articulates with a somite that is not fused with the rest of the pereion. It much resembles that of the preceding pair, but is more cylindrical generally, especially as regards the meros. The ischium is shorter, the propodos longer, and the dactylos not excentrically curved. The coxa is large, deeper than broad, and approximates very nearly to that of the opposite side.

The first pair of pleopoda in the female is a three-jointed styloform appendage, short and closely impacted in the ventral groove of the posterior somite of the pereion.

The following four pairs of pleopoda are long, slender biramose, on a long basal

joint. The outer branch flat multiarticulate, the inner two-jointed—one cylindrical, the other multiarticulate and flattened; both fringed with a few long hairs.

The sixth or posterior pair of pleopoda is biramose on a short basal joint. The branches are uniformly stiff and narrow, being of the same length as the telson, slender, tapering, slightly curved and fringed with hairs, and form the lateral plates of the rhipidura.

The branchial chamber is very large, as may be observed from the anterior position of the cervical furrow, and the dorsally narrow and posteriorly still narrower gastric, genital, and cardiac regions. The inner surface of the carapace is covered with a membrane plicated in a series of fine ridges or folds, radiating from a position near which the muscles of the mandibles are attached to the carapace. This membrane is smooth and clean, and terminates on the interior surface at the posterior margin of the carapace, where a series of thickly-set hairs form a fringe capable of assisting to afford a protection against the admission of extraneous matter. The floor, or pleural surface of the same great chamber, is smooth and highly polished, and is not covered or protected by any tissue. The surface is generally even, but a sudden depression corresponds with cavities that hold the muscles of the gnathopoda. The enlargement or elevation of the portion posterior to these appendages corresponds with the functional requirements of the several pereopoda.

The branchial formula of this species is—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	.	2	2	2	2	2	2	...
Podobranchiæ,	.	.	.	.	1	1	1	1	...	...	...
Mastigobranchiæ,	.	.	.	.	r	r	r	r	r	...	...
					h	i	k	l	m	n	o

There are no pleurobranchial plumes attached to either of the somites. There are two arthrobranchial plumes attached to the articulations of all the appendages of the pereion except the last pair of pereopoda. There are only four podobranchiæ, and these are appendages of mastigobranchial rods of a reduced and imperfect character. Six similarly formed mastigobranchiæ are attached to the six anterior appendages of the pereion, the last, or fifth, pair of pereopoda being without any branchial apparatus whatever. A similarly formed mastigobranchia, being more important in character, extending in length to a considerable distance within the branchial chamber, is attached to the second pair of siagnopoda; whereas the third or next succeeding pair posteriorly has none.

*Observations.*—The branchiæ of this animal are of a peculiar character, and form an interesting feature in their relation to the entire order to which they belong.

The second pair of siagnopoda, as I have just stated, supports a long mastigobranchial appendage, that carries on its margin, more especially at the extremity, numerous extremely long and tolerably stiff hairs of peculiar formation. They are generally straight and rigid, but some are curved at the extremity. As a whole, these hairs gradually

decrease from the base to the apex ; but for about one-half the distance there appears to be a stronger and more important fibrous arrangement than there is within the remainder ; and, coinciding with this variation in internal structure, there is an alteration in the direction of the small stiff cilia that run spirally round the surface externally—those towards the base being directed backwards, those towards the extremity being directed forwards and spirally reversed. This appendage, from its extent and position in the branchial chamber, evidently plays an important function in the branchial system, situated as it is at the anterior opening, and has probably the control over the circulation of the water within the branchial chamber.

The third pair of siagnopoda has not even the rudiment of any mastigobranchial plate. In this it differs from most of the higher Crustacea. Its position is so forced in and compressed that there appears to be scarcely room for the requirements of such an addition, and is absent accordingly.

The mastigobranchia of the first pair of gnathopoda is short, bifid, almost rudimentary, furnished with long rigid hairs at the extremity, and carrying at its base a short podobranchial plume. This plume consists of long trichobranchiate filaments, until they approach the extremity, when they assume a phyllobranchiate character, the petals of which are arranged in a position longitudinal to the axis of the plume. Above, on the membranous articulation, are two arthrobranchiæ. The anterior is trichobranchiate, with the exception of two other phyllobranchiate petals that terminate the plume. This plume is also short, being scarcely as long as the podobranchia. The posterior arthrobranchia is very long and entirely phyllobranchiate, with the exception of a few filaments of an intermediate character at the base. These latter, as they approximate the phyllobranchiate petals, increase their diameter at the base, and become flattened, and so gradually pass from one form into the other. The petals are arranged longitudinally, with the longer axis of the plume on each side of the median line—the longer on the anterior and the shorter on the posterior margin, the longest being the terminal petals, each of which is traversed by a set of channels, without definite walls, that assume an arborescent appearance.

The mastigobranchia attached to the second pair of gnathopoda is short, although a little longer than that of the first pair. It is slightly curved, rigid, furred with numerous short hairs along the lower margin, and subapically tipped with long, straight hairs (which have been accidentally omitted by the lithographer). It supports at its base a long and well-developed podobranchial plume, consisting of a series of phyllobranchiate petals traversing the whole length of the under margin of the longitudinal axis of the plume ; while a series of trichobranchiate filaments are attached to the base. On the coxa, near the branchial articulation, are two fasciculi, or bundles of straight hairs. There are two arthrobranchiæ attached to the membranous articulation ; the anterior is rather shorter than the posterior. Both have a mass of trichobranchiate filaments attached to the base of a long plume of phyllobranchiate petals of considerable number and size. In the

anterior arthrobranchia the central or supporting axis, particularly towards the base, appears to be rigid and multiarticulate, each articulus supporting one or more obtusely pointed processes, the rudiments probably of undeveloped trichobranchiate filaments.

The mastigobranchia, with its attendant podobranchial plume attached to the coxa of the first pair of pereopoda, resembles that of the second pair of gnathopoda both in size and form. At its base are two fasciculi of long straight hairs, which under the microscope are seen to be fringed with fine cilia. Those that spring from the apex of the mastigobranchia are, under the fifth of an inch microscopic power, seen to have their edges serrated rather than ciliated. The anterior arthrobranchia is short, supporting on the under side a row of moderately long trichobranchial filaments on a rigid stem; the upper has a few of these at the base, while the distal extremity supports three broad phyllobranchiate petals. The posterior arthrobranchia is long and phyllobranchiate, the petals being arranged on the posterior margin of the stalk longitudinally from the base to the apex. A bundle of pendent trichobranchiate filaments is attached to a rigid and curved support that appears to be only connected with, and not part of, the longitudinal axis of the long phyllobranchiate plume.

The mastigobranchia and podobranchia belonging to the second pair of pereopoda bear a close resemblance to the appendages attached to the first pair. The anterior and posterior arthrobranchia are also similar, consisting of a long plume of phyllobranchiate petals, one or two of which at the base are double, beneath which is a bundle of trichobranchiate filaments.

The mastigobranchia of the third pair of pereopoda supports no podobranchial plume, and the anterior and posterior arthrobranchiæ are long and well developed, resembling those of the second pair, being phyllobranchiate, and having the largest petal at the base, near the root of which, on the under side, a bundle of trichobranchiate filaments is attached.

The mastigobranchia of the fourth pair of pereopoda, like that of the preceding pair, supports no branchial plume, and the arthrobranchiæ also resemble the preceding, but are much longer, and in the posterior the trichobranchial filaments extend to the foot of the apical petal, decreasing in length gradually from the base, where they are abundant, to the extremity, where they thin out to a single row.

There is neither mastigobranchial lash nor branchial plume attached to the fifth pair of pereopoda and the posterior somite of the pereion. This last somite is not fused with the rest of the pereion, but connected by membranous attachments, that admit of a limited amount of movement on the part of the somite, and one of a more extended degree in every direction in the case of the posterior pair of pereopoda.

The branchiæ are of two distinct kinds, one consisting of finger-like processes or cylindrical filaments, the other of broad thin foliaceous plates. The former are trichobranchiæ, the latter are phyllobranchiæ.

The trichobranchiæ exist as bundles, or fasciculi, and are situated at the base of nearly all the branchial plumes, whereas the phyllobranchial plates traverse the stem from the base to the apex, not compressing each other laterally, but implanted with their broad axis in the longitudinal direction of the stem. In some instances the plates slightly overlap one another, but generally they are fixed end to end.

The trichobranchiate filaments are at the base, just within the margin of the carapace, and exist as a peculiar branchial arrangement corresponding with the lower margin of the branchial chamber, increasing in size and number at the anterior and posterior extremities.

The phyllobranchiate plumes lie farther within the branchial chamber, and compared with the area, appear to occupy but a small portion of the space.

Thus we see that the trichobranchiate bundles are arranged mostly where the water plays most actively and freely, that is, along the margin and at the afferent and efferent passages of the branchial chamber, while the phyllobranchiate plumes lie where the water within the chamber is less likely to be disturbed.

I think there can be little doubt that the phyllobranchial plates and the trichobranchial filaments are derived from one and the same origin, as we see at the base that the one gradually passes into the other. In *Cheramus* this also appears to be the case, though the close compression of the one against the other is probably an inducing cause; but probably there are also other conditions brought into play. The foliaceous petals are not implanted one against the other, but are exposed freely in the chamber. Examination of these plates shows that within the several petals the structure is traversed by canals that assume an arborescent appearance, through which the fluid circulates and is brought by the tenuity of the apparatus into closer contact with the aerating agents than it otherwise would be.

In a respiratory chamber, such as in the genus now before us, the water flows in by the posterior extremity, for which purpose the carapace can be raised or depressed at will within certain limits; and as we may assume that in a large chamber such as the present, the water flows along the lower margin, passing out at the anterior end only, it is probable that the largest amount of current will correspond with that portion of the chamber where the trichobranchiate filaments are best developed and most abundant, whereas the phyllobranchial plates are present in the centre and deeper recesses of the chamber, where the circulation will be more quiescent, and the power of oxygenation less efficient.

We do not know much of the habits of this animal, but many of the group are burrowers in the deposits beneath the seas in which they live, hence it is more than probable, from the matted condition in which I found the fur that covers many parts of the animal, that it inhabits hollow passages in the mud, and that the circulation of the

water through the branchial chamber cannot be very vigorous, and consequently in that portion of the chamber that is most distant from the direct current, the circulation will be very inactive. In the central portion of the chamber the branchiæ, instead of consisting of cylindrical rods, are developed into thin foliaceous plates of considerable dimensions, through the tenuity of the structure of which the blood is brought over a large surface into contact with the aerating medium within the chamber. The circulatory channels seen within the plates demonstrate the organs to be of a complex structure, and capable of performing a function of a less simple kind—namely, of extracting the oxygen from water that has been stored for a long period where it has not been affected by the atmosphere.

I am aware that this is mere speculative reasoning from the appearance and condition of the organs, and that we must know more about the habits and mode of existence of the animal before we can determine with certainty what separate duties or functions these two varieties of branchial organs effect.

That neither of them can be the depauperised form of the other I feel assured, inasmuch as the variation in the several parts of the animal exhibits no depreciation of structure.

The various organs may be abnormal in form, but they are evidently well adapted for their purpose; the mandibles are strong, and the synphipod, which is required for sweeping food within reach of the incisive margin of the mandible, is a very powerful and efficient appendage. The stomach is a large and capacious organ, complicated in its structure, and adapted for the comminution of substances into a form that adapts them for assimilation.

The points of interest which this Crustacean possesses have induced me to give a detailed description of the several parts of its structure. Although the animal is not new, it has never been fully described; and the only figures, so far as I am aware, are a small one in Desmarcst's *Consid. des Crustacés*, another in Leach's *Miscellany*, and in Cuvier's *Atlas to the Règne Animale*.

The animal is interesting, and not only supplies a link connecting the Macrurous with the Anomurous Crustacea, but also shows that the trichobranchiate structure is intimately associated with the phyllobranchiate form, that the one is only a modification of the other in adaptation to varied conditions.

#### Family CALLIANASSIDÆ.

The several genera of this family are conveniently determined by the gradually increasing size of the somites of the pleon, together with the great breadth of the foliaceous plates of the rhipidura, and by the asymmetrical character of the first pair of pereiopoda, which generally have a tendency for the right to be larger, deeper, and less perfectly



chelate than the left, which approaches the more normal form. The carpos of the right side is generally formed as if it were a continuation of the propodos; this is particularly so in *Callianassa*, *Callianidea*, and *Trypæa*, and we presume from their general resemblance to the typical genus that it is the same also in *Cheramus* and *Scallasis*, of which genera, unfortunately, our specimens have lost the first pair of pereopoda.

The genus *Gebia* differs only in this respect, but in nothing else can I detect any anatomical point of separation of more than generic value, and, according to Professor Huxley's observations, the branchiæ are of the same specific character as is found in the type of this family.

Both the podobranchia and mastigobranchia are wanting in *Callianassa*, but the mastigobranchia is present in *Callianidea* in the form of slender plates fringed with hairs, and at its base a small bud-like process represents the podobranchia.

Thus it appears that in the form of the carapace, in the subchelate character of the first pair of pereopoda and the less Anomurous condition of the posterior pair, *Gebia* approximates to *Thalassina*, whereas in the form of the rhipidura, and in the condition of the branchiæ, it approaches nearer to *Callianassa*; it resembles *Callianidea* in having second pair of pleopoda constructed in the same form as the third and following, although fringed with articulate ciliated hairs as in *Cheramus*. It therefore appears correct to divide this family into three divisions.

#### DIVISION A.

The carapace is ovate, the rostrum is reduced to a small point, and the posterior pair of pereopoda is minutely chelate; the podobranchiæ, mastigobranchiæ, and pleurobranchiæ are entirely absent; the second pair of pleopoda is slender and filamentous, and the three following are broad, foliaceous, and fringed with ciliated hairs.

#### *Callianassa*, Leach.

The structure of the branchiæ of *Callianassa* is so intermediate in character that it may be claimed by anatomists as belonging to either the Phyllobranchiata or to the Trichobranchiata, as the plumes consist of two rows of long slender filaments so closely impacted together that they are flattened into plates; but we see in *Cheramus* that when the pressure is relieved, the filaments assume a cylindrical form, as in the typical Trichobranchiata, with which the external features of the animal strongly associate it.

The following table shows the arrangement of the branchiæ as observed in *Callianassa longimana* :—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	.	...	2	2	2	2	2	...
Podobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	.	1	...	...	...	...	...	...
					h	i	k	l	m	n	o

By this it will be seen that all the branchial plumes are absent, except those of the arthrobranchiæ, and the mastigobranchiæ are wanting on every appendage except the first pair of gnathopoda, where one is seen in the form of a rudimentary bulb.

*Geographical Distribution.*—Eighteen species of this genus have been described, and, from the various localities recorded, they appear to be sparsely scattered all over the globe. Some are stated to belong to the western coast of North America, and two to the western coast of South America; two to the eastern coast of North America, including the West Indies; one is from Europe, two from the western coast of Africa, including Cape Verde; the rest from the Pacific and islands of the Indian Ocean.

This scattered distribution suggests that the small number of specimens found is due to the burrowing habits of the animal rather than to paucity of specimens.

Geologically, *Callianassa* has only been found in the more recent series of formations. The largest specimen, *Callianassa maxima*, A. Milne-Edwards, stated to have been found at a great distance from the sea, in alluvial soil, on cutting a canal in Siam. Another, *Callianassa crassa*, A. Milne-Edwards, was found in the Miocene sands of St. Paul, near Dax. Others have been recorded from the Calcaire grossier de Parmes, and the Environs of Gisors; the sands of Beauchamp, and the Chalk formation of Bohemia, according to Anton Fritsch, have yielded six species.

*Callianassa occidentalis*, n. sp. (Pl. II. fig. 2*k*).

The propodos is smooth, longer than broad, and broader than the carpos, which is also longer than the palm, or that portion of the propodos that does not include the pollex. Meros as long as the carpos, the lower margin compressed to a thin convex plate posteriorly serrate. Ischium long, flexed, imperfect.

*Habitat.*—Station 23, March 15, 1873; lat. 18° 24' N., long. 63° 28' W.; off Sombrero Island, West Indies; depth, 450 fathoms; bottom, Pteropod ooze. Associated with *Cheramus occidentalis*.

A solitary specimen of the larger of the first pair of pereiopoda is all that was taken of this animal. This limb appears to differ from that of any known species, more particularly from that of *Callianassa major* (Say), the only one that has been taken in the same neighbourhood, and which is described as having the meros armed with a very strong tooth. It is not impossible that it may belong to the species *Cheramus occidentalis*, but it is too large to have belonged to the specimen with which it was taken.

*Cheramus*, n. gen.

This genus resembles *Callianassa* generally, but differs in having the second pair of gnathopoda pediform; in the form of the second pair of pleopoda; in the third and following pairs being ciliated, and in having strong spines, more or less curved, on the posterior margin of the rhipidura.

*Observations.*—In *Callianassa*, according to Milne-Edwards's figure and description,<sup>1</sup> the second pair of gnathopoda is broad and operculiform, whereas Leach<sup>2</sup> describes and figures the same as being pediform. Bell<sup>3</sup> says that the same part is very broad, but does not give a figure of the structure, although the specimen that he is describing belongs to *Callianassa subterranea*, the same species from which Leach and Edwards drew their descriptions.

De Haan<sup>4</sup> describes the part as being dilated, but figures it as being pediform; whereas Dana, in his description of the genus, has overlooked it altogether.

I have thought it desirable, therefore, to separate those in which the second pair of gnathopoda are pediform from those in which they are operculiform, although feeling it not improbable that further investigation may show that the two forms may be dependent on either difference of age or sexual distinction, although such a condition is not usual.

*Cheramus orientalis*, n. sp. (Pl. I. fig. 2).

Carapace smooth, with a short pointed rostrum. Branchial regions distinctly defined from the gastric and cardiac. Second pair of gnathopoda pediform. Posterior pair of pleopoda having the outer plate much larger than the inner. Telson long, quadrate.

*Habitat.*—Station 188, September 10, 1874; lat. 9° 59' S., long. 139° 42' E.; Arafura Sea; depth, 28 fathoms; bottom, green mud.

Length, 12.5 mm. (half an inch).

There was but a single specimen taken, and this, unfortunately, in a very damaged condition; all the limbs were broken off except the first pair of antennæ, the oral appendages, one of the posterior pair of pereiopoda, and some of the pleopoda.

It resembles *Callianassa* in its general appearance; but the second pair of gnathopoda does not form an efficient operculum.

The ophthalmopoda are horizontally compressed, and formed like a disk with a pointed extremity, the eye being situated in the middle of the outer surface.

<sup>1</sup> "Les pates machoires externes sont operculiformes," *Hist. Nat. des Crust.*, vol. ii. p. 308, pl. xxv. *bis*, fig. 2.

<sup>2</sup> "Palpi pediformes articulo secundo compresso longiore," *Malac. Pod. Brit.*, pl. xxxii.

<sup>3</sup> "External pedipalps, with the second and third joints very broad, constituting when in contact a broad oval disk and terminating in a small seta formed of the last three joints," *Hist. Brit. Stalk-Eyed Crustacea*, p. 217.

<sup>4</sup> "Maxillarum palpi nulli, art. 2<sup>a</sup> et 3<sup>a</sup> dilatati," *Siebold's Fauna Japonica, Crustacea*, p. 162 tab. v.

The first pair of antennæ has the two flagella nearly equal in length, but the primary is the larger, and is furnished with numerous membranous cilia near the extremity. The secondary flagellum is slender and almost destitute of cilia; both flagella have the articuli strongly defined.

The second pair of antennæ has only the peduncle preserved, and this is nearly as long as the first.

The second pair of gnathopoda is pediform. The coxa and basis are short. The ischium is long, and has the infero-internal margin strongly serrated. The meros, carpos, and propodos are subequal; the dactylos is wanting. Each of the joints is copiously supplied with long hairs, more particularly on the under margin.

The posterior pair of pereiopoda is small, and terminates in a chelate hand immersed in a brush of hairs.

The first pair of pleopoda is slender, feeble, and single-branched.

The second pair is long, slender, and double-branched, the inner ramus being two-jointed; a few long hairs fringe the termination of each joint.

The next three pairs of pleopoda consist of large foliaceous plates. The margins of the inner plate are thickly fringed with strong multiarticulate hairs, furnished with short cilia on both sides; the inner margin carries a short, stout stylamblys, the apex of which is crowned with small obtuse-pointed hooks (cincinnuli). The outer plate has the outer margin fringed with long multiarticulate hairs, ciliated on one side only, while the inner margin carries a row of distantly placed, solitary, simple straight hairs.

The posterior pair of pleopoda (the rami of the rhipidura) has the outer branch much larger than the inner. The peduncle is short, and the foliaceous plates somewhat pear-shaped in form. The posterior margin of the outer plate is thickly fringed with both long and short spines, and hairs, plain and ciliated, some of which on the inner angle increase in size and length until they become long and stout spines, with a slight curve or hook at the extremity. These are repeated for a short distance on the outer corresponding angle of the inner plate, where the spines are curved in the opposite direction, and mingled with hairs only that are fringed with long cilia. On the posterior lateral margin of the telson there are, mixed with the ciliated hairs, two sharp, short spines on each side.

*Observations.*—Our specimen has the branchiæ approximating closely to those of *Callianassa* both in arrangement and in character. They consist of four pairs of arthrobranchiæ and one podobranchia according to the following formula:—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	.	...	...	2	2	2	2	...
Podobranchiæ,	.	.	.	.	...	1	...	...	...	...	...
Mastigobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
							h	i	k	l	m n o

The plumes attached to the third pair of pereiopoda are affixed somewhat within the basal extremity, and have the branchial processes somewhat longer at the base, beyond which they rapidly and gradually decrease to the distal extremity, where they lose their lateral compression and appear as cylindrical papillæ. The plumes attached to the second pair of gnathopoda have the processes very long and foliaceous at the base; and after three or four such processes rapidly decrease in size, and become cylindrical, the extremity of the stem of the plume terminating obtusely.

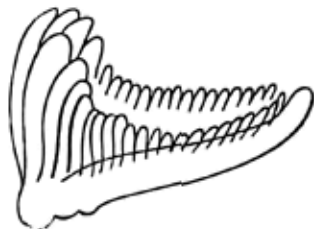


FIG. 1.—Branchial plume of *Cheramus orientalis*.

The second pair of pleopoda is biramose, one branch extending from the terminal extremity of the basal joint, the other, a long and slender one, from the side. The third and following are formed as in *Callinassa*, but support a small stylamblys tipped with minute cincinnuli, and both plates are fringed with hairs that are ciliated and multiarticulate.

There is no doubt that this and the following specimens might have been considered as one species had they been found in the same locality; as it is they may probably be a form common to species before they have attained their mature condition.

This species was taken in comparatively shallow water at the entrance of Torres Strait, off the south coast of New Guinea.

*Cheramus occidentalis*, n. sp. (Pl. II. fig. 1).

Carapace smooth, with a sharp rostrum, reaching nearly to the extremity of the ophthalmopoda. Branchial region defined from the gastric. Telson long, quadrate; posterior margin rather narrower than the anterior, fringed with long ciliated hairs, and having in the median line a strong sharp tooth, and two short sharp spines on the posterior half of the lateral margins.

*Habitat*.—Station 23, March 15, 1873; lat. 18° 24' N., long. 63° 28' W.; off Sombrero Island, West Indies; depth, 450 fathoms; bottom, Pteropod ooze.

Length, 18 mm. (three-fourths of an inch).

The carapace is laterally deep and generally smooth. The rostrum, laterally compressed, projects anteriorly to a sharp point until it reaches nearly as far as the extremity of the ophthalmopoda, which are pointed and rather longer than broad, laterally compressed, and have the eye at the centre of the outer surface. The flagella of the anterior antennæ are nearly of the same size and length. The second joint of the second pair of antennæ is extremely long, and the last is short; the rest of the appendage is wanting. The pereiopoda are all broken off at the basal joint, the two anterior pairs of pleopoda are slender, the three succeeding are small and fringed with cilia. The

posterior pair of pleopoda has the outer branch much larger than the inner, and both have the inner margin fringed with ciliated hairs, and the extremity furnished with hairs and spines.

The mastigobranchial plates and podobranchial plumes are entirely wanting, and so also are the pleurobranchiæ, and in this respect the character of the organs is consonant with those of *Callianassa*, inasmuch as the only plumes that are present are the arthrobranchial, which, however, appear to vary as to number, as shown in the following formula:—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	.	...	...	2	2	2	1	...
Podobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	.	...	...	...	...	...	...	...
					h	i	k	l	m	n	o

A variation exists not only in the number, but also in the form of the structure, more especially in that of the anterior plumes; the tendency being to form large and broad foliaceous plates at the base of the stem, changing in some cases rather suddenly into slender cylindrical processes, that gradually shorten toward the apex of the plume.

Unfortunately there was but a single specimen taken of this interesting little species, and that in a very damaged condition.

Comparing it with the species that we have just described as being taken at the entrance of Torres Straits, in only 28 fathoms of water,—a locality that is almost the antipodes of the other; the one in lat. 19° N. and long. 63° W., while the other was taken in long. 10° S. and 142° E.,—the similarity of the two is very remarkable. The only distinctions by which I could positively determine the one from the other are in the form of the rostrum, branchiæ, and telson, and perhaps of the lateral caudal pleopoda. In *Cheramus orientalis* the telson has the posterior margin fringed with long ciliated hairs, and in the median line there is a very rudimentary point at the bottom of a slight depression. In *Cheramus occidentalis* this depression exists, while in the median line there is a well-defined straight tooth.

The lateral caudal pleopoda have their armature, although strongly spinous, yet scarcely as hooked in form as in *Cheramus orientalis*.

On the inner branch of the third pair of pleopoda is a small stylamblys, rather more pointed than in *Cheramus orientalis*, and fringed with small cincinnuli or hooklets.

With this species was taken an anterior right or large cheliped (Pl. II. fig. 2k). It appears to be rather too large to belong to the individual I have described, but it may belong to another specimen of the species (see p. 29).

The branchial plumes of the two species of this genus, which come from such distant localities, are very instructive in their character. In *Cheramus orientalis*, the arthrobranchia attached to the second pair of gnathopoda is very short, and carries a

series of lobes, arranged in two rows running from the base to the apex of the plume: those at the base are long, broad, flat, and foliaceous; those near the apex are slender, rounded, and digitiform.

In the second pair of pereiopoda the arthrobranchial plume approximates more nearly to the form which exists in *Callianassa*, that is, of two longitudinal rows of long and slender plates compressed closely against one another; but as these plates approach the extremity of the plume, they lose the flattened or compressed condition, and have a more cylindrical appearance.



FIG. 2.—Arthrobranchia of *Cheramus occidentalis*.

In *Cheramus occidentalis* the arthrobranchia attached to the first pair of pereiopoda consists of a double row of long flat plates which gradually become narrow and slender, rounded and digitiform, lessening in length as they approach the apex of the plume—as shown in the accompanying woodcut.

In one instance on the posterior arthrobranchia a process had commenced as a broad and flattened plate, and then became compressed into a narrow cylindrical continuation, showing, I think, very clearly that the two kinds of branchiæ are but modifications of the trichobranchiate type.

### *Scallasis*,<sup>1</sup> n. gen.

This genus resembles *Cheramus*, but differs in the form of the eye. The ophthalmopod, or peduncle of the eye, is globular, with the eye at the extremity. Second pair of gnathopoda pediform. Posterior pair of pereiopoda minutely chelate. Branchia arranged in two rows on a stem, subcylindrical filament slightly if at all compressed. Pleopoda carry a moderately-sized stylamblys. Marginal hairs ciliated and multi-articulate.

#### *Scallasis amboinæ*, n. sp. (Pl. II. figs. 3, 4).

Carapace smooth. Rostrum small and sharp; cervical groove well defined. Telson quadrate; posterior margin slightly excavate, fringed with cilia, and having a small rudimentary pointed tooth in the median line.

Length, 12.5 mm. (half an inch).

*Habitat*.—Taken at Amboina, one of the Celebes Islands, on the 6th of October 1874.

The only specimen taken is very imperfect. The few limbs preserved are the anterior antenna and one of the posterior pair of pereiopoda. Therefore, in giving a description, I am compelled to refer to the only parts that have not been lost, and these may not be of great specific importance.

<sup>1</sup> Σκάλλω, to scrape; αἴς, mud.

When viewed dorsally the carapace is broad, having a straight projecting rostrum *extending little beyond the limit of the eyes*. There is no distinct excavation or orbit to receive the eyes, but outside and beneath there is a deep notch, caused by the anterior production of the lateral or branchial walls of the carapace. From this point a deep line is prolonged backward to the posterior margin, thus indicating very distinctly, by a clearly-defined line, the part which separates the internal viscera from the external, or the gastric and cardiac regions from the branchial. There is also a deep cervical furrow connecting the lateral depressions corresponding with the posterior margin of the cardiac region, and separating it from the post-cardiac.

The pleon is about twice as long as the carapace, and has the second somite as long again as the first, the others not quite so long as the second, and subequal to each other. Telson quadrate, slightly hollowed out in the posterior margin, but the immediate centre of the excavation is occupied by a very small pointed projection or tooth, on each side of which are several short hairs, and a bunch of extremely long ones.

The ophthalmopod, or eye-stalk, is globose, almost round, with a small slightly projecting eye at the anterior extremity.

The first pair of antennæ has a long peduncle, the first two joints of which are short and the third long. The upper or inner flagellum is much stouter than the lower or outer, a feature that is generally characteristic of a male; it is about the same length as the peduncle; it is small at the base, and gradually increases in size to near the extremity, when it again rapidly decreases; the articuli are extremely short and numerous. The outer or lower flagellum is slender, and about the same length as the upper.

The second pair of antennæ has been destroyed beyond the peduncle, which reaches farther than the extremity of that of the upper.

The second pair of gnathopoda has a long and nearly straight dactylos, an equally long propodos, and short carpos; the meros is short and the ischium long, and all the joints are copiously fringed with long hairs.

The pereopoda are wanting, except the posterior pair, which terminates in a minute chelate hand enclosed in a thick brush of hairs, some of which are ciliated on one side.

The branchial appendages consist of five posterior and six anterior arthrobranchiæ, as shown in the annexed table.

Pleurobranchiæ,	.	.	...	...	...	...	...	...	...	...		
Arthrobranchiæ,	.	.	...	...	1	2	2	2	2	...		
Podobranchiæ,	.	.	...	...	...	...	...	...	...	...		
Mastigobranchiæ,	.	.	...	...	...	...	...	...	...	...		
					g	h	i	k	l	m	n	o

These consist of cylindrical digitiform processes attached to a stem forming a plume, of which those at the base are long and exposed below the lateral margin of the carapace, where the extremities are visible as a row of small grape or bead-like bodies.



The pleopoda are biramose, attached to a short peduncle; the outer and larger branch springs from the side of the peduncle, the other from the apex. The outer branch is crescent-shaped, and almost encloses the inner. It is fringed on the outer or convex margin with numerous long hairs of a peculiar structure. Every hair articulates at the



FIG. 3.—Arthrobranchia of *Scyllaris amboinensis*.

base by a movable joint, and beyond a short distance from its base becomes multiarticulate (*i.e.*, is broken up into numerous small sections or joints), and is fringed along the margin with short fine cilia. The inner margin of the outer plate is concave, and fringed with a few equidistant stiff straight hairs. The inner branch is fringed on each side with long pointed hairs, above which, on the side approximating the outer plate, is a row of equidistant straight stiff hairs; on the inner side is a short stylamblys, without hairs or cilia, but furnished near the apex with two rows of small blunt hooks, to which Sars has given the name of cincinnuli.

The posterior pair of pleopoda, with the telson, unite to form the rhipidura or caudal fan. It consists of an extremely short base, and two broad foliaceous plates, of which the outer is larger than the inner, and both are terminally fringed with hairs.

*Observations.*—The jointed character of the hairs that spring from the margins of the pleopoda, as well as in *Cheramus*, are different from those in *Callianassa* both in position and structure. In *Callianassa* the outer margin is reflected on itself so as to show a smooth surface outwardly, as shown in Milne-Edwards's figure, and the hairs are all turned back and pressed against the posterior margin, and are all minutely multiarticulate. In *Cheramus* and *Scyllaris* the margin is not reversed, and the hairs are broken into small joints that are suggestive of the differentiation of character, as shown in the homologous structure of *Callianidea*.

#### DIVISION B.

This division contains only the genus *Callianidea*, of which no species was taken by the Expedition.

#### DIVISION C.

This division contains the genus *Gebia*, of which no species was taken during the Voyage of the Challenger.

#### Family AXIIDÆ.

Dorsal surface of the carapace anteriorly produced to a horizontally flattened point or rostrum. First pair of pereopoda large, chelate, subsymmetrical, subequal. Second

pair of pereopoda small, chelate, symmetrical, equal; posterior pair terminating in a small styloform dactylos. First somite of the pleon shorter than the second and following. External branch of the rhipidura not longer than the inner.

A mastigobranchia present on all the pereopoda except the posterior pair, and a podobranchia is attached to four.

This family contains the following genera:—*Axius*, *Paraxius*, *Eiconaxius*, of the first of which no specimen is in this collection.

*Geographical Distribution.*—*Axius* has been taken only on the southern coast of England; *Paraxius* off Celebes Island; and *Eiconaxius* south of Celebes, and near the Kermadec Islands in the West Pacific.

*Paraxius*, n. gen.

Characters generally resembling *Axius*, but distinguished by having the first somite of the pleon, especially in the extent of the lateral walls, much smaller than the second.

The eyes are fixed on broad bands or conical peduncles. The second pair of antennæ has neither scaphocerite nor stylocerite attached to the peduncle. The hands of the first pair of pereopoda are broader at the dactyloid articulation than at the carpal. Telson quadrate.

*Paraxius altus*, n. sp. (Pl. V. fig. 1, *d-z*).

Lateral walls of the carapace deep; rostrum pointed, flattened dorsally; margins serrate. Second pair of gnathopoda with the dactylos broad and compressed, all the joints subequal in length. First pair of pereopoda having the right propodos large, slightly narrower at the carpal than at the dactyloid joint; pollex thick at the base, sharp, pointed, curved, and smooth; a strong point or tooth at the upper distal angle of the propodos; dactylos robust, curved, pointed, smooth. Second pair of pereopoda having the hand long, ovate; dactylos broad, thick, and obtusely pointed, of the same shape as the pollex.

Length, 25 mm. (1 inch).

*Habitat.*—Station 218, north of Papua, March 1, 1875; lat. 2° 33' S., long. 144° 4' E.; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4.

Carapace about one-third the length of the animal. Compressed laterally, rather more anteriorly than posteriorly. Lateral walls deep, but not produced anteriorly in advance of the dorsal frontal margin, or posteriorly much behind the posterior dorsal margin. Rostrum flat, triangular, with an acute apex; the margins serrate, with three or four upwardly-curved teeth on each side.

First somite of the pleon short; having small coxal plates elevated into a lobe

anteriorly. The four succeeding somites are subequal and similar. They are much longer than the first, and are laterally supported by large coxal plates produced both anteriorly and posteriorly beyond the extremities of their respective somites, and rounded at their posterior and inferior angles.

The sixth somite is rather shorter and less deep laterally than the preceding, and converges dorsally towards the posterior extremity, where it supports a broad, flat telson, quadrate in form, serrate at the sides by a few sharp, small teeth, and armed with two on the dorsal surface on each side of the median line, and fringed along the posterior margin with a row of deeply-implanted plumose cilia.

The eyes are small; the ophthalmopoda conical, broad based, extending to about one-half the length of the rostrum.

The peduncle of the first pair of antennæ is cylindrical, and reaches a little beyond the extremity of the rostrum. The first joint extends beyond the eye, and has the upper surface slightly excavated to receive that organ. The second is shorter than the first, and the third is longer than the second. This last joint supports two subequally long multiarticulate slender flagella, of which the primary or upper branch is rather the shorter and the more robust; one or two long cilia originate from the extremity of each articulus.

The peduncle of the second pair of antennæ reaches beyond the extremity of the peduncle of the first, to an extent equal in length to the last joint of the second pair. There is neither spine nor scale attached to the base of this appendage, and therein it differs fundamentally from the genus *Axius* of Leach, which is described as having a movable spine.<sup>1</sup> The phymacerate is large, and directed inwards towards the anterior part of the metope, which recedes obliquely backwards to the mouth. The terminal joint of the peduncle supports a slender flagellum that is about one-fourth longer than those of the first pair.

The mandibles are a pair of convex plates, having the inner side concave towards the incisive or psalisiform margin, but towards the base they have a sudden enlargement or molar prominence, against which the synnhipod plays. This synnhipod arises on the anterior margin, near where it articulates with the metope; it consists of three joints, of which the distal one is the largest in width and proportions; it folds round the anterior margin of the mandible, and rests between it and the epistoma.

The first pair of gnathopoda is subpediform, that is, it somewhat resembles a pair of

<sup>1</sup> Leach in his *Malac. Brit.* says nothing about the scale (scaphocerite), but figures a rigid, sharp point at the upper extremity of the antepenultimate joint of the peduncle of the second antennæ, which he describes as "antennæ exteriores setacæ corporis ferè longitudine." Milne-Edwards (*Hist. Nat. des Crust.*, vol. ii. p. 311), without any illustration, says, "Le pédoncule des antennes externes présente en dessus une petite épine mobile qui représente le grand palpe lamelleux, que nous rencontrerons chez les Salicoques." Desmarest (*Consid. des Crust.*, p. 206) makes no mention of the scale, and copies Leach's figure. Bell (*Brit. Stalk-Eyed Crust.*, p. 227), without figure, says, "External antennæ nearly as long as the body; the peduncle furnished above with a small movable spine."

legs in general appearance, but consists of only five joints, or two less than the normal number, the coxa and basis being consolidated into one, and the dactylos absent. The second pair of gnathopoda is also subpediform, and consists of six joints, the coxa and basis being fused into one, and differs from the normal pereopod in the form of the dactylos only. Although these two pairs are each described as being subpediform, and differing from each other only in the absence of a single joint, yet in their general appearance they vary considerably. The first joint, or coxa and basis united, in the first pair carries a mastigobranchial plate, and a slender basephysis, consisting of a long basal joint and a terminal multiarticulate flagellum as long as the primary branch. In the second pair the first joint, or coxa and basis united, carries a basephysis not half the length of the primary branch; besides this the mastigobranchial plate is longer and more slender, and it also supports a branchial stem carrying rudimentary papillæ. In the first pair the ischium is short, in the second it is long. In the first pair the meros is long, at least four times as long as the ischium; in the second it is scarcely so long as the ischium, and armed at the inner distal extremity with two strong teeth. The carpos in both pairs bears a corresponding resemblance, but the propodos in the first pair terminates the appendage as a semicircular terminal joint thickly fringed with hairs; in the second pair the propodos is long, cylindrical, and furnished with hairs on the lower margin, and the dactylos, which is short and rounded, ends in an obtuse point, and has the inferior margin thickly fringed with strong hairs.

The first pair of pereopoda has the left hand wanting in our only specimen, but the right is well developed; the meros is long, and excavated beneath on the anterior portion, the inner side of which is armed with a sharp strong tooth. Into this hollow the inferoposterior portions of the carpos and propodos fall when folded back, and the prominent tooth acts as a guide to direct it to its position; the carpos is triangular, having the broad side directed forwards, against which the propodos articulates during its entire depth; the propodos is deep, but scarcely more so than the carpos at its approximate extremity, but it increases as it approaches the dactylos, the anterior upper angle is produced to a sharp-pointed tooth, the inferior angle into a long polliciform process pointed at the extremity, and curved upwards; the dactylos is about as long as the propodos is wide, it is arched on its upper margin, and terminates in a point; the lower incisive margin is nearly straight, except for a small cusp or tubercle near the middle.

The second pair of pereopoda is much smaller than the first; it is chelate, having the hand, when the dactylos is closed against the propodos, of a long ovate form.

The third and fourth pairs of pereopoda are longer than the second, but scarcely as robust; they have the propodos long, and the dactylos short and pointed.

The fifth pair is more feeble than either of the preceding, and appears to be reversed in its articulation with the body. It is long and slender, and terminates in a long propodos, distally tipped on the inner side with long hairs and a sharp dactylos.

The first pair of pleopoda in our specimen, which I believe to be a female, is small and feeble. The four following pairs consist of a long basal joint supporting two multi-articulate branches, fringed at each margin with long delicately ciliated hairs. The inner branch carries on its inner margin, near its base, a single straight stylamblys.

The sixth pair of pleopoda forms the lateral plates of the rhipidura or tailpiece, and consists of a short peduncle and two large subequally broad and long plates, each having a small tooth near the outer terminal angle, while the posterior margin is fringed with a row of long ciliated hairs deeply implanted in the edge.

The branchial apparatus consists of tolerably well-developed mastigobranchiæ, to which a podobranchial plume is attached, excepting the penultimate pair of pereopoda, where the mastigobranchial plate exists in a well-developed condition, without any branchial plume. The plumes generally consist of a stem, with two rows of cylindrical filaments. These may be formulated as follows:—

Pleurobranchiæ,	.	.	.	...	...	...	...	...	...	...	
Arthrobranchiæ,	.	.	.	...	2	2	2	2	2	...	
Podobranchiæ,	.	.	.	...	1	1	1	1	...	...	
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...	
					h	i	k	l	m	n	o

*Eiconaxius*, n. gen.

Characters generally resembling *Axius*. First somite of the pleon shorter than the second. Second pair of antennæ having the peduncle furnished with a scaphocerite and stylocerite.

This genus differs from *Paraxius* in having both scaphocerite and stylocerite, which are absent in that genus; this character also separates it from *Axius*, which has a small scaphocerite only. The stylocerite, which is present in this genus, is wanting in *Axius*, as it is in all the Macrura, except *Eiconaxius* and *Cheiroplatea*. Its presence is a feature most prevalent in the Anomurous Crustacea.

*Geographical Distribution*.—We only know this genus as an inhabitant of the Celebes Seas, and of the Pacific Ocean near the Kermadec Islands.

*Eiconaxius acutifrons* (Pl. V. fig. 2, d–q).

Rostrum dorsally flattened and sharp pointed; narrow in the male, broad, and a little shorter in the female. First pair of pereopoda with the right and left propoda subequal in the male, and equal in the female; compressed laterally and very deep, deeper at the posterior margin than the carpos; pollex armed on the inner side with a long, smooth, depressed tubercle, and the incisive margin beyond slightly serrated. Dactylos broad, deep, arched, and pointed, armed with a strong smooth convex tubercle near the base.

Length, 21 mm. (0·8 inch).

*Habitat*.—Station 194A, off Banda, September 29, 1874; lat. 4° 31' 0" S., long. 129° 57' 20" E.; depth, 360 fathoms; volcanic mud. Associated with *Cheiroplatea cenobita*.

Carapace one-third the length of the animal, laterally compressed, more so anteriorly than posteriorly; lateral walls deep, inferiorly compressed, increasing from the frontal margin obliquely backwards with an imperfect antero-inferior angle; posterior projecting a little beyond the dorsal margin of the carapace. The dorsal surface is arched a little over the gastric region, and projects forwards in the form of a flat triangular rostrum which has a slight elevation in the median line, while on the inferior surface of the rostrum, a similar but more important ridge exists as a projection between the eyes. The margins of the rostrum are smooth, except under a magnifying power, when they appear slightly serrate.

The first somite of the pleon is short and divided into an anterior depressed portion, which is capable of being covered by the carapace, and an elevated posterior portion.

The four following somites are subequally long, and support laterally large and deep coxal plates, the infero-anterior angle of which is rounded to a posteriorly directed oblique line, whereas the infero-posterior angle is produced to a sharp point which becomes less prominent on each somite posteriorly, and scarcely exists in the fifth. The sixth somite is shorter than the preceding, but nearly as broad; it has less important coxal plates, and the posterior margin is excavated to receive the articulated joint of the caudal pleopoda. The telson is square, the posterior margin being fringed with short cilia.

The eyes are small and project on each side, but do not reach beyond the base of the rostrum.

The first pair of antennæ has the peduncle extending considerably beyond the rostrum. The first joint is short, not reaching to the extremity of the rostrum, and is slightly excavated on the upper surface to receive the eye; the second joint is shorter than the first, and reaches beyond the rostrum; the third is shorter than the second, and supports two unequal flagella, the primary or upper being one-fourth longer than the lower.

The second pair of antennæ has the peduncle reaching beyond the extremity of that of the first; its third joint is externally produced to a long sharp tooth or stylocerite, between which and the base of the fourth joint stands a strong sharp movable spine, the homologue of the scaphocerite attached to the second antennæ of most *Macrura*—it is sharp, spine-like, and free from hairs or cilia; the fourth joint of the peduncle is very long, and reaches nearly to the extremity of the scaphocerite, whereas the fifth is shorter than the fourth, reaches beyond it, and supports a slender flagellum that makes the antennæ about half the length of the animal.

The oral appendages do not differ very materially from those of *Paraxius*. The

incisive blade of the mandible is wider and larger, and the molar protuberance within is much less conspicuous.

The first pair of gnathopoda is similarly formed to the same organ in that genus, but the basephysis terminates in a sharp point only, instead of a multiarticulate lash.

The second pair of gnathopoda corresponds much with that of *Paraxius*, but carries a shorter and less conspicuous basephysis, which does not terminate in a multiarticulate lash.

The first pair of pereopoda varies but little in its relative symmetrical proportion, the organ on the right side being the larger in the male, but subequal in the female; in both sexes they are large and powerful members, and have the propodos laterally compressed and deeper than the carpos. The pollex is half the length of the propodos, and is armed with a long flat central cusp and a few small serrate teeth between it and the apex, which is sharp and turned a little upwards. The corresponding edge of the dactylos has a rounded tubercle near the joint, from which the margin continues in an unbroken wavy line to the sharp and downward curved apex.

The second pair of pereopoda is much smaller than the first. It is chelate, the propodos is long, the margins are parallel, and the dactylos strikes the pollex obliquely. The third and fourth pairs of pereopoda are subequal, and scarcely less robust than the second pair, they are simple in structure, and terminate each in a short, flat compressed lanceolate dactylos. The fifth is a more slender and shorter pair of appendages, but similarly constructed to the last, and supporting a small brush of hairs on the inner side at the base of the styliform dactylos.

The first pair of pleopoda is small, slender, and rudimentary in the female, and appears to be wanting in the male. The four next pairs of pleopoda are biramose, consisting of a peduncle formed of the basal joint and two long lamelliform branches, fringed with deeply inserted long ciliated hairs. The inner branch carries, one-third from the base, a single straight stylamblys, which is armed laterally with a row of obtuse pointed curved denticles to which Sars has given the name of "cincinnuli." In the male these branches are smaller and less important, and the inner, instead of carrying one, supports two stylamblydes.

The sixth or posterior pair of pleopoda, which helps to form the rhipidura or fan-like tail, is lodged in an excavation at the external angle of the posterior margin of the sixth somite. The peduncle is short, the branches are as long as the telson, and are broad, foliaceous, and terminally fringed with cilia. The telson is as long again as the sixth somite of the pleon, it is long and rather quadrate in its form, and the terminal margin is fringed with short cilia.

The arrangement of the branchiæ shows the greatest development in connection with the three anterior pairs of pereopoda, the number as well as the size of the plumes diminishing both anteriorly and posteriorly.

A mastigobranchia is attached to the coxa of every appendage from the posterior pair of siagnopoda, where it is very broad and short, to the fourth pair of pereiopoda, where it is long and narrow. It is slender and membranous for the distal half, the margins of which are fringed with short stiff hooks, shortest towards the apex, and gradually lengthening towards the base, where it becomes firm and rigid, and has the margins fringed with hairs.

A podobranchial plume in a rudimentary condition is attached to the base of all the mastigobranchiæ, except that of the first gnathopoda and the penultimate pereiopoda; on those belonging to the second and third pairs of pereiopoda there are a few branchial filaments attached to the base of the stem, but fewer in the third than in the second, and these gradually diminish in importance towards the distal extremity, where they exist only in the form of papilliform protuberances some distance within the extremity, which is sparsely fringed with small hooks, as shown in the annexed woodcut.



FIG. 4.—Podobranchia of *Eiconaxius acutifrons*.

These are mostly small, and so are the arthrobranchial plumes belonging to the third and fourth pairs of pereiopoda.

The branchial filaments are attached to the margins, and form the rudiment of a double row such as exists in the arthrobranchiæ, and even these latter diminish in importance and become papilliform towards the apex.

The following table shows the general arrangement of the branchia in this species :—

Pleurobranchiæ,	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	...	...	2	2	2	2	...
Podobranchiæ,	.	.	.	...	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

*Eiconaxius kermadeci*, n. sp. (Pl. V. fig. 3).

Palm and propodos of the larger chela strongly denticulated, and having a hollow space between them and the dactylos.

Length, 37 mm. (1½ inch).

*Habitat*.—Station 171, north of the Kermadec Islands, July 15, 1874; lat. 28° 33' S., long. 177° 50' W.; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5.

This species much resembles *Eiconaxius acutifrons*, and were they found associated, would probably be mistaken for it. The rostrum is a little longer and less acutely pointed, and the margins are minutely serrate. The gastric region is more distinctly defined by a ridge from the frontal; but a more noticeable distinction exists in the form



of the armature of the large pair of chelate pereiopoda, which exhibits a large hollow space between the impinging margins of the pollex and the closed dactylos. Even here the male and female differ somewhat. In both sexes the left propodos is larger than the right. The right hand in both is similar; it is narrower, less serrate, and has the dactylos and the pollex correspondingly impinging throughout their entire length, being quite half as long as the propodos, whereas on the left side the propodos is two-thirds longer than the dactylos, and so broad that it impinges against the antagonising process of the propodos in an oblique direction at the apex, leaving a large open space between it and the base, the propodal margin of which is serrate with several large teeth, whereas that of the dactylos is smooth.

The second pair of pereiopoda has the propodos long and narrow, not very unlike but more slender than that of the previous species.

The fifth or posterior pair is quite as robust as that of the fourth, but has the infra-terminal angle of the propodos fringed with a brush of rather long cilia.

The females were carrying ova, which were very large, and numbered about twenty, but were not sufficiently advanced to enable me to determine the character of the embryo.

*Eiconaxius parvus*, n. sp. (Pl. V. figs. 4, 5).

Like *Eiconaxius acutifrons*, except in having the impinging surfaces of the dactylos and dactyloid process of the propodos, of the first pair of pereiopoda, smooth.

Length, 12 mm. (0.5 inch).

*Habitat*.—Station 170, off the Kermadec Islands, July 14, 1874; lat. 29° 55' S., long. 178° 14' W.; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°.

This species is distinguishable from the preceding by having the left or larger hand without any teeth on the impinging margins of the dactylos, and pollex or projecting process of the propodos. By the rather long and less lanceolate form of the dactylos on the three posterior pairs of pereiopoda, and by the less pointed and tooth-like appearance of the infero-posterior angle of the coxal plates of the pleon.

There was but one specimen of this species taken, and that a female, which is rather smaller than those of the females of the preceding species.

*Observations*.—There were seven ova attached to our specimen. These, when compared with the size of the animal, were extremely large. They were oval rather than round in shape, and measured about 1 mm. in length. Fortunately they were approaching the period when the embryo is ready to leave the ovum; but having been preserved in spirits, the vitelline substance had been unfortunately rendered so opaque that without the assistance of reagents there was little to be determined with accuracy. But with their assistance, and careful manipulation, I was enabled to take out of the ovum a

young animal that very closely resembled the brephalos of the genus *Homarus* under the same condition. I say very closely, but there are some important points of distinction, which may best be appreciated by comparing the following description of the embryo of the present species with that of the young of our common lobster.

The carapace is circular, and extends over the pereion to the last somite. The rostrum is wanting. The eyes are small, almost minute. The first pair of antennæ is two-branched, one ramus being stout, the other slender, and both nearly of one length. The second is also double-branched; one ramus short, the other long; the short ramus represents the permanent scaphocerite of the adult animal, the other the long flagellum, which is twice the length of that of the anterior pair, and reaches to the posterior extremity of the carapace. The mandibles are present, and are approaching their mature form. The incisive blade has scarcely reached its full proportion, which gives to the synnhipod a large and somewhat pediform appearance. The three succeeding pairs of oral appendages are visible, and approximating to their adult forms.

The two pairs of gnathopoda are simply pediform, each furnished with a strong basephysis (or branch sprouting from the basal joint). The second pair differs from the first in having the basephysis of the same length as the primary branch, whereas in the first the primary or main branch is shorter than its basephysis.

The first pair of pereiopoda has well-developed chelæ; the right and left, being uniform in shape and size, correspond in form with the right or smaller hand in the adult.

The second pair of pereiopoda is also chelate, but much smaller in size, and corresponds closely in form with that of the adult. Neither this nor the preceding pair has an ephysis attached. The three posterior pairs of pereiopoda are simple, and approximate to the adult character; to these an ephysis is attached, although the branchial appendages are not present on any of the limbs, unless a small bud-like process attached to the coxa of the second pair of gnathopoda may be so interpreted.

The first pair of pleopoda appears to be wanting, as in the adult female. The four following pairs are developed as long double-branched appendages surmounting a long stalk. The inner branch, as in the adult female, carries on the margin a small stylamblys, except on the fourth pair. The posterior pair of pleopoda, which ultimately becomes developed into the large side plates of the rhipidura or fan-like tail, differs from the four preceding pairs in having the branches large and the basal joint short, and in carrying no stylamblys on the margin of the inner branch.

The telson is long and broad, reaching to beyond the posterior pleopoda for about one-half their length.

At the period of my examination the various hairs with which the animal is furnished on the several parts of the body were wanting. Evidence of their existence is present, but as they, until the animal has been hatched, and lives freely in the sea for a few hours, invariably remain enclosed within their respective points of attachment, they

are only capable of being detected where they are largest and most important, such as at the extremity of the ecephysis of the gnathopoda, and at the posterior margin of the telson.

Comparing the brephalos with that of *Homarus*, we find that it has the antennæ further advanced in development, that there is no ecephysis attached to the first and second pairs of pereopoda, and that all the pleopoda are well advanced in development, whereas in *Homarus* the pleopoda are all wanting. An ecephysis is attached to the basis of the several pairs of pereopoda, and the flagella of both pairs of antennæ are in a rudimentary condition.

The carapace in both is small, covering only the pereion.

We thus perceive that although the resemblance between them is great, particularly in relation to the cephalon and pereion, a difference exists in the more advanced condition of the brephalos of *Eiconaxius* at the period when it quits the ovum, as compared with the young of *Homarus*.

In each of these genera the ova are extremely large, and few in number.

#### Family THAUMASTOCHELIDÆ.

The carapace is ovate and smooth, and projects to an anteriorly-flattened point or rostrum. The first pair of antennæ has two long flagella, and the second has a well-formed scaphocerite. First pair of pereopoda is chelate, large, having a long slender dactylos and pollex; subequal, somewhat unsymmetrical. Second pair chelate, symmetrical, subequal, small. Pleon has the coxal plates well defined. Rhipidura having the outer plates much larger than the inner. Branchial apparatus having a mastigobranchia attached to all the appendages of the pereion, except the first pair of gnathopoda, where it is rudimentary, and the posterior pair of pereopoda; five podobranchiæ, ten arthrobranchiæ, and four pleurobranchiæ on each side.

The genera in this family are *Thaumastocheles* and *Callocaris*.

#### *Thaumastocheles*, Wood-Mason.

*Astacus*, Subm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 48.

*Thaumastocheles*, Wood-Mason, Proc. Asiat. Soc. Bengal, p. 181, 1874.

Carapace less than half the length of the animal, dorsally flattened and anteriorly produced to a rostrum, divided by a moderately deep cervical sulcus; near the centre the lateral walls are depressed and the posterior margin is secured in its position by a strong blunt process (pleocleis) attached to the lateral portion of the first joint of the pleon.

The pleon is longer than the carapace, and each somite increases in width posteriorly to the fifth and then decreases.

The ophthalmopoda are absent or obsolete.

The first pair of antennæ terminates in two long, slender subequal flagella.

The second pair of antennæ has a short and stiff scaphocerite, and terminates in a long slender flagellum.

The siagon or mandible is strong, and carries a three-jointed synnhipod.

The posterior siagnopod has the distal extremity of the outer branch formed into an operculum, and the mastigobranchia is broad and well developed.

The first pair of gnathopoda has neither branchial plume nor mastigobranchia, but a rudimentary stump alone represents the latter.

The second pair of gnathopoda supports a basephysis, a well-formed podobranchial plume and well-developed mastigobranchia.

The three anterior pairs of pereopoda are chelate, the first pair being much larger than the others, the pollex and dactylos being longer than the propodos, although unequal in proportion on each side. The fourth pair is monodactyle, the dactylos short and hairy. The fifth or posterior pair is minutely chelate, the dactylos being very small and lost amongst a brush of hairs in the only specimen procured. But as this description is taken from a female, it is not improbable that this may be a sexual rather than a generic character.

The form of the rhipidura, the length and increasing width of each posterior somite of the pleon, and the form and character of the pereopoda approximate the character of this genus to *Axius* and others of the Thalassinidæ.

*Thaumastocheles zaleuca* (v. Willemoes-Suhm) (Pl. VI. *b-q*; Pl. VII. fig. 1, *e-h*).

*Astacus zaleucus*, Willemoes-Suhm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 49, pl. x. fig. 1.

*Thaumastocheles zaleuca*, Wood-Mason, Proc. Asiat. Soc. Bengal, p. 181, 1874.

Animal long and slender, sides subparallel and compressed, dorsal surface smooth except on the antennal and post-ocular regions of the carapace, on each side of the rostrum, and the third and fourth somites of the pleon, where there are numerous short, thick tufts of hair.

Rostrum dorsally flat. Ophthalmopoda absent. First pair of antennæ subequally biramosc. Second about as long as the animal and carrying a strongly serrated scaphocerite, first pair of pereopoda asymmetrical. The right being the larger and furnished with a pollex and dactylos, nearly as long as the animal, slender and rod-like, curving towards each other at the extremity, and armed on the inner surface from base to apex with long spine-like teeth that interlock with each other when closed.

Rhipidura having the outer plate large and strong and the inner small. Telson quadrate.

Length, 100 mm. (4 inches).

*Habitat*.—Station 23, off Sombrero Island, West Indies, March 15, 1873; lat. 18° 24' N., long. 63° 28' W.; depth, 450 fathoms; bottom, Pteropod ooze.

The carapace, measuring from the extremity of the rostrum to the posterior margin of the central dorsal surface, is rather more than one-third of the entire length of the animal. The rostrum is dorsally flat and projects as far as the distal extremity of the second joint of the first pair of antennæ, the extremity is pointed and curved upwards, and the lateral margins are fringed with hairs and a few (four) short, sharp teeth on each side. The carapace is divided near the centre by a deep cervical sulcus, and the lateral walls are almost perpendicular, and cover and protect the entire branchial apparatus.

The first somite of the pleon is large and divided into an anterior and a posterior portion. The anterior is smooth, and when the animal is fully extended passes beneath the carapace; the posterior is also smooth but somewhat elevated, and increases at the lateral margins to a ridge that defines the limit between the somite and the coxal plate, which is associated with it; this ridge projects forwards into a small process, or pleocleis, that overrides and assists in keeping the posterior margin of the carapace in position. A line of hairs which fringes the posterior margin of the carapace dies out where the lateral process projects, and commences at the corresponding point on the anterior margin and traverses that of the coxal plate of the first somite of the pleon.

The second somite is dorsally quadrate, but is a little broader at the posterior margin than at the anterior, the lateral crests are well defined and denticulate, the coxal plate is perpendicular, and the infero-lateral margin rounded at the anterior and posterior angles, smooth on the outer surface, but fringed with a row of thickly-set hairs on the inner.

The third somite resembles the previous one, except that instead of being smooth it is extensively covered with thick, short hairs. The lateral crests or ridges are smooth, the small denticulations on the previous somite being but feebly represented.

The fourth resembles the third, but is slightly broader, and equals the breadth of the carapace; the coxal plates, instead of being smooth, are thickly covered with hair on the outer surface towards the postero-inferior angle.

The fifth somite is somewhat narrower than the fourth, and is slightly broader at the posterior than at the anterior margin. The dorsal surface is smooth, and the coxal plate has a tendency to turn obliquely outwards, and has a brush of hair at the postero-inferior surface.

The sixth somite is quadrate, but longer and narrower than the fifth. The coxal plate is less deep than the preceding, and narrows posteriorly.

The seventh somite or telson is square, flat, and posteriorly fringed with a row of closely-planted hairs.

The eyes are absent. The metope is smooth, polished, and submembranous. Two small but prominent tubercles tipped with hairs stand on each side of the median line, and above where the eye should have been the margin of the carapace is slightly excavated to form an orbit.

The first pair of antennæ consists of a three-jointed peduncle and two long sub-equal flagella. The first or coxal joint is longer and larger than the two succeeding, and

articulates with the metope by a strong, smooth, nodular tubercle, visible on the upper surface at the outer angle of the antennæ, near which a slight opening defines the passage to the auditory apparatus; the two succeeding joints are short and narrow, but the third is longer than the second; the flagella are of the same length and size, both being fringed with long, fine, sparsely-planted hairs, among which I have not been able to detect any of those membranous organs that I believe to be auditory cilia.

The second pair of antennæ has a peduncle longer than that of the first. The first joint is short and wide, and supports a large wide-mouthed phymacerite; the second joint is as broad as and longer than the first, particularly at the anterior margin, where, on the inner side, it is produced forwards to a strong point, while the scaphocerite articulates on the outer side. This latter is a stiff curved appendage, smooth on the outer side, and denticulate with several sharp, strong teeth on the inner and distal margins; the joint which supports this appendage is firmly anchylosed with the preceding, but may be determined by a well-defined line marking the boundary between the two; the terminal joint is long and narrow, reaching to the extremity of the peduncle of the upper antennæ, and the flagellum is robust and long, equal to the length of the entire animal.

The siagon or mandible is large, broad, strongly denticulate on the incisive margin, and furnished with a narrow molar ridge on the inner surface; the synaphipod has two joints, of which the first is curved, the second straight but articulated at a right angle to the rest of the appendage; it is directed beneath and within the oral apparatus, and impinges against the molar ridge on the underside.

The first pair of siagnopoda (Pl. VII. fig. 1, *e*) has three branches; the inner one is directed laterally inwards, thin, narrow, and tipped with stiff hairs; the second is directed forwards and inwards, narrow at the base, and wide at the extremity, and fringed with spines and short hairs; the third is two-jointed: the first joint is narrow, strong, and directed forward; the second is slender, whip-like, and directed outwards. The whole organ presses closely against the under surface of the mandible; near the outer basal margin is a thick bunch of ciliated hairs.

The second pair of siagnopoda (*f*) consists of three foliaceous and one styloid branch, together with a short, rounded mastigobranchial plate; the outermost plate which is an anterior prolongation of the mastigobranchia is foliaceous, long, narrow, and thickly fringed with short plumose hairs on the apical and inner margins; the second is styloid, fringed with a few hairs on the outer margin near the base, after which it is smooth, and terminates in a sharp point curved slightly inwards; the next branch is biramose, the outer ramus being the larger, is foliaceous and terminates in a fringe of thick, strong teeth and a few fine hairs; the inner ramus is similar but narrower; the fourth or innermost plate is biramose like the preceding, and resembles it in its foliaceous character, but is rather smaller. The mastigobranchia is flat, thick, and fringed with short plumose hairs.

The third pair of siagnopoda (*g*) consists of three foliaceous branches, and a

large mastigobranchial plate. The outer branch consists of two joints, the basal one, which is long, narrow and sub-foliaceous, is fringed on the outer margin, and supports a second joint at its extremity, the plane of which is at right angles to that of the basal joint; this second joint is long, ovate, and thickly fringed with hairs; in its position it rests as an operculum against, and covers the outer and anterior outlet of the branchial chamber: the second or middle branch stands at right angles with the preceding, it is as long as the first joint of the previous branch, strong, foliaceous, and thickly covered with hairs: the third or inner branch is shorter and broader than the preceding, it is concave inwards and convex outwards, delicately foliaceous, and fringed with hairs, most abundantly on the inner margin. The mastigobranchia which is directed posteriorly is as long as the first branch, it is broad, thin, and studded over with numerous long hairs; on the outer margin, near the base, is a small process that may be the abortive rudiment of a branchia.

The first pair of gnathopoda (*h*) is subpediform; it consists only of six joints. The first or coxal joint supports a strong process thickly fringed with hairs, which appears to be an obsolete or depauperised mastigobranchial plate: the second joint or basis supports an ephysis of two joints, or rather of one joint and a multiarticulate lash fringed with hairs: the third joint is probably the ischium and meros combined, and is tolerably long, three times as long as the basis; it is broader near the base than at the distal extremity, where it articulates diagonally with the next joint, which I consider to be the carpos; it is narrow at the proximal and broad at the distal extremity, where it is fringed both on the inner and outer side with a thick brush of hairs: the penultimate I take to be the propodos; it is narrower at the base than at the distal extremity, where it is thickly fringed with long hairs, and in the centre is deeply excavate, and articulates with the dactylos in the form of a flat ovate plate, tipped with strong hairs.

The second pair of gnathopoda (Pl. VI. *i*) is much larger than the first, and proportionately more slender. It is pediform, and consists of seven joints. The coxa carries a well-formed mastigobranchial plate, that supports a well-formed but not long podobranchial plume; the basis is short, and supports an ephysis consisting of a single joint, which nearly equals the ischium in length, and terminates in a multiarticulate flagellum; the ischium is three-sided, flattened, the inner and outer margins parallel, the outer smooth, corresponding with the basephysis, the upper or central is denticulate and hairless, but the lower or inner is fringed with long hairs; the meros is united with the ischium by an articulation, and corresponds with it in form as well as in armature, but is rather longer; the carpos is about half the length of the meros, and articulates with it at the extremity, the inner side is triangular, and has each margin fringed with long hairs; the propodos is of about the same length as the carpos, three-sided, with sub-parallel margins; each side, particularly the inner as well as the margins, is covered with numerous long hairs; the dactylos is of about the same length as the

propodos; the sides are curved, gradually converging to a point, and covered plentifully with long hairs.

The first pair of pereopoda is asymmetrical both in size and form. That on the right side has a short ischium, convex on the outer side, and flat or concave on the inner. The upper ridge is produced into a backwardly-directed process that overlaps and plays round the neck of an anteriorly directed nodule on the basis (Pl. VI. *k'''*). The meros is flattened vertically, and has but two margins, except near the carpal joint, where it is thickened and has three; the carpos is short and nodular, and articulates on the infero-exterior angle of the meros; the propodos articulates on the infero-anterior angle of the carpos; it consists of a double ovate mass, placed side by side, one division of which only (the upper or anterior) articulates with the carpos, the other is rounded posteriorly; a deep constriction on either side anteriorly separates this body of the propodos from the digital extremity, which is prolonged into a very long, slender pollex, flattened vertically to the plane or surface of the propodos; it is curved at the distal extremity into a long and slender sharp tooth, and armed in its entire length with a series of long, slender teeth, intermingled with shorter ones of the same character. These are regularly planted, some directed obliquely inwards, the others outwards, on the entire length of the pollex. The dactylos closely resembles the pollex both in form and size, and when the two are compressed together, the long, slender teeth are interlocked together very regularly. On the left side the carpos is short, but less bulbous than on the right. The propodos is narrow and long, having the margins parallel, the under side smooth, and the upper surface minutely spinous as far as the base of the pollex, which is but a little longer than the palm; the dactylos resembles the pollex closely, and is a modified type of the right appendage; it is smooth on the outer side, and fringed with a series of delicate teeth, that interlock with similar ones on the inner margin of the pollex.

The second pair of pereopoda is nearly as long as the first, not including the dactylos, but is much more slender and chelate. The propodos and carpos are subequal, and the dactylos and pollex are short, not being half the length of the propodos, which latter is not wider than the carpos, and has the inferior and superior margins parallel.

The third pair of pereopoda very closely resembles the second, but is smaller as a whole.

The fourth pair is still shorter, and differs chiefly in being mono-dactyle, the pollex being absent, or existing only as an unimportant angle of the propodos, much imbedded in fur.

The fifth pair equals the preceding in size and length, but terminates in a minute and perfect chela buried in a thick brush of fur.

The first pair of pleopoda is small, slender, and terminates in a single hairless branch.

The second and three succeeding pairs are short and robust, and carry two narrow



foliaceous plates, of which the inner is the larger, and exhibits a notch, from which a bundle of long hairs projects, but no stylamblys is apparent.

The sixth pair of pereopoda forms part of the rhipidura or caudal fan. It articulates with the posterior angle of the sixth somite; the basal joint is short and broad, and carries two sub-foliaceous plates; the external is large, triangular, narrow at the base, and broad at the extremity, the outer side is the longest, and projects forwards; a diæresis marks the external distal portion, but does not traverse the breadth of the plate, which is strengthened in the middle by a longitudinal ridge; the inner plate is much smaller than the outer, and like it is traversed by a longitudinal ridge, and both are fringed along the distal margins with closely-set hairs; the external plate has a similar row along the line of diæresis.

The specimen above described was taken in the dredge off Sombrero Island, in about 450 fathoms of water, on a bottom of Globigerina ooze. There is only one perfect specimen in the collection, but fragments of a second, consisting of the gnathopod and first pair of pereopoda, appear to be parts of a more spinous variety, perhaps those of a male form.

The branchial arrangement of this species may be tabulated as—

Pleurobranchiæ,	.	.	...	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	...	...	2	2	2	2	2	...
Podobranchiæ,	.	.	...	...	1	1	1	1	1	...
Mastigobranchiæ,	.	.	...	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

The branchial appendages are generally long. The podobranchiæ are the longest, and almost entirely cover and protect the arthrobranchiæ and pleurobranchiæ, particularly those of the four anterior pairs of pereopoda. The mastigobranchiæ form inter-branchial plates similar to those of the *Homarides*; they are long and broad, reach to the extreme length of the branchial plumes, and are sparingly covered all over with long hairs that spread out and penetrate between the branchial filaments. The hairs are generally smooth and pointed. The inner surface of the carapace that covers the branchial chamber is similarly beset with hairs of the same kind, this, with the mastigobranchial plates, and pleura or floor of the branchial chamber, forms a division in which the several branchiæ of each appendage are shut off from the rest (Pl. VII. fig. 1, 1br); the pleurobranchia lies beneath and rests upon the floor of the chamber, the arthrobranchiæ meet in the centre, one on each side above the pleurobranchia, by a single row of short filaments that nearly touch each other at their extremities; the podobranchia covers and overlaps the whole, while long, slender, and somewhat stiff hairs play between the several plumes of the branchiæ, as well as between the numerous filaments that compose them, and probably keep the whole of the complex structure in constant motion.

The posterior pair of pereopoda possesses no podobranchia, arthrobranchia, nor

mastigobranchia, and the pleurobranchia, which is well developed, is implanted high upon the pleura, and is directed anteriorly, lying nearly horizontally beneath the carapace.

In the three next anterior pairs of appendages the pleurobranchia is implanted much lower, and traverses the same line as the overlying podobranchia. The first pair of pereopoda has no pleurobranchia, nor has the second pair of gnathopoda, while the first pair (Pl. VII. fig. 1, *h*) has no branchial plume whatever, and the mastigobranchia is reduced to a rudimentary stump, fringed with a thick brush of hair.

The third pair of siagnopoda (Pl. VII. fig. 1, *g*) supports a broad and tolerably long mastigobranchia, to which is attached, on the upper margin near the base, a small styliform process, fringed with ciliated hairs on one side and simple ones on the other. This organ I take to be the rudimentary homologue of a podobranchial plume. On the second pair of siagnopoda the mastigobranchia is also present, and is large, broad, and rounded at the apex; the margin fringed with short posteriorly-directed plumes or hairs.

The entire branchial apparatus corresponds very closely with that of *Phoberus*, and resembles in general structure that of the Palinuridæ.

*Observations.*—*Thaumastocheles zaleuca* is a blind species, and most probably fossorial in its habits. That it is a degraded form I think we may safely infer from the excavations which correspond with the orbits still remaining in the anterior margin of the carapace, as well as from the depressions in the first pair of antennæ, such as exist in those specimens in which the ophthalmopoda are well-developed.

The metope is a smooth perpendicular plate, bearing two small tubercles tipped with a small brush of hair that projects from the surface immediately on each side of the median line. The general appearance of the metope is sub-membranous and translucent, and it is highly probable that the optic nerve terminates so closely behind it as to receive impressions of light, although probably of a very subdued character, as in the subterranean Amphipoda. The assumption that there is consciousness of light appears to receive support from the extent of surface which the metope occupies (Pl. VI., *c''*), and the depressed position of the first pair of antennæ.

The first pair of antennæ lies inside the second pair and in the same line with it; the upper surface is excavated as if it had been so formed to admit of the presence of a large pedunculated eye, which has disappeared. At the lower part of the metope and just above the attachment of the first pair of antennæ the small, fixed, rounded and polished tubercles, very close to but not associated with the articulation of the antennæ, may be the remains of the peduncle of the obsolete eye; but this is only suggested, because I do not remember to have observed similar tubercles in any form of Crustacea where the ophthalmopoda are developed.

The idea of this species being more or less fossorial in character is suggested by several anatomical conditions: the blindness of the animal; the operculum at the anterior passage of the branchial chamber; the strong pleocleis on the first somite of the pleon,