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On a New Genus, and on Six New Species of Crustacea, with Observations on the development of the Egg, and on the metamorphoses of Caligus, Carcinus, and Pagurus. By HENRY D. S. GOODSIR, Esq., Surgeon, Anstruther.

SECTION I.

On a new Genus, with descriptions of Three New Species of Stomapoda.

The first species belongs to the genus *Cynthia* of Thomson. A single specimen was obtained in the Frith of Forth, near Anstruther; it was found in shallow water, together with a number of other Schizopoda, and, as far as I am aware, is the first instance of a species of this genus got on the British coasts.

GENUS CYNTHIA, fig. 1., Pl. II.

Subabdominal fins composed of two joints, four last fins with the terminal plume double, with an opaque, bifurcate, and convolute organ raising between each.

C. Flemingii.—Inferior antennal scale almost twice as long as the peduncle. A thick fringe of strong hairs bordering its inner edge. Rostrum slender and finely pointed. Volute organ between the plumose setæ of the subabdominal fins minute; edges of the middle plate of the tail spined.

Long. eight lines. Hab. Frith of Forth.

Description.—The whole body of an opaque straw colour, with the reticulated portions of the eyes black. Superior antennæ with the peduncle three-jointed, the two setaceous portions arising from the second joint of the peduncle, the last joint ovate, surrounded with a thick fringe of hairs, these hairs are bent downwards at their extremities, so as to form a concavity on the lower surface. The peduncle is about twice the length of the eyes. The peduncle of the inferior antennæ extends to the origin of the setaceous portion of the superior antennæ, the two last joints are slender and clavate. A long slender and pointed scale arises from the first joint of the peduncle, above the setaceous portion; this is twice as long as the peduncle, and is thickly fringed with long hairs, which are directed inwardly so as to meet

those of the opposite side. The carapace is not very large, curved at its posterior edge, and produced at its posterior and inferior angle. Abdomen slender, the inferior edge of each segment considerably produced, and all of them but the last bearing a fin composed of two joints; the first joint is scale-like clavate; the second is multiarticulate and plumose, all of them but the first pair double. The bifurcate convolute organ between the double plumes is very minute. Middle plate of the tail edged with spines on its sides, and entire at the extremity. External caudal-fins twice as long as the middle plate, and curved upwards, the internal one about the same length as the middle plate, and pointed.

The bifurcate and convolute organ between the double plumes of the four last subabdominal fins, together with the number of joints in these fins, seem to be the most striking characters of this genus. Mr Thompson, in the third memoir of his Zoological Researches, says, "It is not in the *number* of joints alone, however, that they (subabdominal fins) differ, their form and structure is also essentially different. In *Cynthia* the four last of these members are each composed of a very large bilobate scale, supporting at its apex two taper articulate fins, strongly ciliated with plumose setæ; from between these originates an opaque organ which bifurcates, its two extremes of unequal length being rolled inwards, the one over the other." Mr Edwards considers that these last are the branchial apparatus.

The two animals which are presently to be described, present characters of such a nature as to require the formation of a new genus for their reception. This will constitute a connecting link between the true Opossum Shrimp and the genus *Cynthia* of Thompson. The subabdominal fins of the genus *Mysis*, are composed of one short joint, bearing a plumose fringe. The subabdominal fins of the two animals under consideration are of a mixed character, the two first and the fifth are like those of *Mysis*, the third and fourth are like those of the *Cynthia* in so far, that the plumes are double, while at the same time these two fins are triarticulate. Thus approaching to the genus *Noctiluca* of Thompson.

GENUS *Themisto*.

Generic Characters.—Superior antennæ, armed with a scale. First, second, and fifth segments of the abdomen bearing fins like the *Mysis*; third and fourth with the peduncles, biarticulate, and each peduncle

giving off two branches ; the external branch of the fourth very long and slender, semi articulated.

Fig. 4., Pl. II.

T. Longispinosa.—Superior antennal scale of the same length, as the terminal joint of its peduncle, armed at its extremity with a thick tuft of hairs. Inferior antennal scale twice as long as its peduncle ; fringe not strong. Third subabdominal fin, with its internal branch, minute. Internal branch of the fourth, with a few long hairs from the extremity only. External branch reaching to the extremity of the caudal fins. Internal caudal fin truncated.

Long, $\frac{3}{4}$ of an inch.—*Hab.*, Frith of Forth.

Description.—The whole body of a dark-yellowish or greenish colour. Eyes large, reaching to the extremity of the peduncle of the inferior antennæ. The reticulated portion black, and produced backwards inferiorly. Rostrum very short, but sharply pointed. First joint of the peduncle of the inferior antennæ very strong, the two following slender ; the setaceous portion of the antennæ arising from the extremity of the last. The scale arises from the inner and superior part of the first joint of the peduncle ; it is hardly twice the length of the peduncle, slender, and tapering very gradually to the extremity ; it is rather thinly fringed. The upper surface of the peduncles of the superior antennæ hollowed out, forming a bed for the eyes. A short ovate scale arises from the inferior part of the last joint, immediately below the origins of the setaceous portions of the antennæ. A thick bunch of matted hair arises from its extremity, which gives it the appearance of being biarticulated. The inferior edge of the external seta of the superior antennæ bears a thin fringe of very strong hairs, which are thickest and strongest near the base. The carapace is not large, leaving two of the thoracic segments exposed posteriorly ; it is rounded at its anterior and inferior angle, and considerably produced at its inferior and posterior angle. A strong biarticulate and chelate palpus arises from each side of the mouth. The abdomen is slender, but the segments are not produced inferiorly. The branchial subabdominal fins are five in number ; they arise from the inferior and posterior angle of all the abdominal segments except the last. The first, second, and fifth are like those in the genus *mysis*, viz., a single plumose joint ; the third and fourth are pedunculated—the peduncles being composed of two joints. The first joint is minute, the second is of considerable length ; two branches arise from the extremity of the second joint ; these branches, in the third fin, are both plumose ; in the fourth one, the internal only is plumose. The external branch of the fourth consists of a very long six-jointed spine, which reaches beyond the extremity of the caudal fins ; it is very finely pointed ; the internal branch about the same as the first joint of the external branch. The caudal plate is slightly swollen near the base ; its edges are serrated, and its

extremity bifurcated; the bottom of the fork being rounded, and the extremities of the fork also blunted and rounded. The internal caudal fins are truncated at their extremities; the external are paddle-shaped, and rounded at their extremities. Both of these fins are fringed at their extremities, and inferior edges with long hairs.

Fig. 9. Pl. II.

T. Brevi spinosa.—Superior antennal scale not so long as the peduncle; inferior antennal scale four or five times as long as the peduncle. Internal branch of the third subabdominal fin minute; the internal branch of the fourth longer than the first joint of the external branch; the external branch extending a little beyond the base of the caudal fins, ending by means of a dart-like point. The lateral caudal fin ending in a sharp point superiorly, and rounded inferiorly; the internal fin oblong, ovate, and pointed. The lateral edges of the middle plate bearing a single row of long, sharp, and bent spines; contracted near the base and the bottom of the fork, forming an acute angle; prongs pointed.

Long., 1 inch.—*Hab.*, Frith of Forth.

Description.—The whole body more robust than that of the last described species, and of an opaque white colour, with a single row of black spots along the dorsal mesial line of the abdominal segments. The first joint of the peduncle of the inferior antennæ very short and almost circular; the two following are slender. The scale which arises from the superior part of the first joint above the true antennæ is very strong at the base, and then tapers gradually to a fine point. A fringe of long hairs borders its inferior edge. These hairs are matted at the extremity so as to give them the appearance of a second joint; two or three short strong spines arise from the extremity of the scale. The third joint of the peduncle of the superior antennæ is considerably produced at its superior angle. The scale which arises beneath the setaceous portions is strong, bent upwards at its extremity, and pointed, but it is not fringed. The eyes are large; the reticulated portion circular. The rostrum is of considerable length, but it is not sharp. The internal branch of the third subabdominal fin is minute; the external one is long, slender, and finely pointed; it is also fringed with very long hairs. The internal branch of the fourth fin is longer than the first joint of the external branch; and it is both more strongly fringed and more moveable than that of the last described species. The external branch extends a little beyond the base of the caudal fins. The sixth, or last joint of this branch, suddenly contracts near the extremity to about half its original thickness, ending in a dart-like point. The external caudal fins end in a sharp point superiorly, and are rounded inferiorly; the internal fins are oblong, oval, and pointed at the extremity. These are both fringed at their inferior edges and at their ex-

tremities. The lateral edges of the middle plate armed with a single row of strong hooked spines. It is contracted near the base, and the angle formed by the bifurcation is very acute; the extremities of the prongs are also sharp pointed and of a black colour.

SECTION II.

On the development of the Ova, and on the metamorphoses of Caligus.

The larva of *Caligus* bears a great resemblance in its external appearance to the larva of *Cyclops* on the one hand, and that of *Lerneæ* on the other.

As it is my intention to describe how the ovum escapes from the oviduct, it will be necessary, to understand this properly, to give, in the first place, a short description of the organs of reproduction in the female *Caligus*.

These consist of the ovaries, internal and external oviducts, and the vulva through which the oviducts pass. The ovaries are two oval, club-shaped bodies of considerable size, situated on each side, and rather anterior to the stomach. They are large and rounded anteriorly; small, pointed, and converging posteriorly. Each oviduct arises from the external margin of the ovary. It may be divided into three parts, the thoracic, abdominal, and external. The first, or thoracic portion, is very slender; at the posterior part of the thorax, however, it becomes considerably thicker; and, in the abdomen, where it makes four or five convolutions, it is at its greatest diameter; it is considerably contracted as it passes out by the vulva. The external portion is all of the same diameter; and, when arrived at a state of maturity, it is sometimes longer than the body of the animal. But the length altogether depends on the species.

The thoracic portion is colourless; and there a number of small defined objects are seen in it at regular intervals. When it reaches the abdomen these bodies are found to be the immature ova; at this point it is of a delicate carmine colour, and has a striated appearance, from the eggs being placed close together.

The external oviducts, a short time after the ova have escaped, drop off, and new ones soon begin to make their appearance. At first the point only is seen jutting out from the

vulva, they then gradually increase until they arrive at a state of maturity.

I have not ascertained the length of time which is required before they attain their full growth. Seeing, however, that the distal extremity of the external oviduct is thus first protruded, it may be apprehended that the ova contained in that part of the oviduct are first ready for exclusion, and this accordingly we find to be the case.

The internal structure of the external part of the oviduct, consists of a number of cells placed in a single row, and of the same diameter as the duct; these cells are formed by a number of strong membranous septa, placed at regular intervals. The membranous septa, which divide the oviducts into compartments, are of use, in so far as from their strength they prevent the ovum escaping into the empty part of the duct. They act in the following way:—The ova, as they increase in size, cause a considerable degree of pressure on the membranous septa, and especially on the septum, separating the last ovum from the empty part of the cell; this by its resistance throws the pressure on the circumference of the cell, this being the weakest part, and the ovum at the same time extending longitudinally, the smaller end of the egg is thrust through the coats of the duct, and thus becomes free. In each of the cells just mentioned, there is an egg, so that the oviduct consists of one row of eggs only.

Thus, as the ova increase in size, the membranes of the oviducts become tense, and burst, and the ovum escapes, but still remains attached to the oviduct, by means of the ovisac, which acts as a cord; the ovum remaining attached to the oviduct by this means, until the young animal is ready to burst from the egg. After the young animal has escaped from the ovum, it remains for a considerable time attached to, or near, the parent animal. The ova belonging to the distal half of the oviduct are generally freed from their attachment to the mother altogether, before those in the proximal half are ready for exclusion from the oviduct. They burst, with very few exceptions, from the external edge of the oviduct; and I have never seen them burst through the membranous septa. They are of a flat shape while in the

oviduct, bearing considerable resemblance to a double convex lens; after they have escaped from the oviduct, they become more spherical, and when placed under a powerful glass, the young animal is distinctly seen through the transparent membranes. The young animal at this stage is of a brown colour, with various streaks of purple; the body is of a conical shape, and a constriction or neck separates it from the head. There is no appearance of antennæ, but there are one pair of feet on each side of the body, which divide at their extremities into several long slender spines.

When examined during this stage, under a powerful glass, by means of transmitted light, nothing is perceptible but cellular structure in different degrees of density. The intestinal canal is also perceptible. When the ovum is a little more advanced, there is sometimes, although not always, the appearance of two small segments arising from the posterior part of the body. The larva, a short time after being hatched, becomes considerably elongated; it has got three pair of legs, each bearing long spines at the extremity. The third pair were making their appearance before the animal had left the ovum. There are also two spines on each side of the body, at its posterior extremity. The difficulty of keeping these animals alive for any length of time in confinement, has prevented me tracing their further development.

SECTION III.

On Zoe—The development of the Ovum, and the metamorphoses of Carcinus Mœnas, and Pagurus Bernhardus.

The absence of a metamorphosis in the Crustacea, was considered by Leach to be one of the most decisive characters of the class. This opinion, however, has been overturned by J. V. Thompson, who, by a series of observations, has discovered that the Crustacea do undergo a metamorphosis, and that what have hitherto been considered as perfect animals, viz.—the Zoe of authors, are only the larva of different species of Crustacea Decapoda. Mr Westwood again has asserted, that the Crustacea do not undergo any metamorphosis, bringing forward at the same time observations, the results of

which were opposed to those of Mr Thompson. Being anxious to observe for myself, I obtained the different species of the higher Crustacea, common on the shores in this neighbourhood. When loaded with spawn, they were kept alive in vessels of salt water, and in every case I have found the ova to produce Zoe; and even all the lower Crustacea which I have yet examined undergo a metamorphosis, although not so decided as that of the higher Crustacea. At present I shall describe the Zoe of two of our most common species, viz.—*Carcinus Mænas* and *Pagurus Bernhardus*.

When the larvæ of the common crab are newly hatched, the body is destitute of spines, but, in a short time, both the dorsal and frontal spines make their appearance (fig. 18, Pl. III.) The eyes at this time are very large, the central or reticulated portion black, with a beautiful shade of green. The frontal spine as long as the carapace, sharp and pointed. The antennæ arise immediately behind the base of this spine, they are biarticulate, with the peduncle large. The palpi arise immediately behind, and the branchia are in visible and constant motion below the carapace at this spot. The legs are four in number, the first pair at this time composed of two parts, an external and an internal. The external, like those of the Cancer *Pagurus*, are plumose, being armed at the extremities with three or four strong plumose spines; the internal part arises from the extremity of the first joint; it is multiarticulate, and armed at the extremity with a claw; there is no appearance of this division on the last pair of legs. The abdomen is five-jointed, the last joint armed with two long and curved spines, bearing a number of smaller spines on their inner edge near the base. The intestinal canal is observed running along the lower edge of the abdomen, and the heart may be observed at the base of the dorsal spine, beating synchronously with the motions of the branchiæ. If the young animal is freed from the tunics of the ovum a few days before hatching, its appearance is perfectly different (fig. 16, Pl. III.) The antennæ are long and slender. The eyes are small and sessile, and the caudal fork is armed with a number of curious brush-shaped appendages. (Fig. 17. Pl. III.)

The Zoe of the *Pagurus* (fig. 12. Pl. III.) when it escapes

from the egg, or a short time after, is perfectly transparent, the thoracic portion of the body is slightly opaque, and the eyes are black. The abdomen, however, is perfectly translucent, and the observer requires to look very attentively before it can be defined. On being excluded from the egg, the young animal is doubled upon itself; the abdominal portion of the body is bent closely under the thoracic portion, and it is kept in this position by means of a very thin sac or membrane.

It very soon frees itself from this by a few violent efforts, and then the antennæ, the feet, and the abdomen, all become free and extended. The proximate half of the abdomen only is confined within the sac, the distal half is quite free. The Zoe of this species is destitute of spines, the spine on the dorsum of the carapace and the frontal spine being absent. As soon as the young animal frees itself of the sac before mentioned, the thorax apparently becomes much smaller; this arises from the contents of the sac escaping, and the thorax proper only being left. The head is separated from the body by means of a slight constriction. The eyes are very large, reticulated, and black; they are situated on the dorsum and anterior part of the head, on two round tubercles (fig. 15, Pl. III.) there being a notch on the mesial line. These tubercles, I have no doubt, form the ocular footstalks, when the animal has come to maturity. The carapace is about twice the length of the head, its free or lower edge falls considerably down, concealing the origins of the legs; at this part the thorax is quite transparent, the extreme edge being only of a red colour. Immediately below the eyes are the four antennæ; the inferior pair arise from the lower surface of the body, and the first articulation, or what may be termed the peduncle, just reaches the anterior edge of the carapace; it then gives off two articulated setæ, which are considerably longer, very transparent, and taper to exceedingly fine points. The superior antennæ, which are also the innermost pair, are more robust, the peduncle is longer than that of the inferior one; this pair of antennæ act much in the same way as the inferior, only the setæ arises from the superior edge of the peduncle. Four legs arise from the posterior part of the

thorax ; they are bifid to the first like the antennæ. The abdomen is seven-jointed, about three times as long as the thorax, the last joint spoon-shaped, the lower surface being concave. The posterior edge is armed with a single fringe of strong spines, ten in number ; it is notched in the centre. (Fig. 14, Plate II.)

This discovery of a metamorphosis will enable us to decide with greater precision on the species of crustacea, the larvæ of these animals having specific distinctions, as decided, doubtless, as those of the insecta.

SECTION IV.

On the Structure and Habits of the Caprellæ ; with descriptions of some new Species.

The genus *Caprella* of Lamarck was separated by Latreille from the Isopoda, with a number of other crustaceous animals, and formed into a distinct order, viz. the *Læmodipoda* or *Læmipoda*. This order has been further subdivided into two families, viz. the *Læmodipoda Filiformia*, and the *Læmodipoda Ovalia*. It is the first or *Filiform Læmodipoda* and the genus *Caprella* of this family which will engage our attention at present. I have had considerable opportunities of examining the animals belonging to this genus in a living state, and by this means have been enabled to draw up a short account of their history. Little is at present known either of their internal structure or habits. This is owing, in a great measure, to two causes ; firstly, to their pelagic habitats, and, secondly, to the peculiar structure of their bodies, which much resembles in its external appearance the coralines which they inhabit, on which account they are apt to be overlooked. In general, too, they are almost colourless, although they are very often found of various colours, carmine, green, brown, and all the intermediate hues.

The body of the *Caprellæ*, exclusive of the obsolete abdomen, is composed of seven segments, bearing five pairs of ambulatory legs ; the second and third thoracic segments, each bearing one pair of membranous finlets, which act, to a certain extent, as organs of respiration. There are two pairs of an-

tenna, and the mechanism of the mouth* is rather complicated. The digestive canal is a simple straight canal, which, during its course through the post occipital and first thoracic segments is considerably dilated; after this, however, it runs to the distal extremity of the body without farther complication. It is seen to pulsate at irregular intervals, and this is observed at that part only immediately above the ovarian openings; the ovaries when present, are attached to the digestive canal at this point by cellular structure, and by this means they also are subject to this pulsation. The vascular system in the caprellæ is composed of two sets of vessels, the one arterial, the other venous. These are most easily observed in the antennæ; the main artery runs along the superior, and the vein along the inferior edge of the antenna; lesser branches either spring from or run into these main trunks. A large dorsal vessel is seen in the trunk; but owing to the greater opacity of the body, I have been unable to trace the anatomy of the blood-vessels farther. On placing a live caprella under the microscope, the blood is seen circulating through the vessels of the antennæ in a most beautiful manner, passing from the body by means of the superior or arterial trunk, and returning again by means of the inferior or venous. The blood globules in these vessels are seen passing onwards steadily and continuously; some of them are often lost to the field of the microscope, passing off probably by means of the smaller lateral branches. Sometimes it is oscillatory, that is to say, the globules are seen vibrating backwards and forwards, but this is only occasional, in general it is continuously onwards, frequently, however, they jerk suddenly forwards, but they subside as rapidly into their usual course. The circulation does not seem to be guided by any apparent pulsation; the globules are spherical, not very numerous, and are suspended in a colourless liquid. I have not been able as yet to detect any appearance of a nervous system.

The organs of reproduction are extremely curious, and are complicated in the female. I am not acquainted with their peculiar organization in the male.

* M. Edward's *Hist. des Crust.*, vol. iii. p. 103.

The ovaries (fig. 2. Pl. III.) are two long slender bodies which lie along each side of the intestinal canal. Each of them arises from the posterior part of the post-occipital segment; during its course through the first thoracic segment it is thin and slender, but as it reaches the second it becomes considerably larger; and about the middle of this segment each of them gives off a small duct—the oviduct; these meet one another in the mesial line by means of one common opening through the roof of the ovarian pouch; another duct is given off in the same way at the second ovarian opening, and the ovaries then end at the posterior extremity of the fourth thoracic segment. The internal structure of the ovaries is like those of the caligi; they consist of a single row of cells, each of which contains an egg. The external organs of generation in the female are composed of a series of plates four in number, which, when enlarged, forms a floor to a corresponding cavity in the abdominal surface of the two middle thoracic segments; this forms the oviferous sac or pouch. When the animal is with spawn, these two thoracic segments become more intimately joined together, that is to say, their common joint becomes a fixed suture; the two ovarian cavities also approximate on their lower surfaces, and become opposed to one another, thus allowing the ovarian plates to overlap one another, and cover the eggs without becoming inconveniently large.

The ovarian plates (fig. 3. Pl. III.) as I have stated formerly, are four in number; they are of an irregular oval form, and are armed on their edges with a single row of strong hooked spines; these seem to be of use in so far as to prevent the over-distension of the plates by means of hooking into one another. The ova are not large, quite globular, and of an opaque yellow colour. On one occasion, while examining a female *Caprella* under the microscope, I found that her body was thickly covered with young ones; they were firmly attached to her by means of their posterior feet, and they were resting in an erect posture, waving about their long antennæ with great activity. The *Caprellæ*, like all the lower crustacea, cast their skins often. Before the process commences, the animal lies for a considerable time languid, and to all appearance dead; at length a slight quivering takes place all over

the body, attended in a short time with more violent exertions; the skin then bursts behind the head in a transverse direction, and also down the mesial line of the abdominal surface; a few more violent exertions then frees the body of its old covering. After this the animal remains for a considerable time in a languid state, and is quite transparent and colourless.

The habits of the *Caprellæ*, arising from the difficulty of keeping them alive for any length of time, are little known. They are in general local in their habitats, frequenting coralines which are found in deep water. They are never seen catching prey; slow and deliberate in their motions, they are not fitted for this mode of life. While at rest, they firmly adhere to the object by means of their posterior thoracic legs, generally in an erect posture, waving about their long antennæ, by which means they bring within their reach animalcules and other objects of food, which are then drawn into the mouth. Their usual mode of progression is like that of the larvæ of the Geometer moths, as mentioned by Montague. They sometimes walk in this way for a considerable time, and then suddenly stop, remaining perfectly motionless, not even moving their antennæ. I have never seen them swim, and even when pushed off their resting-place, they fall listlessly to the bottom of the vessel in which they are confined.

Caprella. Lamarck.

Generic characters.—Branchial lamellæ, two pairs attached to the second and third segments, which are apodal.*

BODY ARMED WITH SPINES.

Plate III. Fig. 1.

Caprella spinosa.—One spine arises from the dorsum of the head, another from the posterior extremity of the post-occipital segment, other two arise in the same transverse line on the dorsum of the swellings of the first thoracic segment, and a fifth from the posterior extremity of this segment. Superior antennæ as long, or almost as long, as the body, last joint multiarticulate. Swelling on the first thoracic segment near the anterior extremity. Two spines on the lower edge of the last joint of the second pair of feet. Long, 1 inch; hab., Frith of Forth.

* Dr Johnston, 8th vol. of Mag. Nat. Hist. p. 669.

Description.—The whole body of a pale white colour, with the exception of the eyes, which are black. The dorsal surfaces of the two first segments of the body are armed with long sharp curved spines, which point forwards; one arises from the vertex of the head, another from the posterior extremity of the post-occipital segment, other two arise in the same transverse line from the swelling on the first thoracic segment, and a fifth from the distal extremity of the same segment. Superior antennæ as long as the body; first joint obsolete; second and fourth as long as the head and post-occipital segment conjoined; third almost twice as long; fifth multiarticulate, and as long as all the others conjoined; it is composed of about 26 articulations; fourth articulation slightly clavate. Inferior antennæ a little longer than the three first joints of the superior antennæ; the two first joints equal in length to the palpi, the third reaching a little beyond the second joint of the superior pair, fourth and fifth reaching beyond the third, fifth triarticulate.

Head rounded considerably, produced inferiorly, eyes circular, black, and reticulated; post-occipital segment twice as long as the head; first thoracic segment with the swelling before the middle, and a spine pointing forwards immediately above the origin of the second pair of legs; femoral joint clavate, twice the length of the first thoracic segment; last joint oblong ovate, produced into a small blunt tooth at its anterior edge; lower edge armed with two strong spines; the interspace armed with a number of strong spines; claw strong; apodal thoracic segments considerably lengthened, slightly contracted posteriorly. The origin of the branchial lamellæ placed behind the middle of the segment. Posterior thoracic segments nonpediculated; legs long, bearing a few bristles; inferior edge of the last articulation of the last pair of legs armed near the base with a small tooth.

This species differs from the *Caprella Pasma* of Colonel Montague in having five spines on the first thoracic segment, and from the segments of the body being considerably longer. The third joint of the superior antennæ is very much longer, and the first pair of feet are also minute and slender, differing in so far from those of *Pasma*, which are strong and powerful. The inferior edge of the last joint of the second pair of feet is also armed with two strong spines, whereas in the *Pasma* there is only one strong spine.

Plate III. Fig. 6.

2. *Caprella tuberculata*.—Body robust. Superior antennæ almost reaching to the first finlet; fourth joint about half the length of the third; fifth joint composed of about thirteen articulations. A short spine on the summit of the head almost as long as the post-occipital segment;

swelling of the first thoracic segment exactly in the middle; a short tubercle on the summit. Femoral joint of the same length as the depth of the segment; last joint oval. Four tubercles placed in a square form on the dorsum of the fourth thoracic segment. A spine on the last joint of all the three last legs. Long. $\frac{3}{4}$ of an inch. Hab. Frith of Forth.

Description.—Whole body of an opaque yellow colour. All the joints of the body bearing spines or tubercles on the dorsal surface. Head nearly spherical, with a short sharp spine on its vertex, almost as long as the post-occipital segment. Eye small and spherical. Superior antennæ reaching to the middle of the second thoracic segment; first joint obsolete; second as long as the head and post-occipital segment conjoined; third longer; fourth joint about half as long as the third; fifth multiarticulate, moniliform, and composed of fourteen articulations armed with spines on their lower edge. Inferior antennæ reaching to the middle of the fifth joint of the superior antennæ; two first joints together equal in length to the half of the third, fourth, and fifth of the same length; last joint armed with a claw. Eyes small, black. Post-occipital segment a very little longer than the head, and bearing two blunt tubercles at each extremity. First thoracic segment twice as long, swelling very little, and situated in the middle; a blunt short tubercle surmounts its dorsal surface. The femoral joint is very short and robust—it is angular, that is to say, bearing three ridges; last joint is large and oval, serrated on its inferior edge; a large tubercle is situated near the base; the claw is short but powerful. The second and third thoracic segments are of the same length, second more slender: branchial lamellæ are short, and arise considerably behind the middle, and a blunt tubercle arises from the dorsum of the segment immediately above the origin of each. Fourth joint is very rough—it is armed with a tubercle on its dorsal surface at its anterior edge; another larger and flatter one immediately below this on its lateral surface, and four other sharper ones placed in the figure of a square at its posterior part. The two following joints are pediculated, and bearing two sharp spines on each. All the joints of the posterior thoracic legs are powerfully clavate, which gives them a serrated appearance; a short strong tooth arises from the inferior edge of the last joint near the base.

This species is apt to be confounded with the *Caprella acanthifera* of Leach, but may be distinguished from it by the double fringe of spines on the lower edge of the inferior antennæ; the superior antennæ are also much shorter than those of the *acanthifera*.

BODY FREE FROM SPINES.

Plate III. Fig. 4.

Caprella lævis.—Body without spines. Superior antennæ not reaching the origin of the second pair of legs; last joint composed of six articulations. Head almost triangular; post-occipital segment four times as long as the head. Swelling on the first thoracic segment near the posterior edge; coxal joint large produced. Length, one inch.

Description.—The whole body is quite smooth, shining, and free of spines. The head is almost triangular. Eyes near the upper surface and very small. The superior antennæ are very short and strong: third joint very strong, and as long as the two following: last joint composed of thirteen articulations. Inferior antennæ not so long: the two first joints very short: inferior edge of all the articulations armed with a strong fringe of double spines. Front pair of legs strong, and almost as long as the lower antennæ.

Post occipital segment slender, and four times as long as the head. First thoracic segment very long, slender at its anterior extremity, and with the swelling entirely situated at its posterior extremity. Second pair of legs arises from the anterior part of the swellings: coxal joint large and produced: femoral joint considerably bent and slightly clavate: last joint oblong ovate and armed on its inferior edge with two spines, one near, or rather at the middle, which is smallest, and the other about its own length from the anterior extremity: a number of denticles and strong spines arm the interspace: claw strong and bent: slightly flattened on its superior edge.

Second and third thoracic segments very short, wanting about a third of the length of the first thoracic: fourth segment equal in length to either of the two former: fifth and sixth pediculated, last almost globose. Segments of all the posterior legs lengthened; last joint of the last pair with a tooth on its inferior edge near the base: claws strong.

This species may be distinguished from *Caprella linearis*, with which it is most apt to be confounded, by its greater comparative size, the structure of the antennæ; by the shortness of the post-occipital segment; the situation of the swelling on the first thoracic segment, which is at the posterior edge, whereas in the *linearis* it is at the anterior; the femoral joint of the second pair of legs is not clavate in the *linearis*, and is also quite straight.

Plate III. Fig. 8.

Caprella linearis.—Superior antennæ reaching to the middle of third thoracic segment: head very deep: post-occipital segment extremely short, almost of the same length as the head. Swelling at the anterior

extremity of the first thoracic segment. Femoral joint of the second pair of legs almost as long as the first thoracic segment: last joint oval; one tooth on its lower edge near the base. Length, half an inch. Hab. Frith of Forth.

Description.—The whole body almost colourless: very fragile. Head very deep, being almost twice as deep as the post-occipital segment. Superior antennæ reaching almost to the middle of the third thoracic segment. Last joint composed of about twelve articulations. Inferior antennæ hardly so long, and strongly fringed with spines on its lower edge. The post-occipital segment is extremely short, hardly so long as the head itself. First thoracic segment twice as long as the head and post-occipital segment: the swelling is situated near the anterior extremity at this part: it gives off a small branch from which the second pair of legs arises. The femoral joint is not clavate, quite straight, and of no great length, not being so long as the first thoracic segment: last joint oval, almost globular, and armed with one tooth on the inferior edge near its base. Claws small. Second and third thoracic segments of equal length; second more slender. Branchial lamellæ small and situated near the middle of the segment. Fifth and sixth thoracic segments pediculated. The posterior thoracic legs almost moniliform; an almost obsolete tooth being placed on the inferior edge near the base of distal segment of the last pair of feet.

This appears to be the *Caprella linearis* of authors; there are some marks of difference, but they are trivial, and not sufficient to authorize any new specific distinctions.

Description of Plate II.

- Fig. 1. *Cynthia Flemingii*.
 ... 2. Part of inferior antennæ, with scale.
 ... 3. Natural size of *Cynthia Flemingii*.
 ... 4. *Themisto longispinosa*.
 ... 5. The third and fourth subabdominal fins; *a*, peduncle of the third; *b*, external branch; *c*, internal branch; *d*, peduncle of the fourth subabdominal fin; *e*, internal branch; *f*, the long external branch.
 ... 6. The superior antennal scale of *T. longispinosa*.
 ... 7. Nat size of *T. longispinosa*.
 ... 8. Middle caudal plate.
 ... 9. *T. brevispinosa*.
 ... 10. The third and fourth subabdominal fins of *T. brevispinosa*; the letters refer to the same parts as those in the same drawing of the *T. longispinosa*.
 ... 11. Natural size of *T. brevispinosa*.
 ... 12. The middle caudal plate.

Description of Plate III.

- Fig. 1. *Caprella spinosa*.
 ... 2. Natural size.
 ... 3. Ovarian plate, and one of the branchial fins attached, it shews the upper or concave surface with the hooked spines.
 ... 4. *Caprella lævis*, magnified.
 ... 5. Natural size.
 ... 6. *Caprella tuberculata*, magnified.
 ... 7. Natural size.
 ... 8. *Caprella linearis*, magnified.
 ... 9. Natural size.
 ... 10. Magnified lateral view of the second and third thoracic segments of *Caprella spinosa*, shewing how the segments become changed during spawning, with the ovarian plates and branchial finlets in the natural position.
 ... 11. Enlarged view of Ovaries A. and Oviducts B.; *a*, anterior extremity; *b*, posterior.
 ... 12. Zoe of *Pagurus Bernhardus*, lateral view.
 ... 13. Back view.
 ... 15. Ocular tubercles.
 ... 14. Caudal segment.
 ... 16. Lateral view of the Zoe of the *Carcinus mænas*, sometime before it has escaped from the ovum. The tunics of the egg have been stripped off.
 ... 17. Last abdominal segment, and caudal fork of the same, shewing the curious brush-shaped appendages; these drop off when the animal has escaped from the ovum, and are replaced by spines.
- Fig. 18. Side view of the Zoe of the *Carcinus mænas*, a short time after it has escaped from the ovum.
 ... 19. Appearance of the Larva of the *Caligus piscinus*, sometime after it has escaped from the ovum.
 ... 20. Mature ovum of the same.
 ... 21. Ovum in an early stage.
 ... 22. Ovum a little farther advanced.
 ... 23. Young *Caligus* taken from the egg; it is at a more advanced stage than the last.
 ... 24. External oviduct of *Caligus*, shewing the escape of the ova, and how they remain attached until the young are hatched.



