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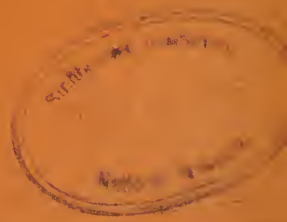
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Description of

**Paracartia Grani, G. O. Sars,**

a peculiar Calanoid occurring in some of the Oyster-beds  
of Western Norway.

By

**G. O. Sars.**

With 4 autographic plates.

## Introduction.

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On studying the physical and biological conditions of the Oyster-beds of western Norway, Dr. H. GRAN has detected in some of them a very remarkable *Calanoid*, which he has kindly placed in my hands for description. This Calanoid is indeed of very particular interest, belonging, as it does, to a hitherto only imperfectly known genus, the type of which is derived from the tropical part of the Atlantic Ocean (the Gulf of Guinea). The occurrence of a species of this genus so far north is very perplexing, and is apparently to be accounted for by the peculiar physical conditions prevailing in the said basins, as spoken of at the close of this paper.

I give below diagnoses of the genus and the species, and also a detailed description of the latter, which I have much pleasure in naming in honour of its detector, the distinguished Norwegian naturalist, Dr. H. GRAN. The accompanying plates have been prepared with the utmost care by the autographic proceeding employed by the present author in most of his recent papers.

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Gen. *Paracartia*, SCOTT, 1894.

*Generic Characters.*—General appearance somewhat resembling that of *Acartia*; the sexual differences, however, much more strongly marked. Last segment of metasome in female very large, and produced on each side to a broad wing-like expansion; that of male simple, with the lateral parts not expanded. Urosome in female comparatively short, 3-articulate, with the genital segment very large

and expanded laterally; caudal rami broad, with one of the apical setæ transformed into a thickish spine. Urosome of male slender, 5-articulate, with the caudal rami normal, and none of the apical setæ transformed. Front provided below with 2 slender recurved tentacular filaments. Anterior antennæ in female about as in *Acartia*; right antenna in male, however, very much transformed, and built upon the same type as in the *Pontellidæ*. Posterior antennæ, oral parts and natatory legs of a structure similar to that in *Acartia*. Last pair of legs, however, rather different, those in female with the basal parts confluent, terminal joints spiniform, those in male very powerfully developed, right leg much the larger and terminating in a slender incurved claw. Spermatophore affixed to the genital segment of the female, constantly accompanied by a thin plate folding more or less upwards on each side.

*Remarks.*—This genus was established in the year 1894 by TH. SCOTT, to include 2 supposed species, *P. spinicaudata* and *P. dubia*, found in some Plankton-samples taken in the Gulf of Guinea by Mr. JOHN RATTRAY during the Expedition of the Telegraph Steamer "Buccaneer". As suggested by Dr. GIESBRECHT, however, these two forms ought undoubtedly to be combined in one, the *P. spinicaudata* representing the female, and the *P. dubia* the male of one and the same species, to which the latter name has been assigned by Dr. GIESBRECHT in his recent synopsis of the Calanoida (Gymnoplea). The name *Paracartia* was originally proposed by TH. SCOTT merely to designate a subgenus of *Acartia*. I think, however, that the differences are great enough to warrant the establishment of a true genus, which will find its place in the family *Acartiidæ*, as defined by the present author in his work on the Norwegian Calanoida. In addition to the typical species and the one described below, the *Acartia latisetosa* of Kriczagin (= *A. verrucosa* THOMPSON) is undoubtedly referable to the present genus.

### *Paracartia Grani*, G. O. Sars.

*Specific Characters.*—*Female.* Body rather slender, with the anterior division scarcely at all tumefied, tapering gradually in front; wing-like expansions of last segment very large, triangular, each terminating in an acute point. Urosome short and broad, constricted in the middle, genital segment about the length of the other 2 com-

bined, and forming on each side a rather large lamellar expansion obliquely truncated at the tip. Caudal rami pronouncedly asymmetrical, the right ramus being considerably broader than the left; marginal setæ comparatively short, the innermost but one on both rami transformed, that on right side much stronger than that on left side. Anterior antennæ scarcely as long as the anterior division of the body. Last pair of legs rather robust and somewhat asymmetrical, terminal joint very strong, claw-like, and coarsely denticulated in its outer part, that of right leg somewhat larger than that of left. Spermatophore narrow bottle-shaped, accompanying plate forming on each side a wing-like expansion folded upwards.

*Male* very unlike the female, with the last segment of metasome quite simple. Urosome much more slender, and narrow cylindrical in form; caudal rami comparatively small and quite symmetrical, marginal setæ normally developed. Right anterior antennæ exceedingly powerful, with the proximal part of the middle section much tumefied, 1st joint of terminal section armed with a long, claw-like spine curving anteriorly. Last pair of legs largely developed and very asymmetrical, right leg more than twice as long as the left, and exhibiting inside the 1st and 3rd joints a narrow lamellar projection, that of 1st joint lanceolate, that of 3rd rounded at the tip, terminal joint very slender, with a knob-like projection outside near the base and a slender seta in the middle of the inner edge, tip armed with a short curved spine. Left leg without any inner projections, penultimate joint forming outside a rounded lobe, to which is appended a very delicate rugulose plate, terminal joint small, digitiform. Length of body in both sexes about 1 mm.

*Remarks.*—The present species is easily distinguishable from that occurring in the Black Sea and the Mediterranean (*P. latisetosa*), both by the large size of the lateral expansions of the last segment of the metasome in the female, and by the very different form of its genital segment. It is much more nearly related to the New Guinea species described by TH. SCOTT, and indeed at first I was much inclined to regard the two as identical. On a closer comparison with the figures given by TH. SCOTT, however, I find several differences, which seem to forbid such an identification. Thus in the New Guinea species the general form of the body in the female is considerably more robust, with the anterior division somewhat tumid and the urosome comparatively longer. Moreover, the genital segment is of rather different form, and the

caudal rami are perfectly symmetrical. Finally, the anterior antennæ are comparatively longer than in the Norwegian form, and the right prehensile antenna of the male is not nearly so powerfully developed as in that species.

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## Description of the Female.

(Pl. I—III).

The length of fully grown specimens slightly exceeds 1 mm. (1.03 mm.), and the size of this form is accordingly intermediate between that of the 2 other known species.

*The general form of the body* (see Pl. I, figs. 1 & 2) is on the whole rather slender, and the integuments, as in the species of the genus *Acartia*, are very thin and pellucid. The *anterior division* is composed of 5 rather unequal segments, the 1st of which represents the head, the last the 2 completely coalesced posterior segments of the metasome. Seen from above (fig. 1), this division appears rather narrow, gradually tapering towards the front, which is somewhat obtusely truncated.

The cephalic segment about equals in length the 3 succeeding segments combined, and is only slightly vaulted above (see fig. 2). The frontal part is narrowly rounded, and carries 2 extremely delicate recurved tentacular filaments below (see also Pl. II, figs. 3 & 4). The lateral edges of this segment appear somewhat incurved in the middle (see Pl. I, fig. 2), leaving the oral parts quite unobscured. The 1st segment of the metasome is about as long as the 2 succeeding ones combined, and of these last the anterior one is much the shorter. The last segment is deeply emarginated behind in the middle, and projects on each side in a large wing-like expansion of triangular form and terminating in an acute, somewhat exsurgent corner.

*The urosome* is comparatively very short, scarcely exceeding  $\frac{1}{4}$  of the length of the anterior division, and is composed of only 3 segments, the 1st of which, the genital segment, is about as long as the other 2 combined, and of a rather peculiar form (see fig. 4), being produced on each side to a broad, obliquely backwards-pointing

lamellar expansion obtusely truncated at the tip and fringed at the anterior corner with delicate hairs. The genital orifices are placed far apart just at the base of the above-mentioned expansions; and immediately in front of them the seminal receptacles, with their short twisted ducts, are distinctly observed (see fig. 5). The 2nd segment is conspicuously constricted at the base, and gradually widens distally. The 3rd segment is still broader and is transversely truncated behind.

The *caudal rami* (see fig. 4) are comparatively short, but rather broad and pronouncedly asymmetrical, the right ramus being considerably larger than the left. They both originate with a broad base from the last segment, and slightly taper towards the tip, which is transversely truncated. The marginal setæ are not much elongated; they are 5 in number on each ramus, 2 of them issuing from the outer edge, the 3 others from the tip. The middle apical seta, however, on both rami is peculiarly transformed, constituting a strong, almost naked spine, which on the right ramus is somewhat coarser than on the left. As in the genus *Acartia*, moreover, a very delicate and finely ciliated seta springs from the dorsal face of each ramus at some distance from the inner corner. This seta originates from a bulbous base and is undoubtedly of a sensory nature.

To the ventral face of the genital segment, a narrow bottle-shaped *spermatophore* (fig. 7) is generally found attached. This spermatophore is always accompanied by a thin plate, which on each side forms a wing-like expansion folding upwards so as partly to encompass the urosome (see figs. 1, 2, 4). A somewhat similar formation has been described by the present author in *Epischura baikalensis*, and the problematic plate mentioned by Dr. GIESBRECHT in *Acartia verrucosa* THOMPSON, is unquestionably of the same nature. The intimate connection of this plate with the spermatophore in the present form, is easily proved by dissection (see fig. 6).

In immature female specimens, the urosome exhibits a somewhat different appearance (see Pl. III, fig. 8). Thus the genital segment has the lateral parts quite evenly rounded, and all the caudal setæ are normally developed, the innermost but one differing from the others only in its greater length. In such specimens, moreover, the lateral expansions of the last segment of the metasome are not nearly so large as in adult specimens, and are nearly rectangular in form.

The *eye* is of large size and located near the frontal edge (see

Pl. I, figs. 1, 2, 3). The finer details of its structure are rather difficult to make out in preserved specimens, owing to the destructive action of the alcohol.

The *anterior antennæ* (Pl. II, fig. 1) are built upon the very same type as in *Acartia*, being of nearly uniform thickness throughout, and exhibiting a peculiar nodular appearance. They are somewhat shorter than the anterior division of the body, and consist each of apparently 17 articulations, some of which, however, are only faintly indicated. The articulations carry setæ of very various lengths and pointing in different directions, most of them being finely ciliated. None of the articulations are produced in front to dentiform projections.

The *posterior antennæ* (fig. 2), as in *Acartia*, are very delicate in structure, with the inner ramus considerably elongated and imperfectly defined from the basal part. The 1st joint of the latter carries a strong curved seta in front. The proximal joint of the inner ramus has, in the middle of the anterior edge, a dense row of about 8 finely ciliated setæ gradually increasing in length distally; and a similar seta is attached to the end of the joint in front. The terminal joint is very slender and is scarcely expanded distally. Along the obliquely truncated and slightly bilobed end, are attached numerous slender setæ, some of which are almost as long as the whole antenna. The outer ramus is scarcely  $\frac{1}{3}$  the length of the inner, and is apparently composed of 5 articulations, the 1st of which is more than twice as long as all the others combined. It carries in all 7 setæ, none of which are particularly elongated.

The *anterior lip* (see Pl. I, fig. 3, Pl. II, figs. 3, 5) is rather large and is trilobate at the end, the middle lobe being quadrangular in form and very prominent (see Pl. I, fig. 3).

The *posterior lip* (see Pl. II, fig. 5) is much smaller and is bilobate, each lobe being produced at the outer corner in an incurved ciliated lappet.

The *mandibles* (fig. 6) are powerfully developed, with the body thick and vaulted, appearing, in the dorsal aspect of the animal (Pl. I, fig. 1), as 2 rounded lateral prominences. The masticatory part is strongly inflexed and securiformly dilated, with the cutting edge divided into numerous sharp teeth, the outermost of which is much stronger than the others. The palp is of considerable size, with the basal part oblong in form, and carrying 2 densely plumous setæ outside. The inner ramus is imperfectly biarticulate, the



proximal joint being only indicated by a ledge on the outer edge, carrying 2 setæ. From the tip of the ramus issue 6 slender setæ, gradually increasing in length outwards. The outer ramus is somewhat shorter than the inner, and is apparently divided into 6 articulations, each carrying a strong seta.

The *maxillæ* (fig. 7) resemble in structure those in *Acartia*, the masticatory lobe being comparatively small, with only a restricted number of spines, whereas the vibratory plate is well developed and provided with 8 strong plumose setæ. Between the masticatory part and the palp, there is only a single appendicular lobe, carrying on the tip 3 setæ. The palp itself has the endopodal part quite rudimentary, and only represented by a single thickish seta. The exopodal part, on the other hand, is well developed, forming a rounded oval, somewhat recurved joint carrying 7 slender setæ, 2 of which issue from a ledge in the outer edge, the other 5 from the tip.

The *anterior maxillipeds* (Pl. III, fig. 1) form each a stout anteriorly-curving stem divided into 5 segments rapidly diminishing in size. Of these segments, the first 2 constitute the basal part, and are each provided in front with 2 short digitiform lobes. From all the articulations spring slender claw-shaped spines, which curve anteriorly towards the oral orifice, and are clothed with scattered stiff hairs.

The *posterior maxillipeds* (fig. 2) are much smaller than the anterior, and are only 4-articulate. The 1st basal joint is rather broad, and forms anteriorly a projecting lobe carrying 5 long plumose setæ. The 2nd basal joint is much smaller and is oval in form, with a single short seta at the base anteriorly. The terminal part is very narrow and is composed of only 2 joints, the proximal one sub-linear in form and provided with 3 short setæ anteriorly, the distal joint very small, with 2 similar setæ at the tip.

The *natatory legs* (figs. 3, 4, 6) are of a very delicate structure, and, as in *Acartia*, are distinguished by the great length and slenderness of the natatory setæ. The basal part is rather elongated, and is, as usual, composed of 2 joints, the 1st of which, however, wholly wants the usual plumose seta inside. Of the rami, the outer one is distinctly 3-articulate, whereas the inner consists of only 2 joints, and is considerably shorter than the outer.

The *1st pair of legs* (fig. 3) are considerably smaller than the others, and also somewhat different in structure. On the outer ramus.

besides the usual natatory seta, each of the 2 first joints has a well-defined setiform spine outside, and the 3rd joint has 2 similar spines and 5 natatory setæ, 2 of which issue from the tip. The inner ramus has the proximal joint somewhat shorter than the distal one, and is provided with only a single natatory seta inside. The distal joint carries 6 such setæ, 2 on the inner edge, 1 on the outer, and 3 on the tip.

In the 3 succeeding pairs (figs. 4, 6) the outer ramus has no true spines outside; but each of the joints is only produced at the end to a short dentiform projection. The terminal joint carries on the tip a very long and slender, sword-shaped spine, bordered outside with a thin, coarsely-serrate rim (see fig. 5), and has, moreover, 5 slender natatory setæ, all originating from the inner edge. On the inner ramus, the proximal joint is much longer than the distal one, and carries in the 2nd and 3rd pairs (fig. 4) 2, in the 4th pair (fig. 6) 3, comparatively short setæ. The number of setæ on the terminal joint of this ramus in the 2nd and 3rd pairs is 7, in the 4th pair 6.

The last pair of legs (fig. 7) are very different from the preceding pairs, and are not natatory. As compared with those in *Acartia*, they are much more strongly built, and moreover differ in the complete fusion of the basal parts, their original duplex nature being only indicated by a slight incision behind. On each side of this common basal part, a delicate ciliated seta is attached. The terminal part of each leg has the form of a very strong curved claw, slightly dilated at the base and armed on both edges with coarse denticles. On a closer examination, the right claw is constantly found to be somewhat larger than the left.

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## Description of the Male.

(Pl. IV).

The adult male is of nearly the same size as the female, but is of a very different external appearance. Seen dorsally (fig. 1), the anterior division of the body exhibits a rather regular narrow fusiform shape, with the greatest width about in the middle, and gradually

attenuated both in front and behind. The last segment of the metasome does not exhibit any trace of the wing-like expansions found in the female, but has the lateral corners simply rounded off. The suture defining this segment from the preceding one dorsally, is conspicuously incurved in the middle.

The *urosome* is comparatively much more elongated than in the female, attaining almost half the length of the anterior division. It is narrow cylindrical in form, and is composed of 5 segments, the 1st of which is very small, the 2nd the longest, and the penultimate very short and less perfectly defined from the last one.

The *caudal rami* (see fig. 5) are perfectly symmetrical and much smaller than in the female. All the setæ are normally developed and rather elongated, especially the innermost but one.

The *right anterior antenna* (fig. 2), which in the species of *Acartia* is but slightly modified and imperfectly geniculate, in the present form is transformed into a very powerful prehensile organ, somewhat resembling in structure that in the *Pontellidæ*. It is apparently composed of the same number of articulations as in the female; but the articulations group themselves in several successive sections, which appear very sharply marked off from one another. The basal section apparently consists of 8 articulations, some of which, however, are imperfectly defined. It is followed by a very tumid section of about the same length and composed of 4 firmly connected articulations. This section, which more properly answers to the proximal part of the middle section in other Calanoids, is provided anteriorly, like the basal one, with setæ of various lengths, and has moreover on the outer face 2 small knob-like prominences densely fringed with fine spinules, as also near the end anteriorly a dagger-like spine. It contains a very strong muscle extending through its axis, part of it acting upon the following joint, and part being continued throughout the whole length of that joint as a thin chitinous tendon, which joins the terminal section of the antenna. This joint, which in other Calanoids forms part of the middle section, in the present form is so sharply marked off both at the base and at the end, that it has the appearance of a separate section. It is highly chitinized and of considerable length, but rather narrow, especially in its proximal part, and without any setæ, only exhibiting anteriorly a finely ciliated crest. As stated above, this joint is movably articulated with the preceding section; but the true hinge of the antenna occurs between it and the following joint which belong

to the terminal section. This joint, like the preceding one, is highly chitinized, but is scarcely more than half as long, and is oblong oval in form. It gives origin to an exceedingly strong, claw-like spine curving anteriorly, and carries at the end a slender ciliated seta. The 4 outer articulations are of quite normal appearance, the 1st of them being, however, very small and imperfectly defined from the succeeding joint.

The posterior antennæ, oral parts, and natatory legs do not exhibit any difference from those parts in the female.

The *last pair of legs* (fig. 3), on the other hand, are greatly transformed, and together form a very powerful grasping organ. The 2 legs originate from a common base, and are very unequally developed, the right one being more than 3 times as long as the left. Both legs apparently consist of 4 joints, the 1st of which, however, as shown by the seta attached to the outer edge, ought more properly to be referred to the basal part. On the right leg, this joint is produced inside to a lanceolate deflexed projection. The 2nd joint of this leg is slightly dilated at the base, exhibiting inside a small rounded lobule, behind which a short seta is attached. The 3rd joint is somewhat larger than the 2nd, and projects inside at the base to a rather large, linguiform prominence, rounded at the tip and carrying a single seta behind. The last joint has the form of a very long and slender incurved claw, exhibiting, at some distance from the base outside, a knob-like prominence, and inside, somewhat beyond the middle, a small seta; at the tip, this joint is armed with a short curved spine. The left leg does not exhibit any projections inside, and has the 1st joint somewhat thicker than on the right leg. The 2nd joint is quite simple and slightly curved. The 3rd joint is much shorter than the 2nd, but rather broad, being expanded outside to a rounded prominence, to which a peculiar, soft, transversely rugulose lamella is appended (see also fig. 4). The last joint is much more abruptly narrowed than the others, forming a comparatively small digitiform piece, conspicuously constricted at the base, and terminating in a very acute point; in the middle this joint exhibits an annular instriktion, defined by 2 sharp transversal crests.

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## Occurrence.

This peculiar Calanoid was found last summer (1903) by Dr. GRAN in great abundance in an oyster-bed (Espevigpollen), situated at Tysnæs, south of Bergen. It also occurred in another neighbouring bed (Selöpollen), but in not nearly such abundance as in the first-named. Several other basins have been examined by Dr. GRAN, and numerous plankton-samples kindly forwarded to me for examination. In none of these, however, did the present Calanoid occur. Its place was taken by other allied forms, among which *Acartia Clausi* and *A. discaudata* were the commonest.

The great importance, as regards oyster-culture, of the above-mentioned oyster-beds, consists chiefly in the ease with which the spat of the oyster, by suitable apparatus (the collectors) kept floating in the water at some distance below the surface, may be secured in any numbers, for the purpose of transference to suitable feeding-grounds for further growth. This property of the beds is due to their very peculiar physical conditions; and it may be worth while here to give some information upon this point. None of these beds are artificial. They have originally simply formed the inner part of bays, which, however, by the successive rise of the land-crust, have gradually become separated from the sea, with which they now only occasionally communicate through a very narrow passage. The beds have therefore much the appearance of ordinary lakes, and their level is also, as a rule, somewhat above that of the sea. The depth of the beds varies somewhat, but seldom exceeds a few fathoms; and the bottom consists everywhere of a dark, loose mud, smelling strongly of sulphuretted hydrogen. It is therefore only along the rocky borders of the beds that the parent oysters are found, generally firmly attached at some distance below the surface. Owing to the long separation of these basins from the sea, a superficial layer of almost fresh water is formed, and this layer seems to act as an isolator, keeping the temperature of the underlying

salt water at a very uniform, and in some cases exceedingly high, point, amounting, according to the statements of Dr. GRAN, during the summer-months to no less than  $+ 30^{\circ}$  C. Even in the winter, when the surface of the beds is covered with ice, the temperature of the water at some distance below the ice is found to be unusually high, being in some cases stated to be  $+ 10^{\circ}$  C. It is indeed this high and uniform temperature, and perhaps also the chemical composition of the water, that in such a remarkable manner favours the great productiveness of the parent oysters in some of these beds; and it is possible that the occurrence of the present peculiar Calanoid may also find its explanation in the same exceptional physical conditions.

There is abundant evidence for the assumption that the marine fauna of Norway has been subjected to great changes during past ages, in accordance with the changes in the climate and other physical conditions, and that of course a repeated emigration and immigration of species has taken place. Thus, at a rather remote epoch, the so-called glacial period, the fauna exhibited everywhere off our coasts a pronouncedly arctic character, as shown by the fossil shells contained in the glacial beds, and also by the so-called relict forms still living in the great deeps of our fjords, and even in some of our lakes. This period was followed by another, in which a great change of climate occurred, the mean temperature of the year having in all probability been considerably higher than it is at present; and during this period, while a boreal fauna replaced the arctic one, an immigration of some pronouncedly southern forms also seems to have taken place. In the subsequent change in the climate, these latter forms for the most part again disappeared, or retired to more southern latitudes, leaving only very slight traces of their presence in the recent Norwegian fauna. It is, however, very likely that in certain exceptional cases some few of these southern forms may have been able to survive in higher latitudes — a survival analogous to that of the above-mentioned relict arctic forms — and that the present Calanoid ought to be regarded as an isolated remnant of a previous fauna different from that now existing on our coasts, its southern origin being not only proved by its luxuriant development in the warm water of the oyster-beds, but also by its very near relationship to the tropical species recorded by TH. SCOTT from the Gulf of Guinea.

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## Explanation of the Plates.

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### Pl. I.

- Fig. 1. Adult female, viewed from above, magnified 114 diameters.  
" 2. Same, exhibited from left side.  
" 3. Anterior extremity of body together with the oral area, viewed from left side, and more highly magnified.  
" 4. Urosome and adjoining part of metasome, dorsal view.  
" 5. Right lateral expansion of genital segment, viewed from the ventral face, showing the seminal receptacle with its efferent duct; highly magnified.  
" 6. Spermatophore with accompanying plate, ventral view.  
" 7. Spermatophore isolated, highly magnified.

### Pl. II.

- Fig. 1. Anterior antenna of female.  
" 2. Posterior antenna.  
" 3. Anterior extremity of body, ventral view.  
" 4. One of the frontal filaments, highly magnified.  
" 5. Anterior and posterior lips, ventral view.  
" 6. Mandible with palp.  
" 7. Maxilla.

### Pl. III.

- Fig. 1. Anterior maxilliped.  
" 2. Posterior maxilliped.  
" 3. Leg of 1st pair.  
" 4. Leg of 3rd pair.  
" 5. Extremity of outer ramus of same leg, showing the structure of the terminal spine; highly magnified.  
" 6. Leg of 4th pair.  
" 7. Last pair of legs.  
" 8. Urosome and last segment of metasome from an immature female specimen, dorsal view.

## Pl. IV.

- Fig. 1. Adult male, viewed from above, magnified 114 diameters.  
" 2. Right anterior antenna.  
" 3. Last pair of legs.  
" 4. Outer part of left leg of same pair, highly magnified.  
" 5. Outer part of urosome, viewed from above.
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